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571-272-7822

Paper 23
Entered: January 21, 2021

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

NRG ENERGY, INC. and
TALEN ENERGY CORPORATION
Petitioner,

v.

MIDWEST ENERGY EMISSIONS CORP.,
Patent Owner.

IPR2020-00832
IPR2020-00834
Patent 10,343,114 B2[1]

Before KRISTINA M. KALAN, CHRISTOPHER M. KAISER, and AVELYN M. ROSS, *Administrative Patent Judges*.

KALAN, *Administrative Patent Judge*.

TERMINATION
Due to Settlement After Institution of Trial and
Granting Joint Request to Treat Settlement Agreement as
Business Confidential Information
35 U.S.C. § 317; 37 C.F.R. § 42.74

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[1] This Order applies to both proceedings. We exercise our discretion to issue one Order to be filed in each case. The parties are not authorized to use this style heading for any subsequent papers.

I. INTRODUCTION

Petitioner and Patent Owner (collectively "the Parties") have requested that the above-identified *inter partes* review proceeding be terminated pursuant to a settlement. On January 14, 2021, the Parties filed a Joint Motion to Terminate in each of the above-identified proceedings ("Joint Motion"). Paper 20.[2] We had authorized the Parties to file a joint motion to terminate the above-identified proceedings in a January 4, 2021 email. *See* Joint Motion 2.

The Parties also filed a Fleetwide License and Supply Agreement (Exhibit 1071, "License and Supply Agreement"), a Term Sheet (Exhibit 1072, "Term Sheet"), and a Joint Request That Agreements Be Treated As Business Confidential Information (Paper 19, "Joint Request") in each of the above-identified proceedings.

II. DISCUSSION

Under 35 U.S.C. § 317(a), "[a]n inter partes review instituted under this chapter shall be terminated with respect to any petitioner upon the joint request of the petitioner and the patent owner, unless the Office has decided the merits of the proceeding before the request for termination is filed." It is also provided in 35 U.S.C. § 317(a) that if no petitioner remains in the *inter partes* review, the Office may terminate the review.

In the Joint Motion, the Parties represent that they have reached an agreement to jointly seek termination of these *inter partes* review proceedings, that the filed copies of the License and Supply Agreement and

[2] For expediency, we cite to the Papers and Exhibits filed in IPR2020-00832, unless otherwise indicated. Similar Papers and Exhibits were filed in IPR2020-00834.

Term Sheet are true and correct copies, and there are no collateral agreements or understandings made in connection with, or in contemplation of, the termination of these proceedings. Joint Motion 2–3. The Joint Motion indicates that the settlement resolves all currently pending Patent Office and District Court proceedings between the Parties involving Patent 10,343,114. *Id.* at 2.

We instituted a trial on the above-identified proceedings on October 26, 2020. Paper 17. We have not yet decided the merits of the proceeding, and a final written decision has not been entered. Notwithstanding that the proceeding has moved beyond the preliminary stage, the Parties have shown adequately that the termination of the proceeding is appropriate. Under these circumstances, we determine that good cause exists to terminate the proceeding with respect to the Parties.

The Parties also requested that the License and Supply Agreement and Term Sheet be treated as business confidential information and be kept separate from the file of Patent 10,343,114. Joint Request 2. After reviewing the License and Supply Agreement and Term Sheet, we find that these documents contain confidential business information regarding the terms of settlement. We determine that good cause exists to treat the License and Supply Agreement and Term Sheet as business confidential information pursuant to 35 U.S.C. § 317(b) and 37 C.F.R. § 42.74(c).

This Order does not constitute a final written decision pursuant to 35 U.S.C. § 318(a).

III. ORDER

Accordingly, for the reasons discussed above, it is:

ORDERED that the Joint Motions are *granted*, and IPR2020-00832 and IPR2020-00834 are each *terminated* with respect to Petitioner and Patent Owner, pursuant to 35 U.S.C. § 317(a) and 37 C.F.R. § 42.72; and

FURTHER ORDERED that the Joint Requests are *granted*, and the License and Supply Agreement and Term Sheet shall be kept separate from the file of Patent 10,343,114, and made available only to Federal Government agencies on written request, or to any person on a showing of good cause, pursuant to 35 U.S.C. § 317(b) and 37 C.F.R. § 42.74(c).

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Paper 24
Entered: January 21, 2021

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

NRG ENERGY, INC. and
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Petitioner,

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MIDWEST ENERGY EMISSIONS CORP.,
Patent Owner.

IPR2020-00832
IPR2020-00834
Patent 10,343,114 B2[1]

Before KRISTINA M. KALAN, CHRISTOPHER M. KAISER, and AVELYN M. ROSS, *Administrative Patent Judges*.

KALAN, *Administrative Patent Judge*.

TERMINATION
Due to Settlement After Institution of Trial and
Granting Joint Request to Treat Settlement Agreement as
Business Confidential Information
35 U.S.C. § 317; 37 C.F.R. § 42.74

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I. INTRODUCTION

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The Parties also filed a Fleetwide License and Supply Agreement (Exhibit 1071, "License and Supply Agreement"), a Term Sheet (Exhibit 1072, "Term Sheet"), and a Joint Request That Agreements Be Treated As Business Confidential Information (Paper 19, "Joint Request") in each of the above-identified proceedings.

II. DISCUSSION

Under 35 U.S.C. § 317(a), "[a]n inter partes review instituted under this chapter shall be terminated with respect to any petitioner upon the joint request of the petitioner and the patent owner, unless the Office has decided the merits of the proceeding before the request for termination is filed." It is also provided in 35 U.S.C. § 317(a) that if no petitioner remains in the *inter partes* review, the Office may terminate the review.

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[2] For expediency, we cite to the Papers and Exhibits filed in IPR2020-00832, unless otherwise indicated. Similar Papers and Exhibits were filed in IPR2020-00834.

Term Sheet are true and correct copies, and there are no collateral agreements or understandings made in connection with, or in contemplation of, the termination of these proceedings. Joint Motion 2–3. The Joint Motion indicates that the settlement resolves all currently pending Patent Office and District Court proceedings between the Parties involving Patent 10,343,114. *Id.* at 2.

We instituted a trial on the above-identified proceedings on October 26, 2020. Paper 17. We have not yet decided the merits of the proceeding, and a final written decision has not been entered. Notwithstanding that the proceeding has moved beyond the preliminary stage, the Parties have shown adequately that the termination of the proceeding is appropriate. Under these circumstances, we determine that good cause exists to terminate the proceeding with respect to the Parties.

The Parties also requested that the License and Supply Agreement and Term Sheet be treated as business confidential information and be kept separate from the file of Patent 10,343,114. Joint Request 2. After reviewing the License and Supply Agreement and Term Sheet, we find that these documents contain confidential business information regarding the terms of settlement. We determine that good cause exists to treat the License and Supply Agreement and Term Sheet as business confidential information pursuant to 35 U.S.C. § 317(b) and 37 C.F.R. § 42.74(c).

This Order does not constitute a final written decision pursuant to 35 U.S.C. § 318(a).

III. ORDER

Accordingly, for the reasons discussed above, it is:

ORDERED that the Joint Motions are *granted*, and IPR2020-00832 and IPR2020-00834 are each *terminated* with respect to Petitioner and Patent Owner, pursuant to 35 U.S.C. § 317(a) and 37 C.F.R. § 42.72; and

FURTHER ORDERED that the Joint Requests are *granted*, and the License and Supply Agreement and Term Sheet shall be kept separate from the file of Patent 10,343,114, and made available only to Federal Government agencies on written request, or to any person on a showing of good cause, pursuant to 35 U.S.C. § 317(b) and 37 C.F.R. § 42.74(c).

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FOR PATENT OWNER:

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AO 120 (Rev. 08/10)

TO:	**Mail Stop 8** **Director of the U.S. Patent and Trademark Office** **P.O. Box 1450** **Alexandria, VA 22313-1450**	**REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK**

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court District of Delaware on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
	7/17/2019	District of Delaware

PLAINTIFF	DEFENDANT
Midwest Energy Emissions Corp. and MES Inc.	Vistra Energy Corp., et al.

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	US 10,343,114 B2	7/9/2019	Midwest Energy Emissions Corp.
2	US 8,168,147 B2	5/1/2012	Midwest Energy Emissions Corp.
3			
4			
5			

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
2		
3		
4		
5		

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

Copy 1—Upon initiation of action, mail this copy to Director Copy 3—Upon termination of action, mail this copy to Director
Copy 2—Upon filing document adding patent(s), mail this copy to Director Copy 4—Case file copy

Trials@uspto.gov
571-272-7822

Paper 11
Entered December 14, 2020

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

AEP GENERATION RESOURCES INC., AEP TEXAS INC. and SOUTHWESTERN ENERGY POWER CO.,
Petitioner,

v.

MIDWEST ENERGY EMISSIONS CORP.,
Patent Owner.

IPR2020-01294 and IPR2020-01295 (Patent 10,343,114 B2)
IPR2020-01296 and IPR2020-01297 (Patent 8,168,147 B2)[1]

Before KRISTINA M. KALAN, ZHENYU YANG, CHRISTOPHER M. KAISER, and AVELYN M. ROSS, *Administrative Patent Judges*.[2]

PER CURIAM

DECISION

Granting Joint Motion to Withdraw Petition and
Dismissal Prior to Institution of Trial
37 C.F.R. § 42.71(a)

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[1] This Order applies to each of the above-listed proceedings. We exercise our discretion to issue one Order to be filed in each proceeding. The parties are not authorized to use this style heading for any subsequent papers.

[2] This listing of Administrative Patent Judges does not reflect an expanded panel under SOP 1 § III.M. This order addresses multiple proceedings that collectively involve more than three Administrative Patent Judges.

On July 15, 2020, AEP Generation Resources Inc., AEP Texas Inc., and Southwestern Energy Power Co. (collectively "Petitioner") filed two petitions requesting an *inter partes* review of certain claims of U.S. Patent No. 10,343,114 (*see* IPR2020-01294, Paper 1; IPR2020-01295, Paper 1) and two petitions requesting an *inter* partes review of certain claims of U.S. Patent No. 8,168,147 (*see* IPR2020-01296, Paper 1; IPR2020-01297, Paper, 1). On December 8, 2020, with Board authorization, the parties filed a Joint Motion to Withdraw the Petition in each *inter partes* review. *See* IPR2020-01294, Paper 10; IPR2020-01295, Paper 11; IPR2020-01296, Paper 11; IPR2020-01297, Paper 10 (collectively "Motions" or "Motions to Withdraw"). The Motions to Withdraw filed in each *inter partes* review are substantively identical. *See id.*

In the Motions to Withdraw, the parties represented that they "have reached an agreement to settle IPRs and litigation between them" and that the District Court has dismissed the related litigation between the parties. Motions 1. Accordingly, "the parties jointly move to withdraw the petition . . . without adverse judgment and without a decision on institution." *Id.* at 2.

As the parties explain, "[t]he Board may take up petitions or motions for decisions in any order, may grant, deny, or dismiss any petition or motion, and may enter any appropriate order." *Id.* at 1 (quoting 37 C.F.R. § 42.71(a)). This proceeding is at an early stage and we have not yet decided whether to institute trial. Under the circumstances presented here, we determine it is appropriate to dismiss the Petition and terminate the proceeding to promote efficiency and minimize unnecessary costs. Therefore, the parties' Joint Motions to Withdraw are *granted.*

This Order does not constitute a final written decision pursuant to 35 U.S.C. § 318(a).

Accordingly, it is,

ORDERED that the Parties' Joint Motion to Withdraw the Petition in each case is *granted*;

FURTHER ORDERED that the Petition in each case is dismissed, and IPR2020-01294, IPR2020-1295, IPR2020-01296, and IPR2020-1297 are terminated;

IPR2020-01294 and IPR2020-01295 (Patent 10,343,114 B2)
IPR2020-01296 and IPR2020-01297 (Patent 8,168,147 B2)

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Paper 17
Date: October 26, 2020

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

NRG ENERGY, INC. and
TALEN ENERGY CORPORATION,
Petitioner,

v.

MIDWEST ENERGY EMISSIONS CORP.,
Patent Owner.

IPR2020-00832
Patent 10,343,114 B2

Before KRISTINA M. KALAN, CHRISTOPHER M. KAISER, and AVELYN M. ROSS, *Administrative Patent Judges.*

KALAN, *Administrative Patent Judge*.

DECISION
Granting Institution of *Inter Partes* Review
35 U.S.C. § 314, 37 C.F.R. § 42.4

I. INTRODUCTION

NRG Energy, Inc., Talen Energy Corporation, and Vistra Corp. (formerly known as Vistra Energy Corp.) filed a Petition (Paper 3, "Pet.") requesting an *inter partes* review of claims 1–9 and 12–30 of U.S. Patent No. 10,343,114 B2 (Ex. 1001, "the '114 patent"). Subsequently, Vistra Corp. and Midwest Energy Emissions Corp. ("Patent Owner") filed a Joint Motion to Terminate Vistra Corp. as a petitioner pursuant to a settlement. Paper 10. That motion was granted. Paper 13. Therefore, NRG Energy, Inc. and Talen Energy Corporation (collectively, "Petitioner") remain as petitioners. *Id.* at 4. Patent Owner filed a Preliminary Response to the Petition (Paper 9, "Prelim. Resp."). Pursuant to our authorization, Petitioner filed a Reply (Paper 15, "Pet. Reply"), and Patent Owner filed a Sur-reply (Paper 16, "Sur-reply").

To institute an *inter partes* review, we must determine that the information presented in the Petition shows "there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition." 35 U.S.C. § 314(a). For the reasons discussed below, after considering the parties' submissions and the evidence of record, we determine that Petitioner has demonstrated a reasonable likelihood of prevailing with respect to at least one claim of the '114 patent. Thus, we institute an *inter partes* review.

A. Related Proceedings

The parties identify *Midwest Energy Emissions Corp. v. Vistra Energy Corp.*, No. 1:19-cv-01334-RGA (D. Del.) as a related matter. Pet. 6–7; Paper 6, 2. Petitioner also identifies IPR2020-00834 as a second petition against the '114 patent. Pet. 8.

B. The '114 Patent

The '114 patent, titled "Sorbents for the Oxidation and Removal of Mercury," "relates to methods and materials for the removal of pollutants from flue gas or product gas from a gasification system," and "[i]n particular, mercury is removed from gas streams generated during the burning or gasification of fossil fuels by highly reactive regenerable sorbents." Ex. 1001, code (54), 1:27–31. The'114 patent discloses that the "combustion and gasification of fossil fuel such as coal generates flue gas that contains mercury and other trace elements that originate from the fuel" and "[s]everal types of mercury control methods for flue gas have been investigated, including injection of fine sorbent particles into a flue gas duct and passing the flue gas through a sorbent bed." *Id.* at 1:33–35, 1:56–59. However, the '114 patent explains that a "major problem with existing carbon injection systems is that the sorbent is relatively unreactive toward mercury" and therefore "these sorbents must be used in large amounts." *Id.* at 2:10–12. The '114 patent further describes other mercury sorbent approaches and their problems. *Id.* at 2:20–3:15.

The '114 patent describes a halogen/halide-promoted sorbent "that is highly effective for the removal of mercury from flue gas streams" and that the "sorbent comprises any activated carbon and/or non-carbon compound." *Id.* at 3:36–39. Further, "[o]ptional secondary components and alkali may be added to further increase reactivity and mercury capacity." *Id.* at 3:43–44. The '114 patent states that "the optional secondary component is selected from the group consisting of Group V halides, Group VI halides, HI, HBr, HCl, and combinations thereof." *Id.* at 4:52–55.

The '114 patent discloses in "an embodiment, the promoted sorbent is introduced by direct injection into the flue gas stream" and in "another

embodiment, the base sorbent is promoted within the flue gas stream." *Id.* at 5:41–43. The '114 patent describes that in "some embodiments, the carbon base sorbent and the promoter are introduced into the mercury-containing gas at the same location or at separate locations." *Id.* at 7:5–8. For instance, the '114 patent explains for one example that "the sorbent is injected into the flue gas after the boiler" and the "additive can be injected where desired (e.g., before, after, or within the boiler)." *Id.* at 30:1–4.

The '114 patent explains that when "a promoted or a non-promoted base sorbent reacts with elemental or oxidized mercury, a mercury/sorbent chemical composition is formed and, in the case of elemental mercury reacting with the promoted base sorbent, the mercury is oxidized." *Id.* at 3:53–57. The '114 patent further describes separating the promoted sorbent from the gas stream and adjusting "the rate at which the carbon base sorbent is introduced or the rate at which the promoter is introduced or combination thereof" according to a monitored mercury content of the cleaned gas "so that the mercury content of the cleaned gas is maintained at substantially the desired level with minimal operating cost." *Id.* at 7:10–16.

C. Illustrative Claim

1. A method of separating mercury from a mercury containing gas, the method comprising:
combusting coal in a combustion chamber, to provide the mercury-containing gas, wherein the mercury-containing gas comprises a halogen or halide promoter comprising HBr, Br-, or a combination thereof, wherein
the coal comprises added Br_2, HBr, Br-, or a combination thereof, added to the coal upstream of the combustion chamber, or
the combustion chamber comprises added Br_2, HBr, Br-, or a combination thereof, or
a combination thereof;

injecting a sorbent material comprising activated carbon into the mercury-containing gas downstream of the combustion chamber;
contacting mercury in the mercury-containing gas with the sorbent, to form a mercury/sorbent composition;
separating the mercury/sorbent composition from the mercury-containing gas, to form a cleaned gas;
monitoring the mercury content of the cleaned gas; and
controlling, in response to the monitored mercury content of the cleaned gas, an injection rate of injecting the sorbent into the mercury-containing gas, the sorbent composition, or a combination thereof, so that the mercury content of the cleaned gas is maintained at or below a desired level.

Ex. 1001, 33:49–34:7.

D. The Asserted Grounds of Unpatentability

Petitioner contends claims 1–9 and 12–30 of the '114 patent are unpatentable on the following grounds. Pet. 10.

Reference(s)	Basis	Claim(s) Challenged
Sjostrom,[1] Eckberg[2]	§ 103	1, 2, 4–9, 12–28, 30
Sjostrom, Olson-646[3]	§ 103	1–9, 12–30[4]

[1] Sharon Sjostrom, "Full Scale Evaluations of Mercury Control Technologies with PRB Coals," Track A, Session A3 (Mercury – Control), Presentation A3b, EUEC: 8TH ELECTRIC UTILITIES ENVIRONMENTAL CONFERENCE (Tucson, Arizona: January 25, 2005) (Ex. 1010).
[2] Craig Eckberg *et al.*, "Mercury Control Evaluation of Halogen Injection into a Texas Lignite-Fired Boiler," Track A, Session A3 (Mercury – Control), Presentation A3c, EUEC: 8TH ELECTRIC UTILITIES ENVIRONMENTAL CONFERENCE (Tucson, Arizona: January 25, 2005) (Ex. 1011).
[3] US 2006/0048646 A1, published Mar. 9, 2006 (Ex. 1014).
[4] The Petition states that claims 1–9 and 12–30 are being challenged under this ground, but Petitioner's actual arguments for this ground appear to address only claims 1–4, 6–9, 14, 19–22, and 24–30. *Compare* Pet. 10, 69 (indicating that Ground 2 challenges claims 1–9 and 12–30) *with* Pet. 69–97

In support of its unpatentability arguments, Petitioner relies on the declaration of Dr. Stephen Niksa. Ex. 1002 ("Niksa Declaration").

II. ANALYSIS

A. Claim Construction

We apply the claim construction standard articulated in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005); 37 C.F.R. § 42.100(b) (2019); *see also Changes to the Claim Construction Standard for Interpreting Claims in Trial Proceedings Before the Patent Trial and Appeal Board*, 83 Fed. Reg. 51,340 (Oct. 11, 2018) (applicable to *inter partes* reviews filed on or after November 13, 2018). Under *Phillips*, claim terms are afforded "their ordinary and customary meaning." *Phillips*, 415 F.3d at 1312. "[T]he ordinary and customary meaning of a claim term is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention." *Id.* at 1313. Only terms that are in controversy need to be construed, and then only to the extent necessary to resolve the controversy. *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999).

Neither party asserts a claim construction for the challenged claims. *See* Pet. 10; *see generally* Prelim. Resp. On this record, we determine that no claim terms require express construction.

B. Principles of Law

"In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable." *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363

(addressing only claims 1–4, 6–9, 14, 19–22, and 24–30). Clarification is requested.

(Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (requiring *inter partes* review petitions to identify "with particularity . . . the evidence that supports the grounds for the challenge to each claim")). This burden of persuasion never shifts to Patent Owner. *See Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (discussing the burden of proof in *inter partes* review).

A claim is unpatentable under § 103(a) if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) when in evidence, objective indicia of non-obviousness (i.e., secondary considerations). *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). "To satisfy its burden of proving obviousness, a petitioner cannot employ mere conclusory statements. The petitioner must instead articulate specific reasoning, based on evidence of record, to support the legal conclusion of obviousness." *In re Magnum Oil Tools Int'l, Ltd.*, 829 F.3d 1364, 1380 (Fed. Cir. 2016).

We analyze the asserted grounds of unpatentability in accordance with these principles to determine whether Petitioner has met their burden to establish a reasonable likelihood of success at trial.

C. Level of Ordinary Skill in the Art

Petitioner argues:

> A person of ordinary skill in the art ("POSITA") would have at least a bachelor's degree in chemical engineering, mechanical engineering, or a related field of study with at least two years of experience with implementing pollution control in power generation plants for natural gas, coal, and/or industrial waste incineration.

Pet. 12 (citing Ex. 1002 ¶ 64). Patent Owner does not appear to dispute this proposed definition. *See generally* Prelim. Resp. Neither party argues that the outcome of this case would differ based on our adoption of any particular definition of one of ordinary skill in the art.

In light of the record before us, we adopt Petitioner's proposal regarding the level of one of ordinary skill in the art. The level of ordinary skill in the art is also reflected by the prior art of record. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001).

D. Real Parties-In-Interest

Petitioner identifies a number of real parties-in-interest and potential real parties-in-interest. Pet. 1–6.

Patent Owner argues that "35 U.S.C. § 312(a)(2) provides that a petition may only be considered if 'the petition identifies all real parties in interest.'" Prelim. Resp. 8. Patent Owner contends that Petitioner lists "dozens of 'potential real parties in interest,' without explanation as to their relationship to petitioners," that this "is not an identification of *all real parties in interest*," and that, if instituted, this proceeding would be under a cloud of uncertainty because the ambiguity in Petitioner's list "will likely lead to confusion and disputes as to which parties are real parties in interest and which are bound by the estoppel provisions of 35 U.S.C. § 315." *Id.* For instance, Patent Owner asserts that Petitioner identifies various vendors and suppliers as "potential real parties in interest" but states that "[n]one of

these companies or any unnamed entity is funding, controlling, or directing, or otherwise has an opportunity to control or direct this Petition or proceeding" and this implies that these entities are not actually real parties in interest. *Id.* In addition, Patent Owner argues that some entities are identified both as "potential real parties in interest" and "real parties in interest," which creates ambiguity and conflict in the listing of entities. *Id.* For these reasons, Patent Owner contends that Petitioner has "not met their burden of identifying all real parties in interest" and "the Board should deny institution for failure to comply with § 312(a)(2)." *Id.* at 8–9.

We are not made aware of any rule, statute, or case law that prohibits Petitioner from identifying multiple real parties-in-interest or multiple potential real parties-in-interest. Petitioner's identification of about a dozen real parties-in-interest does not appear problematic or overly burdensome. Pet. 1–2. Petitioner's identification of numerous potential real parties-in-interest, while unusual, also does not appear problematic. *Id.* at 2–6. To the extent Petitioner has identified an entity as both a real party-in-interest and a potential real party-in-interest, we interpret that to mean that party is identified as a real party-in-interest. Petitioner's reasons for identifying numerous potential real parties-in-interest appear plausible: Petitioner identifies these parties "out of an abundance of caution" because "they are vendors and suppliers" in the related litigation but have not "agreed to be listed as a real party-in-interest" in this Petition. Pet. 1–6. This provides the Board and Patent Owner notice that other potential entities may be indirectly involved, but also provides reasons for not committing those parties to the real party-in-interest category. Ordinarily, problems regarding identification of real parties-in-interest arise when a petitioner fails to identify a real party-in-interest. *See, e.g., Ventex Co., Ltd. v. Columbia Sportswear N. Am., Inc.*,

IPR2017-00651, Paper 152 (PTAB Jan. 24, 2019) (precedential) (terminating proceeding where Petition failed to name time-barred RPI and privy). Here, the alleged problem is over-identification of potential real parties-in-interest. Without express violation of a known rule, statute, or case law, however, this does not appear to be a problem warranting non-institution of *inter partes* review.

E. Discretion under 35 U.S.C. § 325(d)

Patent Owner argues that the Board should exercise its discretion to deny institution under 35 U.S.C. § 325(d). Prelim. Resp. 1–2. Patent Owner asserts:

> Petitioners contend that the challenged claims cannot claim priority to earlier applications because those applications fail to provide written description support for two limitations: (1) using HBr, Br_2, or Br^-/bromide as an additive (Pet. at VI.C.2); and (2) adding the additive to coal (Pet. at VI.C.3). They contend that this dispute is appropriate for *Inter Partes* Review because: "Examiners do not make findings of priority as a matter of course during prosecution." Pet. at 11-12. This assertion is misguided. Petitioners fail to mention that the examiner found written description support for the challenged claims based on material contained in, or equivalent to, the parent applications. Because Petitioners identify no material error in the examiner's conduct, the Board should deny institution under § 325(d).

Id. at 2.

> To evaluate whether to exercise discretion under 35 U.S.C. §325(d),
>
> the Board uses the following two-part framework: (1) whether the same or substantially the same art previously was presented to the Office or whether the same or substantially the same arguments previously were presented to the Office; and (2) if either condition of first part of the framework is satisfied, whether the petitioner has demonstrated that the Office erred in a manner material to the patentability of challenged claims

Advanced Bionics LLC v. MED-EL Elektromedizinische Geräte GmbH, IPR2019-01469, Paper 6 at 8 (PTAB Feb. 13, 2020) (precedential). The factors set forth in *Becton, Dickinson & Co. v. B. Braun Melsungen AG*, IPR2017-01586, Paper 8 (PTAB Dec. 15, 2017) (precedential as to § III.C.5, first paragraph) provide insight into how to apply the framework, because *Becton, Dickinson* factors (a), (b), and (d) relate to part (1) of the framework and factors (c), (e), and (f) relate to part (2).

1. Advanced Bionics Framework Part (1)

For part (1) of the *Advanced Bionics* framework (and factors (a), (b), and (d) of *Becton, Dickinson*), Patent Owner contends that, shortly after filing the '760 application, a new independent claim was added which recited, among other things, "combusting coal in a combustion chamber, to provide the mercury-containing gas, wherein the mercury-containing gas comprises a halogen or halide promoter comprising Br_2, HBr, Br^-, or a combination thereof" and "injecting a sorbent material comprising activated carbon into the mercury-containing gas downstream of the combustion chamber." *Id.* at 4–5 (citing Ex. 1026, 75–76). According to Patent Owner, "this claim encompasses all of the features that Petitioner alleges are absent from the various parent applications, i.e., the use of HBr, Br2, or Br-, and the addition of a bromine material to the coal." *Id.* at 5.

Patent Owner, however, acknowledges that the new claim "does not expressly recite providing bromine to the coal" but argues "its scope covers that embodiment because it covers combusting coal to obtain a mercury-containing gas that also contains those bromine species." *Id.* Patent Owner cites a subsequent interview with the Examiner to discuss support for the amended claims and argues that the Examiner found support for the claim

scope in Figure 6 of the '114 patent, which is reproduced below. *Id.* (citing Ex. 1026, 1535).

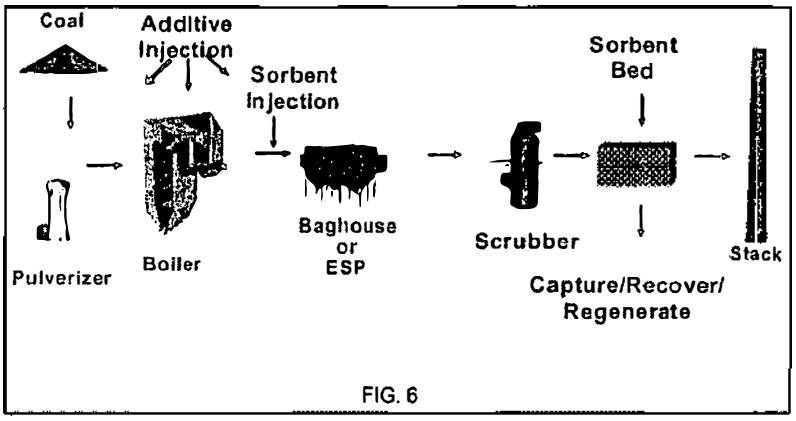


Figure 6 of the '114 patent is "a block diagram illustrating the use of the invention in a coal fueled facility." Ex. 1001, 9:33–34. Patent Owner asserts that Figure 6 "is taken directly from the provisional application" and "the same written description issues that form the basis of the Petition were already considered by the examiner during prosecution." Prelim. Resp. 6.

Petitioner replies that the Examiner "at most considered whether the '114 Patent, *as filed*, included support for all claim limitations in the '114 Patent specification," but did not "address entitlement to benefit through each of the parent applications." Reply 4.

The independent claims of the '114 patent require that coal comprise added Br_2, HBr, Br- or a bromide compound, or a combination thereof, *or* the combustion chamber comprises added Br_2, HBr, Br- or a bromide compound, or a combination thereof. Ex. 1001, 33:55–60, 35:9–14, 35:29–34, 36:10–15. The scope of the claim added during prosecution of the '760 application may be viewed as encompassing various methods of adding the bromine species so coal is combusted and a mercury-containing gas is

provided that includes the bromine species. However, as acknowledged by Patent Owner, the claim added during prosecution of the '760 application "does not expressly recite providing bromine to the coal." Prelim. Resp. 5. Nor does the claim expressly recite that the bromine species are added to the combustion chamber.

Therefore, the Examiner did not necessarily consider whether the '760 application and its priority applications provided support for the two specific embodiments of adding the bromine species to coal and adding the bromine species to the combustion chamber. Analysis of the claim added during prosecution of the '760 application did not require analysis of whether there was written description support for these two specific embodiments, but rather, whether there was sufficient written description support for the claimed genus of adding the bromine species, which encompassed numerous ways of adding the bromine species. In other words, the analysis of support for the genus did not necessarily require analysis of support for the species. As a result, we do not agree with Patent Owner that the same or substantially the same arguments regarding the priority of the '114 patent previously were presented to the Office. Having reached this conclusion, we need not necessarily analyze the second part of the *Advanced Bionics* framework. Nevertheless, because Patent Owner argues that the Examiner implicitly considered priority issues during examination (Prelim. Resp. 6–8), we address this argument below.

2. Advanced Bionics Framework Part (2)

For part (2) of the *Advanced Bionics* framework (and factors (c), (e), (f) of *Becton, Dickinson*), Patent Owner contends that Petitioner "could have attempted to argue that the examiner's § 112/priority date analysis contained some material error, but they failed to do so," and, thus, factors (c), (e),

and (f) of *Becton, Dickinson* weigh against institution. Prelim. Resp. 6. In response to Petitioner's statement that "Examiners do not make findings of priority as a matter of course during prosecution, instead accepting applicant's asserted priority date" (Pet. 11–12), Patent Owner argues that although "examiners are not required to provide a priority date analysis for every application, such an analysis is required when considering references that post-date the earliest claimed filing date." Prelim. Resp. 6–7 (citing MPEP § 201.08). Patent Owner asserts that during prosecution, "the examiner considered several references with prior art dates in between the provisional filing date and the '114 filing date" but, nonetheless, "the fact that the examiner did not reject the claims based on this reference indicates that she did not accept Petitioners' assertion of a lapse in priority." *Id.* at 7. In view of this, Patent Owner argues that the Board should deny the petition. *Id.* at 8.

Petitioner argues "the Patent Office made no finding regarding priority of the '114 Patent to earlier filed applications." Pet. 21. Petitioner also asserts that although "the Patent Office did not make a determination regarding priority to earlier applications, applicants cited to the as-filed '760 Application for written-description support" when amending the pending claims of the '760 application to recite the addition of bromine-containing species (Br_2, HBr, Br^-, bromine compound) to coal upstream of a combustion chamber. *Id.* at 20–21, 23–24. However, Petitioner contends that some portions of the '760 application cited for written description support were not present in the '594 application, and earlier applications do not provide written description support for the independent claims of the '114 patent. *Id.* at 24–26. Petitioner further asserts that "the Examiner at most considered whether the '114 Patent, *as filed*, included support for all

claim limitations in the '114 Patent specification," the "Examiner did not address entitlement to benefit through each of the parent applications," and "[b]reaks in the priority chain occurred." Pet. Reply 4 (citing Ex. 1026, 1535; Pet. 26–33).

We find that Petitioner has demonstrated that the Office erred in a manner material to the patentability of the challenged claims. As discussed below with regard to the priority of the '114 patent, Petitioner demonstrates, on this record, a break in the priority chain of the '114 patent, and that the independent claims of the '114 patent lack written description support in each application of the priority chain. This is further illustrated by Patent Owner's arguments, which show that the Examiner cited Figure 6 of the '760 application for written description support when considering the claim amendments cited by Patent Owner. Prelim. Resp. 5–6 (citing Ex. 1026, 1535). Although Figure 2 of the provisional application corresponds to Figure 6 of the '760 application, Petitioner is correct that this drawing was removed from intervening applications, including the '163 and '595 applications, and was added to the specification when the '760 application was filed. Pet. Reply 5; *see* Ex. 1020, 16; Ex. 1021, 41–47; Ex. 1022, 40–46; Ex. 1026, 62.

For these reasons, we decline to exercise our discretion under § 325(d) to deny institution.

F. Discretion under 35 U.S.C. § 314(a)

Under § 314(a), we have discretion to deny institution of an *inter partes* review. *Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2140 (2016); *SAS Inst. Inc. v. Iancu*, 138 S. Ct. 1348, 1356 (2018); *Harmonic Inc.*, 815 F.3d at 1367 ("[T]he PTO is permitted, but never compelled, to institute an IPR proceeding."); *see also* 37 C.F.R. § 42.4(a) ("The Board institutes the

trial on behalf of the Director."). In deciding whether to institute an *inter partes* review, we consider the guidance in the Consolidated Trial Practice Guide, which states:

> Based on the Board's experience, one petition should be sufficient to challenge the claims of a patent in most situations. Two or more petitions filed against the same patent at or about the same time . . . may place a substantial and unnecessary burden on the Board and the patent owner and could raise fairness, timing, and efficiency concerns.

Patent Trial and Appeal Board Consolidated Trial Practice Guide ("CTPG") (Nov. 2019), https://www.uspto.gov/sites/default/files/documents/tpgnov.pdf, 59.

Here, Petitioner filed two petitions on the same day challenging claims 1–9 and 12–30 of the '114 patent. In IPR2020-00834, Petitioner presented two anticipation grounds, one based on Vosteen and one based on Downs-Boiler, and six obviousness grounds based on either Vosteen or Downs-Boiler and additional references. IPR2020-00834, Paper 3, 10. In this proceeding, Petitioner presented two obviousness challenges, the first based on Sjostrom and Eckberg and the other based on Sjostrom and Olson-646. Pet. 10.

Petitioner filed a Petitioner's Explanation Regarding the Necessity of Multiple Petitions. Paper 2 ("Explanation"). Arguing that "[g]iven the strength of the prior-art references on the merits, and noncumulative nature of the references, both petitions should be instituted," Petitioner nevertheless ranks the IPR2020-00834 petition above the IPR2020-00832 petition. Explanation 2.

Citing the CTPG's statement that "more than one petition may be necessary . . . when there is a dispute about priority date requiring arguments

under multiple prior art references," Petitioner also contends that the two petitions assert different priority dates and assert different references. *Id.* at 3 (citing CTPG 59). Petitioner further argues that the issues presented to the Board by the two Petitions are limited, because the Petition in IPR2020-00834 uses only two primary references and two secondary references whereas the Petition in this proceeding uses only one primary reference and two secondary references. *Id.* at 3–4. Petitioner also contends that Patent Owner may attack obviousness grounds for dependent claims in IPR2020-00834 via evidence of secondary considerations. *Id.* at 4. In view of this possibility, Petitioner requests that the Board also institute in this proceeding because Olson-646 discloses numerous limitations of the same dependent claims. *Id.* Petitioner also argues that, instead of each party individually filing separate petitions, the parties joined forces for reasons of efficiency. *Id.* at 4–5.

Petitioner's arguments are persuasive. As argued by Petitioner, the CTPG recognizes that more than one petition may be necessary when there is a priority date dispute that requires arguments under multiple prior art references. CTPG 59. We also agree with Petitioner that the second petition in this proceeding does not unduly burden the Board, due to its two grounds based on three references. Because the remaining grounds in IPR2020-00834 based on Downs-Boiler appear to challenge only claims 1–7 and 12–30 of the '114 patent, the petition in this proceeding potentially challenges claims (i.e., claims 8 and 9) in addition to those challenged by the ground based on Downs-Boiler in IPR2020-00834.

Patent Owner does not contest Petitioner's arguments that the simultaneous filing of two petitions does not unduly burden the Board. *See generally* Prelim. Resp.; Sur-reply. Nor does Patent Owner argue that two

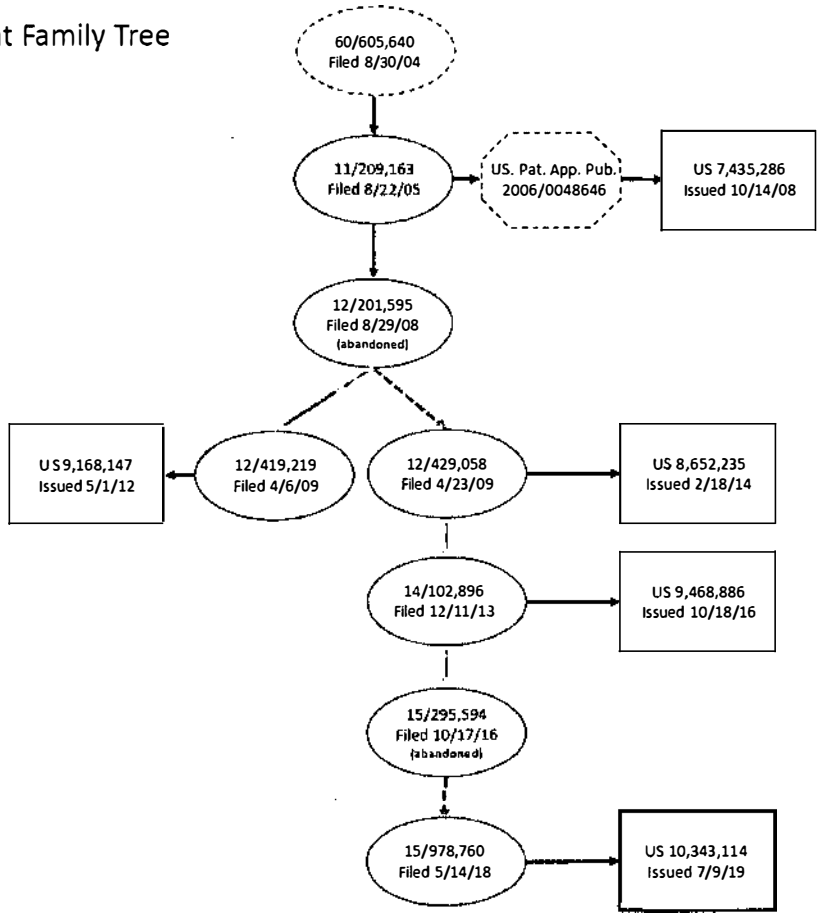
petitions prejudice Patent Owner or otherwise request us to exercise our discretion under § 314(a). *Id.* Given the unique circumstances in this proceeding, we find this to be a rare instance in which we should decline to exercise our discretion to deny the lower-ranked Petition.

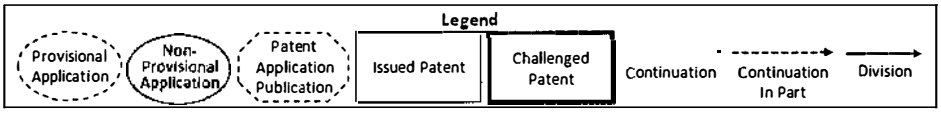
G. Priority of '114 Patent

Petitioner asserts that the priority date of the '114 patent is no earlier than its filing date of May 14, 2018. Pet. 20. Petitioner asserts it has demonstrated "the invalidity of the '114 Patent claims in the grounds below" and this places the burden on Patent Owner "to come forward with evidence 'to prove entitlement to claim priority to an earlier filing date.'" Pet. 21–22 (citing *PowerOasis, Inc. v. T-Mobile USA, Inc.*, 522 F.3d 1299, 1305–06 (Fed. Cir. 2008) (stating a patent owner has "to prove entitlement to claim priority to an earlier filing date").

Petitioner provides the following summary of the '114 patent's priority chain and family:

Patent Family Tree





Ex. 1017. This summary depicts the earliest filed application at the top and shows the latest filed application at the bottom. As illustrated above, the '114 patent has the following priority chain:

- Provisional Application 60/605,640, filed August 30, 2004, ("the provisional application");
- Non-provisional Application 11/209,163 ("the '163 application"), filed August 22, 2005, claiming priority to the Provisional Application;
- Non-provisional Application 12/201,595 ("the '595 application"), filed August 29, 2008, claiming priority to the '163 application as a divisional application;
- Non-provisional Application 12/429,058 ("the '058 application"), filed April 23, 2009, claiming priority to the '595 application as a continuation-in-part;
- Non-provisional Application 14/102,896 ("the '896 application"), filed December 11, 2013, claiming priority to the '058 application as a continuation;
- Non-provisional Application 15/295,594 ("the '594 application"), filed October 17, 2016, claiming priority to the '896 application as continuation; and
- Non-provisional Application 15/978,760 ("the '760 application"), filed May 14, 2018, claiming priority to the '594 application as a continuation-in-part.

Id.; Ex. 1001, code (21), (22), (60). The provisional application has an earlier date than when Sjostrom and Eckberg were publicly accessible (February 2005) and when Olson-646 was published (March 2006).

Reply 1. Therefore, if the '114 patent were entitled to the priority date of the provisional application, Sjostrom, Eckberg and Olson-646 would not qualify as prior art to the '114 patent.

Petitioner contends the priority date of the '114 patent is no earlier than its filing date of May 14, 2018, because:

> The earlier-filed applications in the priority chain fail to include sufficient written description of claim limitations that appear in each of the independent claims (Claims 1, 23–25), at least because there is no disclosure of adding any type of bromine-containing species (Br_2, HBr, Br^-, bromine compound) to the coal upstream of the combustion chamber, let alone the particular species recited in the claims.

Pet. 20. Petitioner asserts that the provisional application cannot be relied upon for support because the intervening applications do not include the relied-upon disclosure of the provisional application. *Id.* at 26 (citing *Lockwood v. American Airlines, Inc.*, 107 F.3d 1565 (Fed. Cir. 1997)).

Petitioner argues that "in the '760 Application and earlier applications, the Provisional is only 'incorporated by reference ***to the extent appropriate***,'" indicating that applicants did not intend to incorporate the entire document, but only parts of it, again without identifying the specific material to incorporate." *Id.* at 27 (citing Ex. 1001, 1:20–22). Petitioner asserts that "material from a provisional application incorporated by reference cannot be considered as providing written description support in a priority analysis, because such material would be deemed 'essential material.'" *Id.* at 27–28. "'[E]ssential material'—which includes 'material that is necessary to: provide a written description of the claimed invention'—'may be incorporated by reference, but ***only*** by way of incorporation by reference to a ***U.S. patent or U.S. patent application publication***.'" *Id.* (citing 37 C.F.R. § 1.57(d) (2020); 37 C.F.R. § 1.57(c)

(2005)). Petitioner further argues that the provisional application "fails to disclose adding to the coal or to the combustion chamber each of the particular bromine-containing species recited in the Newly Introduced Limitations, such as Br_2, Br^- and 'bromide compounds.'" *Id.* at 28–33 (citing Ex. 1002 ¶¶ 187, 192–196).

In addition, Petitioner contends there is a lack of support for the '114 patent claims in the intervening applications between the provisional application and the '114 patent because "[n]othing in the '595 Application filed 8/29/2008 describes adding the bromine promoter independently from the mercury sorbent, let alone to the coal or combustion chamber." *Id.* at 34 (citing Ex. 1022, 1–34). Petitioner also argues that the '058, '594, and '896 applications are deficient in their written description support. *Id.* at 34–36.

Patent Owner argues that a petitioner initially has the burden of persuasion and the burden of production on all issues, and if the petitioner provides *prima facie* evidence that its burden has been met, the burden of production shifts to patentee on some issues, such as the determination of a patent's priority date. Prelim. Resp. 13 (citing *Dynamic Drinkware*, 800 F.3d at 1379–80). According to Patent Owner, if "the patentee meets this burden by providing evidence of an earlier priority date, the Board must evaluate the petitioner's arguments in light of all the evidence to determine if the petitioner has met its burden of persuasion." *Id.* (citing *Dynamic Drinkware*, 800 F.3d at 1380; *Boart Longyear Ltd. v. Australian Mud Co. Pty Ltd.*, No. IPR2019-01129, 2019 WL 6442439, at *14 (PTAB Nov. 25, 2019)). Patent Owner contends that Petitioner confuses the burden of production with the burden of persuasion. *Id.* at 14.

In view of the above, Patent Owner asserts that Petitioner "must demonstrate that one or more of these applications lacks written description

support for the challenged claims of the '114 patent" but Petitioner has not met its burden. *Id.* at 14–15. Specifically, Patent Owner argues that the provisional application supports the claims of the '114 patent and the '594 application, the '896 application, and the '058 application collectively[5] support the claims of the '114 patent. *Id.* at 16–22, 24–31.

Patent Owner also addresses the '595 and '163 applications, stating that they "contain substantively identical disclosures," and therefore refers to the '595 application when arguing that those two applications support the claims of the '114 patent. *Id.* at 22. Specifically, Patent Owner asserts that the "'595 application discloses the same chemical model as the '594 application," "the use of a 'promoter' that supplies Br- such as HBr or Br_2," "and the practice of adding the promoter and sorbent at one or multiple locations." *Id.* (citing Ex. 1022 ¶¶ 52–53, 56, 64, Fig. 2, original claim 8).

Patent Owner acknowledges that "instead of the hypothetical example depicted in figure 5 of the ['594] patent, the ['595][6] patent describes an experimental test setup at an actual coal plant" in which "the promoter and sorbent were both injected downstream of the boiler" but argues "the inventors explained that these components could be added before, after, or within the boiler." *Id.* at 22–23 (citing Ex. 1022 ¶ 107). Patent Owner asserts that because "a halogen/halide promoted sorbent necessarily includes a halogen/halide such as Br_2, HBr, or Br-, a POSITA would recognize that adding this material before the boiler necessarily results in the limitations at

[5] Patent Owner states that the '595 application is representative of the '163 application and the '594 application is representative of the '058 and '896 applications. Prelim. Resp. 14.

[6] There appears to be a typographical error in this passage. It appears that the '594 application and the '595 application were inadvertently switched with one another.

issue in the '114 patent." *Id.* at 23. In response to Petitioner's arguments regarding lack of written description support in the intervening applications (including the '595 and '163 applications), Patent Owner contends that Petitioner offers "only brief, vague assertions as to why these applications fail to provide support for the challenged claims, or they criticize portions of the applications not relied upon above." *Id.* at 31.

Petitioner responds by arguing that it has shown Sjostrom and Eckberg to be printed publications, and that Olson-646 was published in March 2006, and this has shifted the burden to Patent Owner to show an earlier filing date. Pet. Reply 1 (citing *Mueller Sys., LLC v. Rein Tech, Inc.*, IPR2020-00100, 2020 WL 2478524, at *10 (PTAB May 12, 2020)). Petitioner asserts that "Patent Owner has not demonstrated written-description support through *each* of the parent applications" and that Patent Owner has not shown that all limitations are found in the provisional application. *Id.* at 1–4. Petitioner contends that Patent Owner does not dispute that a provisional application cannot be incorporated by reference for a priority analysis. *Id.* at 4. In addition, Petitioner disputes Patent Owner's analysis for support in the intervening applications, arguing that "[t]he '163 Application states that 'the ***inventive sorbent*** can be injected where desired (e.g., before, after, or within the boiler)" and "[t]he 'inventive sorbents' are those formed from '***chemically combin[ing] molecular bromine . . . with activated carbon***.'" *Id.* at 4–5 (citing Ex. 1021, 18, 29; Ex. 1022, 14, 25 (emphasis added)). Petitioner asserts that "the '114 Patent claims require ***separately*** injecting the promoter and sorbent (i.e., before they chemically combine)—the promoter must be added to the coal or to the boiler, and the sorbent must be injected downstream of the boiler." *Id.* at 5 (citing Ex. 1001, claims 1, 23–25). Petitioner further argues that Figure 2 of the

provisional application was removed from all intervening applications but added to the specification when the '114 patent was filed (i.e., as Figure 6 in the '760 application). *Id.*

Patent Owner argues that the provisional application supports the challenged claims. Sur-reply 1–4. In response to Petitioner's arguments regarding the '163 application and the separate injection of promoter and sorbent, Patent Owner argues that "[n]o such language appears in the claims," "[a]t best, Petitioners are raising a new argument based on a new claim construction position, but they fail to identify the claims affected, the claim language that they seek to construe, or any intrinsic or extrinsic evidence in support of their position", and "the claims do not merit such a construction" because the claim language "does not exclude adding bromine or sorbent at both locations." *Id.* at 4. Patent Owner further contends that claim 14 of the '114 patent recites "wherein the sorbent material injected into the mercury-containing gas is a promoted sorbent" and "[t]hus, the claims plainly do not exclude injection of bromine with sorbent so long as some bromine is provided upstream of the combustion chamber and some activated carbon is injected downstream of the combustion chamber." *Id.* at 5. In addition, Patent Owner asserts "the specification describes embodiments where multiple injection points are used to inject combined promoter and sorbent." *Id.* (citing Ex. 1001 at 14:10–16).

Having considered the parties' positions and evidence, we determine that Petitioner has demonstrated a reasonable likelihood that one or more of the applications in the priority chain for the '114 patent lacks written description support for the challenged claims. Conversely, Patent Owner's arguments are insufficient to establish that the applications in question provide written description support.

According to *Lockwood v. American Airlines, Inc.*,

> In order to gain the benefit of the filing date of an earlier application under 35 U.S.C. § 120, *each application in the chain leading back to the earlier application must comply with the written description requirement of 35 U.S.C. § 112. In re Hogan,* 559 F.2d 595, 609, 194 USPQ 527, 540 (CCPA 1977).

107 F.3d at 1571 (emphasis added). Even if the provisional application and/or the '760 application were found to provide support for the challenged claims of the '114 patent, at least the '163 application and the '595 application do not provide written description support for the challenged claims.

The independent claims of the '114 patent recite that coal comprises added Br_2, HBr, Br^-, or a combination thereof (claims 1, 23, and 24), or Br_2, HBr, a bromide compound or a combination thereof (collectively, the "promoter"), (claim 25), or the combustion chamber comprises the added promoter, and the sorbent material is injected into the mercury-containing gas downstream of the combustion chamber. Ex. 1001, 33:55–63, 35:9–17, 35:30–38, 36:10–18. Therefore, regardless of whether the independent claims of the '114 patent encompass injecting both promoter and sorbent material into the mercury-containing gas downstream of the combustion chamber and/or adding that combination to coal or the combustion chamber, the issue is whether there is written description support in each application of the '114 patent's priority chain for a method that includes both (1) adding the promoter to coal or to the combustion chamber and (2) injecting the sorbent material into the mercury-containing gas downstream of the combustion chamber, as claims 1 and 23–25 recite.

Patent Owner states that the '595 application is representative of the '163 application and "[t]he '595 and '163 applications contain

substantively identical disclosures." Prelim. Resp. 14, 22. Petitioner does not dispute these assertions. *See generally* Pet.; Pet. Reply. For expediency, we analyze the disclosure of the '595 application.

Although Figure 6 of the '760 application corresponds to Figure 2 of the provisional application, that drawing is absent from the '595 and '163 applications. Ex. 1026, 62; Ex. 1020, 16; Ex 1020, 41–47; Ex. 1022, 40–46.[7] The '595 application describes methods for "the removal of mercury from the gases produced in the utilization of fossil fuels." Ex. 1022, 2, ¶ 8. To achieve this, the '595 application describes a "halogen/halide promoted activated carbon sorbent" that "comprises a new halide-modified carbon form containing a reactive compound produced by the reaction of bromine (or halide or other halogen) with the carbon," although "[o]ptional secondary components and alkali may be added to further increase reactivity and mercury capacity." *Id.* at 3, ¶ 9. The promoter can be selected from a group that includes "molecular halogens" and the optional secondary component may be selected from a group that includes HBr. *Id.* at 3–4, ¶¶ 11, 15. In another embodiment, the promoter is selected from a group that includes Br_2. *Id.* at 4, ¶ 18. The '595 application also describes the reaction of "[m]olecular bromine or a bromine compound" with activated carbon and the role of "halide anions electrons" in the oxidation of mercury. *Id.* at 10, ¶¶ 52–53.

[7] It appears that material from the provisional application was added to the '760 application. Ex. 1026, 36. However, it does not appear that this practice was followed for the '595 and '163 applications. One example of this is the absence of a drawing corresponding to Figure 6 in the '760 application or Figure 2 in the provisional application.

The '595 application further describes an example that involves "Full-Scale Testing." *Id.* at 25, ¶ 107. For this example, the '595 application discloses "the halogen/halide promoted carbon sorbent was injected into the flue gas after the boiler." *Id.* Thus, this passage describes a combination of promoter and sorbent material being added at one single point: "into the flue gas after the boiler." The '595 application continues the description of this example by stating "[i]n general however, the inventive sorbent can be injected where desired (e.g., before, after, or within the boiler)." *Id.* Although this describes other injection points ("e.g., before, after, or within the boiler"), this disclosure regards the promoted sorbent material. As a result, it describes the addition of both the promoter and the sorbent material at a single point, not (1) the addition of the promoter with the coal or the combustion chamber and (2) the injection of the sorbent material into mercury-containing gas downstream of the combustion chamber, as claims 1 and 23–25 of the '114 patent recite. As a result, we do not agree with Patent Owner's arguments regarding paragraph 107 of the '595 application. *See* Prelim. Resp. 22–23; Sur-reply 4–5.

Patent Owner further argues that paragraph 56 of the '595 application describes "the practice of adding the promoter and sorbent at one or multiple locations." Prelim. Resp. 22. Paragraph 56 explains that "single injection points 116 or 119 are shown in Figure 3, although one skilled in the art will understand that multiple injection points are within the scope of the present invention." Ex. 1022, 11, ¶ 56. However, this refers to injection points in flue gas stream 15 described in paragraph 55 of the '595 application, not multiple injection points at different points in the process (e.g., in the flue gas stream, in the combustion chamber, or with coal). *Id.* at 10–11, ¶ 55. Further, to the extent Patent Owner argues there is written description

support in the '595 and '163 applications for adding the promoter to the coal or to the combustion chamber (in addition to injecting the sorbent material downstream of the combustion chamber) because this would have been an obvious variation of the '595 application's disclosure, rendering an invention obvious does not satisfy the written description requirement. *Ariad Pharms., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1352 (Fed. Cir. 2010) (en banc) (citing *Lockwood*, 107 F.3d at 1571–72).

We further note that the '595 and '163 applications each incorporate by reference the provisional application in its entirety. Ex. 1021, 5, ¶ 1; Ex. 1022, 1, ¶ 1. Petitioner asserts that "material from a provisional application incorporated by reference cannot be considered as providing written support in a priority analysis, because such material would be deemed 'essential material,'" and such essential material may only be incorporated by reference to a U.S. patent or U.S. patent application publication. Pet. 27–28 (citing 37 C.F.R. § 1.57(d) (2020); 37 C.F.R. § 1.57(c) (2005)). Petitioner is correct that 37 C.F.R. § 1.57(c) (2005) permitted the incorporation by reference of essential material, which included material necessary to provide a written description of the claimed invention, but it is critical to note that it limited such incorporations to U.S. patents and U.S. patent application publications. 37 C.F.R. § 1.57(c) (2005)). Patent Owner does not dispute this point. *See generally* Prelim. Resp.; Sur-reply; *cf. Ex parte Maziere,* 27 USPQ2d 1705, 1706–07 (Bd. Pat. App. & Inter. 1993) (holding that if "essential material" is included in the application at issue, incorporation by reference in the parent application was sufficient to claim priority and to satisfy the written description requirement, but not discussing provisional applications). Therefore, to the extent the provisional application provides support for the challenged claims, the

incorporation by reference of the provisional application by the '595 and '163 applications cannot cure the deficiencies discussed above.

Moreover, although we have only analyzed the '595 and '163 applications, we also look to the incorporation statements in the other applications in the chain leading to the '760 application. Reply 4. The incorporation statement in the '058 application provides: "The disclosures of US Patent Applications 12/201,595; 11/209,163; and 60/604,640 are hereby incorporated herein by reference to the extent appropriate." Ex. 1023, 7. The incorporation statement in the '896 application provides: "The disclosures of US Patent Application Serial Nos. 12/429,058; 12/201,595; 11/209,163; and 60/605,640 are hereby incorporated herein by reference to the extent appropriate." Ex. 1024, 8. The incorporation statement in the '594 application provides: "The disclosures of US Patent Application Serial Nos. 14/102,896; 12/429,058; 12/201,595; 11/209,163; and 60/605,640 are hereby incorporated herein by reference to the extent appropriate." Ex. 1025, 10. "To incorporate material by reference, the host document must identify with *detailed particularity* what specific material it incorporates and *clearly indicate where* that material is found in the various documents." *Zenon Envtl., Inc. v. U.S. Filter Corp.*, 506 F.3d 1370, 1378, 1379 (Fed. Cir. 2007) (quoting *Cook Biotech Inc. v. Acell, Inc.*, 460 F.3d 1365, 1376 (Fed. Cir. 2006)). It is unclear to us what the term "to the extent appropriate" means in this context. The incorporation statements in the '058 application, the '896 application, and the '594 application all fail to identify with detailed particularity the specific material incorporated "to the extent appropriate," and fail to clearly indicate where that material is found in the various documents. *See also* MPEP 211.02 ("In view of this requirement for a specific reference in the later-filed

application, the right to rely on a prior application may be waived by an applicant if a proper reference to the prior application is not included in the later-filed application."). This ambiguity creates an additional concern regarding the chain of priority of the '760 application.

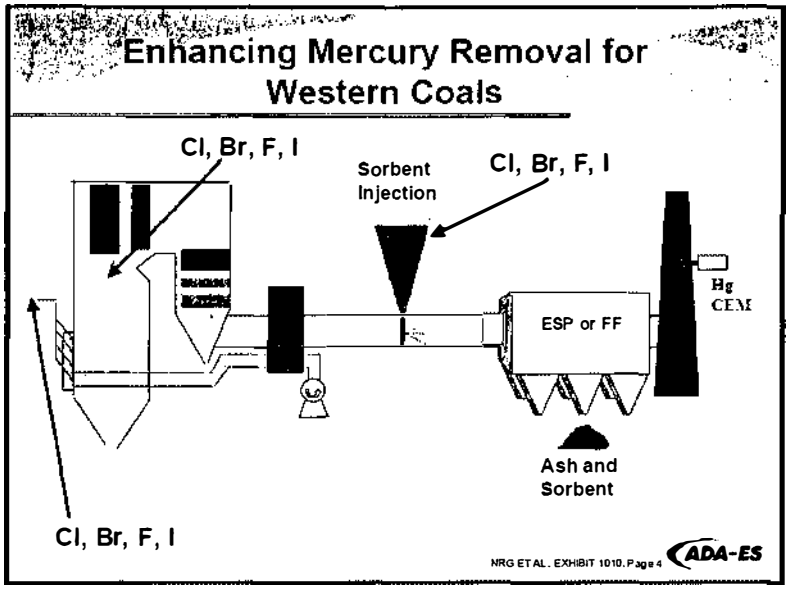
In view of the present record, Petitioner has demonstrated that one or more of the applications in the priority chain for the '114 patent lacks written description support for the challenged claims. Patent Owner, on this record, has not presented persuasive arguments or evidence that the '114 patent is entitled to a priority date earlier than the May 14, 2018 filing date of the '760 application.

H. Asserted Obviousness over Sjostrom and Eckberg (Ground 1)

Petitioner argues that claims 1, 2, 4–9, 12–28, and 30 are unpatentable over Sjostrom and Eckberg. Pet. 36–69.

1. Sjostrom

Sjostrom is a presentation titled "Full Scale Evaluations of Mercury Control Technologies with PRB Coals" that was made during the 2005 Electric Utilities Environment Conference ("EUEC"). Ex. 1010, 1; Ex 1030, 3, 23. Sjostrom includes the following drawing of a process:

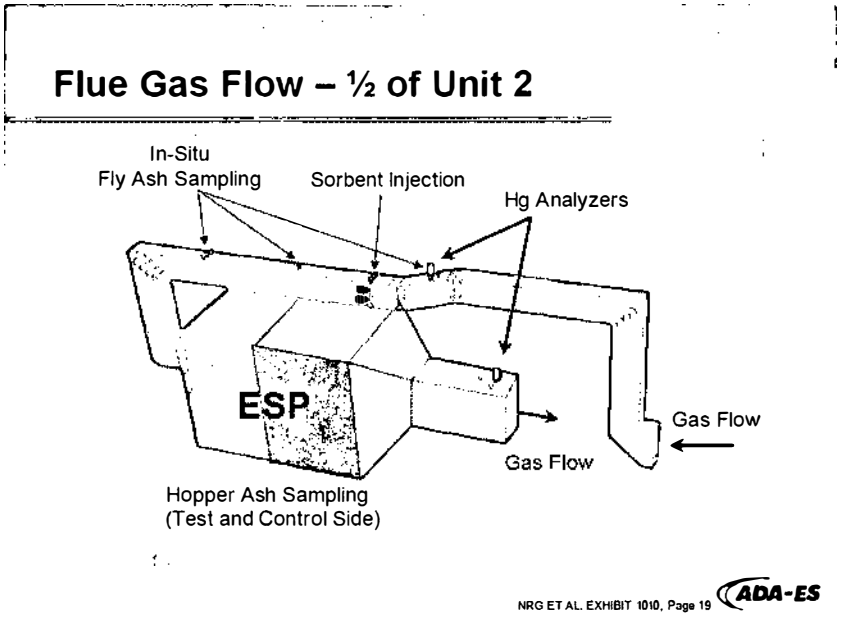


Sjostrom's Process Diagram

Ex. 1010, 4. Sjostrom's Process Diagram is captioned "Enhancing Mercury Removal for Western Coals." *Id.* The Figure includes a boiler (or combustion chamber) on the left and arrows pointing to what appears to be upstream of the boiler, into the boiler, and to a "Sorbent Injection" device, which appears to be located downstream of the boiler. *Id.* The arrows are labeled with chemical species, such as bromine. *Id.* An "ESP or FF" is located on the right side of the figure with "Ash and Sorbent" located below the "ESP or FF" device. *Id.*

Sjostrom describes "KNX (Alstom Power)" when discussing "Coal Additives at Meramec" and describes "Activated Carbon Injection to Improve Mercury Control." *Id.* at 10, 23.

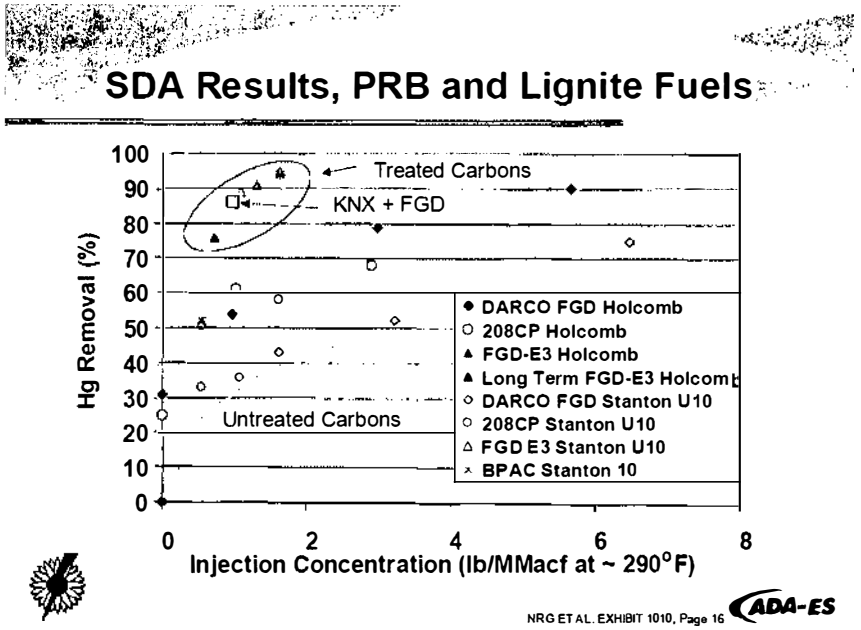
The far right side of Sjostrom's figure also has a "Hg CEM." *Id.* at 4. Sjostrom provides the following drawing when discussing "Flue Gas Flow – ½ of Unit 2:"



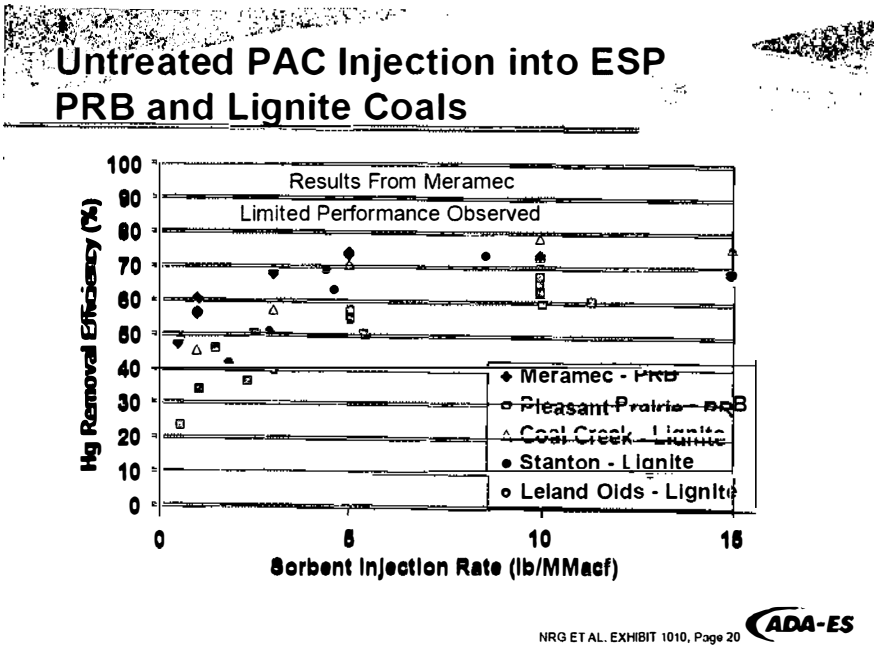
Sjostrom's Flue Gas Flow Figure

Id. at 19. Sjostrom's Flue Gas Flow figure includes "Hg Analyzers." *Id.*

Sjostrom also includes the following graphs:



Sjostrom's "SDA Results" Graph

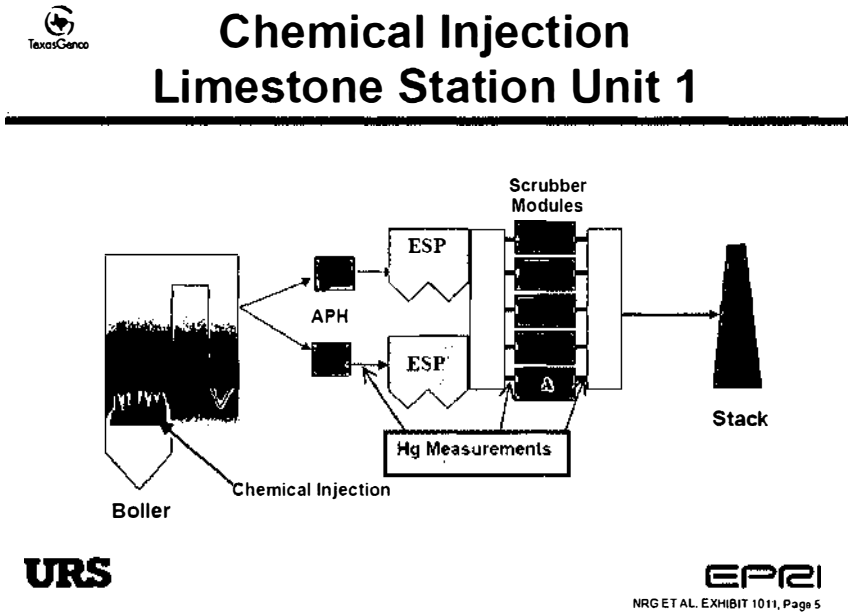


Sjostrom's "Untreated PAC Injection" Graph

Id. at 16, 20.

2. Eckberg

Eckberg is a presentation titled "Mercury Control Evaluation of Halogen Injection into a Texas Lignite-Fired Boiler" that, like Sjostrom, was made during the 2005 EUEC. Ex. 1011, 1; Ex 1030, 3, 23–24. Eckberg includes the following process figure:



Eckberg's Process Figure

Ex. 1011, 5. Eckberg's process figure includes a boiler on the left with an arrow pointing to the boiler that is labeled "Chemical Injection." *Id.* Eckberg further describes $CaBr_2$ as a chemical addition for its tests and refers to a "Salt Solution Tank" when depicting injection equipment. *Id.* at 3, 8–9.

3. Public Accessibility of Sjostrom and Eckberg

Petitioner asserts "Sjostrom and Eckberg are printed publications, available as prior art under 35 U.S.C. §§ 102(a) and (b) (pre-AIA) and §102(a)(1) (post-AIA)." Pet. 39. Petitioner argues that the "Sjostrom and Eckberg presentations, delivered consecutively at the Electric Utilities Environment Conference ("EUEC") in January 2005 and mailed on CD to conference participants within a few weeks" meet the standard for public accessibility set forth in *GoPro, Inc. v. Contour IP Holding LLC*, 908 F.3d 690, 693 (Fed. Cir. 2018). *Id.*

Patent Owner does not dispute whether Sjostrom and Eckberg were publicly accessible. *See generally* Prelim. Resp.

On this record, Petitioner has demonstrated a reasonable likelihood that Sjostrom and Eckberg were publicly available. *Hulu, LLC v. Sound View Innovations, LLC*, IPR2018-01039 (PTAB Dec. 20, 2019) (Paper 29) (for purposes of institution, a petitioner must show a reasonable likelihood that an asserted reference qualifies as a printed publication). Petitioner provides evidence that Sjostrom and Eckberg were presented on January 25, 2005 at the 2005 EUEC and that there were over eight hundred attendees. Ex. 1002 ¶¶ 239, 245–250; Ex. 1030, 2–3, 23, 106–118. Petitioner's evidence does not indicate that attendance of the 2005 EUEC was restricted. *Id.* Petitioner also provides evidence of the CD that was mailed to the conference attendees and copies of the Sjostrom and Eckberg presentations from the CD, without any apparent restriction or expectation of confidentiality. Ex. 1002 ¶ 240; Ex. 1031; Ex. 1010; Ex. 1011; *GoPro*, 908 F.3d at 694–95. Therefore, on this record, Petitioner has met its burden of showing that Sjostrom and Eckberg qualify as printed publications.

4. Unpatentability Analysis

With respect to claim 1, Petitioner argues that Sjostrom and Eckberg disclose:

Preamble: "A method of separating mercury from a mercury-containing gas" (Pet. 44 (relying on Ex. 1010, 1, 8, 15–17, 20–21; Ex. 1002 ¶ 512));

Element 1(a): "combusting coal in a combustion chamber, to provide the mercury-containing gas," (Pet. 44–45 (relying on Ex. 1010, 3, 4, 12, 18; Ex. 1011, 5; Ex. 1002 ¶¶ 513–514));

Element 1(b): "the mercury-containing gas comprises a halogen or halide promoter comprising HBr, Br^-, or a combination thereof, wherein the coal comprises added Br_2, HBr, Br^-, or a combination thereof, added to the coal upstream of the combustion chamber, or the combustion chamber comprises added Br_2, HBr, Br^-, or a combination thereof, or a combination thereof;" (Pet. 46–48 (relying on Ex. 1010, 4, 23; Ex. 1011, 5, 8–9; Ex. 1002 ¶¶ 515–520));

Element 1(c)(a): "injecting a sorbent material comprising activated carbon into the mercury-containing gas downstream of the combustion chamber" (Pet. 48 (relying on Ex. 1010, 4; Ex. 1011, 10–11, 16; Ex. 1002 ¶¶ 521–522));

Element 1(c)(b): "contacting mercury in the mercury-containing gas with the sorbent, to form a mercury/sorbent composition;" (Pet. 49 (relying on Ex. 1002 ¶¶ 523–524));

Element 1(d): "separating the mercury/sorbent composition from the mercury-containing gas, to form a cleaned gas;" (Pet. 49–50 (relying on Ex. 1010, 4; Ex. 1002 ¶ 525));

Element 1(e): "monitoring the mercury content of the cleaned gas"

(Pet. 50–52 (relying on Ex. 1010, 4, 19, 22; Ex. 1002 ¶ 526));

Element 1(f)(1): "controlling, in response to the monitored mercury content of the cleaned gas, an injection rate of injecting the sorbent into the mercury-containing gas, the sorbent composition, or a combination thereof," and element 1(f)(2): "so that the mercury content of the cleaned gas is maintained at or below a desired level." (Pet. 52–54 (relying on Ex. 1010, 16, 20, 22; Ex. 1002 ¶¶ 527–530)).

Relying on the Niksa Declaration, Petitioner argues that one of ordinary skill in the art would have been motivated to combine the teachings of Sjostrom and Eckberg, and would have had a reasonable expectation of success in doing so. Pet. 42–44 (citing Ex. 1010, 4, 15–16, 20–21; Ex. 1011, 5, 9, 14; Ex. 1002 ¶¶ 503–511; Ex. 1030, 23). For example, Petitioner argues that Sjostrom and Eckberg are both "directed to using bromine (in conjunction with activated carbon) for improving mercury removal." *Id.* at 42. Petitioner argues "Sjostrom states that 'Br' is used, but does not identify the specific chemical that contains that bromine or its injection rate." *Id.* (citing Ex. 1010, 4; Ex. 1002 ¶ 503). Petitioner asserts that "Eckberg describes a similar system, including injection of halogens into a coal-fired boiler for mercury removal" and "Eckberg informs a POSITA of the type of bromine to be used (calcium bromide), the bromine:coal ratio, the bromine feed rate, and the bromine concentration in the flue gas." *Id.* at 42–43 (citing Ex. 1011, 5, 9, 14; Ex. 1002 ¶ 504). Petitioner asserts that one of ordinary skill in the art would "have understood it was obvious that a calcium bromide in an aqueous solution would dissociate to form Br^- (bromide ions)." *Id.* at 47.

Petitioner also argues that further "motivation to combine existed because both references were presented consecutively during the 'A3'

session at the 2005 EUEC" and, thus, "a POSITA attending the conference, or reading the materials after receiving the mailed CD, would have understood that the two presentations included related material and would have complemented one another." *Id.* at 43 (citing Ex. 1030, 23; Ex. 1002 ¶ 505). In addition, Petitioner asserts that a "POSITA would have been motivated to apply the teachings of Eckberg to Sjostrom because it would have provided well-known chemical substances to use as the 'Cl' or 'Br' identified in the figures of Sjostrom" and a "POSITA would have found supplementing the system of Sjostrom with the teachings of Eckberg obvious to try." *Id.* According to Petitioner, there would have been a reasonable expectation of success in combining the teachings of Sjostrom and Eckberg "because they described nearly identical processes. Both references add bromine to coal-plants to remove mercury from flue gas," both "references include similar surrounding equipment—such as boilers, air pre-heaters, and ESPs or other particulate matter control devices" and in "combining Sjostrom with Eckberg, no modifications would need to be made to the overall process equipment, operating conditions, or activated carbon sorbent used in Sjostrom." *Id.* at 43–44 (citing Ex. 1010, 4; Ex. 1011, 5, 9; Ex. 1002 ¶¶ 506–511).

Petitioner also presents arguments and evidence that Sjostrom and Eckberg suggest the limitations of challenged dependent claims 2, 4–9, and 12–22, which depend from claim 1. Pet. 54–66.

Regarding claim 23, Petitioner asserts that "[c]laim 23 copies Elements 1(Pre)-1(d)" and, thus, "claim 23 is obvious over Sjostrom in view of Eckberg for the same reasons." *Id.* at 66 (citing Ex. 1002 ¶¶ 563–568).

Regarding claim 24, Petitioner contends that "[c]laim 24 is nearly identical to claim 1" and, thus, "claim 24 is obvious over Sjostrom in view

of Eckberg for the same reasons." *Id.* at 66 (citing Ex. 1002 ¶¶ 569–578). Petitioner further asserts that element 24(c) "adds that 'the activated carbon reacts with the halogen or halide promoter in the mercury-containing gas to form a promoted sorbent' and that the mercury is contacted with 'the promoted sorbent.'" *Id.* at 67 (citing Ex. 1001, claim 24). Petitioner contends that the "bromine added at Addition Location 1 or Addition Location 2 of Sjostrom would contact the sorbent in the flue gas at or downstream of the sorbent injection point" and at least "a quantity of promoted sorbent would have formed as a reaction between the sorbent and halogen upon contact." *Id.* (citing Ex. 1010, 4). Petitioner argues that it "was well-known in the art that halogens (including bromine) 'promoted' activated carbon sorbents because they improved mercury removal by increasing the ability of the activated carbon to bind with the mercury." *Id.* (citing Ex. 1002 ¶¶ 573–574).

In addition, Petitioner contends

> Claim 24 also differs in that Element 24(f)(1) requires "controlling, in response to the mercury content of the cleaned gas, an injection rate of injecting the sorbent into the mercury-containing gas, a rate of addition to the coal or the combustion chamber of the added Br_2, HBr, the bromide compound, or a combination thereof, or a combination thereof."

Id. (citing Ex. 1001, claim 24). Petitioner asserts that as "discussed for Element 1(f), Sjostrom discloses continuously controlling the rate of injecting the sorbent based on the continuous mercury content measurements." *Id.* (citing Ex. 1002 ¶ 577).

Regarding claim 25, Petitioner argues that "[c]laim 25 is nearly identical to Elements 1(Pre)-1(d)" and, thus, "claim 25 is obvious over Sjostrom in view of Eckberg for the same reasons." *Id.* at 68 (citing

Ex. 1002 ¶¶ 579–584). Petitioner further asserts that claim 25 "differs from Claim 1 in that it replaces 'Br⁻' with 'a bromide compound'" but as "discussed above with respect to Claim 1, it would have been obvious that Sjostrom's 'Br' teaches a bromide compound, and Eckberg discloses using the specific bromide compound as an aqueous solution of calcium bromide." *Id.* (citing Ex. 1001, claim 25; Ex. 1002 ¶ 582).

Petitioner also presents arguments and evidence that Sjostrom and Eckberg suggest the limitations of challenged dependent claims 26–28 and 30. Pet. 68–69.

Patent Owner does not substantively address Petitioner's Ground 1 challenges, aside from arguing the priority of the '114 patent, as discussed herein. Based on the preliminary record before us, we find that Petitioner's arguments and evidence are sufficient to show a reasonable likelihood Petitioner would prevail in proving unpatentability of claims 1, 2, 4–9, 12–28, and 30.

I. Asserted Obviousness over Sjostrom and Olson-646

Petitioner argues that claims 1–9 and 12–30 are unpatentable over Sjostrom, Eckberg, and Olson-646. Pet. 69–97.[8]

1. Olson-646

Olson-646 is a patent publication titled "Sorbents for the Oxidation and Removal of Mercury." Ex. 1014, code (54). Petitioner acknowledges that Olson-646 is the patent publication of the '163 application, but argues that the earliest priority date for the challenged claims of the '114 patent is May 2018, which is the filing date of the '760 application, and thus that Olson-646 is available as prior art under 35 U.S.C. §§ 102(a) and 102(b)

[8] *See supra* n.4.

(pre-AIA) and §§ 102(a)(1) and 102(a)(2). Pet. 70–72 (citing Ex. 1017; Ex. 1002 § 264).

Olson-646 "relates to methods and materials for the removal of pollutants from flue gas or product gas from a gasification system. In particular, mercury is removed from gas streams generated during the burning or gasification of fossil fuels by highly reactive regenerable sorbents." Ex. 1014 ¶ 4. Olson-646 proposes a model for the oxidation of mercury in Figure 2, which is reproduced below.

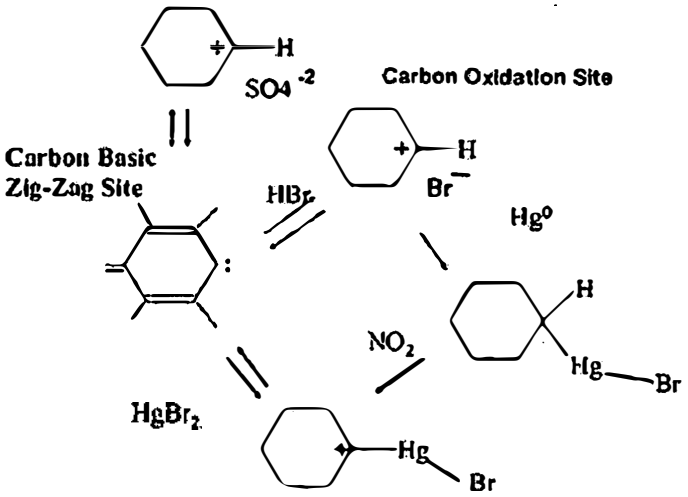


FIG. 2

Figure 2 is a proposed mechanistic model of the chemical reactions in the oxidation and capture of mercury. *Id.* ¶ 33. Olson-646 explains that "as illustrated in FIG. 2, hydrogen bromide reacts with the unsaturated structure of the activated carbon" and this "may be, by way of illustration only, a carbene species on the edge of the graphene sheet structures of the carbon." *Id.* ¶ 54. According to Olson-646, "[m]olecular bromine or a bromine

compound reacts to form a similar structure, with a positive carbon that is active for oxidizing the mercury with subsequent capture by the sorbent." *Id.* Olson-646's Figure 3 is reproduced below.

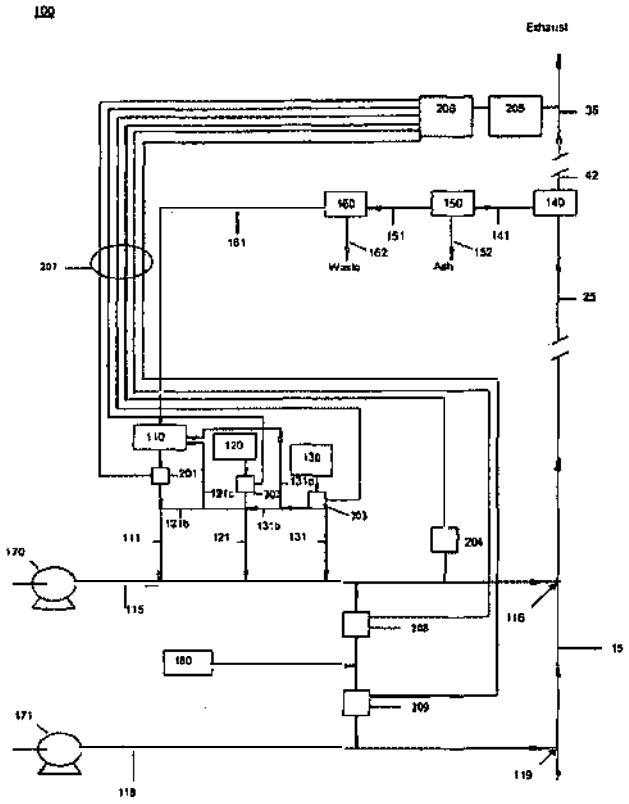


FIG. 3

Figure 3 is schematic for the preparation of promoted carbon sorbents and processes for flue gas mercury reduction in flue gases. *Id.* ¶ 34. Figure 3 depicts a schematic of a "mercury control system 100 comprising preparation of promoted carbon sorbents" that includes a "base activated carbon reservoir 110, an optional halogen/halide promoter reservoir 120, an optional secondary component reservoir 130, and an optional a[l]kali

component reservoir 180, each of which with corresponding flow control device(s) 201, 202, 203, and 208/209, respectively." *Id.* ¶ 56. Olson-646 further explains that in "operation, promoted carbon sorbent and/or an optional alkali component is injected into contaminated flue gas stream 15." *Id.* ¶ 61.

2. Unpatentability Analysis

Regarding reasons to combine the references, Petitioner argues that Sjostrom does not expressly state which specific "Br" compounds to use, or their specific injection rate. Pet. 74. One of ordinary skill in the art, however, would have been motivated to "use the 'HBr or Br_2' of Olson-646 as the bromine-containing species ('Br') of Sjostrom" with a reasonable expectation of success, because Olson-646 "describes the chemicals and associated reactions theorized to have been used in the system of Sjostrom" and "both references teach using the same conventional halogen to achieve the same results." *Id.* at 75 (citing Ex. 1014 ¶¶ 43, 66; Ex. 1002 ¶¶ 594–596).

Regarding its claim-specific arguments, Petitioner largely relies on its arguments for Ground 1 and Sjostrom. We discuss below Petitioner's additional reliance on Olson-646 for certain challenged claims. Regarding claim 1, Petitioner adds that "Olson-646 supplements the teachings of Sjostrom, describing specific 'Br' containing compounds that react with activated-carbon and improve mercury removal." *Id.* at 76–77. Petitioner also argues that "Figure 3 of Olson-646 shows the sorbent, along with the halide promoter, injected into the mercury-containing (flue) gas (item 15) at injection point 116." *Id.* at 78 (citing Ex. 1014, Fig. 3). For the "controlling" limitations of claim 1, Petitioner argues that one of ordinary skill in the art "would not have needed to remove anything from the system

of Sjostrom, they merely would have had to apply the teachings of Olson-646 to fill in the missing details, such as flow controllers and valves, to implement the desired control system." *Id.* at 82.

Regarding claims 2 and 3, Petitioner argues that "Olson-646 provides a method 'for reducing mercury in flue gas'" and "collecting greater than 70 wt-% of the mercury in the flue gas." *Id.* (citing Ex. 1014 ¶ 22).

Regarding claim 4, Petitioner argues that Olson-646 discloses that "the sorbent comprises from about 1 to about 30 grams promoter per 100 grams of base activated carbon." *Id.* at 83 (citing Ex. 1014 ¶¶ 14, 18, claims 3, 17).

Regarding claim 6, Petitioner argues that Olson-646 also discloses and identifies the effectiveness of HBr or Br_2. *Id.* at 84–85.

Regarding claim 7, Petitioner argues that Olson-646 also teaches embodiments "wherein the halogen/halide promoter is in gaseous or vapor form" that comprises "gaseous HBr or Br_2." *Id.* at 86 (citing Ex. 1014 ¶ 66).

Regarding claims 8 and 9, Petitioner argues that Olson-646 refers to a "secondary component," which is another term for "secondary material," and its introduction into the system of Olson-646. *Id.* at 86–88 (citing Ex. 1014 ¶¶ 11, 14, 15, 17, 56, 63).

Regarding claim 14, Petitioner argues that Olson-646 also uses Norit Darco FGD sorbent, and motivates one of ordinary skill in the art to add bromine to the sorbent before injecting at Addition Location 3. *Id.* at 88–90 (citing Ex. 1014, Fig. 1, ¶¶ 45–48; Ex. 1002 ¶¶ 633–635).

Regarding claims 19, 21, and 22, Petitioner argues that one of ordinary skill in in the art would understand that Olson-646 refers to HBr or Br_2 as sorbent enhancement additives. *Id.* at 90–91 (citing Ex. 1002 ¶¶ 640–645).

Regarding claim 20, Petitioner argues that one of ordinary skill in the art would have been motivated to look to Olson-646 to select HBr or Br_2 as the "Br." *Id.* at 91 (citing Ex. 1002 ¶¶ 640–641).

Regarding claim 24, Petitioner argues that Olson-646 clarifies the relationship between the halogen and the activated carbon disclosed by Sjostrom. *Id.* at 92 (citing Ex. 1002 ¶ 658).

Regarding claims 26–27, Petitioner argues that Olson-646 describes the effectiveness of HBr or Br_2 in promoting activated carbon. *Id.* at 93 (citing Ex. 1002 ¶¶ 669–674).

Regarding claim 29, Petitioner argues that Olson-646 discloses that "the promoter is added at from about 1 to about 30 grams per 100 grams of activated carbon." *Id.* at 94 (citing Ex. 1014 ¶¶ 23, 27, claims 3, 17, 37, 47).

Regarding claim 30, Petitioner argues that Olson-646 explains the reaction and relationship already occurring between the halogen, activated carbon, and mercury disclosed by Sjostrom. *Id.* at 97 (citing Ex. 1014, Fig. 2; Ex. 1002 ¶¶ 680–681).

Patent Owner does not substantively address Petitioner's Ground 2 challenges, aside from arguing the priority of the '114 patent, as discussed herein. Based on the preliminary record before us, we find that Petitioner's arguments and evidence are sufficient to show a reasonable likelihood Petitioner would prevail in proving unpatentability of claims 1--4, 6–9, 14, 19–22, and 24–30.[9]

III. CONCLUSION

For the reasons set forth above, we determine that Petitioner has demonstrated a reasonable likelihood of prevailing with respect to at least

[9] *See supra* n.4.

one challenged claim of the '114 patent. Thus, we institute an *inter partes* review on all challenged claims and on all grounds presented.

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that an *inter partes* review is instituted on each of the grounds asserted in the Petition; and

FURTHER ORDERED that, pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4, notice is hereby given of the institution of a trial, which shall commence on the entry date of this decision.

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Paper 18
Date: October 26, 2020

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

NRG ENERGY, INC. and
TALEN ENERGY CORPORATION,
Petitioner,

v.

MIDWEST ENERGY EMISSIONS CORP.,
Patent Owner.

IPR2020-00834
Patent 10,343,114 B2

Before KRISTINA M. KALAN, CHRISTOPHER M. KAISER, and AVELYN M. ROSS, *Administrative Patent Judges.*

KALAN, *Administrative Patent Judge.*

DECISION
Granting Institution of *Inter Partes* Review
35 U.S.C. § 314, 37 C.F.R. § 42.4

I. INTRODUCTION

NRG Energy, Inc., Talen Energy Corporation, and Vistra Corp. (formerly known as Vistra Energy Corp.) filed a Petition (Paper 3, "Pet.") requesting an *inter partes* review of claims 1–9 and 12–30 of U.S. Patent No. 10,343,114 B2 (Ex. 1001, "the '114 patent"). Subsequently, Vistra Corp. and Midwest Energy Emissions Corp. ("Patent Owner") filed a Joint Motion to Terminate Vistra Corp. as a petitioner pursuant to a settlement. Paper 11. That motion was granted. Paper 14. Therefore, NRG Energy, Inc. and Talen Energy Corporation (collectively, "Petitioner") remain as petitioners. *Id.* at 4. Patent Owner filed a Preliminary Response to the Petition (Paper 10, "Prelim. Resp."). Pursuant to our authorization, Petitioner filed a Reply (Paper 16, "Pet. Reply"), and Patent Owner filed a Sur-reply (Paper 17, "Sur-reply").

To institute an *inter partes* review, we must determine that the information presented in the Petition shows "there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition." 35 U.S.C. § 314(a). For the reasons discussed below, after considering the parties' submissions and the evidence of record, we determine that Petitioner has demonstrated a reasonable likelihood of prevailing with respect to at least one claim of the '114 patent. Thus, we institute an *inter partes* review.

A. Related Proceedings

The parties identify *Midwest Energy Emissions Corp. v. Vistra Energy Corp.*, No. 1:19-cv-01334-RGA (D. Del.) as a related matter. Pet. 6–7; Paper 6, 2. Petitioner also identifies IPR2020-00832 as a second petition against the '114 patent. Pet. 8.

B. The '114 Patent

The '114 patent, titled "Sorbents for the Oxidation and Removal of Mercury," "relates to methods and materials for the removal of pollutants from flue gas or product gas from a gasification system," and "[i]n particular, mercury is removed from gas streams generated during the burning or gasification of fossil fuels by highly reactive regenerable sorbents." Ex. 1001, code (54), 1:27–31. The '114 patent discloses that the "combustion and gasification of fossil fuel such as coal generates flue gas that contains mercury and other trace elements that originate from the fuel" and "[s]everal types of mercury control methods for flue gas have been investigated, including injection of fine sorbent particles into a flue gas duct and passing the flue gas through a sorbent bed." *Id.* at 1:33–35, 1:56–59. The '114 patent explains that a "major problem with existing carbon injection systems is that the sorbent is relatively unreactive toward mercury" and therefore "these sorbents must be used in large amounts." *Id.* at 2:10–12. The '114 patent further describes other mercury sorbent approaches and their problems. *Id.* at 2:20–3:15.

The '114 patent describes a halogen/halide-promoted sorbent "that is highly effective for the removal of mercury from flue gas streams" and that the "sorbent comprises any activated carbon and/or non-carbon compound." *Id.* at 3:36–39. Further, "[o]ptional secondary components and alkali may be added to further increase reactivity and mercury capacity." *Id.* at 3:43–44. The '114 patent states that "the optional secondary component is selected from the group consisting of Group V halides, Group VI halides, HI, HBr, HCl, and combinations thereof." *Id.* at 4:52–55.

The '114 patent discloses in "an embodiment, the promoted sorbent is introduced by direct injection into the flue gas stream" and in "another

embodiment, the base sorbent is promoted within the flue gas stream." *Id.* at 5:41--43. The '114 patent describes that in "some embodiments, the carbon base sorbent and the promoter are introduced into the mercury-containing gas at the same location or at separate locations." *Id.* at 7:5–8. For instance, the '114 explains for one example that "the sorbent is injected into the flue gas after the boiler" and the "additive can be injected where desired (e.g., before, after, or within the boiler)." *Id.* at 30:1–4.

The '114 patent explains that when "a promoted or a non-promoted base sorbent reacts with elemental or oxidized mercury, a mercury/sorbent chemical composition is formed and, in the case of elemental mercury reacting with the promoted base sorbent, the mercury is oxidized." *Id.* at 3:53–57. The '114 patent further describes separating the promoted sorbent from the gas stream and adjusting "the rate at which the carbon base sorbent is introduced or the rate at which the promoter is introduced or combination thereof" according to a monitored mercury content of the cleaned gas "so that the mercury content of the cleaned gas is maintained at substantially the desired level with minimal operating cost." *Id.* at 7:10–16.

C. Illustrative Claim

1. A method of separating mercury from a mercury containing gas, the method comprising:
combusting coal in a combustion chamber, to provide the mercury-containing gas, wherein the mercury-containing gas comprises a halogen or halide promoter comprising HBr, Br-, or a combination thereof, wherein
the coal comprises added Br_2, HBr, Br-, or a combination thereof, added to the coal upstream of the combustion chamber, or
the combustion chamber comprises added Br_2, HBr, Br-, or a combination thereof, or
a combination thereof;

injecting a sorbent material comprising activated carbon into the mercury-containing gas downstream of the combustion chamber;
contacting mercury in the mercury-containing gas with the sorbent, to form a mercury/sorbent composition;
separating the mercury/sorbent composition from the mercury-containing gas, to form a cleaned gas;
monitoring the mercury content of the cleaned gas; and
controlling, in response to the monitored mercury content of the cleaned gas, an injection rate of injecting the sorbent into the mercury-containing gas, the sorbent composition, or a combination thereof, so that the mercury content of the cleaned gas is maintained at or below a desired level.

Ex. 1001, 33:49–34:7.

D. The Asserted Grounds of Unpatentability

Petitioner contends claims 1–9 and 12–30 of the '114 patent are unpatentable on the following grounds:

Reference(s)	Basis	Claim(s) Challenged
Vosteen[1]	§ 102	23–28, 30
Vosteen	§ 103	1–9, 12–30
Downs-Boiler[2]	§ 102	23, 25–27, 30
Downs-Boiler	§ 103	1–7, 12–28, 30
Vosteen, EPA-	§ 103	1–7,[4] 12–22, 24, 28

[1] US 6,878,358 B2, issued Apr. 12, 2005 (Ex. 1008).
[2] US 2008/0107579 A1, published May 8, 2008 (Ex. 1006). Although the first inventor is named Downs (*id.* at code (76)), we follow the parties' practice of referring to this reference as "Downs-Boiler."
[4] In its Identification of Challenged Claims, Petitioner states this Ground 5 challenges claims 1–7, 12–22, 24, and 28 (Pet. 10), but then states that "Ground 5 explains why Claims 1–9, 12–22, 24, and 28 would have been obvious over Downs-Boiler in view of EPA-Proposal." *Id.* at 67. Clarification is requested.

Reference(s)	Basis	Claim(s) Challenged
Proposal[3]		
Downs-Boiler, EPA-Proposal	§ 103	1–9,[5] 12–22, 24, 28
Vosteen, Nelson[6]	§ 103	2–4, 17, 18, 24, 29, 30
Downs-Boiler, Nelson	§ 103	2–4, 18, 24, 29, 30

In support of its unpatentability arguments, Petitioner relies on the declaration testimony of Dr. Stephen Niksa. Ex. 1002.

II. ANALYSIS

A. Claim Construction

We apply the claim construction standard articulated in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005). 37 C.F.R. § 42.100(b) (2019); *see also Changes to the Claim Construction Standard for Interpreting Claims in Trial Proceedings Before the Patent Trial and Appeal Board*, 83 Fed. Reg. 51,340 (Oct. 11, 2018) (applicable to *inter partes* reviews filed on or after November 13, 2018). Under *Phillips*, claim terms are afforded "their ordinary and customary meaning." *Phillips*, 415 F.3d at 1312. "[T]he ordinary and customary meaning of a claim term is the meaning that the

[3] Proposed National Emission Standards for Hazardous Air Pollutants; and, in the Alternative, Proposed Standards of Performance for New and Existing Stationary Sources: Electric Utility Steam Generating Units, 69 Fed. Reg. 4652–4752 [Volume 69, No. 20] (Jan. 30, 2004) (Ex. 1009).
[5] In its Identification of Challenged Claims, Petitioner states this Ground 6 challenges claims 1–9, 12–22, 24, and 28 (Pet. 10), but then states that "Ground 6 explains why Claims 1–7, 12–22, 24, and 28 would have been obvious over Downs-Boiler in view of EPA-Proposal." *Id.* at 67. Clarification is requested.
[6] US 6,953,494 B2, issued Oct. 11, 2005 (Ex. 1012).

term would have to a person of ordinary skill in the art in question at the time of the invention." *Id.* at 1313. Only terms that are in controversy need to be construed, and then only to the extent necessary to resolve the controversy. *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999).

Petitioner does not assert a claim construction for the challenged claims. *See* Pet 22. Patent Owner contends that all challenged claims of the '114 patent require "injecting a sorbent material comprising activated carbon into the mercury-containing gas downstream of the combustion chamber" and Petitioner appears "to implicitly interpret this limitation more broadly than the plain meaning of the words." Prelim. Resp. 14. Patent Owner requests that the Board construe this limitation "to require that the sorbent material comprising activated carbon be injected into the duct, pipe, or other structure that contains the mercury containing gas." *Id.* Patent Owner asserts that this meaning is consistent with the claim language and the specification of the '114 patent, which describes the injection of sorbent into flue gas but not placing a sorbent-coated filter in a passageway and exposing the passageway to mercury-containing gas. *Id.* at 14–15 (citing Ex. 1001, 14:5–9, 14:10–25). According to Patent Owner, this "contrasts with Petitioners' interpretation of this limitation as encompassing blowing activated carbon into a filter, placing the filter in a structure, and then transporting mercury containing gas to the structure." *Id.* at 14.

Having considered Patent Owner's argument, we agree that "injecting a sorbent material comprising activated carbon into the mercury-containing gas downstream of the combustion chamber" does not encompass blowing activated carbon into a filter, placing the filter in a structure, and then transporting mercury containing gas to the structure. However, we decline

to use Patent Owner's proposed construction, which introduces a structure to convey the mercury-containing gas. The plain meaning of the claim language is that the sorbent material is injected into the mercury-containing gas, not vice versa (e.g., that the mercury-containing gas is passed over or through the sorbent material).

B. Principles of Law

"In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable." *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (requiring *inter partes* review petitions to identify "with particularity . . . the evidence that supports the grounds for the challenge to each claim")). This burden of persuasion never shifts to Patent Owner. *See Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (discussing the burden of proof in *inter partes* review).

To anticipate a claim under 35 U.S.C. § 102, "a single prior art reference must expressly or inherently disclose each claim limitation." *Finisar Corp. v. DirecTV Grp., Inc.*, 523 F.3d 1323, 1334 (Fed. Cir. 2008). Accordingly, "the dispositive question regarding anticipation [i]s whether *one skilled in the art* would reasonably understand or infer from the [prior art reference's] teaching" that every claim element was disclosed in that single reference. *Dayco Prods., Inc. v. Total Containment, Inc.*, 329 F.3d 1358, 1368 (Fed. Cir. 2003).

A claim is unpatentable under § 103(a) if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.

KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) when in evidence, objective indicia of non-obviousness (i.e., secondary considerations). *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). "To satisfy its burden of proving obviousness, a petitioner cannot employ mere conclusory statements. The petitioner must instead articulate specific reasoning, based on evidence of record, to support the legal conclusion of obviousness." *In re Magnum Oil Tools Int'l, Ltd.*, 829 F.3d 1364, 1380 (Fed. Cir. 2016).

We analyze the asserted grounds of unpatentability in accordance with these principles to determine whether Petitioner has met its burden to establish a reasonable likelihood of success at trial.

C. Level of Ordinary Skill in the Art

Petitioner argues:

> A person of ordinary skill in the art ("POSITA") would have at least a bachelor's degree in chemical engineering, mechanical engineering, or a related field of study with at least two years of experience with implementing pollution control in power generation plants for natural gas, coal, and/or industrial waste incineration.

Pet. 14 (citing Ex. 1002 ¶ 64). Patent Owner does not appear to dispute this proposed definition. *See generally* Prelim. Resp. Neither party argues that the outcome of this case would differ based on our adoption of any particular definition of one of ordinary skill in the art.

In light of the record before us, we adopt Petitioner's proposal regarding the level of one of ordinary skill in the art. The level of ordinary

skill in the art is also reflected by the prior art of record. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001).

D. Real Parties-In-Interest

Petitioner identifies a number of real parties-in-interest and potential real parties-in-interest. Pet. 1–6.

Patent Owner argues that "35 U.S.C. § 312(a)(2) provides that a petition may only be considered if 'the petition identifies all real parties in interest.'" Prelim. Resp. 7. Patent Owner contends that Petitioner lists "dozens of 'potential real parties in interest,' without explanation as to their relationship to petitioners," that this "is not an identification of all real parties in interest," and that, if instituted, this proceeding would be under a cloud of uncertainty because the ambiguity in Petitioner's list "will likely lead to confusion and disputes as to which parties are real parties in interest and which are bound by the estoppel provisions of 35 U.S.C. § 315." *Id.* For instance, Patent Owner asserts that Petitioner identifies various vendors and suppliers as "potential real parties in interest" but states that "[n]one of these companies or any unnamed entity is funding, controlling, or directing, or otherwise has an opportunity to control or direct this Petition or proceeding" and this implies that these entities are not actually real parties in interest. *Id.* at 7–8. In addition, Patent Owner argues that some entities are identified both as "potential real parties in interest" and "real parties in interest," which creates ambiguity and conflict in the listing of entities. *Id.* at 8.

For these reasons, Patent Owner contends that "Petitioners have not met their burden of identifying all real parties in interest" and "the Board should deny institution for failure to comply with § 312(a)(2)." *Id.* at 8–9.

We are not made aware of any rule, statute, or case law that prohibits Petitioner from identifying multiple real parties-in-interest or multiple potential real parties-in-interest. Petitioner's identification of about a dozen real parties-in-interest does not appear problematic or overly burdensome. Pet. 1–2. Petitioner's identification of numerous potential real parties-in-interest, while unusual, also does not appear problematic. *Id.* at 2–6. To the extent Petitioner has identified an entity as both a real parties-in-interest and as a potential real parties-in-interest, we interpret that to mean that party is identified as a real party-in-interest. Petitioner's reasons for identifying numerous potential real parties-in-interest reasons appear plausible: Petitioner identifies these parties "out of an abundance of caution" because "they are vendors and suppliers" in the related litigation but have not "agreed to be listed as a real party-in-interest" in this Petition. Pet. 1–6. This provides the Board and Patent Owner notice that other potential entities may be indirectly involved, but also provides reasons for not committing those parties to the real party-in-interest category. Ordinarily, problems regarding identification of real parties-in-interest arise when a petitioner fails to identify a real party-in-interest. *See, e.g., Ventex Co., Ltd. v. Columbia Sportswear N. Am., Inc.*, IPR2017-00651, Paper 152 (PTAB Jan. 24, 2019) (precedential) (terminating proceeding where Petition failed to name time-barred RPI and privy). Here, the alleged problem is over-identification of potential real parties-in-interest. Without express violation of a known rule, statute, or case law, however, this does not appear to be a problem warranting non-institution of *inter partes* review.

E. Asserted Anticipation by Vosteen (Ground 1)

Petitioner argues that claims 23–28 and 30 are anticipated by Vosteen. Pet. 22–29.

1. Vosteen

Vosteen is a patent titled "Process for Removing Mercury from Flue Gases." Ex. 1008, code (54). Vosteen "relates to a process for removing mercury from flue gases of high-temperature plants, in particular power stations and waste incineration plants." *Id.* at 1:6–8. Specifically, Vosteen describes:

> The invention relates to a process for removing mercury from flue gases of high-temperature plants, in particular from power stations and waste incineration plants, in which bromine and/or a bromine compound and/or a mixture of various bromine compounds is fed to the if appropriate multistage furnace and/or to the flue gas in a plant section downstream of the furnace, the temperature during the contact of the bromine compound with the flue gas being at least 500° C., preferably at least 800° C., the combustion taking place in the presence of a sulphur compound, in particular sulphur dioxide, with or without the addition of sulphur and/or a sulphur compound and/or of a mixture of various sulphur compounds, and then the flue gas being subjected to an if appropriate multistage cleanup for removing mercury from the flue gas, which cleanup comprises a wet scrubber and/or a dry cleanup.

Id. at 1:66–2:14.

Vosteen discloses that the bromine compound may be sodium bromide and can be in the form of a salt that can be added to waste mixture, coal, or the like to be burnt. *Id.* at 4:4–8. Vosteen describes a flue gas emission control system including a dry emission control system that may use, for example, "cloth filters which are impinged with a blown-in finely pulverulent slaked lime/activated carbon or slaked line/lignite coal coke mixture." *Id.* at 5:19–30. Vosteen further describes continuously measuring the mercury content of the flue gas and controlling the amount and/or

mixture of bromine and/or bromine compound fed by Vosteen's emission control system. *Id.* at 5:48–54.

2. Unpatentability Analysis

Petitioner discusses claim 25 first, because "the other independent claims copy its limitations." Pet. 22 (citing Ex. 1002 ¶¶ 290, 298, 323). Regarding the preamble of claim 25, Petitioner asserts that Vosteen discloses a "process for removing mercury from flue gases." *Id.* at 23 (quoting Ex. 1008, code (54)).

For the limitation "combusting coal in a combustion chamber, to provide the mercury-containing gas," Petitioner contends that "Vosteen discloses 'feeding the coal to the furnace' and 'carrying out a combustion or incineration process, within the furnace' to provide the mercury-containing gas." *Id.* (citing Ex. 1008, claim 1, 18, 7:25–28, 10:63–11:6, 11:23–24, Figs. 7–9; Ex. 1002 ¶ 271).

Regarding the limitation "the coal comprises added Br2, HBr, a bromide compound, or a combination thereof, added to the coal upstream of the combustion chamber, or the combustion chamber comprises added Br2, HBr, a bromide compound, or a combination thereof, or a combination thereof," Petitioner argues that Vosteen discloses adding bromine-containing ingredients, such as Br_2, HBr, and/or sodium bromide into one of its combustion chambers and/or to coal to be burnt. *Id.* (citing Ex. 1008, 2:54–61, 4:4–33, claims 1, 2, 18; Ex. 1002 ¶¶ 272–273).

For the limitation "injecting a sorbent material comprising activated carbon into the mercury-containing gas downstream of the combustion chamber; contacting mercury in the mercury-containing gas with the sorbent, to form a mercury/sorbent composition," Petitioner argues that "Vosteen discloses a dry-emission control system that injects activated-

carbon sorbent into the mercury-containing gas downstream of the combustion chamber" because the dry-emission control system has "cloth filters … impinged with … blown-in finely pulverant slaked lime/activated carbon." *Id.* at 24 (citing Ex. 1008, 5:27–30). Petitioner asserts that "'[b]low[ing] in' activated carbon is a form of injecting the sorbent into a mercury-containing gas" and "Vosteen confirms that mercury removal in the dry-emission system is 'from the flue gases…downstream of the combustion.'" *Id.* (citing Ex. 1008, 2:16–19, claims 1, 12; Ex. 1002 ¶¶ 274–278). Petitioner further argues that mercury in Vosteen's flue gas "is adsorbed, and thus contacted, with the activated-carbon sorbent to form a mercury/sorbent composition." *Id.* at 24–25 (citing Ex. 1008, 2:20–31, 5:19–39; Ex. 1002 ¶¶ 279–280.

For the limitation "separating the mercury/sorbent composition from the mercury-containing gas, to form a cleaned gas," Petitioner argues that "Vosteen separates the mercury/sorbent composition from the mercury-containing (flue) gas using a cloth-fabric filter with activated carbon to provide 'for the substantially complete removal of mercury (Hg).'" Pet. 25 (citing Ex. 1008, 5:15–30, 5:50–53, 6:2–4, claims 1, 10, 18; Ex. 1002 ¶¶ 281–282).

Patent Owner contends that "[a]ll of the challenged claims of the '114 Patent require 'injecting a sorbent material comprising activated carbon into the mercury-containing gas downstream of the combustion chamber.'" Prelim. Resp. 29. Patent Owner asserts that Petitioner has "failed to provide evidence demonstrating that a POSITA would understand Vosteen to describe activated carbon injection into a mercury-containing gas." *Id.* at 31. Patent Owner argues there are various technologies for capturing particulate matter, such as fly ash, and one such technology is termed a

"baghouse." *Id.* at 32. Patent Owner asserts that a "baghouse contains cylindrical filters made of a woven or felted cloth such as fiber glass or nylon." *Id.* (citing Ex. 1027). Patent Owner argues that "gas is pulled or pushed through the filters to generate a cleaned gas" and when "particulates first come into contact with a baghouse filter, some of the particulates impinge and become trapped on the fabric fibers." *Id.* at 32–33 (citing Ex. 1027, 33–38). Patent Owner contends that these particulates "trap additional incoming particulates" and. ultimately, "the primary filtration mechanism comes from the particles on the filter, known as the 'dust cake,' rather than the filter medium itself." *Id.* at 33–34 (citing Ex. 2018, 7).

Patent Owner asserts that for decades, "POSITA have recognized that the flue gas exiting a coal combustion chamber contains high velocity particles and acid gases," which can damage fabric filters. *Id.* at 34. Patent Owner argues that operators "can reduce this risk by applying a protective dust layer, known as a 'precoat' to the filters before bringing them online," which "provides a protective layer and promotes dust cake formation." *Id.* (citing Ex. 2019, 2; Ex. 2020, 7–9). Patent Owner further asserts that "the EPA has explained that various coatings may be blown onto filter bags before using them in operation," including the injection of limestone to precoat bags to aid the filtering mechanism before initial dust cake formation. *Id.* at 34–35 (citing Ex. 2018, 7, 15; Ex. 2021, 5).

Patent Owner contends that Petitioner has failed to show that Vosteen discloses injecting activated carbon sorbent into a mercury-containing gas, as the challenged claims recite. *Id.* at 35. Patent Owner argues that Petitioner asks "the Board to infer that Vosteen's description of 'blowing in' is the same as 'injecting'" but Petitioner fails "to show that Vosteen teaches injecting activated carbon into the *mercury-containing gas*, rather than onto

cloth filters." *Id.* Citing their argument that "a POSITA would have been aware of the process of precoating filter bags to support development of a filter cake *before* exposing them to mercury containing gas," Patent Owner contends that Petitioner fails "to prove that a POSITA would interpret Vosteen's statement as anything other than a description of precoating cloth filters outside of a baghouse or during scheduled maintenance when the filters are not exposed to mercury-containing gas." *Id.* at 36 (citing Ex. 2018, 7, 15). In view of the above, Patent Owner asserts that Petitioner has failed to show that Vosteen discloses injecting a sorbent downstream of a combustion chamber. *Id.* at 37–39.

Petitioner replies that "Patent Owner relies on counsel's interpretation of four extraneous reports to rewrite Vosteen," "Exhibits 2018 and 2020 date from 1979 and 1982, and Exhibit 2019 relates to using 'diatomaceous earth … available from retail garden centers,'" and "[n]one of the four reports (Ex. 2018–2021) discuss activated carbon or removing mercury from flue gases." Pet. Reply. 10. Petitioner argues that, though "Patent Owner's counsel hypothesizes that a generic fabric filter *could* be 'precoated' with materials 'prior to bringing the unit on-line' in certain circumstances (POPR at 34), that does not preclude injecting activated carbon into the filter of Vosteen *after* it goes online." *Id.* Petitioner further argues that they have provided expert testimony "that Vosteen '*describes injecting* a mixture of lime and activated carbon onto fabric filters *downstream of the combustion chamber* [which] spontaneously brominates the activated carbon (sorbent) in the mercury-containing flue gas *as both the activated-carbon sorbent and the bromine-containing species move towards the fabric filter unit*.'" *Id.* (citing Ex. 1002 ¶¶ 275–278). Petitioner asserts that any "genuine issue of material fact created by 'testimonial evidence will be viewed in the light

most favorable to the petitioner' prior to institution," and "Petitioners' expert should be given even more weight here, where Patent Owner did not submit *any* testimonial evidence regarding Vosteen, instead submitting unsponsored and irrelevant exhibits." *Id.* (citing 37 C.F.R. § 42.108(c)).

In its Sur-reply, Patent Owner reiterates that Vosteen fails to disclose injecting activated carbon and asserts that Petitioner "merely restate[s] their expert's testimony that these elements are disclosed in Vosteen," but "that testimony is merely a conclusion with no analysis or citation to the actual words used in Vosteen" that cannot sustain their burden. Sur-reply 9–10 (citing *TQ Delta, LLC v. CISCO Sys., Inc.*, 942 F.3d 1352, 1362 (Fed. Cir. 2019)).

Vosteen describes a flue gas emission control system including a dry emission control system that may use, for example, "cloth filters which are impinged with a blown-in finely pulverulent slaked lime/activated carbon or slaked lime/lignite coal coke mixture." Ex. 1008, 5:19–30. Petitioner asserts that "'[b]low[ing] in' activated carbon is a form of injecting the sorbent into a mercury-containing gas" but does not explain how a blown in activated carbon on Vosteen's cloth filters would result in the activated carbon being injected into gas, as the challenged claims require. Pet. 24.

Dr. Niksa declares:

> Vosteen describes adding bromine-containing species to the coal (and/or or to the combustion chamber) to introduce HBr and other bromine-containing species into the mercury-containing flue gas generated in the combustion chamber, *and also describes injecting a mixture of lime and activated carbon onto fabric filters downstream of the combustion chamber*. This treatment configuration spontaneously brominates the activated carbon (sorbent) in the mercury-containing flue gas as both the activated-carbon sorbent and the bromine-containing species move towards the fabric filter unit. The bromination also occurs

> in the dust cakes of fly ash, activated carbon, and lime on the outer bag surfaces. In turn, the brominated activated carbon captures elemental and oxidized mercury at extremely high efficiency, due to the large concentration of brominated sites in the activated carbon in a dust cake.

Ex. 1002 ¶ 276 (citing Ex. 1008, 5:27–30) (emphasis added). However, Dr. Niksa provides no explanation how Vosteen "also describes injecting a mixture of lime and activated carbon onto fabric filters downstream of the combustion chamber," as Dr. Niksa states above. Nor does Petitioner provide evidence (other than Dr. Niksa's testimony) that Vosteen's arrangement of cloth filters impinged with a mixture would result in the mixture being injected into gas that passes through the cloth filters (e.g., due to release of the mixture from the cloth filters into the gas). Thus, given the lack of support, we are not persuaded that Petitioner's testimonial evidence regarding whether Vosteen discloses the injection of a sorbent material is entitled to much weight.

Conversely, Patent Owner cites evidence explaining the nature of Vosteen's cloth filters and how particles would cake upon them. Prelim. Resp. 31–35. Considering the parties' positions and weighing the evidence before us, we determine, on this record, that Petitioner has not demonstrated a reasonable likelihood that Vosteen discloses the injection of sorbent material comprising activated carbon into a mercury-containing gas, as the challenged claims require.

In view of the foregoing, Petitioner has not demonstrated a reasonable likelihood of prevailing on its assertion that claim 25 of the '114 patent is anticipated by Vosteen.

Petitioner presents separate arguments for claims 23, 24, 26–28, and 30. Pet. 26–29. Petitioner's arguments, however, do not remedy the

deficiencies discussed above with regard to claim 25, which are common to all claims challenged under this ground. Therefore, Petitioner has not demonstrated a reasonable likelihood of prevailing on its assertion that claim 23, 24, 26–28, and 30 of the '114 patent are anticipated by Vosteen.

F. Asserted Obviousness over Vosteen (Ground 2)

Petitioner argues that claims 1–9 and 12–30 are unpatentable over Vosteen. Pet. 29–43. Petitioner relies on the arguments regarding claims 23–28 and 30 presented in its Ground 1, and provides additional arguments directed to claims 1–9, 12–22, and 29. *Id.*

Patent Owner, referring to its anticipation-based arguments against Vosteen, argues that Petitioner does not offer any additional analysis in its obviousness grounds explaining how a person of ordinary skill in the art would have been motivated to modify Vosteen to arrive at the sorbent injection limitations of the challenged claims. Prelim. Resp. 29. We agree, because Petitioner's arguments for this ground do not remedy the deficiencies discussed above with regard to Petitioner's anticipation arguments based on Vosteen. Therefore, Petitioner has not demonstrated a reasonable likelihood of prevailing on its assertion that claims 1–9 and 12–30 of the '114 patent would have been unpatentable over Vosteen.

G. Asserted Anticipation by Downs-Boiler (Ground 3)

Petitioner argues that claims 23, 25–27, and 30 are anticipated by Downs-Boiler. Pet. 44–50.

1. Downs-Boiler

Downs-Boiler is a patent publication titled "Bromine Addition for the Improved Removal of Mercury from Flue Gas." Ex. 1006, code (54). Downs-Boiler explains that bromine-containing compounds, "added to the coal, or to the boiler combustion furnace, are used to enhance the oxidation

of mercury, thereby enhancing the overall removal of mercury in downstream pollution control devices." *Id.* at code (57).

Downs-Boiler's Figure 2 is reproduced below:

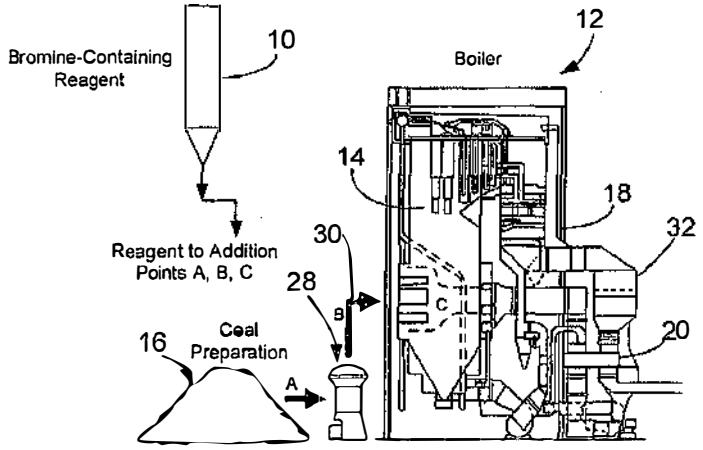


FIG. 2

Figure 2 shows adding bromine to improve mercury removal from flue gases. *Id.* ¶ 10. Downs-Boiler discloses that bromine-containing reagent 10 is added to boiler 12 of combustion furnace 14 "either directly or by premixing with the incoming coal 16." *Id.* ¶ 15. Downs-Boiler describes the use of an aqueous solution of calcium bromide for injection into the combustion chamber 14, and the use of HBr or Br_2 as the bromine-containing reagent 10. *Id.* ¶¶ 18, 21. Downs-Boiler also discloses "powdered activated carbon (PAC)" as a sorbent, and describes "downstream pollution control systems such as wet 22 and SDA 24 FGD systems, and PAC injection systems." *Id.* ¶¶ 15, 25. Downs-Boiler states that "experimental results indicate that bromine addition also results in an increased fraction of particulate-bound mercury." *Id.* ¶ 15.

2. Unpatentability Analysis

Petitioner discusses claim 25 first, asserting this is done "because the other independent claims copy its limitations." Pet. 45 (citing Ex. 1002 ¶ 388). Specifically, Petitioner argues the following:

Preamble: "A method of separating mercury from a mercury-containing gas, the method comprising:" (Pet. 46 (relying on Ex. 1006, code (54); Ex. 1007, code (54); Ex. 1002 ¶ 389));

Element 25(a): "combusting coal in a combustion chamber, to provide the mercury-containing gas" (Pet. 46 (relying on Ex. 1006 ¶¶ 1, 20, Fig. 4; Ex. 1007 ¶¶ 2, 3, 9, 18, 23, Fig. 4; Ex. 1002 ¶¶ 390–391));

Element 25(b): "the coal comprises added Br_2, HBr, a bromide compound, or a combination thereof, added to the coal upstream of the combustion chamber, or the combustion chamber comprises added Br_2, HBr, a bromide compound, or a combination thereof, or a combination thereof," (Pet. 46–47 (relying on Ex. 1006 ¶¶ 7, 18, 19, 21, 22, Fig. 2; Ex. 1007 ¶¶ 9, 21, 22, 24, 25, Fig. 2; Ex. 1002 ¶¶ 392–398));

Element 25(c): "injecting a sorbent material comprising activated carbon into the mercury-containing gas downstream of the combustion chamber; contacting mercury in the mercury-containing gas with the sorbent, to form a mercury/sorbent composition" (Pet. 48 (relying on Ex. 1006 ¶¶ 3, 4, 15, 16; Ex. 1007 ¶¶ 5, 18, 19; Ex. 1002 ¶¶ 399–402));

Element 25(d): "separating the mercury/sorbent composition from the mercury-containing gas, to form a cleaned gas." (Pet. 48 (relying on Ex. 1006 ¶ 4; Ex. 1007 ¶ 5; Ex. 1002 ¶ 403).

Petitioner asserts that "[c]laim 23 is nearly identical to Claim 25, with minor changes" and argues that Downs-Boiler discloses the limitation "wherein the mercury-containing gas comprises a halogen or halide

promoter comprising HBr, Br^- or a combination thereof." *Id.* at 49–50 (relying on Ex. 1006 ¶¶ 18, 19, 21, Fig. 2; Ex. 1007 ¶¶ 21, 22, Fig. 2; Ex. 1002 ¶¶ 407–415).

Petitioner presents separate arguments for claims 26, 27, and 30. Pet. 49. Patent Owner does not address Petitioner's arguments regarding the claims challenged under this ground, aside from arguing a prior date of invention for the '114 patent, as discussed below. Based on the preliminary record before us, we find that Petitioner's arguments and evidence are sufficient to show a reasonable likelihood Petitioner would prevail in proving unpatentability of claims 23, 25–27, and 30.

H. Asserted Obviousness over Downs-Boiler (Ground 4)

Petitioner argues that claims 1–7, 12–28, and 30 are unpatentable over Downs-Boiler. Pet. 50–67.

Petitioner asserts that claim 1 "combines the limitations of Claims 23 and 25" and thus the above analysis in the anticipation ground over Downs-Boiler applies to claim 1. *Id.* at 51. Petitioner also provides arguments for the following limitations:

Element 1(e): "monitoring the mercury content of the cleaned gas" (Pet. 52 (relying on Ex. 1006; Ex. 1007, Fig. 3; Ex. 1002 ¶ 429));

Element 1(f)(1): "controlling, in response to the monitored mercury content of the cleaned gas, an injection rate of injecting the sorbent into the mercury-containing gas, the sorbent composition, or a combination thereof," (Pet. 52–53 (arguing "a POSITA would have been motivated to at least try adjusting, in response to the monitored mercury content, the sorbent injection rate at a level that minimized costs while reaching mercury content removal targets" and relying on Ex. 1006 ¶ 4; Ex. 1007 ¶ 5, Fig. 3; Ex. 1002 ¶¶ 430–431));

Element (1)(f)(2): "so that the mercury content of the cleaned gas is maintained at or below a desired level." (Pet. 54 (relying on Ex. 1006 ¶ 1; Ex. 1007 ¶ 2; Ex. 1002 ¶ 432)).

Petitioner also presents arguments and evidence that Downs-Boiler suggests the limitations of dependent claims 2–7 and 12–22. Pet. 54–63.

Petitioner asserts that claims 23, 25–27, and 30 "are obvious for the same reasons as in Ground 3, as anticipation is the epitome of obviousness," those claims are also obvious for the reasons discussed in this ground, and "[e]lements and claims not mentioned below are disclosed or rendered obvious for the reasons stated above" in the anticipation ground over Downs-Boiler. Pet. 50 (citing Ex. 1002 ¶ 416). Petitioner also provides arguments for the limitations "contacting mercury in the mercury-containing gas with the sorbent, to form a mercury/sorbent composition" of claims 23 and 25 and the limitation "the mercury sorbent composition comprises the element bromine, the sorbent material, and mercury" of claim 30. *Id.* at 51.

Petitioner asserts that claim 24 "combines the limitations of Claims 1, 23 and 25" and for "the same reasons, Downs-Boiler also renders obvious Claim 24." Pet. 64 (citing Ex. 1002 ¶¶ 290, 298, 323, 463–473). Petitioner also provides arguments for the following limitations:

Element 24(c): "the activated carbon reacts with the halogen or halide promoter in the mercury-containing gas to form a promoted sorbent" and the mercury is contacted "with the promoted sorbent" (Pet. 64–65 (relying on Ex. 1006 ¶ 4; Ex. 1007 ¶ 5; Ex. 1002 ¶¶ 467–468));

Element 24(f)(1): "controlling, in response to the mercury content of the cleaned gas, an injection rate of injecting the sorbent into the mercury-containing gas, *a rate of addition to the coal or the combustion chamber of the added Br2, HBr, the bromide compound*, or a combination thereof, or a

combination thereof." (Pet. 65–66 (arguing that one of ordinary skill in the art, upon reviewing the test data presented in Downs-Boiler's Figure 3, "would have been motivated to control the bromine addition rate in response to fluctuations in mercury content, such as by selecting a given addition rate . . . and/or by interpolating an intermediate value in response to the monitored mercury content of the cleaned gas" and relying on Ex. 1006 ¶ 18, Fig. 3; Ex. 1007 ¶ 21, Fig. 3; Ex. 1002 ¶¶ 471–472)).

Petitioner argues that claim 28 "combines Elements 24(e), 24(f)(1), and 24(f)(2), and is obvious for the same reasons." Pet. 67 (citing Ex. 1002 ¶¶ 474–477).

Patent Owner does not present arguments addressing the specific merits of Petitioner's obviousness ground based on Downs-Boiler in the Preliminary Response to the Petition. *See generally* Prelim. Resp. Based on the preliminary record before us, we find that Petitioner's arguments and evidence are sufficient to show a reasonable likelihood Petitioner would prevail in proving unpatentability of claims under this ground. In view of the foregoing, Petitioner has demonstrated a reasonable likelihood of prevailing on its assertion that claims 1–7, 12–28, and 30 of the '114 patent are unpatentable over Downs-Boiler.

I. Asserted Obviousness over Vosteen and EPA-Proposal (Ground 5)

Petitioner argues that claims 1–9, 12–22, 24, and 28 are unpatentable over Vosteen and EPA-Proposal. Pet. 67–74.

1. EPA-Proposal

EPA-Proposal is a publication of "Proposed National Emission Standards for Hazardous Air Pollutants; and, in the Alternative, Proposed Standards of Performance for New and Existing Stationary Sources: Electric Utility Steam Generating Units" in the Federal Register. Pet. 67; Ex. 1009,

2. EPA-Proposal states that the "primary goal in this rulemaking is to reduce power plant emissions of Hg by 70 percent from today's level by 2018." *Id.* at 48. EPA-Proposal describes the use of sorbent injection to improve the removal of mercury and other gaseous pollutants that are carried with combustion fine particulates in all coal-fired subcategories. *Id.* at 26. EPA-Proposal discloses that the sorbent can be activated carbon and "the types of sorbent that may be viable for use in sorbent injection include two basic types of activated carbon (AC; regular and impregnated), as well as other carbon (mixed with other sorbents) and non-carbon sorbents." *Id.*

2. Analysis

Petitioner's arguments for this ground do not remedy the deficiencies discussed above with regard to Ground 1 over Vosteen. Pet. 67–74. Therefore, Petitioner has not demonstrated a reasonable likelihood of prevailing on its assertion that claims 1–9, 12–22, 24, and 28 of the '114 patent would have been unpatentable over Vosteen and EPA-Proposal.

J. Asserted Obviousness over Downs-Boiler and EPA-Proposal (Ground 6)

Petitioner argues that claims 1–7, 12–22, 24, and 28 are unpatentable over Downs-Boiler and EPA-Proposal. Pet. 67–74.

Patent Owner does not present arguments addressing the specific merits of Petitioner's ground in the Preliminary Response. Having reviewed Petitioner's assertions regarding claims 1, 2, 3, 13, 14, 24, and 28, as well as the cited portions of Downs-Boiler and EPA-Proposal, we determine that Petitioner has demonstrated a reasonable likelihood of establishing that claims 1, 2, 3, 13, 14, 24, and 28 would have been obvious over Downs-Boiler and EPA-Proposal.

We have reviewed Petitioner's argument and evidence that Downs-Boiler and EPA-Proposal disclose the limitations of the remaining challenged claims 4–7, 12, and 15–22. Pet. 67 ("Elements and claims not mentioned below are disclosed or rendered obvious for the reasons stated above in . . . Grounds 3–4 (Downs-Boiler)."), 67–74. Patent Owner does not address Petitioner's challenges to these challenged claims. Based on the preliminary record before us, we also find that Petitioner's argument and evidence is sufficient to show a reasonable likelihood Petitioner would prevail in proving unpatentability of dependent claims 4–7, 12, and 15–22.

K. Asserted Obviousness over Vosteen and Nelson (Ground 7)

Petitioner argues that claims 2–4, 17, 18, 24, 29, and 30 are unpatentable over Vosteen and Nelson. Pet. 74–87.

1. Nelson

Nelson is a patent titled "Sorbents and Methods for the Removal of Mercury from Combustion Gases." Ex. 1012, code (54). Nelson "relates to the removal of mercury from combustion gas streams and more specifically to the use of halogenated carbon materials to reduce the emissions of mercury from coal-fired power plants." *Id.* at 1:24–27.

Nelson's Figure 1 is reproduced below.

Figure 1.

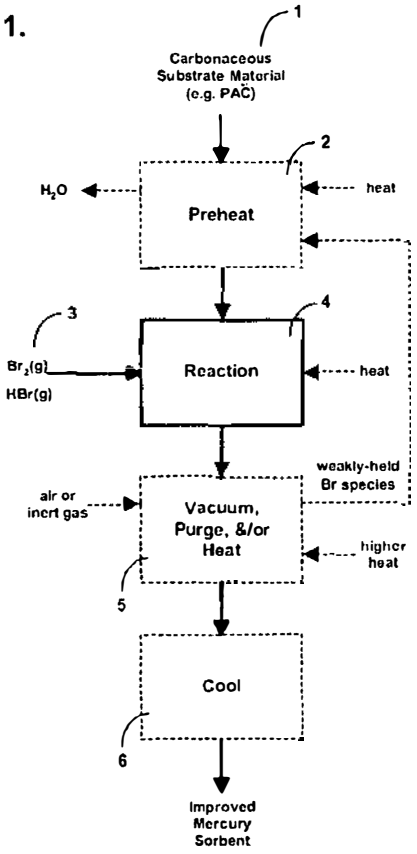


Figure 1 depicts a mercury sorbent manufacturing process. *Id.* at 5:28–29. Nelson discloses that the process shown in Figure 1 begins with carbonaceous substrate material 1 for a mercury sorbent. *Id.* at 7:4–5. The carbonaceous material can be activated carbon. *Id.* at 7:7–8.

Nelson states that a "critical element in the process is that a bromine-containing gas 3 is used to treat the carbonaceous substrate. Preferably this gas comprises elemental bromine, $Br_2(g)$, although other bromine-containing gases, such as hydrogen bromide, HBr, will also have the advantageous effect of the invention." *Id.* at 7:46–51. Nelson further discloses that the

mercury sequestration performance of activated carbons can be improved when the latter are combined with halogen compounds. *Id.* at 2:10–12.

2. Analysis

Petitioner's arguments for this ground, including their rationale for combining the references, do not remedy the deficiencies discussed above with regard Ground 1 based on Vosteen. Pet. 74–87. Therefore, Petitioner has not demonstrated a reasonable likelihood of prevailing on its assertion that claims 2–4, 17, 18, 24, 29, and 30 of the '114 patent would have been unpatentable over Vosteen and Nelson.

L. Asserted Obviousness over Downs-Boiler and Nelson (Ground 8)

Petitioner argues that claims 2–4, 18, 24, 29, and 30 are unpatentable over Downs-Boiler and Nelson. Pet. 74–87.

Patent Owner does not present arguments addressing the specific merits of Petitioner's ground in the Preliminary Response. Having reviewed Petitioner's assertions regarding claims 2–4, 17,[7] 24, 29, and 30, as well as the cited portions of Downs-Boiler and Nelson, we determine that Petitioner has demonstrated a reasonable likelihood of establishing that claims 2–4, 17, 24, 29, and 30 would have been obvious over Downs-Boiler and Nelson.

We have reviewed Petitioner's argument and evidence that Downs-Boiler and Nelson disclose the limitations of the remaining challenged claim 18. Pet. 74 ("Elements and claims not mentioned below are disclosed or rendered obvious for the reasons stated above in . . . Grounds 3-4 (Nelson)."), 67–74. Patent Owner does not address Petitioner's challenges

[7] Petitioner does not explicitly identify claim 17 as being challenged under this ground (*see* Pet. 10, 74) but presents arguments directed to claim 17 as obvious in view of Downs-Boiler and Nelson (*see* Pet. 86–87). Therefore, on this record, we consider claim 17 to be part of this Ground 8.

to this challenged claim. Based on the preliminary record before us, we also find that Petitioner's argument and evidence is sufficient to show a reasonable likelihood Petitioner would prevail in proving unpatentability of claim 18.

M. Availability of Prior Art and Priority of '114 Patent

Petitioner asserts that Vosteen is prior art. Pet. 9 (table indicating that Vosteen was "filed 5/6/2003, and issued 4/12/2005); 10 ("Each reference is also prior art under §102(b) (pre-AIA) and §102(a)(1) (post-AIA)."). Petitioner also asserts that Downs-Boiler is prior art, "with a priority date back to the March 22, 2004 filing date of 60/555,353," the "'Downs-Boiler Provisional' (Ex[1007])." *Id.* at 44 (citing *Dynamic Drinkware*, 800 F.3d at 1378; *Amgen Inc. v. Sanofi*, 872 F.3d 1367, 1380 (Fed. Cir. 2017) (finding that *Dynamic* applies to published patent applications). Petitioner further argues that the "disclosure of Downs-Boiler is supported by Downs-Boiler-Provisional, as illustrated in a redline between the two. Ex[1032]." *Id.*

Patent Owner argues that the primary references fail to qualify as prior art because "the inventors actually reduced the '114 invention to practice before the asserted Downs-Boiler § 102(e) date, and they conceived of the '114 invention before the asserted Vosteen § 102(e) date." Prelim. Resp. 16. Specifically, Patent Owner argues that the inventors of the '114 patent "conceived of the invention at least by August 2002" and "reduced the challenged claims to practice at least as early as September 2003." *Id.* at 19; *see also id.* at 19–21, 23–28. Patent Owner presents evidence in the form of declaration testimony and a "research ideas" file to support its argument that the inventors had "conceived of using bromine as the pre-combustion additive" by August 2002. *Id.* at 22 (citing Ex. 2024 ¶¶ 25–30; Ex. 2014). Patent Owner presents further evidence in the form of

declaration testimony, logbooks, and reports to support its argument that the inventors reduced the invention to practice "through pilot scale testing conducted in September 2003, December 2003, and February 2004." *Id.* at 27 (citing Ex. 2024; Ex. 2016; Ex. 2011–2013). Patent Owner argues that the relevant period for establishing diligence "is from May 5, 2003 to September 18, 2003" and that the "inventors were reasonably diligent in obtaining funding for PTC testing and then carrying out that testing." *Id.* at 28–29.

Petitioner disputes Patent Owner's assertion of an earlier actual reduction to practice. Pet. Reply. 1–2, 6–9. More particularly, Petitioner argues that "Patent Owner has not come forward with evidence of conception or reduction to practice of every claim limitation to pre-date" Vosteen and Downs-Boiler, decrying Patent Owner's evidence as "a hodgepodge compilation of future research ideas from unnamed individuals" and "unwitnessed laboratory notebook(s)" that "fail to disclose adding the claimed species of bromine-containing ingredients to coal and to the combustion chamber, and numerous other claim limitations." *Id.* at 1. Petitioner argues that trial should be instituted so it may depose Patent Owner's declarants. *Id.* at 2. Petitioner also presents detailed arguments against Patent Owner's conception evidence (*id.* at 4–6), reduction to practice evidence (*id.* at 6–9), and diligence evidence (*id.* at 9).

Patent Owner replies that Petitioner misunderstands the "rule of reason" for a conception date. Sur-reply 3. Patent Owner also replies that Petitioner failed to show that the inventors' asserted reduction to practice date lacks credibility. *Id.* at 5. Finally, Patent Owner argues that Petitioner failed to show that the inventors lacked diligence. *Id.* at 8.

To remove a patent as a prior art reference, the record must establish either (1) a conception and reduction to practice before the filing date of the patent or (2) a conception before the filing date of the patent combined with diligence and reduction to practice after that date. *See Taurus IP, LLC v. DaimlerChrysler Corp.*, 726 F.3d 1306, 1323 (Fed. Cir. 2013).

"Conception exists when a definite and permanent idea of an operative invention, including every feature of the subject matter sought to be patented, is known." *Sewall v. Walters*, 21 F.3d 411, 415 (Fed. Cir. 1994). Furthermore, the "conception analysis necessarily turns on the inventor's ability to describe his invention with particularity. Until he can do so, he cannot prove possession of the complete mental picture of the invention." *Burroughs Wellcome Co. v. Barr Labs., Inc.*, 40 F.3d 1223, 1228 (Fed. Cir. 1994). Objective evidence that corroborates an inventor's testimony regarding the conception of the invention is required "because of the danger in post-hoc rationales by an inventor claiming priority." *Invitrogen Corp. v. Clontech Labs., Inc.*, 429 F.3d 1052, 1065 (Fed. Cir. 2005). The sufficiency of corroboration is determined according to a "rule of reason." *Price v. Symsek*, 988 F.2d 1187, 1195 (Fed. Cir. 1993). Under the rule of reason, "all pertinent evidence is examined in order to determine whether the inventor's story is credible." *Fleming v Escort Inc.*, 774 F.3d 1371, 1377 (Fed. Cir. 2014) (quoting *Sandt Tech., Ltd. v. Resco Metal & Plastics Corp.*, 264 F.3d 1344, 1350 (Fed. Cir. 2001)).

To establish an actual reduction to practice, as opposed to the constructive reduction to practice that occurs when a patent application is filed, a party must establish that: (1) the inventor constructed an embodiment or performed a process that satisfies every element of the claim at issue; and (2) the inventor determined that the invention would work for its intended

purpose. *E.I. du Pont De Nemours & Co. v. Unifrax I LLC*, 921 F.3d 1060, 1075 (Fed. Cir. 2019). The same requirement for evidence that corroborates inventor testimony on conception under the rule of reason also applies to the reduction to practice determination. *Id.* at 1076. To demonstrate diligence, a patent owner "must show there was *reasonably continuous* diligence" throughout the critical period. *Perfect Surgical Techniques, Inc. v. Olympus Am., Inc.*, 841 F.3d 1004, 1009 (Fed. Cir. 2016).

Petitioner bears the burden of persuasion that the challenged claims are unpatentable, which includes the burden of establishing that any reference upon which it relies constitutes prior art under 35 U.S.C. § 102. *See* 35 U.S.C. § 316(e); *Mahurkar v. C.R. Bard, Inc.*, 79 F.3d 1572, 1576 (Fed. Cir. 1996) (holding that the challenger "bore the burden of persuasion . . . on all issues relating to the status of [the asserted reference] as prior art"). However, because Petitioner initially offered up the prior art references, which qualify on their face as prior art, into evidence, Patent Owner bears the subsequent procedural burden of producing evidence antedating the prior art references. *See Dynamic Drinkware*, 800 F.3d at 1378–80; *Magnum Oil*, 829 F.3d at 1375. Although the burden of production can be a shifting burden, we note that the burden of persuasion is on Petitioner to ultimately prove "unpatentability by a preponderance of the evidence," and that this burden never shifts to Patent Owner. *Dynamic Drinkware*, 800 F.3d at 1378.

Petitioner has come forward with evidence to support its assertion that the prior art references are in fact prior art. *See* Pet. 9–10, 44. Patent Owner has come forward with evidence and argument that the proffered prior art references are not, in fact, prior art, due to the asserted prior conception, reduction to practice, and diligence on the part of the inventors. *See* Prelim.

Resp. 19–28; Sur-reply 3–9. However, on this record and at this preliminary stage, we are not persuaded that the evidence and arguments before us are sufficient to show the asserted conception date, reduction to practice date(s), or diligence. Most importantly, Patent Owner does not explain in sufficient detail how the proffered testimony and documents disclose every feature of the subject matter challenged. It is also unclear, without further explanation, what the documents that purport to show conception and reduction to practice actually demonstrate, and how they are related specifically to the limitations of the challenged claims.

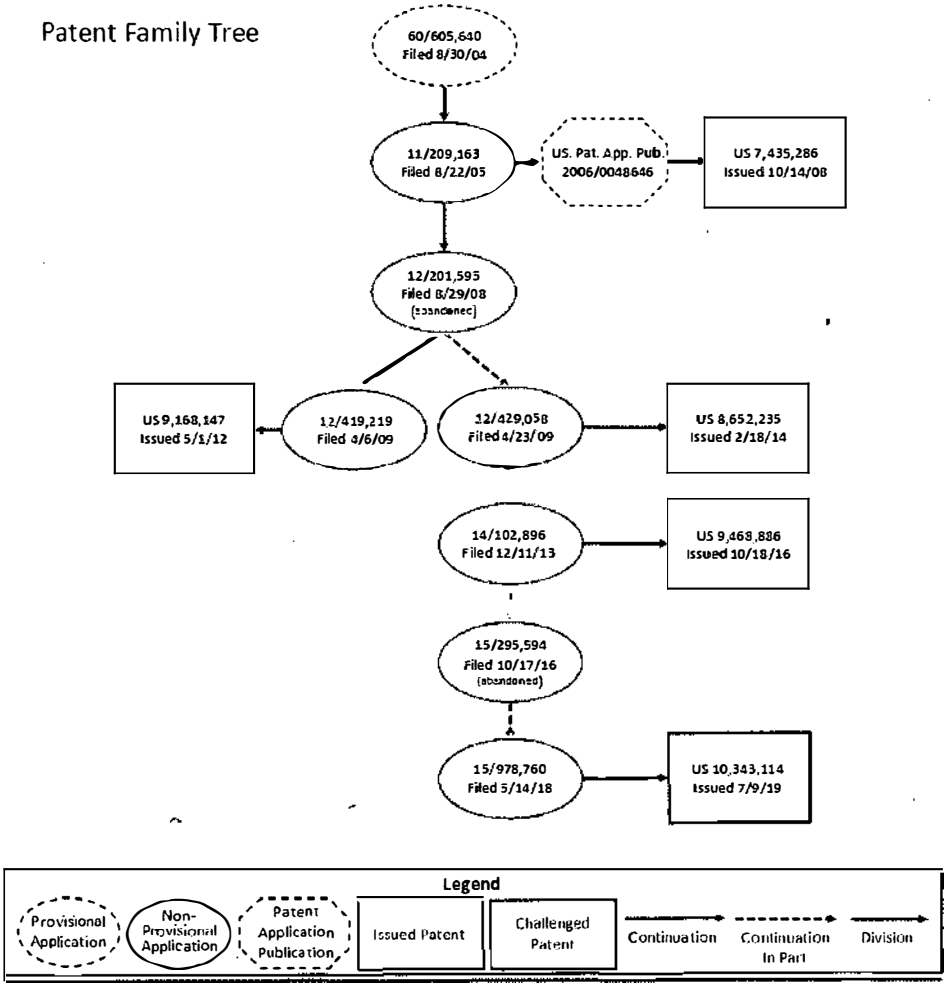
Accordingly, based on the preliminary record, we determine that, for purposes of this Decision, Vosteen and Downs-Boiler constitute prior art under 35 U.S.C. § 102. The parties may further address this issue in post-institution briefing.

Petitioner also replies that "Patent Owner has not satisfied its burden of production to antedate prior art patent documents *filed and published* years before the May 2018 filing of the '114 Patent." Reply 1. Specifically, Petitioner asserts that "Patent Owner has not come forward with *any* evidence that the '114 Patent traces priority through two continuation-in-part (CIP) applications and three other applications to avoid §102(a)(2) (post-AIA) or §102(b) (pre-AIA) statutory bars." *Id.*

Patent Owner asserts that Petitioner "initially attempted to justify their filing of multiple IPR petitions by arguing that the -832 proceeding would address the parties' priority date dispute, and the -834 proceeding would assume that the '114 patent is entitled to its earliest claimed priority date" but that Petitioner now asks "the Board to reach the opposite conclusion and insist that the parties' priority date dispute should be addressed in both proceedings." Sur-reply 1. Patent Owner argues that because "Petitioners

previously indicated that the -834 proceeding would not address the parties' priority date dispute, they may not raise the issue after the fact." *Id.* at 1–2 (citing *Magnum Oil*, 829 F.3d at 1381; *SAS Inst., Inc. v. ComplementSoft, LLC*, No. 2015-1347, 825 F.3d 1341, 1351 (Fed. Cir. June 10, 2016)). However, Patent Owner further contends that, for "all of the reasons addressed in the parties' -832 briefing, the Board should determine that the '114 patent is entitled to the earliest claimed priority date" and "the evidence required to evaluate this issue, i.e., the priority applications, is already before the Board. Exs. 1017–1026. As explained in the -832 proceeding, those applications support the claims." *Id.* at 2, 2 n.1.

Petitioner provides the following summary of the '114 patent's priority chain and family:



Ex. 1017. This summary depicts the earliest filed application at the top and shows the latest filed application at the bottom. As illustrated above, the '114 patent has the following priority chain:

- Provisional Application 60/605,640, filed August 30, 2004, ("the provisional application");

- Non-provisional Application 11/209,163 ("the '163 application"), filed August 22, 2005, claiming priority to the Provisional Application;
- Non-provisional Application 12/201,595 ("the '595 application"), filed August 29, 2008, claiming priority to the '163 application as a divisional application;
- Non-provisional Application 12/429,058 ("the '058 application"), filed April 23, 2009, claiming priority to the '595 application as a continuation-in-part;
- Non-provisional Application 14/102,896 ("the '896 application"), filed December 11, 2013, claiming priority to the '058 application as a continuation;
- Non-provisional Application 15/295,594 ("the '594 application"), filed October 17, 2016, claiming priority to the '896 application as continuation; and
- Non-provisional Application 15/978,760 ("the '760 application"), filed May 14, 2018, claiming priority to the '594 application as a continuation-in-part.

Id.; Ex. 1001, code (21), (22), (60). Therefore, if the '114 patent is entitled to the priority date of the provisional application, Downs-Boiler and Vosteen would not qualify as prior art to the '114 patent.

Patent Owner contends that Petitioner raises this issue as a new argument in Petitioner's Reply. Sur-reply 1. Petitioner, however, appears to make its Reply argument in response to Patent Owner's assertion of a prior invention date in their Preliminary Response, stating that "Patent Owner's assertions of an earlier invention date cannot overcome" the statutory bars of

§102(a)(2) (post-AIA) or §102(b) (pre-AIA) because determining "invention date for Rule 1.131 is a separate inquiry from determining effective filing date for a chain of patent applications." Reply 2. In response, Patent Owner presents its own arguments regarding the priority date issue, asserting that the '114 patent is entitled to its earliest claimed priority date for the reasons discussed in IPR2020-00832. Sur-reply 2 n.1.

The Petition in this case does not raise the same priority date arguments made in IPR2020-00832, but the Reply in this case raises these arguments in response to Patent Owner's arguments by referring to the arguments raised in the IPR2020-00832 Petition. Patent Owner's Sur-reply refers to and invites us to consider the priority date arguments raised and evidence presented in IPR2020-00832. In the IPR2020-00832 Institution Decision, we analyze this priority date issue in depth based on the parties' arguments and evidence presented in that proceeding. We are aware of the potential problems that could arise if we were to ignore or fail to address a priority date issue in this case, when the same potentially dispositive issue has been raised and analyzed in IPR2020-00832 concerning the same patent and the same priority date evidence. Patent Owner argues that Petitioner may not "raise the issue after the fact," but we are not directed to any authority indicating that we must disregard this potentially dispositive issue entirely, particularly if the parties are on notice that the issue is relevant to this proceeding. Sur-reply 1–2 (citing *Magnum Oil*, 829 F.3d at 1381; *SAS,* 825 F.3d 1341). Finally, we are aware that Petitioner elected to take two different priority date approaches in the Petitions in IPR2020-00832 and IPR2020-00834, for the purposes of qualifying each petition for separate institution. Paper 2, 1–2 ("Explanation"). This drafting choice results in two Petitions that ostensibly present different sets of evidence, but that may

end up turning on the same priority date issue raised in IPR2020-00832. The conception, reduction to practice, and diligence issues raised here, however, distinguish this case sufficiently that our reasoning for granting institution in both petitions, further explained below, is unchanged.

In view of the above, we acknowledge that the priority of the '114 patent and whether the applications of the '114 patent's priority chain comply with the written description requirement may be another reason to question whether the references asserted in this proceeding are available as prior art.

N. Discretion under 35 U.S.C. § 325(d)

Petitioner argues that the "Board should not deny institution under 35 U.S.C. § 325(d), because the Examiner did not consider some of the asserted references, and for the remainder, the Office erred in a manner material to the patentability of the challenged claims." Pet. 11. More particularly, Petitioner argues that EPA-Proposal "was not considered by the Examiner during prosecution" (*id.*); the Examiner "did not use Downs-Boiler in a substantive rejection" and "erred by not citing Downs-Boiler during prosecution" (*id.* at 12); and the Examiner "cited Vosteen early in prosecution" but "erred in overlooking the teachings of" Vosteen (*id.* at 12–13). Patent Owner does not address Petitioner's EPA-Proposal and Downs-Boiler arguments, but argues that the Board should exercise its discretion to deny institution under 35 U.S.C. § 325(d), because Vosteen was previously before the Office during prosecution of the '760 application. Prelim. Resp. 1–7 (citing Ex. 1026, 2003).

> To evaluate whether to exercise discretion under 35 U.S.C. §325(d), the Board uses the following two-part framework: (1) whether the same or substantially the same art previously was presented

> to the Office or whether the same or substantially the same arguments previously were presented to the Office; and (2) if either condition of first part of the framework is satisfied, whether the petitioner has demonstrated that the Office erred in a manner material to the patentability of challenged claims.

Advanced Bionics LLC v. MED-EL Elektromedizinische Geräte GmbH, IPR2019-01469, Paper 6 at 8 (PTAB Feb. 13, 2020) (precedential). The factors set forth in *Becton, Dickinson & Co. v. B. Braun Melsungen AG*, IPR2017-01586, Paper 8 (PTAB Dec. 15, 2017) (precedential as to § III.C.5, first paragraph) provide insight into how to apply the framework, because *Becton, Dickinson* factors (a), (b), and (d) relate to part (1) of the framework and factors (c), (e), and (f) relate to part (2).

1. Advanced Bionics Framework Part (1)

For part (1) of the *Advanced Bionics* framework (and factors (a), (b), and (d) of *Becton, Dickinson*), Patent Owner contends that "Vosteen was described in the '114 patent's specification, cited in an IDS, and identified by the examiner in a rejection." Prelim. Resp. 4. According to Patent Owner, "the prosecution record reflects that this reference was sufficiently considered such that the examiner's decision to allow the claims is entitled to deference." *Id.* Petitioner contends that the "Examiner cited Vosteen early in prosecution to reject then-pending claims 20–21, but only as a secondary reference for features recited in a dependent claim related to 'monitoring the mercury content,'" and those claims were later cancelled. Pet. 12 (citing Ex. 1026, 75–79, 1530–1531, 1569).

Vosteen was, therefore, before the Office during prosecution of the challenged patent. Ex. 1026, 75–79, 1530–1531. It does not appear, however, that the same or substantially the same arguments predicated on Vosteen were before the Office. *Id.* Moreover, EPA-Proposal was not

before the Office, and Downs-Boiler, although one of the sixteen columns' worth of cited references on the face of the '114 patent, was not substantively considered by the Examiner. Pet. 12. Thus, Part (1) of the framework is not met as to EPA-Proposal and Downs-Boiler, nor is it met with respect to the same or substantially the same Vosteen arguments being before the Office. However, Vosteen was previously before the Office, and we review Part (2) of the framework with respect to Vosteen.

2. Advanced Bionics Framework Part (2)

For part (2) of the *Advanced Bionics* framework (and factors (c), (e), (f) of *Becton, Dickinson*), Petitioner argues that, following the Examiner's rejection based on Vosteen, "the claims underwent significant amendments" and the amended claims "were prosecuted without citation by the Examiner to Vosteen." Pet. 13 (citing Ex. 1026, 1646 (claim 7), 1905–1911). Therefore, Petitioner alleges, "the 'Office erred in overlooking the teachings of' Vosteen" because, for example, Vosteen "clearly discloses bromine addition to the coal and/or combustion chamber, along with separation via activated carbon, and highlights the Examiner's error in overlooking Vosteen's teachings." *Id.*

Patent Owner argues that Petitioner "offers no authority indicating that the Board should avoid deferring to an examiner based on the assumption that the examiner forgot about a reference when evaluating later amended claims." Prelim. Resp. 4–5. Rather, Patent Owner argues, the Examiner "allowed claim scope coverage for those embodiments" where bromine is provided on coal, into the combustion chamber, or via some other step, "even when well aware of Vosteen." *Id.* at 5.

We find that Petitioner has sufficiently shown how the Examiner failed to fully consider the aspects of Vosteen not related to "monitoring the

mercury content," such as the amended claims requiring that "coal must comprise particular bromine-containing species." Pet. 12–13 (citing Ex. 1026, 75–79, 1530–1531, 1646 (claim 7), 1905–1911). *See Advanced Bionics*, Paper 6, 8 n.9 ("An example of a material error may include misapprehending or overlooking specific teachings of the relevant prior art where those teachings impact patentability of the challenged claims."). Although we have preliminarily analyzed Vosteen and determined that it does not anticipate or provide the basis for an obviousness ground against the challenged claims, this preliminary determination does not conflict with our Part (2) determination that the Examiner erred in not considering Vosteen in a manner potentially material to the patentability of the challenged claims.

For these reasons, considering the *Advanced Bionics* framework as applied to the various references before us, we decline to exercise our discretion under § 325(d) to deny institution.

O. Discretion under 35 U.S.C. § 314(a)

Under § 314(a), we have discretion to deny institution of an *inter partes* review. *Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2140 (2016); *SAS Inst. Inc. v. Iancu*, 138 S. Ct. 1348, 1356 (2018); *Harmonic Inc.*, 815 F.3d at 1367 ("[T]he PTO is permitted, but never compelled, to institute an IPR proceeding."); see also 37 C.F.R. § 42.4(a) ("The Board institutes the trial on behalf of the Director."). In deciding whether to institute an *inter partes* review, we consider the guidance in the Consolidated Trial Practice Guide, which states

> Based on the Board's prior experience, one petition should be sufficient to challenge the claims of a patent in most situations. Two or more petitions filed against the same patent at or about the same time . . . may place a substantial and unnecessary burden

> on the Board and the patent owner and could raise fairness, timing, and efficiency concerns.

Patent Trial and Appeal Board Consolidated Trial Practice Guide ("CTPG") 64 (Nov. 2019), https://www.uspto.gov/sites/default/files/documents/tpgnov.pdf, 59.

Here, Petitioner filed two petitions on the same day, both challenging claims 1–9 and 12–30 of the '114 patent. In this Petition, Petitioner presents two anticipation grounds, one based on Vosteen and one based on Downs-Boiler, and six obviousness grounds based on either Vosteen or Downs-Boiler and additional references. Pet. 10. In IPR2020-00832, Petitioner presents two obviousness challenges, the first based on Sjostrom and Eckberg and the other based on Sjostrom and Olson-646. IPR2020-00832, Paper 3, 10.

Petitioner's Explanation Regarding the Necessity of Multiple Petitions argues that "[g]iven the strength of the prior-art references on the merits, and noncumulative nature of the references, both petitions should be instituted." Explanation 2. The Explanation ranks this Petition above the Petition in IPR2020-00832. *Id.*

The Explanation further argues why Petitioner believes institution of both petitions is appropriate. *Id.* at 3–5. Specifically, Petitioner contends that the two petitions assert different priority dates and assert different references, citing the CTPG's statement that "more than one petition may be necessary . . . when there is a dispute about priority date requiring arguments under multiple prior art references." *Id.* at 3 (citing CTPG 59). Petitioner further argues that the issues presented to the Board by the two Petitions are limited, because the Petition in this proceeding uses two primary references and two secondary references, whereas the Petition in IPR2020-00832 uses

only one primary reference and two secondary references. *Id.* at 3–4. Petitioner also contends that Patent Owner may attack obviousness grounds for dependent claims in IPR2020-00832 via evidence of secondary considerations. *Id.* at 4. In view of this possibility, Petitioner requests that the Board also institute in this proceeding because Petitioner argues Olson-646 discloses numerous limitations of the same dependent claims. *Id.* Petitioner also argues that they joined efforts to provide efficiency instead of each party individually filing separate petitions. *Id.* at 4–5.

Petitioner's arguments are persuasive. The existence of different priority date arguments and different prior art references in the two petitions before us invokes the CTPG statement that "more than one petition may be necessary . . . when there is a dispute about priority date requiring arguments under multiple prior art references." CTPG 59. Notwithstanding Petitioner's and Patent Owner's post-Petition arguments regarding the similarity of the priority date arguments, the fact remains that the Petitions themselves present different priority date arguments and rely on different prior art references. The Petitions are the documents to which the Patent Owner will be responding in the *inter partes* review proceeding. Moreover, Petitioner ranks this Petition first and, for the reasons discussed above, *inter partes* review will be instituted in this proceeding. We also institute *inter partes* review in IPR2020-00832 for the reasons discussed in that proceeding.

III. CONCLUSION

For the reasons set forth above, we determine that Petitioner has demonstrated a reasonable likelihood of prevailing with respect to at least one challenged claim of the '114 patent. Thus, we institute an *inter partes* review on all challenged claims and on all grounds presented.

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that an *inter partes* review is instituted on each of the grounds asserted in the Petition; and

FURTHER ORDERED that, pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4, notice is hereby given of the institution of a trial, which shall commence on the entry date of this decision.

FOR PETITIONER:
Brian Oaks
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For PATENT OWNER:
Hamad Hamad
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AO 120 (Rev. 08/10)

TO:	Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court District of Delaware on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
	7/17/2019	District of Delaware

PLAINTIFF	DEFENDANT
Midwest Energy Emissions Corp. and MES Inc.	Vistra Energy Corp., et al.

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	US 10,343,114 B2	7/9/2019	Midwest Energy Emissions Corp.
2	US 8,168,147 B2	5/1/2012	Midwest Energy Emissions Corp.
3			
4			
5			

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
2		
3		
4		
5		

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

Copy 1—Upon initiation of action, mail this copy to Director Copy 3—Upon termination of action, mail this copy to Director
Copy 2—Upon filing document adding patent(s), mail this copy to Director Copy 4—Case file copy

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UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/978,760	07/09/2019	10343114	4820.007US4	6432

21186 7590 06/19/2019

SCHWEGMAN LUNDBERG & WOESSNER, P.A.
P.O. BOX 2938
MINNEAPOLIS, MN 55402

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

Edwin S. Olson, Grand Forks, ND;
Midwest Energy Emissions Corp, Lewis Center, OH;
Michael J. Holmes, Thompson, ND;
John H. Pavlish, East Grand Forks, MN;

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit SelectUSA.gov.

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Substitute for form 1449A/PTO **INFORMATION DISCLOSURE STATEMENT BY APPLICANT** (Use as many sheets as necessary)	*Complete if Known*	
	Application Number	15/978,760
	Filing Date	May 14, 2018
	First Named Inventor	Edwin S. Olson
	Group Art Unit	Unknown
	Examiner Name	Unknown
Sheet 5 of 19	Attorney Docket No: 4820.007US4	

US PATENT DOCUMENTS

Examiner Initial *	USP Document Number	Publication Date	Name of Patentee or Applicant of cited Document
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	US-7,767,174	8/3/2010	Lui, K., et al.
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	US-8,168,147	5/1/2012	Olson, Edwin S, et al.
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	US-9,011,805	4/21/2015	Olson, Edwin S, et al.
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	US-9,757,689	9/12/2017	Olson, Edwin S, et al.

Change(s) applied to document, /N.W.S./ 5/15/2019

FOREIGN PATENT DOCUMENTS

Examiner Initial *	Foreign Document Number	Publication Date	Name of Patentee or Applicant of cited Document	T1
	CA-1099490A	4/21/1981	DeJong, Geert, et al.	
	CA-2150529A1	12/29/1995	Scherer, Volker, et al.	
	CA-2327602A1	6/6/2001	Robles, Antonio	
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EXAMINER /AMBER R ORLANDO/ **DATE CONSIDERED** 06/24/2018

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/978,760	05/14/2018	Edwin S. Olson	4820.007US4	6432

21186 7590 05/30/2019
SCHWEGMAN LUNDBERG & WOESSNER, P.A.
P.O. BOX 2938
MINNEAPOLIS, MN 55402

EXAMINER
ORLANDO, AMBER ROSE

ART UNIT	PAPER NUMBER
1776	

NOTIFICATION DATE	DELIVERY MODE
05/30/2019	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

SLW@blackhillsip.com
uspto@slwip.com

PTOL-90A (Rev. 04/07)

Notice of Allowability	Application No. 15/978,760	Applicant(s) Olson et al.	
	Examiner AMBER R ORLANDO	Art Unit 1776	AIA (FITF) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to the IDS having an incorrect doc number.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 2-19 and 22-33 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information , please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some *c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file areply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☑ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/AMBER R ORLANDO/
Primary Examiner, Art Unit 1776

Applicant-Initiated Interview Summary	Application No. 15/978,760	Applicant(s) Olson et al.		
	Examiner AMBER R ORLANDO	Art Unit 1776	AIA (First Inventor to File) Status No	Page 1 of 1

All participants (applicant, applicants representative, PTO personnel):

1. AMBER R ORLANDO (Primary Examiner); Telephonic 2. Nicholas Lanzatell (Attorney); Telephonic

Date of Interview: 24 May 2019

Issues Discussed:

Formalities:
The IDS submitted had an invalid number. The applicant's representative stated that it should be US2002150516. Examiner amendment to correct this was authorized.

/AMBER R ORLANDO/ Primary Examiner, Art Unit 1776	

Applicant is reminded that a complete written statement as to the substance of the interview must be made of record in the application file. It is the applicants responsibility to provide the written statement, unless the interview was initiated by the Examiner and the Examiner has indicated that a written summary will be provided. See MPEP 713.04
Please further see:
MPEP 713.04
Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews, paragraph (b)
37 CFR § 1.2 Business to be transacted in writing

Applicant recordation instructions: The formal written reply to the last Office action must include the substance of the interview. (See MPEP section 713.04). If a reply to the last Office action has already been filed, applicant is given a non-extendable period of the longer of one month or thirty days from this interview date, or the mailing date of this interview summary form, whichever is later, to file a statement of the substance of the interview.

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 1 of 19

Complete if Known	
Application Number	15/978,760
Filing Date	May 14, 2018
First Named Inventor	Edwin S. Olson
Group Art Unit	Unknown
Examiner Name	Unknown
Attorney Docket No: 4820.007US4	

US PATENT DOCUMENTS

Examiner Initial *	USP Document Number	Publication Date	Name of Patentee or Applicant of cited Document
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	US-20030136509A1	7/24/2003	Virtanen, Jorma
	US-20030206843A1	11/6/2003	Sidney Jr, Nelson G
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	US-20060048646A1	3/9/2006	Olson, Edwin S, et al.
	US-20060057044A1	3/16/2006	Chang, Shih-ger, et al.
	US-20060112823A1	6/1/2006	Avina, David Christopher
	US-20060191835A1	8/31/2006	Petrik, Viktor I, et al.
	US-20060204418A1	9/14/2006	Chao, Chien-chung, et al.
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	US-20070234902A1	10/11/2007	Fair, David L, et al.
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	US-20080182747A1	7/31/2008	Sinha, R. K.
	US-20080207443A1	8/28/2008	Gadkaree, Kishor Purushottam, et al.
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EXAMINER /AMBER R ORLANDO/ DATE CONSIDERED 06/24/2018 05/24/2019

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Sheet 2 of 19

Complete if Known	
Application Number	15/978,760
Filing Date	May 14, 2018
First Named Inventor	Edwin S. Olson
Group Art Unit	Unknown
Examiner Name	Unknown
Attorney Docket No: 4820.007US4	

US PATENT DOCUMENTS

Examiner Initial *	USP Document Number	Publication Date	Name of Patentee or Applicant of cited Document
	US-20090031708A1	2/5/2009	Schmidt, Darren D.
	US-20090062119A1	3/5/2009	Olson, Edwin S., et al.
	US-20090081092A1	3/26/2009	Yang, Xiaolin David, et al.
	US-20090136401A1	5/28/2009	Yang, Xiaolin David, et al.
	US-20090235848A1	9/24/2009	Eiteneer, Boris Nikolaevich, et al.
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	US-20100024642A1	2/4/2010	Fukumoto, Kazuhiro, et al.
	US-20100047146A1	2/25/2010	Olson, Edwin S., et al.
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	US-20140056787A1	2/27/2014	Olson, Edwin S, et al.
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	US-20170239644A1	8/24/2017	Olson, Edwin S, et al.
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	US-2,456,272A1	2/7/2002	Pahlman, John, et al.
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	US-4,338,896	7/13/1982	Papasideris, Stamos I.

EXAMINER /AMBER R ORLANDO/ **DATE CONSIDERED** 06/24/2018 05/24/2019

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	US-4,500,327	2/19/1985	Nishino, Hirosh, et al.
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	First Named Inventor	Edwin S. Olson
	Group Art Unit	Unknown
	Examiner Name	Unknown
Sheet 4 of 19	Attorney Docket No: 4820.007US4	

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	Group Art Unit	Unknown
	Examiner Name	Unknown
Sheet 5 of 19	Attorney Docket No: 4820.007US4	

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Sheet 6 of 19	Attorney Docket No: 4820.007US4	

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	Group Art Unit	Unknown
	Examiner Name	Unknown
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	"Application Serial No. 13/966,768, Supplemental Preliminary Amendment filed 08-15-13", 6 pgs.	
	"Application Serial No. 14/102,896, Advisory Action mailed 12-16-15", 3 pgs	
	"Application Serial No. 14/102,896, Final Office Action mailed 08-26-15", 12 pgs	
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	"Application Serial No. 14/102,896, Notice of Allowance mailed 06-10-16", 7 pgs	
	"Application Serial No. 14/102,896, Response filed 01-22-16 to Advisory Action mailed 12-16-15", 11 pgs	
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	"Application Serial No. 14/195,360, Corrected Notice of Allowance mailed 02-27-17", 2 pgs	
	"Application Serial No. 14/195,360, Corrected Notice of Allowance mailed 03-29-17", 2 pgs	
	"Application Serial No. 14/195,360, Final Office Action mailed 03-18-16", 18 pgs	
	"Application Serial No. 14/195,360, Final Office Action mailed 11-22-16", 7 pgs	

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Substitute for form 1449A/PTO **INFORMATION DISCLOSURE STATEMENT BY APPLICANT** (Use as many sheets as necessary)	*Complete if Known*	
	Application Number	15/978,760
	Filing Date	May 14, 2018
	First Named Inventor	Edwin S. Olson
	Group Art Unit	Unknown
	Examiner Name	Unknown
Sheet 10 of 19	Attorney Docket No: 4820.007US4	

OTHER DOCUMENTS – NON PATENT LITERATURE DOCUMENTS		
Examiner Initial *	**Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.**	**T1**
	"Application Serial No. 14/195,360, Non Final Office Action mailed 06-20-16", 11 pgs	
	"Application Serial No. 14/195,360, Non Final Office Action mailed 06-20-16", 11 pgs	
	"Application Serial No. 14/195,360, Non Final Office Action mailed 11-24-15", 19 pgs	
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	"Application Serial No. 14/195,360, Response filed 01-18-17 to Final Office Action mailed 11-22-16", 7 pgs.	
	"Application Serial No. 14/195,360, Response filed 02-22-16 to Non Final Office Action mailed 11-24-15", 21 pgs.	
	"Application Serial No. 14/195,360, Response filed 05-17-16 to Final Office Action mailed 03-18-16", 15 pgs	
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	"Application Serial No. 14/318,270, Corrected Notice of Allowance mailed 05-22-17", 2 pgs	
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	"Application Serial No. 14/564,860, Preliminary Amendment filed 12-10-14", 8 pgs	
	"Application Serial No. 14/564,860, Preliminary Amendment filed 12-10-14", 6 pgs.	
	"Application Serial No. 14/564,860, Response filed 05-06-16 to Restriction Requirement mailed 03-16-16", 9 pgs.	
	"Application Serial No. 14/564,860, Response filed 10-03-16 to Non Final Office Action mailed 07-12-16", 11 pgs	
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	"Application Serial No. 14/712,558, Examiner Interview Summary mailed 03-05-18", 3 pgs	
	"Application Serial No. 14/712,558, Final Office Action mailed 12-06-17", 9 pgs	
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	Group Art Unit	Unknown
	Examiner Name	Unknown
Sheet 11 of 19	Attorney Docket No: 4820.007US4	

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	"Application Serial No. 14/712,558, Response filed 01-23-18 to Final Office Action mailed 12-06-17", 13 pgs	
	"Application Serial No. 14/712,558, Response filed 04-02-18 to Final Office Action mailed 12-06-17", 7 pgs.	
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	"Application Serial No. 14/712,558, Supplemental Amendment Filed 5-15-2018", 6 pgs.	
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	"Application Serial No. 15/449,112, Final Office Action mailed 02-15-18", 13 pgs	
	"Application Serial No. 15/449,112, Non Final Office Action mailed 09-27-17", 17 pgs	
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	"Canadian Application Serial No. 2,584,327, Response filed 09-02-09 to Office Action mailed 03-03-09", 21 pgs	
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	"Canadian Application Serial No. 2,871,422, Office Action mailed 08-31-17", 4 pgs	
	"Canadian Application Serial No. 2,871,422, Office Action mailed 09-09-15", 3 pgs	
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	"Canadian Application Serial No. 2,871,422, Response filed 02-26-18 to Office Action mailed 08-31-17", w/ Amended Claims, 53 pgs	
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	"Canadian Application Serial No. 2,871,422, Response filed 08-28-15 to Canadian Office Action mailed 04-02-15", 22 pgs	
	"Chinese Application Serial No. 200480017704.4, Office Action mailed 12-08-11", (w/ English Translation), 6 pgs	
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	"Chinese Application Serial No. 200580037037.0, Chinese Office Action, dated June 25, 2013 (and English translation)", no english translation, 46 pgs	
	"Chinese Application Serial No. 201380033231.6, Office Action mailed 09-21-15", w/ Partial English Translation, 6 pgs	
	"Chinese Application Serial No. 201380033231.6, Response filed 01-14-16 to Office Action mailed 09-21-15", w/English Claims, 7 pgs	
	"Chinese Application Serial No. 201480025701.9, Office Action mailed 01-16-18", (English Translation), 8 pgs	
	"Chinese Application Serial No. 201480025701.9, Office Action mailed 07-12-17", W/ English Translation, 8 pgs	
	"Chinese Application Serial No. 201480025701.9, Office Action mailed 07-25-16", (With English Translation), 4 pgs	
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	"Chinese Application Serial No. 201480025701.9, Office Action mailed 12-23-16", 24 pgs.	
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	"DARCO® FGD- Powdered Activated Carbon", Norit Americas Inc. Datasheet No. 1100, (May 2009), 1 pg	
	"DATABASE WPI Week 197450", Thomson Scientific, London, GB; AN 1974-86199V XP002514926	
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	"European Application Serial No. 05814011.2, Decision to grant mailed 06-08-12", 2 pgs	
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	"European Application Serial No. 05814011.2, Office Action mailed 04-27-12", 6 pgs	
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	"European Application Serial No. 05814011.2, Partial European Search Report mailed 04-14-09", 13 pgs.	
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	"European Application Serial No. 05814011.2, Response filed 05-11-10 to Communication Pursuant to Article 94(3) EPC mailed 11-05-09", 11 pgs	
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	"European Application Serial No. 10767465.7, Extended European Search Report mailed 12-06-12", 5 pgs	

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	"European Application Serial No. 10767465.7, Intention to Grant mailed 03-17-14", 44 pgs	
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	"European Application Serial No. 10767465.7, Response filed 02-03-14 to Intention to Grant mailed 09-30-13", 11 pgs	
	"European Application Serial No. 10767465.7, Response filed 06-20-13 to Extended European Search Report mailed 12-06-12", 18 pgs	
	"European Application Serial No. 11189249.3, Communication Pursuant to Article 94(3) EPC mailed 11-26-12", 4 pgs	
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	"European Application Serial No. 11189252.7, Decision to grant mailed 05-02-14", 2 pgs	
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	"European Application Serial No. 11189252.7, Extended European Search Report mailed 05-09-12", 12 pgs	
	"European Application Serial No. 11189252.7, Office Action mailed 10-30-13", 4 pgs	
	"European Application Serial No. 11189252.7, Office Action mailed 12-11-13", 6 pgs	
	"European Application Serial No. 11189252.7, Response filed 02-11-13 to Communication Pursuant to Article 94(3) EPC mailed 01-09-13", 5 pgs	
	"European Application Serial No. 11189252.7, Response filed 10-10-13 to Office Action mailed 04-15-13", 18 pgs	
	"European Application Serial No. 11189252.7, Response filed 11-22-12 to Extended European Search Report mailed 05-09-12", 13 pgs	
	"European Application Serial No. 11189252.7, Summons to Attend Oral Proceedings mailed 04-15-13", 6 pgs	
	"European Application Serial No. 13719338.9, Notification Regarding Rule 164 and Article 94(3) EPC mailed 04-24-17", 8 pgs	
	"European Application Serial No. 13719338.9, Office Action mailed 05-12-17", 6 pgs	
	"European Application Serial No. 13719338.9, Office Action mailed 12-19-14", 2 pgs.	

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	"European Application Serial No. 14711106.6, Communication Pursuant to Article 94(3) EPC mailed 02-22-17", 6 pgs	
	"European Application Serial No. 14711106.6, Response filed 08-17-17 to Communication Pursuant to Article 94(3) EPC mailed 02-22-17", 10 pgs	
	"International Application No. PCT/US2008/071986, International Search Report mailed 01-30-09", 3 pgs	
	"International Application Serial No. PCT/US2005/030018, International Preliminary Report on Patentability mailed 12-27-06", 3 pgs	
	"International Application Serial No. PCT/US2005/030018, International Search Report mailed 07-25-06", 2 pgs	
	"International Application Serial No. PCT/US2005/030018, Written Opinion mailed 07-25-06", 3 pgs	
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	"International Application Serial No. PCT/US2010/022807, International Search Report mailed 09-13-10", 3 pgs	
	"International Application Serial No. PCT/US2010/022807, Written Opinion mailed 09-13-10", 4 pgs	
	"International Application Serial No. PCT/US2013/036964, International Preliminary Report on Patentability mailed 07-17-14", 11 pgs	
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	"International Application Serial No. PCT/US2013/036964, Invitation to Pay Additional Fees and Partial Search Report mailed 08-02-13", 7 pgs	
	"International Application Serial No. PCT/US2013/036964, Written Opinion mailed 04-15-14", 10 pgs	
	"International Application Serial No. PCT/US2013/036964, Written Opinion mailed 11-29-13", 13 pgs	
	"International Application Serial No. PCT/US2014/019916, International Search Report mailed 10-13-14", 6 pgs.	
	"International Application Serial No. PCT/US2014/019916, Invitation to Pay Additional Fees and Partial Search Report mailed 05-30-14", 6 pgs	
	"International Application Serial No. PCT/US2014/019916, Written Opinion mailed 10-13-14", 13 pgs.	
	"Powdered Activated Carbon", Cabot Corp, [Online] retrieved from the internet: <http://www.cabotcorp.com/solutions/products-plus/activated-carbon/powdered>, (01/03/15), 3 pgs	

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	"Response filed 09-04-17 to Notification Regarding Rule 164 and Article 94(3) EPC mailed 04-24-17", 7 pgs	
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EXAMINER /AMBER R ORLANDO/ **DATE CONSIDERED** 06/24/2018 05/24/2019

* EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. 1 Applicant is to place a check mark here if English language Translation is attached

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Modified form PTO/SB/08A(04-07) OMB 651-0031
US Patent & Trademark Office: U.S. DEPARTMENT OF COMMERCE
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Substitute for form 1449A/PTO **INFORMATION DISCLOSURE STATEMENT BY APPLICANT** (Use as many sheets as necessary)	*Complete if Known*	
	Application Number	15/978,760
	Filing Date	May 14, 2018
	First Named Inventor	Edwin S. Olson
	Group Art Unit	Unknown
	Examiner Name	Unknown
Sheet 17 of 19	Attorney Docket No: 4820.007US4	

OTHER DOCUMENTS – NON PATENT LITERATURE DOCUMENTS

Examiner Initial *	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T1
	GOMEZ-AVILES, A., et al., "Multifunctional materials based on graphene-like/sepiolite nanocomposites", Applied Clay Science, 47, (2010), 203-211	
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EXAMINER /AMBER R ORLANDO/ **DATE CONSIDERED** 06/24/2018 05/24/2019

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	Filing Date	May 14, 2018
	First Named Inventor	Edwin S. Olson
	Group Art Unit	Unknown
	Examiner Name	Unknown
Sheet 18 of 19	Attorney Docket No: 4820.007US4	

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Examiner Initial *	**Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.**	**T1**
	OLSON, EDWIN S., et al., "Surface Compositions of Carbon Sorbents Exposed to Simulated Low-Rank Coal Flue Gases", J. Air & Water Waste Manage. Assoc., 55, (2005), 747-754	
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	Filing Date	May 14, 2018
	First Named Inventor	Edwin S. Olson
	Group Art Unit	Unknown
	Examiner Name	Unknown
Sheet 19 of 19	Attorney Docket No: 4820.007US4	

OTHER DOCUMENTS – NON PATENT LITERATURE DOCUMENTS		
Examiner Initial *	**Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.**	**T1**
	ZHENG, YUANJING, et al., "Review of technologies for mercury removal from flue gas from cement production processes", Progress in Energy and Combustion Science, Vol. 38, No. 5, (26 April 2012), 599-629	
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EXAMINER /AMBER R ORLANDO/ **DATE CONSIDERED** 06/24/2018 05/24/2019

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s):	Edwin S. Olson et al.	Examiner:	Amber Orlando
Serial No.:	15/978,760	Group Art Unit:	1776
Filed:	May 14, 2018	Docket No.:	4820.007US4
Customer No..	21186	Confirmation No..	6432
Title:	SORBENTS FOR THE OXIDATION AND REMOVAL OF MERCURY		

COMMUNICATION RE: FEE ADDRESS

Mail Stop Issue Fee
Commissioner for Patents
P.O.Box 1450
Alexandria, VA 22313-1450

In response to the Notice of Allowance and Issue Fee Due, please record the Fee Address under the provisions of 37 CFR 1.363 as the following:

Customer Number 21186

Please direct any inquiries to the undersigned attorney at (612) 349-9580.

Respectfully submitted,

SCHWEGMAN LUNDBERG & WOESSNER, P.A.
P.O. Box 2938
Minneapolis, MN 55402
(612) 349-9580

Date May 8, 2019

By /Nicholas P. Lanzatella/
Nicholas P. Lanzatella
Reg. No. 63,803

NPL:CMG:deb

CERTIFICATE UNDER 37 CFR 1.8: The undersigned hereby certifies that this correspondence is filed using the USPTO's electronic filing system EFS-Web, and is addressed to: Mail Stop Issue Fee, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on this 8th day of May, 2019.

Debra E. Bartell
Name

/ Debra E. Bartell /
Signature

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(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/978,760	05/14/2018	Edward S. Olson	4829.007USN	6432

TITLE OF INVENTION: SORBENTS FOR THE OXIDATION AND REMOVAL OF MERCURY

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1000	$0.00	$0.00	$1000	08/08/2019

EXAMINER	ART UNIT	CLASS-SUBCLASS
ORLANDO, AMBER ROSE	1776	095-141.000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

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2 Woessner, P.A.
3

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Midwest Energy Emissions Corp | Lewis Center, Ohio

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5. **Change in Entity Status** (from status indicated above)

☐ Applicant certifying micro entity status. See 37 CFR 1.29

☐ Applicant asserting small entity status. See 37 CFR 1.27

☐ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
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Authorized Signature [signature] Date May 8, 2019

Typed or printed name Nicholas P. Lanzatella Registration No. 63,803

PTOL-85 Part B (08-18) Approved for use through 01/31/2020 OMB 0651-0033 U.S. Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s): Edwin S. Olson et al.
Title: SORBENTS FOR THE OXIDATION AND REMOVAL OF MERCURY

Docket No.:	4820.007US4	Serial No.:	15/978,760
Filed:	May 14, 2018	Due Date:	August 8, 2019
Examiner:	Amber Orlando	Group Art Unit:	1776
Customer No.:	21186	Confirmation No.:	6432

Notice of Allowance Date: May 8, 2019

Mail Stop Issue Fee
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Customer No.: 21186
NPL:CMG:deb

By /Nicholas P. Lanzatella/
Nicholas P. Lanzatella
Reg. No. 63,803

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Debra E. Bartell
Name

/ Debra E. Bartell /
Signature

Electronic Patent Application Fee Transmittal

Application Number:	15978760
Filing Date:	14-May-2018
Title of Invention:	SORBENTS FOR THE OXIDATION AND REMOVAL OF MERCURY
First Named Inventor/Applicant Name:	Edwin S. Olson
Filer:	Nathan D. Ellefson/Debra Bartell
Attorney Docket Number:	4820.007US4

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
UTILITY APPL ISSUE FEE	1501	1	1000	1000

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**1000**

Electronic Acknowledgement Receipt	
EFS ID:	35953965
Application Number:	15978760
International Application Number:	
Confirmation Number:	6432
Title of Invention:	SORBENTS FOR THE OXIDATION AND REMOVAL OF MERCURY
First Named Inventor/Applicant Name:	Edwin S. Olson
Customer Number:	21186
Filer:	Nathan D. Ellefson/Debra Bartell
Filer Authorized By:	Nathan D. Ellefson
Attorney Docket Number:	4820.007US4
Receipt Date:	08-MAY-2019
Filing Date:	14-MAY-2018
Time Stamp:	14:22:36
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$1000
RAM confirmation Number	050919INTEFSW00000554190743
Deposit Account	190743
Authorized User	Debra Bartell
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	Multipart Description/PDF files in .zip description		
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New Applications Under 35 U.S.C. 111

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National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

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NOTICE OF ALLOWANCE AND FEE(S) DUE

21186 7590 05/08/2019
SCHWEGMAN LUNDBERG & WOESSNER, P.A.
P.O. BOX 2938
MINNEAPOLIS, MN 55402

EXAMINER	
ORLANDO, AMBER ROSE	
ART UNIT	PAPER NUMBER
1776	

DATE MAILED: 05/08/2019

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/978,760	05/14/2018	Edwin S. Olson	4820.007US4	6432

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APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1000	$0.00	$0.00	$1000	08/08/2019

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PTOL-85 (Rev. 02/11)

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

21186 7590 05/08/2019
SCHWEGMAN LUNDBERG & WOESSNER, P.A.
P.O. BOX 2938
MINNEAPOLIS, MN 55402

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/978,760	05/14/2018	Edwin S. Olson	4820.007US4	6432

TITLE OF INVENTION: SORBENTS FOR THE OXIDATION AND REMOVAL OF MERCURY

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1000	$0.00	$0.00	$1000	08/08/2019

EXAMINER	ART UNIT	CLASS-SUBCLASS
ORLANDO, AMBER ROSE	1776	095-142000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1_____
2_____
3_____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑Issue Fee ❑Publication Fee (if required) ❑Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

PAC ET AL. EXHIBIT 1026
Page 143

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/978,760	05/14/2018	Edwin S. Olson	4820.007US4	6432

21186 7590 05/08/2019

SCHWEGMAN LUNDBERG & WOESSNER, P.A.
P.O. BOX 2938
MINNEAPOLIS, MN 55402

EXAMINER	
ORLANDO, AMBER ROSE	
ART UNIT	**PAPER NUMBER**
1776	

DATE MAILED: 05/08/2019

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

PTOL-85 (Rev. 02/11)

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 15/978,760	Applicant(s) Olson et al.	
	Examiner AMBER R ORLANDO	Art Unit 1776	AIA (FITF) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to the correspondence filed 04/24/2019.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 2-19 and 22-33 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information , please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some *c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file areply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☑ Examiner's Amendment/Comment
6. ☑ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/AMBER R ORLANDO/
Primary Examiner, Art Unit 1776

DETAILED ACTION

Notice of Pre-AIA or AIA Status

The present application is being examined under the pre-AIA first to invent provisions.

Terminal Disclaimer

The terminal disclaimer filed on 04/23/2019 disclaiming the terminal portion of any patent granted on this application which would extend beyond the expiration date of **7,435,286, 8,168,147, 8,512,655, 8,821,819, 8,652,235, 9,468,886, 14/721,558, 15/382,114, 15/859,359, 15/295,594, 15/951,970** has been reviewed and is accepted. The terminal disclaimer has been recorded.

Allowable Subject Matter

Claims 2-19 and 22-33 are allowed.

Reasons for allowance provided in the office action mailed 04/19/2019.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to AMBER ROSE ORLANDO whose telephone number is (571)270-3149. The examiner can normally be reached on Monday-Thursday 7:00-5:30.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Duane Smith can be reached on (571)272-1166. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

AMBER ROSE. ORLANDO
Primary Examiner
Art Unit 1776

/AMBER R ORLANDO/
Primary Examiner, Art Unit 1776

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/978,760	Olson et al.
	Examiner	**Art Unit**
	AMBER R ORLANDO	1776

CPC								
Symbol							**Type**	**Version**
B01D	/	53	/	64			F	2013-01-01
B01J	/	20	/	3416			I	2013-01-01
B01J	/	20	/	223			I	2013-01-01
B01J	/	20	/	28004			I	2013-01-01
B01J	/	20	/	20			I	2013-01-01
B01J	/	20	/	12			I	2013-01-01
B01J	/	20	/	106			I	2013-01-01
B01J	/	20	/	10			I	2013-01-01
B01J	/	20	/	043			I	2013-01-01
B01J	/	20	/	041			I	2013-01-01
B01J	/	20	/	04			I	2013-01-01
B01J	/	20	/	027			I	2013-01-01
B01J	/	20	/	0262			I	2013-01-01
B01D	/	53	/	10			I	2013-01-01
B01D	/	53	/	346			I	2013-01-01
B01D	/	53	/	83			I	2013-01-01
B01D	/	53	/	96			I	2013-01-01
B01J	/	2220	/	42			A	2013-01-01
B01D	/	2257	/	602			A	2013-01-01
B01D	/	2253	/	102			A	2013-01-01
B01D	/	2251	/	108			A	2013-01-01
B01D	/	2258	/	0283			A	2013-01-01
B01D	/	2259	/	128			A	2013-01-01

CPC Combination Sets								
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	30	
/AMBER R ORLANDO/ Primary Examiner, Art Unit 1776	02 May 2019	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	2	5A

U.S. Patent and Trademark Office — Part of Paper No.: 20190503

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/978,760	Olson et al.
	Examiner	**Art Unit**
	AMBER R ORLANDO	1776

INTERNATIONAL CLASSIFICATION				
CLAIMED				
B01D	A	53	F	64
B01J	A	20	F	34
B01J	C	20	F	22
B01J	C	20	F	28
B01J	A	20	C	20
B01J	A	20	F	12
B01J	C	20	F	10
B01J	A	20	F	04
B01J	C	20	F	02
B01D	C	53	C	34
B01D	A	53	C	83
B01D	C	53	F	96
	F		F	

NON-CLAIMED				
	F		F	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	30	
/AMBER R ORLANDO/ Primary Examiner, Art Unit 1776	02 May 2019	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	2	5A

U.S. Patent and Trademark Office — Part of Paper No.: 20190503

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/978,760	Olson et al.
	Examiner	Art Unit
	AMBER R ORLANDO	1776

☑ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	30	
/AMBER R ORLANDO/ Primary Examiner, Art Unit 1776	02 May 2019	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	2	5A

U.S. Patent and Trademark Office — Part of Paper No.: 20190503

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/978,760	Olson et al.
	Examiner	Art Unit
	AMBER R ORLANDO	1776

CPC - Searched*		
Symbol	Date	Examiner

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
IDS Search (EAST and DAV)	06/24/2018	AO
Inventor Search (DAV)	06/24/2018	AO
EAST searched for inflight promotion of sorbents.	06/24/2018	AO
EAST searched for inflight promotion of sorbents.	10/04/2018	AO
EAST searched for inflight promotion of sorbents.	12/19/2018	AO
EAST searched for inflight promotion of sorbents.	04/15/2019	AO

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
	SEE EAST SEARCH HISTORY	05/03/2019	AO

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	45	(95/134.ccls. or 95/142.ccls. or 110/345.ccls. or 423/210.ccls.) and activated carbon and promoter	US-PGPUB; USPAT	ADJ	ON	2013/09/09 09:19
S2	0	(95/134.ccls. or 95/142.ccls. or 110/345.ccls. or 423/210.ccls.) and sorben and promoter and activated carbond and mercury	US-PGPUB; USPAT	ADJ	ON	2013/09/09 09:19
S3	0	(95/134.ccls. or 95/142.ccls. or 110/345.ccls. or 423/210.ccls.) and sorbent and promoter and activated carbond and mercury	US-PGPUB; USPAT	ADJ	ON	2013/09/09 09:20
S7	73	("20020150516" | "4786483" | "5409522" | "5505766" | "6383981" | "6878358" | "20020033097" | "4530765" | "5346674" | "6080281" | "4708853" | "6027551" | "6136072" | "6258334" | "6818043" | "20060057044" | "20080207443" | "20010002387" | "3826618" | "4814152" | "4820318" | "4889698" | "5891324" | "6528030" | "20050227146" | "5419834" | "7942566" | "20080134888" | "3662523" | "3849267" | "4196173" | "4500327" | "6942840" | "20020134242" | "20030136509" | "20050147549" | "20060112823" | "20080134888" | "6471936" | "20010003116" | "20050019240" | "20060048646" | "4956162" | "5575982" | "6372187" | "6375909" | "7435286" | "7514052" | "20050074380" | "20090081092" | "5288306" | "1984164" | "4101631" | "5695726" | "6080281" | "6848374" | "20050000197" | "5300137" | "5607496" | "5672323" | "6214304" | "6953494" | "5245120" | "20070168213" | "7938571" | "20040003716" | "20040013589" | "3194629" | "3786619" | "5827352" | "20040109800" | "20070295347" | "5435980" | "6136749" | "20030206846").PN.	US-PGPUB; USPAT	ADJ	ON	2015/03/17 12:25
S8	13	"11209163"	US-PGPUB; USPAT	ADJ	ON	2015/03/17 12:28
S9	3	"11209163" and non carbon	US-PGPUB; USPAT	ADJ	ON	2015/03/17 12:28
S10	161	(B01D53/64, B01D2257/602, B01D2253/104, B01D2253/10, B01D53/10).cpc. and (halogen or halide of HBr) with sorbent	US-PGPUB; USPAT	ADJ	ON	2015/03/17 13:49
S11	0	(95/134.ccls. or 95/142.ccls. or 110/345.ccls. or 423/210.ccls.) and	US-PGPUB; USPAT	ADJ	ON	2015/03/17 13:50

		sorbent and promoter and activated carbond and mercury				
S12	116	(95/134.ccls. or 95/142.ccls. or 110/345.ccls. or 423/210.ccls.) and (halogen or halide of HBr) with sorbent	US-PGPUB; USPAT	ADJ	ON	2015/03/17 13:50
S13	172	(B01D53/64. B01D2257/602, B01D2253/104, B01D2253/10, B01D53/10).cpc. and (halogen or halide of HBr) with sorbent	US-PGPUB; USPAT	ADJ	ON	2015/08/20 22:04
S14	67	(95/134.ccls. or 95/142.ccls. or 110/345.ccls. or 423/210.ccls.) and activated carbon and promoter	US-PGPUB; USPAT	ADJ	ON	2015/08/20 22:04
S15	67	"6136749"	US-PGPUB; USPAT	ADJ	ON	2016/05/27 09:11
S16	20	"684374"	US-PGPUB; USPAT	ADJ	ON	2016/05/27 09:12
S17	1	"20040003716"	US-PGPUB; USPAT	ADJ	ON	2016/05/27 09:12
S18	68	"6848374"	US-PGPUB; USPAT	ADJ	ON	2016/05/27 09:12
S19	41	"7435286"	US-PGPUB; USPAT	ADJ	ON	2016/05/27 09:13
S20	13	"8168147"	US-PGPUB; USPAT	ADJ	ON	2016/05/27 09:13
S21	69	(95/134.ccls. or 95/142.ccls. or 110/345.ccls. or 423/210.ccls.) and activated carbon and promoter	US-PGPUB; USPAT	ADJ	ON	2016/06/07 09:06
S22	181	(B01D53/64, B01D2257/602, B01D2253/104, B01D2253/10, B01D53/10).cpc. and (halogen or halide of HBr) with sorbent	US-PGPUB; USPAT	ADJ	ON	2016/06/07 09:06
S25	28	"5266280"	US-PGPUB; USPAT	ADJ	ON	2016/06/07 13:41
S26	281	sorbent with mercury and (diameter or size) with ("30" or "40" or "50" or "60" or "70") with (sorbent or carbon)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/09/29 15:01
S27	148	sorbent with mercury and (diameter or size) with ("30" or "40" or "50" or "60" or "70") with (sorbent or carbon) and halogen	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/09/29 15:02
S28	159	sorbent with mercury and (diameter or size) with ("30" or "40" or "50" or "60" or "70") with (sorbent or carbon) and halogen$4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/09/29 16:18
S29	206	(sorbent or activated carbon) with mercury and (diameter or size) with ("30" or "40" or "50" or "60" or "70") with (sorbent or carbon) and halogen$4 and	US-PGPUB; USPAT; USOCR; FPRS;	ADJ	ON	2016/09/29 16:22

		activated carbon	EPO; JPO; DERWENT; IBM_TDB			
S30	195	(B01D53/64. B01D2257/602, B01D2253/104, B01D2253/10, B01D53/10).cpc. and (halogen or halide of HBr) with sorbent	US-PGPUB; USPAT	ADJ	ON	2016/09/30 13:48
S33	6	"20040003719"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/11/16 10:56
S34	49	"2004003716"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/11/16 10:57
S35	81	"6848374"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/11/16 10:58
S36	56	"7435286"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/11/16 11:02
S37	7	olson.in. and ("40" microns).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/11/16 11:04
S38	0	("40" microns and halocarbon sorbent).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/11/16 11:05
S39	0	(halocarbon sorbent).clm. and "40" microns and olson.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/11/16 11:05
S40	65	"40" microns and olson.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	ADJ	ON	2016/11/16 11:06

			DERWENT; IBM_TDB			
S41	3907	("40" microns).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/11/16 11:06
S42	29	("40" microns and sorbent).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/11/16 11:06
S43	1	(halocarbon sorbent).clm. and olson.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/11/16 11:08
S44	36	(sorbent).clm. and olson.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/11/16 11:08
S45	0	(sorbent).clm. and olson.in. and "40" micron	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/11/16 11:08
S46	17	"11209163"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/11/16 11:09
S47	2	"20110233133"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/11/16 11:27
S48	7	"20110023427"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/11/16 11:28
S49	15	"2004025274"	US-PGPUB; USPAT; USOCR;	ADJ	ON	2016/11/16 11:32

			FPRS; EPO; JPO; DERWENT; IBM_TDB			
S50	11	"20040025274"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/11/16 11:32
S51	15	"2004025274"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/11/16 11:33
S52	40	"6312489"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/11/16 11:33
S53	30	("20030024872" | "20050045553" | "20050144916" | "4008060" | "4640779" | "4655921" | "4673503" | "4738778" | "4746432" | "4799944" | "5043000" | "5051118" | "5120296" | "5174896" | "5320657" | "5512075" | "5674302" | "6152979" | "6312489" | "6315130" | "6336946" | "6398836" | "6585793" | "6598749" | "7648546").PN. OR ("7931723").URPN.	US-PGPUB; USPAT; USOCR	ADJ	ON	2016/11/16 11:36
S54	33	("4200444" | "4640779" | "5968215" | "6059851").PN. OR ("6312489").URPN.	US-PGPUB; USPAT; USOCR	ADJ	ON	2016/11/16 11:40
S55	5	"8518142"	US-PGPUB; USPAT; USOCR	ADJ	ON	2016/11/16 11:54
S56	4	"8747505"	US-PGPUB; USPAT; USOCR	ADJ	ON	2016/11/16 11:57
S57	2	"14318270"	US-PGPUB; USPAT; USOCR	ADJ	ON	2016/11/16 12:06
S58	13	pac with size with sorbent	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/11/16 12:13
S59	197	(B01D53/64, B01D2257/602, B01D2253/104, B01D2253/10, B01D53/10).cpc. and (halogen or halide of HBr) with sorbent	US-PGPUB; USPAT	ADJ	ON	2016/11/16 15:23
S60	0	(B01D53/64, B01D2257/602, B01D2253/104, B01D2253/10.	US-PGPUB; USPAT	ADJ	ON	2016/11/17 12:39

		B01D53/10).cpc. and (halogen or halide of HBr) with sorbent "4198388"				
S61	10	"4198388"	US-PGPUB; USPAT	ADJ	ON	2016/11/17 12:39
S62	0	"2010083696"	US-PGPUB; USPAT	ADJ	ON	2016/11/17 13:32
S63	2	"20100083696"	US-PGPUB; USPAT	ADJ	ON	2016/11/17 13:32
S64	2	absorp$5 with mea with methanol with acid	US-PGPUB; USPAT	ADJ	ON	2016/11/17 13:36
S65	2	"20070283813"	US-PGPUB; USPAT	ADJ	ON	2016/11/17 13:39
S66	21	"4469596"	US-PGPUB; USPAT	ADJ	ON	2016/11/21 08:29
S67	4	"2003229245"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2017/05/10 10:36
S68	2	"20030229245"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2017/05/10 10:36
S69	45	"5,338,458"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2017/05/10 10:38
S70	45	"5338458"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2017/05/10 10:38
S71	213	(B01D53/64, B01D2257/602, B01D2253/104, B01D2253/10, B01D53/10).cpc. and (halogen or halide of HBr) with sorbent	US-PGPUB; USPAT	ADJ	ON	2017/05/10 11:02
S72	64	("1786483" | "1984164" | "2317857" | "20010002387" | "20010003116" | "20020134242" | "20020150516" | "20030136509" | "20040003716" | "20040013589" | "20050019240" | "20060048646" | "20060191835" | "20090062119" | "20100047146" | "20120183458" | "20140056787" | "3194629" | "3662523" | "3786619" | "3826618" | "3849267" | "4196173" | "4500327" | "4814152" | "4820318" | "4889698" | "4959162" | "5300137" | "5409522" | "5462908" | "5505766" | "5575982" | "5607496" | "5672323" |	US-PGPUB; USPAT	ADJ	ON	2017/05/10 11:20

		"5695726" | "5827352" | "5891324" | "6027551" | "6080281" | "6136072" | "6136749" | "6214304" | "6258334" | "6372187" | "6375909" | "6383981" | "6471936" | "6528030" | "6818043" | "6848374" | "6878358" | "6942840" | "6953494" | "7101631" | "7435286" | "7479263" | "7514052" | "7563311" | "7611564" | "8007749" | "8168147" | "8168149" | "8512655").PN.				
S73	3	("20090235848" | "20110076210" | "20150246315").PN.	US-PGPUB; USPAT	ADJ	ON	2017/05/10 11:31
S79	3	("20090235848" | "20110076210" | "20140224121").PN.	US-PGPUB; USPAT	ADJ	ON	2017/06/27 09:36
S80	96	("1984164" | "2317857" | "20010002387" | "20010003116" | "20020043496" | "20020134242" | "20020150516" | "20030104937" | "20030136509" | "20040003716" | "20040013589" | "20040076570" | "20050019240" | "20060048646" | "20060191835" | "20080182747" | "20080292512" | "20090062119" | "20090136401" | "20090320678" | "20100047146" | "20110168018" | "20120183458" | "20130280156" | "20140056787" | "20140255279" | "20140308188" | "20150098878" | "3194629" | "3662523" | "3786619" | "3826618" | "3849267" | "3876393" | "4094777" | "4101631" | "4196173" | "4338896" | "4500327" | "4708853" | "4786483" | "4814152" | "4820318" | "4889698" | "4956162" | "5300137" | "5336835" | "5409522" | "5462908" | "5505766" | "5575982" | "5607496" | "5672323" | "5695726" | "5827352" | "5891324" | "6027551" | "6080281" | "6136072" | "6136749" | "6214304" | "6258334" | "6372187" | "6375909" | "6383981" | "6471936" | "6528030" | "6638485" | "6808692" | "6818043" | "6848374" | "6878358" | "6942840" | "6953494" | "6960329" | "7081434" | "7211707" | "7435286" | "7479263" | "7514052" | "7521032" | "7544338" | "7563311" | "7611564" | "7622092" | "7722843" | "7767174" | "7780765" | "8007749" | "8168147" | "8168149" | "8216535" | "8512655" | "8652235" | "8821819" | "9011805").PN.	US-PGPUB; USPAT	ADJ	ON	2017/06/27 09:41
S81	593	honeycomb with plug$4 and plug$4 with length	US-PGPUB; USPAT	ADJ	ON	2017/06/27 14:45
S82	0	honeycomb with plug$4 and plug$4 with length with less than with "5"	US-PGPUB; USPAT	ADJ	ON	2017/06/27 14:45
S83	0	honeycomb with plug$4 and plug$4 with length with less than	US-PGPUB; USPAT	ADJ	ON	2017/06/27 14:45
S84	127	honeycomb with plug$4 and plug$4 with length with "5"	US-PGPUB; USPAT	ADJ	ON	2017/06/27 14:46
S85	241	honeycomb with plug$4 and plug$4 with length with mm	US-PGPUB; USPAT	ADJ	ON	2017/06/27 14:47
S86	41	honeycomb with plug$4 and plug$4 with	US-PGPUB;	ADJ	ON	2017/06/27

		length with "3 mm "	USPAT			14:49
S87	28	honeycomb with plug$4 and plug$4 with length with "3 mm " and plug$4 with porosity	US-PGPUB; USPAT	ADJ	ON	2017/06/27 14:52
S88	28	honeycomb and plug$4 with length with "3 mm " and plug$4 with porosity	US-PGPUB; USPAT	ADJ	ON	2017/06/27 14:53
S89	43	honeycomb and plug$4 with porosity with "100"	US-PGPUB; USPAT	ADJ	ON	2017/06/27 15:06
S90	20	honeycomb and plug$4 with pore (size or diameter) with "100"	US-PGPUB; USPAT	ADJ	ON	2017/06/27 15:07
S91	8	saw with honeycomb with filter	US-PGPUB; USPAT	ADJ	ON	2017/06/29 13:31
S92	230	(B01D53/64. B01D2257/602. B01D2253/104, B01D2253/10. B01D53/10).cpc. and (halogen or halide of HBr) with sorbent	US-PGPUB; USPAT	ADJ	ON	2017/12/01 14:36
S93	2	"20060260468"	US-PGPUB; USPAT	ADJ	ON	2018/07/03 10:34
S94	19	engine with air with inlet with filter$4 with cone	US-PGPUB; USPAT	ADJ	ON	2018/07/03 15:26
S95	36	engine with air with inlet with filter$4 with (cone or conical or (diameter with (increas$4 or decreas$4)))	US-PGPUB; USPAT	ADJ	ON	2018/07/03 15:27
S96	24	("3771638" | "3870495" | "3872012" | "4157902" | "4702754" | "5125940" | "5522909" | "5549724" | "5632793").PN. OR ("5888260").URPN.	US-PGPUB; USPAT; USOCR	ADJ	ON	2018/07/03 15:31
S97	41	("0153535" | "0439091" | "1398685" | "1530163" | "1887052" | "2087688" | "4003836" | "4018580" | "4032455" | "4039308" | "4065276" | "4261710" | "4410341" | "4414110" | "4699715" | "5106397" | "5178656" | "5522909" | "5549722" | "5549724" | "5888260" | "6397842" | "6508052" | "D401597" | "D401942" | "D403414" | "D403416").PN. OR ("6808552").URPN.	US-PGPUB; USPAT; USOCR	ADJ	ON	2018/07/03 15:31
S98	15	("D403416").URPN.	USPAT	ADJ	ON	2018/07/03 15:33
S99	0	"20030089233"	USPAT	ADJ	ON	2018/07/04 12:29
S100	3	"20030089233"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/07/04 12:29
S101	26	"6833023"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/07/04 12:29
S102	2	"20070168213"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/07/09 13:08
S103	14	carbocations with sorbent with bromine	US-PGPUB; USPAT;	ADJ	ON	2018/07/09 13:14

			USOCR; FPRS; EPO; JPO			
S104	0	a side forming a cross sectional shape of each of the first	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/07/09 13:47
S105	0	non of side forming	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/07/09 13:56
S106	0	none of side forming	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/07/09 13:56
S107	0	none of sides forming	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/07/09 13:56
S109	13	olson.in. and (alkali and promoter and earth).clm.	US-PGPUB; USPAT	ADJ	ON	2018/07/17 16:22
S110	0	olson.in. and (alkali and promoter and earth with vapor).clm.	US-PGPUB; USPAT	ADJ	ON	2018/07/17 16:22
S111	10	olson.in. and (alkali and promoter with vapor).clm.	US-PGPUB; USPAT	ADJ	ON	2018/07/17 16:22
S112	0	"2015008283"	US-PGPUB; USPAT	ADJ	ON	2018/07/23 06:26
S113	2	"20150082833"	US-PGPUB; USPAT	ADJ	ON	2018/07/23 06:26
S114	24	olson.in. and liquid.clm. and promoted	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/07/23 07:50
S115	75	remov$4 with mercury and (br or bromine) with liquid with carbon	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/07/23 07:54
S116	0	separating greater than "70" wt% of the mercury	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/07/23 09:17
S117	0	((separating greater) with (of the mercury)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/07/23 09:17
S118	20	"11209163"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/07/23 09:43

S119	40	(during with after with mercury with sorbent)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/01 17:38
S120	304	sorbent with mercury and sorbent with boiler	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/01 17:39
S121	2	"20070168213"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/01 17:41
S122	18	before with burn$4 with coal with sorbent	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/01 17:42
S123	204	("0174348" | "0202092" | "0208011" | "0224649" | "0229159" | "0298727" | "0346765" | "0347078" | "0367014" | "0537926" | "0537998" | "0541025" | "0625754" | "0647622" | "0685719" | "0688782" | "0700888" | "0744908" | "0846338" | "0894110" | "0896876" | "0911960" | "0945331" | "0945846" | "1112547" | "1167471" | "1167472" | "1183445" | "1788466" | "1984164" | "20020065581" | "20020114749" | "20020184817" | "20030088370" | "20030103882" | "20040003716" | "20040013589" | "20040086439" | "20040219083" | "20050039598" | "20060047526" | "20060210463" | "2016821" | "2059388" | "2089599" | "2511288" | "3194629" | "3288576" | "3437476" | "3599610" | "3662523" | "3725530" | "3764496" | "3823676" | "3838190" | "3849267" | "3849537" | "3956458" | "3961020" | "3974254" | "4040802" | "4075282" | "4094777" | "4101631" | "4115518" | "4148613" | "4174373" | "4196173" | "4226601" | "4233274" | "4272250" | "4280817" | "4305726" | "4322218" | "4377599" | "4387653" | "4394354" | "4440100" | "4472278" | "4474896" | "4519807" | "4519995" | "4555392" | "4582936" | "4602918" | "4629721" | "4693731" | "4716137" | "4741278" | "4758418" | "4764219" | "4786483" | "4804521" | "4807542" | "4824441" | "4830829" | "4873930" | "4886519" | "4892567" | "4915818" | "4933158" | "4936047" | "4964889" | "5013358" | "5024171" | "5049163" | "5116793" | "5126300" | "5137854" | "5162598" | "5190566" | "5238488" | "5350728" | "5368617" | "5409522" | "5435980" | "5447703" | "5460643" | "5505746" | "5505766" | "5571490").PN. OR ("5587003" |	US-PGPUB; USPAT; USOCR	ADJ	ON	2018/10/01 17:42

		"5618508" | "5635150" | "5659100" | "5670122" | "5733516" | "5738834" | "5787823" | "5810910" | "5897688" | "5910292" | "5989506" | "6024931" | "6083289" | "6240859" | "6258334" | "6372187" | "6375909" | "6475451" | "6521021" | "6528030" | "6533842" | "6558454" | "6610263" | "6613110" | "6719828" | "6732055" | "6737031" | "6746531" | "6790420" | "6808692" | "6848374" | "6878358" | "6942840" | "6953494" | "6962617" | "6974564" | "6975975" | "7468170" | "7507083" | "7674442" | "7758827" | "7776301").PN.				
S124	1	"15573128"	US-PGPUB; USPAT; USOCR	ADJ	ON	2018/10/02 12:07
S125	2	"20110207597"	US-PGPUB; USPAT; USOCR	ADJ	ON	2018/10/02 12:08
S126	2	"20070168213"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/02 17:30
S127	71	sorbent with before with coal and remov$4 with mercury	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/02 17:30
S128	234	"6953494"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/02 17:38
S129	121	"5435980"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/02 17:40
S130	35	promoter with sorbent and "30" g	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/02 22:19
S131	28	promoter with sorbent with mercury and "30" g	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/02 22:19
S132	4	promoter with sorbent with mercury and ("30" g).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/02 22:20
S133	4	promot$4 with sorbent with mercury and ("30" g).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/02 22:23

S134	4	promot$4 with sorbent with mercury and pre.clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/02 22:41
S135	2	promot$4 with sorbent with mercury and pre-heater	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/02 22:42
S136	2	promot$4 with sorbent with mercury and pre heater	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/03 08:36
S137	57	promot$4 with sorbent with mercury and pre	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/03 08:36
S138	24	sorbent with preheat$4 with coal	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/03 08:39
S139	121	"5435980"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/03 08:47
S140	23	"11209163"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/03 11:28
S141	5	"14102896"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/03 11:48
S142	7	"12429058"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/03 12:09
S143	4	"12202595"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/03 12:23
S144	20	"12201595"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/03 12:24
S145	3	"14564860"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/03 12:27

S146	1	"15978760"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/03 12:28
S147	1	"15589359"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/03 12:32
S148	1	"15853029"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/03 12:37
S149	6	"15997091"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/03 12:42
S150	6	"14712558"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/03 12:42
S151	2	"15951970"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/03 15:18
S152	4	"15382114"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/03 15:47
S153	1	"15853029"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/03 15:51
S154	2	"20070168213"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/03 18:18
S155	69	"4279873"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/03 18:42
S156	75	"7435286"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/04 07:59
S157	4	"15295594"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/04 08:08

S158	1	("20180257030").PN.	US-PGPUB; USPAT	ADJ	ON	2018/10/04 09:31
S159	86	"5569436"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/04 09:32
S160	6	"5785935"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/04 09:33
S161	8	"6475471"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/04 09:33
S162	53	"6103205"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/04 11:46
S163	0	pyrolysis with char with mercury with activated	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/04 11:49
S164	17	pyrolysis with char with mercury	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/04 11:49
S165	121	pyrolysis with char with activated carbon	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/04 11:50
S166	0	pyrolysis with char with activated carbon with mercury with sorbent	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/04 11:50
S167	43	pyrolysis with char with activated carbon and mercury with sorbent	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/04 11:50
S168	118	pyrolysis with char with tire	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/04 12:04
S169	58	pyrolysis with char with activated carbon and mercury	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/04 12:04
S170	8	"20040081724"	US-PGPUB; USPAT; USOCR;	ADJ	ON	2018/10/04 15:07

			FPRS; EPO; JPO			
S171	4	"14128179"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/04 15:10
S172	84	activat$4 carbon with boiler with coal and remov$4 with mercury	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/15 13:27
S173	68	activat$4 carbon with boiler with coal and (remov$4 or filter$4 or absorb$4 or adsorb$4) with mercury	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/15 13:27
S174	0	mercury with stabiliz$4 with sulfer dioxide	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/15 14:23
S175	75	"7435286"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/15 15:07
S176	6	"9468886"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/16 06:48
S177	17	"8821819"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/16 06:51
S178	15	"8652235"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/16 06:55
S179	93	"6136749"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/24 09:08
S180	4	"9757689"	US-PGPUB; USPAT	ADJ	ON	2018/10/24 12:37
S181	9	"8939388"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/29 09:59
S182	669	urea with inject$4 with filter$4 with exhaust	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/29 10:15

S183	2	urea with inject$4 with filter$4 with exhaust and urea with quench$4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/29 10:16
S184	13	"3615165"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/29 10:35
S185	136	urea with quench$4 with remov$4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/29 10:39
S186	48	urea dust with scrub$4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/29 11:25
S187	38	"6221155"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/29 12:04
S188	6	"9468886"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/10/29 14:12
S189	773	ammonium with remov$4 with mercury	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/12/03 14:14
S190	108	ammonium with salt with remov$4 with mercury	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/12/03 14:15
S191	45	ammonium with salt with remov$4 with mercury and activated carbon	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/12/03 14:15
S192	42	"5556447"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/12/03 14:21
S193	174	"4500327"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/12/03 14:21
S194	72	"4500327" and ammonium	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/12/03 14:23

S195	3	anionic couterion	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/12/03 14:32
S196	3480	anionic counterion	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/12/03 14:32
S197	2422	anionic counterion and ammonium with salt	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/12/03 14:32
S198	9	anionic counterion and ammonium with salt and remov$4 with mercury	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/12/03 14:32
S199	52	"6960329"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/12/03 14:50
S200	4	"20040003716"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2018/12/06 11:23
S201	1	"45219176".FMID.	US-PGPUB; USPAT; FPRS	ADJ	ON	2018/12/06 13:32
S202	0	pyrolysis with char with activated carbon with mercury with sorbent	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2019/01/07 09:41
S203	284	(sorbent or activated carbon) with mercury and (diameter or size) with ("30" or "40" or "50" or "60" or "70") with (sorbent or carbon) and halogen$4 and activated carbon	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2019/04/15 14:29
S204	88	activat$4 carbon with boiler with coal and (remov$4 or filter$4 or absorb$4 or adsorb$4) with mercury	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	ADJ	ON	2019/04/15 14:29

5/3/2019 12:00:48 PM
C:\Users\amillerharris\Documents\EAST\Workspaces\12429058.wsp

Application Number	Application/Control No.	Applicant(s)/Patent under Reexamination	
* 15/978,760 *	15/978,760	Olson et al.	
	Examiner	**Art Unit**	
	ORLANDO, AMBER ROSE	1776	

Document Code - DISQ	**Internal Document - DO NOT MAIL**

TERMINAL DISCLAIMER	☑ APPROVED	☐ DISAPPROVED
Date Filed: 23 April 2019	**This patent is subject to a Terminal Disclaimer**	

Approved/Disapproved by:
/JEAN PROCTOR/
Technology Center: OPLC
Telephone: (571)272-1040
2 td's

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 15/978,760	Filing Date 05/14/2018	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $460 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

AMENDMENT	04/23/2019	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 30	Minus	** 30	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 4	Minus	*** 4	= 0		x $460 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/ZURIASHWORK ZENEBE/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Modified PTO/AIA/25 (04-13)
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TERMINAL DISCLAIMER TO OBVIATE A PROVISIONAL DOUBLE PATENTING REJECTION OVER A PENDING "REFERENCE" APPLICATION	**Docket Number** 4820.007US4

In re Application of: EDWIN S. OLSON ET AL.
Application No.: 15/978,760
Filed: May 14, 2018
For: SORBENTS FOR THE OXIDATION AND REMOVAL OF MERCURY

The applicant, **Midwest Energy Emissions Corp**, owner of 100 percent interest in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application which would extend beyond the expiration date of the full statutory term of any patent granted on pending reference Application Number(s) **14/712,558; 15/382,114; 15/589,359; 15/295,594; 15/853,029; 15/951,970**, filed, **05/14/15; 12/16/16; 05/08/17; 10/17/16; 12/22/17; 04/12/18**, as the term of any patent granted on said reference application may be shortened by any terminal disclaimer filed prior to the grant of any patent on the pending reference application. The applicant hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and any patent granted on the reference application are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.

In making the above disclaimer, the applicant does not disclaim the terminal part of any patent granted on the instant application that would extend to the expiration date of the full statutory term of any patent granted on said reference application, "as the term of any patent granted on said reference application may be shortened by any terminal disclaimer filed prior to the grant of any patent on the pending reference application," in the event that: any such patent granted on the pending reference application expires for failure to pay a maintenance fee, is held unenforceable, is found invalid by a court of competent jurisdiction, is statutorily disclaimed in whole or terminally disclaimed under 37 CFR 1.321, has all claims canceled by a reexamination certificate, is reissued, or is in any manner terminated prior to the expiration of its full statutory term as shortened by any terminal disclaimer filed prior to its grant.

Check either box 1 or 2 below, if appropriate:

1. ☐ The undersigned is the applicant. If the applicant is an assignee, the undersigned is authorized to act on behalf of the assignee.

I hereby acknowledge that any willful false statements made are punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

2. ☒ The undersigned is an attorney or agent of record. Reg. No. 63,803

/Nicholas P. Lanzatella/ — April 23, 2019
Signature — **Date**

Nicholas P. Lanzatella
Typed or printed name

Attorney/Agent of Record — (612) 349-9580
Title — **Telephone Number**

☒ Terminal disclaimer fee under 37 CFR 1.20(d) included.

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This collection of information is required by 37 CFR 1.321. The information is required to obtain or retain a benefit by the public, which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Electronic Patent Application Fee Transmittal

Application Number:	15978760
Filing Date:	14-May-2018
Title of Invention:	SORBENTS FOR THE OXIDATION AND REMOVAL OF MERCURY
First Named Inventor/Applicant Name:	Edwin S. Olson
Filer:	Janal M. Kalis/Megan Reed
Attorney Docket Number:	4820.007US4

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
STATUTORY OR TERMINAL DISCLAIMER	1814	2	160	320
		Total in USD ($)		**320**

Electronic Acknowledgement Receipt	
EFS ID:	35802051
Application Number:	15978760
International Application Number:	
Confirmation Number:	6432
Title of Invention:	SORBENTS FOR THE OXIDATION AND REMOVAL OF MERCURY
First Named Inventor/Applicant Name:	Edwin S. Olson
Customer Number:	21186
Filer:	Janal M. Kalis/Megan Reed
Filer Authorized By:	Janal M. Kalis
Attorney Docket Number:	4820.007US4
Receipt Date:	23-APR-2019
Filing Date:	14-MAY-2018
Time Stamp:	13:02:01
Application Type:	Utility under 35 USC 111(a)

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Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$320
RAM confirmation Number	042419INTEFSW00002275190743
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		SIGNED_4820_007US4_ExParte QuayleResp_TD.pdf	350831 10e12b7f4441c4cc85f519b201f98369ac74b5fd	yes	18

Multipart Description/PDF files in .zip description

Document Description	Start	End
Transmittal Letter	1	1
Response after Ex Parte Quayle Action	2	2
Claims	3	9
Applicant Arguments/Remarks Made in an Amendment	10	16
Terminal Disclaimer Filed	17	17
Terminal Disclaimer Filed	18	18

Warnings:

Information:

2	Fee Worksheet (SB06)	fee-info.pdf	30318 95c49e274ff6ec42f198b9772a713074a4d048b7	no	2

Warnings:

Information:

Total Files Size (in bytes):	381149

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s): Edwin S. Olson et al.
Title: SORBENTS FOR THE OXIDATION AND REMOVAL OF MERCURY

Docket No.:	4820.007US4	Serial No.:	15/978,760
Filed:	May 14, 2018	Due Date:	June 19, 2019
Examiner:	Amber Orlando	Group Art Unit:	1776
Customer No.:	21186	Confirmation No.:	6432

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

We are transmitting herewith the following attached items (as indicated with an "X"):

X Response to Ex Parte Quayle Action (15 pgs.)
X Terminal Disclaimer - Prior Patents (1 pg.)
X Terminal Disclaimer - Pending Applications (1 pg.)
X Authorization to charge Deposit Account 19-0743 in the amount of $320.00 to cover the fee for the two Terminal Disclaimers

If not provided for in a separate paper filed herewith, please consider this a PETITION FOR EXTENSION OF TIME for sufficient number of months to enter these papers and please charge any additional fees or credit overpayment to Deposit Account No. 19-0743. If applicable, any papers or fees supplied herewith are considered to be timely filed pursuant to 37 C.F.R. § 1.7(a), the response period falling on a Federal Holiday, Saturday or Sunday being extended to the next succeeding business day.

SCHWEGMAN LUNDBERG & WOESSNER, P.A.
Customer No.: 21186

By: /Nicholas P. Lanzatella/
Nicholas P. Lanzatella
Reg. No. 63,803

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s): Edwin S. Olson et al.	Examiner: AMBER ROSE ORLANDO
Application No.. 15/978,760	Group Art Unit: 1776
Filed: May 14, 2018	Docket No.: 4820.007US4
Confirmation No.: 6432	
Title: SORBENTS FOR THE OXIDATION AND REMOVAL OF MERCURY	

RESPONSE TO EX PARTE QUAYLE ACTION

Mail Stop AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

This responds to the Ex Parte Quayle Action mailed April 19, 2019.

IN THE CLAIMS

Please amend the claims as follows:

1. (Canceled)

2. (Previously Presented) A method of separating mercury from a mercury-containing gas, the method comprising:

combusting coal in a combustion chamber, to provide the mercury-containing gas, wherein the mercury-containing gas comprises a halogen or halide promoter comprising HBr, Br^-, or a combination thereof, wherein

the coal comprises added Br_2, HBr, Br^-, or a combination thereof, added to the coal upstream of the combustion chamber, or

the combustion chamber comprises added Br_2, HBr, Br^-, or a combination thereof, or

a combination thereof;

injecting a sorbent material comprising activated carbon into the mercury-containing gas downstream of the combustion chamber;

contacting mercury in the mercury-containing gas with the sorbent, to form a mercury/sorbent composition;

separating the mercury/sorbent composition from the mercury-containing gas, to form a cleaned gas;

monitoring the mercury content of the cleaned gas; and

controlling, in response to the monitored mercury content of the cleaned gas, an injection rate of injecting the sorbent into the mercury-containing gas, the sorbent composition, or a combination thereof, so that the mercury content of the cleaned gas is maintained at or below a desired level.

3. (Previously Presented) The method of claim 2, comprising removing greater than 70 wt% of the mercury in the mercury-containing gas.

4. (Previously Presented) The method of claim 2, comprising removing greater than 70 wt% of the mercury in the mercury-containing gas on the sorbent.

5. (Previously Presented) The method of claim 2, wherein the sorbent in the mercury-containing gas comprises about 1 g to about 30 g of the halogen or halide promoter per 100 g of the sorbent material.

6. (Previously Presented) The method of claim 2, wherein the combustion chamber comprises the halogen or halide promoter.

7. (Previously Presented) The method of claim 2, wherein the coal comprises added Br_2, HBr, Br^-, or a combination thereof, added to the coal upstream of the combustion chamber.

8. (Previously Presented) The method of claim 2, wherein the promoter is contacted with the sorbent in vapor form, gaseous form, liquid form, or in an organic solvent.

9. (Previously Presented) The method of claim 2, further comprising injecting a secondary material into the mercury-containing gas downstream of the combustion chamber.

10. (Previously Presented) The method of claim 9, wherein the secondary material comprises a halogen, a compound derived from a halogen, a hydrohalide, a compound comprising a Group V or Group VI element and a molecular halogen, or a combination thereof.

11. (Previously Presented) The method of claim 2, wherein the sorbent material injected into the mercury-containing gas further comprises a non-carbon sorbent material.

12. (Previously Presented) The method of claim 11, wherein the non-carbon sorbent material comprises at least one of a porous felsic material, a vesicular felsic material, a porous basaltic material, a vesicular basaltic material, a clay-based compound, an alkaline compound, a calcium hydroxide compound, a sodium acetate compound, and a bicarbonate compound.

13. (Previously Presented) The method of claim 2, wherein the activated carbon comprises powdered activated carbon, granular activated carbon, or a combination thereof.

14. (Previously Presented) The method of claim 2, wherein the sorbent material injected into the mercury-containing gas is substantially free of halogen and halide promotion.

15. (Previously Presented) The method of claim 2, wherein the sorbent material injected into the mercury-containing gas is a promoted sorbent obtained by contacting a base sorbent with another halogen or halide promoter.

16. (Previously Presented) The method of claim 2, wherein the combustion chamber comprises a boiler.

17. (Previously Presented) The method of claim 2, wherein the mercury-containing gas is a flue gas.

18. (Previously Presented) The method of claim 2, wherein the injection of the sorbent material into the mercury-containing gas occurs upstream of an air pre-heater.

19. (Previously Presented) The method of claim 2, wherein the injection of the sorbent material into the mercury-containing gas occurs upstream of a particulate separator or a scrubber.

20.-21. (Canceled)

22. (Previously Presented) The method of claim 2, wherein the coal comprises added halide sorbent enhancement additive.

23. (Previously Presented) The method of claim 2, wherein the combustion chamber comprises added Br_2, HBr, Br^-, or a combination thereof.

24. (Previously Presented) The method of claim 2, wherein the coal comprises added sorbent enhancement additive that comprises Br^-.

25. (Previously Presented) The method of claim 24, wherein the sorbent enhancement additive comprises a bromide compound.

26. (Previously Presented) A method of separating mercury from a mercury-containing gas, the method comprising:

combusting coal in a combustion chamber, to provide the mercury-containing gas, wherein the mercury-containing gas comprises a halogen or halide promoter comprising HBr, Br^-, or a combination thereof, wherein

the coal comprises added Br_2, HBr, Br^-, or a combination thereof, added to the coal upstream of the combustion chamber, or

the combustion chamber comprises added Br_2, HBr, Br^-, or a combination thereof, or

a combination thereof;

injecting a sorbent material comprising activated carbon into the mercury-containing gas downstream of the combustion chamber;

contacting mercury in the mercury-containing gas with the sorbent, to form a mercury/sorbent composition; and

separating the mercury/sorbent composition from the mercury-containing gas, to form a cleaned gas.

27. (Previously Presented) A method of separating mercury from a mercury-containing gas, the method comprising:

combusting coal in a combustion chamber, to provide the mercury-containing gas, wherein the mercury-containing gas comprises a halogen or halide promoter comprising HBr, Br^-, or a combination thereof, wherein

the coal comprises added Br_2, HBr, Br^-, or a combination thereof, added to the coal upstream of the combustion chamber, or

the combustion chamber comprises added Br_2, HBr, Br^-, or a combination thereof, or

a combination thereof;

injecting a sorbent material comprising activated carbon into the mercury-containing gas downstream of the combustion chamber such that the activated carbon reacts with the halogen or halide promoter in the mercury-containing gas to form a promoted sorbent;

contacting mercury in the mercury-containing gas with the promoted sorbent, to form a mercury/sorbent composition;

separating the mercury/sorbent composition from the mercury-containing gas, to form a cleaned gas;

monitoring the mercury content of the cleaned gas; and

controlling, in response to the mercury content of the cleaned gas,

an injection rate of injecting the sorbent into the mercury-containing gas,

a rate of addition to the coal or the combustion chamber of the added Br_2, HBr, the bromide compound, or a combination thereof, or

a combination thereof,

so that the mercury content of the cleaned gas is maintained at or below a desired level.

28. (Previously Presented) A method of separating mercury from a mercury-containing gas, the method comprising:

combusting coal in a combustion chamber, to provide the mercury-containing gas, wherein

the coal comprises added Br_2, HBr, a bromide compound, or a combination thereof, added to the coal upstream of the combustion chamber, or

the combustion chamber comprises added Br_2, HBr, a bromide compound, or a combination thereof, or

a combination thereof;

injecting a sorbent material comprising activated carbon into the mercury-containing gas downstream of the combustion chamber;

contacting mercury in the mercury-containing gas with the sorbent, to form a mercury/sorbent composition; and

separating the mercury/sorbent composition from the mercury-containing gas, to form a cleaned gas.

29. (Previously Presented) The method of claim 28, wherein the coal comprises the added Br_2, HBr, the bromide compound, or a combination thereof, added to the coal upstream of the combustion chamber.

30. (Previously Presented) The method of claim 28, wherein the combustion chamber comprises the added Br_2, HBr, the bromide compound, or a combination thereof.

31. (Previously Presented) The method of claim 28, further comprising

monitoring the mercury content of the cleaned gas; and

controlling, in response to the mercury content of the cleaned gas,

an injection rate of injecting the sorbent into the mercury-containing gas,

a rate of addition to the coal or the combustion chamber of the added Br_2, HBr, the bromide compound, or a combination thereof, or

a combination thereof,

so that the mercury content of the cleaned gas is maintained at or below a desired level.

32. (Previously Presented) The method of claim 28, wherein the mercury-containing gas comprises about 1 g to about 30 g of the element bromine per 100 g of the sorbent.

33. (Previously Presented) The method of claim 28, wherein the mercury/sorbent composition comprises the element bromine, the sorbent material, and mercury.

REMARKS

This responds to the Ex Parte Quayle Action mailed on April 19, 2019.

No claims are amended, no claims are presently canceled, claims 1 and 20-21 were canceled previously, and no new claims are added; as a result, claims 2-19 and 22-33 are now pending in this application.

Interview Summary

Applicant thanks Examiner Amber Orlando for the courtesy of a video interview on March 25, 2019 with Applicant's representative Nicholas P. Lanzatella and with inventor John Pavlish. During the interview, the content of the response and Declarations filed with RCE on March 20, 2019 was discussed. Differences between the claimed invention and that of the Felsvang and Nelson references were discussed. Lack of motivation to combine the cited references as alleged was discussed. The Declarations submitted to overcome the rejections of record were discussed. No agreement was reached.

Applicant also thanks Examiner Amber Orlando for the courtesy of a phone call on April 23, 2019 to Applicant's representative Nicholas P. Lanzatella to explain that instead of claims "2-19 and 22-28" as referenced throughout the Ex Parte Quayle action, claims "2-19 and 22-33" was intended.

Allowable Subject Matter

The Office Action states:

> Claims 2-19 and 22-28 contain allowable subject matter as discussed below.
>
> For claims 2-19 and 22-28, as shown within the declarations, in flight promotion with HBR or Br promoters is more effective for mercury removal than treating the sorbent with HBr, Br or Br_2 outside the mercury-containing gas. Further the Nelson reference seems to teach away from inflight promotion as it states that the bromide is extremely corrosive. Lastly one having ordinary skill in the art would not have looked to in-flight promotion because for the prior art the contact time between the bromine promoter and the activated carbon is about 15 min, while when the promoter is contacted with the activated carbon in-flight, the contact time is generally less than 10 s.

Applicant thanks the Examiner for indicating allowable subject matter, and notes that during the phone call on April 23, 2●19 Examiner Orlando explained that, instead of claims "2-19 and 22-28", claims "2-19 and 22-33" were intended to be indicated as allowable.

Double Patenting Rejections

I(A). The Office Action rejected claims 2-19 and 22-27 for nonstatutory double patenting over claims 1-30 of U.S. patent no. 7,435,286 in view of U.S. patent no. 5,435,980 ("Felsvang").

This rejection is respectfully traversed. Applicant does not admit that claims 2-19 and 22-27 are obvious over claims 1-30 of U.S. patent no. 7,435,286 in view of Felsvang. However, merely to expedite prosecution, a Terminal Disclaimer in compliance with 37 C.F.R. § 1.321 is enclosed herewith to obviate these rejections.

Applicant therefore respectfully requests reconsideration and withdrawal of the double patenting rejection.

I(B). The Office Action rejected claims 2-19 and 22-27 were rejected for nonstatutory double patenting over claims 1-25 of U.S. patent no. 8,168,147 in view of U.S. patent no. 5,435,98● ("Felsvang").

This rejection is respectfully traversed. Applicant does not admit that claims 2-19 and 22-27 are obvious over claims 1-25 of U.S. patent no. 8,168,147 in view of Felsvang. However, merely to expedite prosecution, a Terminal Disclaimer in compliance with 37 C.F.R. § 1.321 is enclosed herewith to obviate these rejections.

Applicant therefore respectfully requests reconsideration and withdrawal of the double patenting rejection.

I(C). The Office Action rejected claims 2-19 and 22-27 were rejected for nonstatutory double patenting over claims 1-60 of U.S. patent no. 8.512,655 in view of U.S. patent no. 5,435,980 ("Felsvang").

This rejection is respectfully traversed. Applicant does not admit that claims 2-19 and 22-27 are obvious over claims 1-6● of U.S. patent no. 8,512,655 in view of Felsvang. However,

merely to expedite prosecution, a Terminal Disclaimer in compliance with 37 C.F.R. § 1.321 is enclosed herewith to obviate these rejections.

Applicant therefore respectfully requests reconsideration and withdrawal of the double patenting rejection.

I(D). The Office Action rejected claims 2-19 and 22-27 were rejected for nonstatutory double patenting over claims 1-60 of U.S. patent no. 8,821,819 in view of U.S. patent no. 5,435,980 ("Felsvang").

This rejection is respectfully traversed. Applicant does not admit that claims 2-19 and 22-27 are obvious over claims 1-60 of U.S. patent no. 8,821,819 in view of Felsvang. However, merely to expedite prosecution, a Terminal Disclaimer in compliance with 37 C.F.R. § 1.321 is enclosed herewith to obviate these rejections.

Applicant therefore respectfully requests reconsideration and withdrawal of the double patenting rejection.

I(E). The Office Action rejected claims 2-19 and 22-27 were rejected for nonstatutory double patenting over claims 1-33 of U.S. patent no. 9,757,689 in view of U.S. patent no. 5,435,980 ("Felsvang").

This rejection is respectfully traversed. Applicant does not admit that claims 2-19 and 22-27 are obvious over claims 1-33 of U.S. patent no. 9,757,689 in view of Felsvang. However, merely to expedite prosecution, a Terminal Disclaimer in compliance with 37 C.F.R. § 1.321 is enclosed herewith to obviate these rejections.

Applicant therefore respectfully requests reconsideration and withdrawal of the double patenting rejection.

I(F). The Office Action rejected claims 2-19 and 22-27 were rejected for nonstatutory double patenting over claims 1-20 of U.S. patent no. 9,468,886 in view of U.S. patent no. 5,435,980 ("Felsvang").

This rejection is respectfully traversed. Applicant does not admit that claims 2-19 and 22-27 are obvious over claims 1-20 of U.S. patent no. 9,468,886 in view of Felsvang. However,

merely to expedite prosecution, a Terminal Disclaimer in compliance with 37 C.F.R. § 1.321 is enclosed herewith to obviate these rejections.

Applicant therefore respectfully requests reconsideration and withdrawal of the double patenting rejection.

I(G). The Office Action rejected claims 2-19 and 22-27 were rejected for nonstatutory double patenting over claims 1-3● of U.S. Patent No. 8,652,235 in view of U.S. patent no. 5,435,98● ("Felsvang").

This rejection is respectfully traversed. Applicant does not admit that claims 2-19 and 22-27 are obvious over claims 1-3● of U.S. Patent No. 8,652,235 in view of Felsvang. However, merely to expedite prosecution, a Terminal Disclaimer in compliance with 37 C.F.R. § 1.321 is enclosed herewith to obviate these rejections.

Applicant therefore respectfully requests reconsideration and withdrawal of the double patenting rejection.

I(H). The Office Action provisionally rejected claims 2-19 and 22-27 for nonstatutory double patenting over claims 1-16 of copending application no. 15/295594.

This rejection is respectfully traversed. Applicant does not admit that claims 2-19 and 22-27 are obvious over claims 1-16 of copending application no. 15/295594. However, merely to expedite prosecution, a Terminal Disclaimer in compliance with 37 C.F.R. § 1.321 is enclosed herewith to obviate these rejections.

Applicant therefore respectfully requests reconsideration and withdrawal of the double patenting rejection.

I(I). The Office Action provisionally rejected claims 2-19 and 22-27 for nonstatutory double patenting over claims 8-2● of copending application no. 15/589359 in view of U.S. patent no. 5,435,98● ("Felsvang").

This rejection is respectfully traversed. Applicant does not admit that claims 2-19 and 22-27 are obvious over claims 8-2● of copending application no. 15/589359 in view of Felsvang.

However, merely to expedite prosecution, a Terminal Disclaimer in compliance with 37 C.F.R. § 1.321 is enclosed herewith to obviate these rejections.

Applicant therefore respectfully requests reconsideration and withdrawal of the double patenting rejection.

I(J). The Office Action provisionally rejected claims 2-19 and 22-27 for nonstatutory double patenting over claims 1-20 of copending application no. 15/853029.

This rejection is respectfully traversed. Applicant does not admit that claims 2-19 and 22-27 are obvious over claims 1-20 of copending application no. 15/853029. However, merely to expedite prosecution, a Terminal Disclaimer in compliance with 37 C.F.R. § 1.321 is enclosed herewith to obviate these rejections.

Applicant therefore respectfully requests reconsideration and withdrawal of the double patenting rejection.

I(K). The Office Action provisionally rejected claims 2-19 and 22-27 for nonstatutory double patenting over claims 1-20 of copending application no. 14/712558.

This rejection is respectfully traversed. Applicant does not admit that claims 2-19 and 22-27 are obvious over claims 1-20 of copending application no. 14/712558. However, merely to expedite prosecution, a Terminal Disclaimer in compliance with 37 C.F.R. § 1.321 is enclosed herewith to obviate these rejections.

Applicant therefore respectfully requests reconsideration and withdrawal of the double patenting rejection.

I(L). The Office Action provisionally rejected claims 2-19 and 22-27 for nonstatutory double patenting over claims 1-20 of copending application no. 15/951970.

This rejection is respectfully traversed. Applicant does not admit that claims 2-19 and 22-27 are obvious over claims 1-20 of copending application no. 15/951970. However, merely to expedite prosecution, a Terminal Disclaimer in compliance with 37 C.F.R. § 1.321 is enclosed herewith to obviate these rejections.

Applicant therefore respectfully requests reconsideration and withdrawal of the double patenting rejection.

I(M). The Office Action provisionally rejected claims 2-19 and 22-27 for nonstatutory double patenting over claims 1-20 of copending application no. 15/382114 in view of U.S. patent no. 5,435,980 ("Felsvang").

This rejection is respectfully traversed. Applicant does not admit that claims 2-19 and 22-27 are obvious over claims 1-20 of copending application no. 15/382114 in view of Felsvang. However, merely to expedite prosecution, a Terminal Disclaimer in compliance with 37 C.F.R. § 1.321 is enclosed herewith to obviate these rejections.

Applicant therefore respectfully requests reconsideration and withdrawal of the double patenting rejection.

I(N). The Office Action provisionally rejected claims 2-19 and 22-27 for nonstatutory double patenting over claims 1-20 of copending application no. 15/853029.

This rejection is respectfully traversed. Applicant does not admit that claims 2-19 and 22-27 are obvious over claims 1-20 of copending application no. 15/853029. Applicant notes that this rejection is identical to the one reported herein at **I(J)**. Merely to expedite prosecution, a Terminal Disclaimer in compliance with 37 C.F.R. § 1.321 is enclosed herewith to obviate these rejections.

Applicant therefore respectfully requests reconsideration and withdrawal of the double patenting rejection.

CONCLUSION

Applicant respectfully submits that the claims are in condition for allowance, and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicant's representative at (612) 349-958● to facilitate prosecution of this application.

If necessary, please charge any additional fees or credit overpayment to Deposit Account No. 19-●743.

Respectfully Submitted,

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.
P.O. Box 2938
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(612) 373-69●●

Date April 23, 2●19 By /Nicholas P. Lanzatella/
Nicholas P. Lanzatella
Reg. No. 63,8●3

Modified PTO/AIA/26 (04-14)
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TERMINAL DISCLAIMER TO OBVIATE A DOUBLE PATENTING REJECTION OVER A "PRIOR" PATENT	Docket Number 4820.007US4

In re Application of: Edwin S. Olson et al.

Application No.: 15/978,760

Filed: May 14, 2018

For: SORBENTS FOR THE OXIDATION AND REMOVAL OF MERCURY

The applicant, **Midwest Energy Emissions Corp**, owner of the entire interest in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application which would extend beyond the expiration date of the full statutory term of **prior patent** No.(s) **7,435,286; 8,168,147; 8,512,655; 8,821,819; 9,757,689; 8,652,235; 9,468,886** as the term of said **prior patent(s)** is presently shortened by any terminal disclaimer. The applicant hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and the **prior patent(s)** are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.

In making the above disclaimer, the applicant does not disclaim the terminal part of the term of any patent granted on the instant application that would extend to the expiration date of the full statutory term of the **prior patent(s)**, "as the term of said **prior patent(s)** is presently shortened by any terminal disclaimer," in the event that said **prior patent(s)** later:

- expires for failure to pay a maintenance fee;
- is held unenforceable;
- is found invalid by a court of competent jurisdiction;
- is statutorily disclaimed in whole or terminally disclaimed under 37 CFR 1.321;
- has all claims canceled by a reexamination certificate;
- is reissued; or
- is in any manner terminated prior to the expiration of its full statutory term as presently shortened by any terminal disclaimer.

Check either box 1 or 2 below, if appropriate.

1. ☐ The undersigned is the applicant. If the applicant is an assignee, the undersigned is authorized to act on behalf of the assignee.

I hereby acknowledge that any willful false statements made are punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

2. ☒ The undersigned is an attorney or agent of record. Reg. No. 63,803

/Nicholas P. Lanzatella/ — April 23, 2019

Nicholas P. Lanzatella — **Date**

Attorney/Agent of Record — **612-349-9580**

Title — **Telephone Number**

☒ Terminal disclaimer fee under 37 CFR 1.20(d) included.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/978,760	05/14/2018	Edwin S. Olson	4820.007US4	6432

21186 7590 04/19/2019
SCHWEGMAN LUNDBERG & WOESSNER, P.A.
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MINNEAPOLIS, MN 55402

EXAMINER
ORLANDO, AMBER ROSE

ART UNIT	PAPER NUMBER
1776	

NOTIFICATION DATE	DELIVERY MODE
04/19/2019	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

SLW@blackhillsip.com
uspto@slwip.com

PTOL-90A (Rev. 04/07)

Office Action Summary	**Application No.** 15/978,760	**Applicant(s)** Olson et al.	
	Examiner AMBER R ORLANDO	**Art Unit** 1776	**AIA (FITF) Status** No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 03/20/2019.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☐ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☑ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 2-19 and 22-28 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 2-19 and 22-26 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☑ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☑ Other: PTO-413.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

The present application is being examined under the pre-AIA first to invent provisions.

Response to Amendment

The Declarations filed on 03/20/2019 under 37 CFR 1.131(a) is sufficient to overcome the Felsvang et al. US 5,435,980 and Nelson Jr. US 2004/0003716 references.

Double Patenting

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on nonstatutory double patenting provided the reference application or patent either is shown to be commonly owned with the examined application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement. See MPEP § 717.02 for applications subject to examination under the first inventor to file provisions of the AIA as explained in MPEP § 2159. See MPEP §§ 706.02(l)(1) - 706.02(l)(3) for

applications not subject to examination under the first inventor to file provisions of the AIA. A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO Internet website contains terminal disclaimer forms which may be used. Please visit www.uspto.gov/patent/patents-forms. The filing date of the application in which the form is filed determines what form (e.g., PTO/SB/25, PTO/SB/26, PTO/AIA/25, or PTO/AIA/26) should be used. A web-based eTerminal Disclaimer may be filled out completely online using web-screens. An eTerminal Disclaimer that meets all requirements is auto-processed and approved immediately upon submission. For more information about eTerminal Disclaimers, refer to www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp.

Claims 2-19 and 22-27 are rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-30 of U.S. Patent No. US 7,435,286 ('286) in view of Felsvang et al. US 5,435,980.

The current claim set corresponds to '286 expect for the mercury containing gas comprises a halogen or halide promoter.

Felsvang et al. discloses this limitation as shown in previous action.

It would have been obvious to one having ordinary skill in the art to have modified the '286 reference to include the mercury containing gas comprises a halogen or halide promoter (Felsvang et al. column 5, 60-65 and column 4, lines 42-45) so as to supplement the chlorine content of the system so as to increase the mercury sorption capability.

Claims 2-19 and 22-27 are rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-25 of U.S. Patent No. US 8,168,147 ('147) in view of Felsvang et al. US 5,435,980.

The current claim set corresponds to '147 expect for the mercury containing gas comprises a halogen or halide promoter.

Felsvang et al. discloses this as shown in previous action.

It would have been obvious to one having ordinary skill in the art to have modified the '147 reference to include the mercury containing gas comprises a halogen or halide promoter (Felsvang et al. column 5, 60-65 and column 4, lines 42-45) so as to supplement the chlorine content of the system so as to increase the mercury sorption capability.

Claims 2-19 and 22-27 are rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-60 of U.S. Patent No. US 8,512,655 ('655) in view of Felsvang et al. US 5,435,980.

The current claim set corresponds to '655 expect for the mercury containing gas comprises a halogen or halide promoter.

Felsvang et al. discloses this limitation as shown in previous action.

It would have been obvious to one having ordinary skill in the art to have modified the '655 reference to include the mercury containing gas comprises a halogen or halide promoter (Felsvang et al. column 5, 60-65 and column 4, lines 42-45) so as to supplement the chlorine content of the system so as to increase the mercury sorption capability.

Claims 2-19 and 22-27 are rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-60 of U.S. Patent No. US 8,821,819 ('819) in view of Felsvang et al. US 5,435,980.

The current claim set corresponds to '819 expect for the mercury containing gas comprises a halogen or halide promoter.

Felsvang et al. discloses this limitation as shown in previous action.

It would have been obvious to one having ordinary skill in the art to have modified the '819 reference to include the mercury containing gas comprises a halogen or halide promoter (Felsvang et al.

column 5, 60-65 and column 4, lines 42-45) so as to supplement the chlorine content of the system so as to increase the mercury sorption capability.

Claims 2-19 and 22-27 are rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-33 of U.S. Patent No. US 9,757,689 ('689) in view of Felsvang et al. US 5,435,980.

The current claim set corresponds to '689 expect combusting a fossil fuel in a combustion chamber to provide a mercury-containing gas, wherein the mercury containing gas comprises a halogen or halide promoter.

Felsvang et al. discloses this limitation as shown in previous action.

It would have been obvious to one having ordinary skill in the art to have modified the '689 reference to include a fossil fuel in a combustion chamber to provide a mercury-containing gas, wherein the mercury containing gas comprises a halogen or halide promoter. (Felsvang et al. column 5, 60-65 and column 4, lines 42-45) so as to supplement the chlorine content of the system so as to increase the mercury sorption capability within a fossil fuel operation.

Claims 2-19 and 22-27 are rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-20 of U.S. Patent No. US 9,468,886 ('886) in view of Felsvang et al. US 5,435,980.

The current claim set corresponds to '886 expect for the mercury containing gas comprises a halogen or halide promoter.

Felsvang et al. discloses this limitation as shown in previous action.

It would have been obvious to one having ordinary skill in the art to have modified the '886 reference to include the mercury containing gas comprises a halogen or halide promoter (Felsvang et al. column 5, 60-65 and column 4, lines 42-45) so as to supplement the chlorine content of the system so as to increase the mercury sorption capability.

Claims 2-19 and 22-27 are rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-30 of U.S. Patent No. 8,652,235 ('235) in view of Felsvang et al. US 5,435,980.

The current claim set corresponds to '235 expect for the mercury containing gas comprises a halogen or halide promoter.

Felsvang et al. discloses this limitation as shown in previous actions.

It would have been obvious to one having ordinary skill in the art to have modified the '235 reference to include the mercury containing gas comprises a halogen or halide promoter (Felsvang et al. column 5, 60-65 and column 4, lines 42-45) so as to supplement the chlorine content of the system so as to increase the mercury sorption capability.

Claims 2-19 and 22-27 are provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-16 of copending Application No. 15/295594 ('594). Although the claims at issue are not identical, they are not patentably distinct from each other because while the current claim set includes different wording it the limitations correspond to '594.

This is a provisional nonstatutory double patenting rejection because the patentably indistinct claims have not in fact been patented.

Claims 2-19 and 22-27 are provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over claims 8-20 of copending Application No. 15/589359 ('359) in view of Felsvang et al. US 5,435,980.

The current claim set corresponds to '359 expect for the mercury containing gas comprises a halogen or halide promoter.

Felsvang et al. discloses this limitation as shown in previous actions.

It would have been obvious to one having ordinary skill in the art to have modified the '359 reference to include the mercury containing gas comprises a halogen or halide promoter (Felsvang et al.

column 5, 60-65 and column 4, lines 42-45) so as to supplement the chlorine content of the system so as to increase the mercury sorption capability.

This is a provisional nonstatutory double patenting rejection because the patentably indistinct claims have not in fact been patented.

Claims 2-19 and 22-27 are provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-20 of copending Application No. 15/853029 ('029). Although the claims at issue are not identical, they are not patentably distinct from each other because while the current claim set includes different wording it the limitations correspond to '029.

This is a provisional nonstatutory double patenting rejection because the patentably indistinct claims have not in fact been patented.

Claims 2-19 and 22-27 are provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-20 of copending Application No. 14/712558 ('558) Although the claims at issue are not identical, they are not patentably distinct from each other because while the current claim set includes different wording it the limitations correspond to '760.

This is a provisional nonstatutory double patenting rejection because the patentably indistinct claims have not in fact been patented.

Claims 2-19 and 22-27 are provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-20 of copending Application No. 15/951970 ('970). Although the claims at issue are not identical, they are not patentably distinct from each other because while the current claim set includes different wording, the limitations correspond to '970.

This is a provisional nonstatutory double patenting rejection because the patentably indistinct claims have not in fact been patented.

Claims 2-19 and 22-27 are provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over 1-20 of copending Application No. 15/382114 ('114) in view of Felsvang et al. US 5,435,980.

The current claim set corresponds to '114 expect for the mercury containing gas comprises a halogen or halide promoter.

Felsvang et al. discloses this limitation as shown in previous actions.

It would have been obvious to one having ordinary skill in the art to have modified the '114 reference to include the mercury containing gas comprises a halogen or halide promoter (Felsvang et al. column 5, 60-65 and column 4, lines 42-45) so as to supplement the chlorine content of the system so as to increase the mercury sorption capability.

This is a provisional nonstatutory double patenting rejection because the patentably indistinct claims have not in fact been patented.

Claims 2-19 and 22-27 are provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over 1-20 of copending Application No. 15/853029 ('029). Although the claims at issue are not identical, they are not patentably distinct from each other because while the current claim set includes different wording it the limitations correspond to '029.

This is a provisional nonstatutory double patenting rejection because the patentably indistinct claims have not in fact been patented.

Allowable Subject Matter

Claims 2-19 and 22-28 contain allowable subject matter as discussed below.

For claims 2-19 and 22-28, as shown within the declarations, in flight promotion with HBR or Br promoters is more effective for mercury removal than treating the sorbent with HBr, Br or Br_2 outside the mercury-containing gas. Further the Nelson reference seems to teach away from inflight promotion

as it states that the bromide is extremely corrosive. Lastly one having ordinary skill in the art would not have looked to in-flight promotion because for the prior art the contact time between the bromine promoter and the activated carbon is about 15 min, while when the promoter is contacted with the activated carbon in-flight, the contact time is generally less than 10 s.

Conclusion

This application is in condition for allowance except for the following formal matters:

The double patenting rejections as shown above.

Prosecution on the merits is closed in accordance with the practice under *Ex parte Quayle*, 25 USPQ 74, 453 O.G. 213, (Comm'r Pat. 1935).

A shortened statutory period for reply to this action is set to expire **TWO MONTHS** from the mailing date of this letter.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to AMBER ROSE ORLANDO whose telephone number is (571)270-3149. The examiner can normally be reached on Monday-Thursday 7:00-5:30.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Duane Smith can be reached on (571)272-1166. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained

from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

AMBER ROSE. ORLANDO
Primary Examiner
Art Unit 1776

/AMBER R ORLANDO/
Primary Examiner, Art Unit 1776

Applicant-Initiated Interview Summary	**Application No.** 15/978,760	**Applicant(s)** Olson et al.		
	Examiner AMBER R ORLANDO	**Art Unit** 1776	**AIA (First Inventor to File) Status** No	**Page** **1 of** 2

All participants (applicant, applicants representative, PTO personnel):

1. AMBER R ORLANDO (Primary Examiner); Telephonic
2. Nicholas Lanzatella (Attorney); Telephonic
3. John Pavlish (Inventor); Telephonic
4. Rick McPhearson(Midwest Exec); Telephonic
5. Stacey Hyatt (Midwest Admin); Telephonic

Date of Interview: 25 March 2019

Claims Discussed: 2, 26-28

Prior Art Discussed: Felsvang et al. US 5,435,980 and Nelson Jr. US 2004/0003716

Brief Description of the main topic(s) of discussion: The applicant described in detail their Declarations A-C submitted 03/20/2019

Issues Discussed:

Item(s) under 35 U.S.C. 103:
The applicant described the difference between the claimed invention and that of the prior art. The applicant's representative also went through each of the Declarations and described how they help distinguish the current claims over the prior art.

Affidavits/Declarations:

/AMBER R ORLANDO/ Primary Examiner, Art Unit 1776	

Applicant is reminded that a complete written statement as to the substance of the interview must be made of record in the application file. It is the applicants responsibility to provide the written statement, unless the interview was initiated by the Examiner and the Examiner has indicated that a written summary will be provided. See MPEP 713.04
Please further see:
MPEP 713.04
Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews, paragraph (b)
37 CFR § 1.2 Business to be transacted in writing

U.S. Patent and Trademark Office
PTOL-413/413b (Rev. 01/01/2015) **Interview Summary** Paper No. 20190415

Applicant recordation instructions: The formal written reply to the last Office action must include the substance of the interview. (See MPEP section 713.04). If a reply to the last Office action has already been filed, applicant is given a non-extendable period of the longer of one month or thirty days from this interview date, or the mailing date of this interview summary form, whichever is later, to file a statement of the substance of the interview

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/978,760	Olson et al.
	Examiner	Art Unit
	AMBER R ORLANDO	1776

CPC - Searched*		
Symbol	Date	Examiner

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
IDS Search (EAST and DAV)	06/24/2018	AO
Inventor Search (DAV)	06/24/2018	AO
EAST searched for inflight promotion of sorbents.	06/24/2018	AO
EAST searched for inflight promotion of sorbents.	10/04/2018	AO
EAST searched for inflight promotion of sorbents.	12/19/2018	AO
EAST searched for inflight promotion of sorbents.	04/15/2019	AO

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

Modified form PTO/SB/08A(04-07) OMB 651-0031
US Patent & Trademark Office: U.S. DEPARTMENT OF COMMERCE
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Substitute for form 1449A/PTO **INFORMATION DISCLOSURE STATEMENT BY APPLICANT** (Use as many sheets as necessary)	*Complete if Known*	
	Application Number	15/978,760
	Filing Date	May 14, 2018
	First Named Inventor	Edwin S. Olson
	Group Art Unit	1776
	Examiner Name	Amber Orlando
Sheet 1 of 1	Attorney Docket No: 4820.007US4	

US PATENT DOCUMENTS

Examiner Initial *	USP Document Number	Publication Date	Name of Patentee or Applicant of cited Document
	US-20190009247A1	1/10/2019	Olson, Edwin S, et al.

FOREIGN PATENT DOCUMENTS

Examiner Initial *	Foreign Document Number	Publication Date	Name of Patentee or Applicant of cited Document	T 1

OTHER DOCUMENTS – NON PATENT LITERATURE DOCUMENTS

Examiner Initial *	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T 1
	"Application Serial No. 14/712,558, Amendment and Response filed 12-03-18 to Non Final Office Action mailed 10-19-18", 28 pgs	
	"Application Serial No. 14/712,558, Final Office Action mailed 01-11-19", 27 pgs	
	"Application Serial No. 15/382,114, Non Final Office Action mailed 12-12-18", 46 pgs	
	"Application Serial No. 15/589,359, Amendment and Response filed 01-17-19 to Non Final Office Action mailed 10-22-18", 14 pgs	
	"Application Serial No. 15/974,343, Amendment and Response filed 12-03-18 to Non Final Office Action mailed 10-29-18", 37 pgs	
	"Application Serial No. 15/974,343, Final Office Action mailed 01-14-19", 25 pgs	
	"Application Serial No. 15/997,091, Final Office Action mailed 01-11-19", 20 pgs	
	"Application Serial No. 15/997,091, Response filed 12-03-18 Non Final Office Action mailed 11-02-18", 40 pgs	

EXAMINER /AMBER R ORLANDO/ **DATE CONSIDERED** 04/15/2019

* EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. 1 Applicant is to place a check mark here if English language Translation is attached

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /A.R.O/

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FOREIGN PATENT DOCUMENTS				
Examiner Initial *	**Foreign Document Number**	**Publication Date**	**Name of Patentee or Applicant of cited Document**	**T 1**

OTHER DOCUMENTS – NON PATENT LITERATURE DOCUMENTS		
Examiner Initial *	**Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.**	**T 1**
	"Canadian Application Serial No. 2,904,039, Office Action mailed 02-18-19", 6 pgs	

EXAMINER /AMBER R ORLANDO/ **DATE CONSIDERED** 04/15/2019

* EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. 1 Applicant is to place a check mark here if English language Translation is attached

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	Group Art Unit	1776
	Examiner Name	Amber Orlando
Sheet 1 of 2	Attorney Docket No: 4820.007US4	

US PATENT DOCUMENTS			
Examiner Initial *	USP Document Number	Publication Date	Name of Patentee or Applicant of cited Document

FOREIGN PATENT DOCUMENTS				
Examiner Initial *	Foreign Document Number	Publication Date	Name of Patentee or Applicant of cited Document	T1

OTHER DOCUMENTS – NON PATENT LITERATURE DOCUMENTS		
Examiner Initial *	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T1
	"Application Serial No. 15/382,114, Response filed 3-12-19 to Non Final Office Action mailed 12-12-18", 24 pgs	
	"Application Serial No. 15/589,359, Final Office Action mailed 03-01-19", 10 pgs	
	, et al., "Coal Combustion Products (CCPs): Characteristics, Utilization and Beneficiation", Edited by Tom Robl, et al., Woodhead Publishing (Elsevier), (2017), 565 pgs	
	"Control of Mercury Emissions from Coal Fired Electric Utility Boilers: An Update", US EPA Air Pollution Prevention and Control Division, National Risk Management Research Laboratory, Office of Research and Development, (February 18, 2005), 59 pgs	
	"Sorbent Enhancement Additives for Mercury Control", US DOE Office of Fossil Energy, National Energy Technology Laboratory, (June 2008), 4 pgs	
	BENSON, STEVEN A., et al., "JV Task 73 - Mercury Control Technologies for Electric Utilities Burning Subbituminous Coals - Draft Final Report", University of North Dakota Energy and Environmental Research Center, (June 2005), 165 pgs	
	BENSON, STEVEN A., et al., "Pilot-and Full-Scale Demonstration of Advanced Mercury Control Technologies for Lignite-Fired Power Plants", University of North Dakota Energy and Environmental Research Center, (February 2005), 97 pgs	
	BERRY, MARK, et al., "Mercury control evaluation of calcium bromide injection into a PRB-fired furnace with an SCR", Proc. of the Air Quality VI Conference, Arlington, VA, (2007), 9 pgs	
	BROWN, THOMAS D., et al., "Mercury Measurement and its Control: What We Know, Have Learned, and Need to Further Investigate", Journal of the Air and Waste Management Association, 49(6), (June 1999), 98 pgs	
	FEELEY, THOMAS J., et al., "A Review of DOE/NETL's Mercury Control Technology R and D Program for Coal-Fired Power Plants", DOE/NETL Hg R and D Program Review, (April 2003), 32 pgs	
	FRENCH, CHARLES L., et al., "Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units - Final Report to Congress: Volume 1", US EPA Office of Air Quality Planning and Standards, (February 1998), 502 pgs	

EXAMINER /AMBER R ORLANDO/ DATE CONSIDERED 04/15/2019

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	Examiner Name	Amber Orlando
Sheet 2 of 2	Attorney Docket No: 4820.007US4	

OTHER DOCUMENTS – NON PATENT LITERATURE DOCUMENTS		
Examiner Initial *	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T1
	GHORISHI, BEHROOZ S., et al., "In-Flight Capture of Elemental Mercury by Chlorine-Impregnated Activated Carbon", Proc. of the 94th Annual Meeting of the Air and Waste Management Association, Orlando, FL, (June 2001), 14 pgs	
	JONES, ANDREW P., et al., "DOE/NETL's Phase II Mercury Control Technology Field Testing Program: Preliminary Economic Analysis of Activated Carbon Injection", Environmental Science and Technology, 41(4), (2007), 7 pgs	
	KEATING, MARTHA H., et al., "Mercury Study Report to Congress Volume 1: Executive Summary", US EPA Office of Air Quality Planning and Standards, (December 1997), 95 pgs	
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	NELSON, SID JR., et al., "How China Can Leapfrog the World in Mercury Emission Reductions", Proc. of the AWMA Intl. Specialty Conference on Leapfrogging Opportunities for Air Quality Improvement, (2010), 24 pgs	
	PAVLISH, JOHN H., et al., "Status review of mercury control options for coal-fired power plants", Fuel Processing Technology, Vol. 82, (2003), 77 pgs	
	YANG, YANG, et al., "Effect of HBr formation on mercury oxidation via CaBr(2) addition to coal during combustion", RSC Advances, 6(64), (2016), 7 pgs	

EXAMINER /AMBER R ORLANDO/ DATE CONSIDERED 04/15/2019

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ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /A.R.O/

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/978,760	05/14/2018	Edwin S. Olson	4820.007US4

CONFIRMATION NO. 6432

21186
SCHWEGMAN LUNDBERG & WOESSNER, P.A.
P.O. BOX 2938
MINNEAPOLIS, MN 55402

POA ACCEPTANCE LETTER

OC000000106839430

Date Mailed: 03/26/2019

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 03/20/2019.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/zabraha/

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15/978,760	05/14/2018	Edwin S. Olson	4820.007US4	6432

21186 7590 03/25/2019
SCHWEGMAN LUNDBERG & WOESSNER, P.A.
P.O. BOX 2938
MINNEAPOLIS, MN 55402

EXAMINER
ORLANDO, AMBER ROSE

ART UNIT	PAPER NUMBER
1776	

NOTIFICATION DATE	DELIVERY MODE
03/25/2019	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

SLW@blackhillsip.com
uspto@slwip.com

Decision Granting Request for Prioritized Examination (Track I)	**Application No.** 15/978,760	**Applicant(s)** Olson et al.	
	Examiner BRIAN W BROWN	**Art Unit** OPET	**AIA (First Inventor to File) Status** No

1. THE REQUEST FILED 20 March 2019 IS **GRANTED** .

The above-identified application has met the requirements for prioritized examination

A. ☐ for an original nonprovisional application (Track I).
B. ☑ for an application undergoing continued examination (RCE).

2. **The above-identified application will undergo prioritized examination**. The application will be accorded special status throughout its entire course of prosecution until one of the following occurs:

A. filing a **petition for extension of time** to extend the time period for filing a reply;

B. filing an **amendment to amend the application to contain more than four independent claims, more than thirty total claims** , or a multiple dependent claim;

C. filing a **request for continued examination** ;

D. filing a notice of appeal;

E. filing a request for suspension of action;

F. mailing of a notice of allowance;

G. mailing of a final Office action;

H. completion of examination as defined in 37 CFR 41.102; or

I. abandonment of the application.

Telephone inquiries with regard to this decision should be directed to BRIAN BROWN at (571)272-5338.

In his/her absence, calls may be directed to Petition Help Desk at (571) 272-3282.

/BRIAN W BROWN/ Petitions Examiner, OPET	

Modified form PTO/SB/08A(04-07) OMB 651-0031
US Patent & Trademark Office: U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Substitute for form 1449A/PTO **INFORMATION DISCLOSURE STATEMENT BY APPLICANT** (Use as many sheets as necessary)	*Complete if Known*	
	Application Number	15/978,760
	Filing Date	May 14, 2018
	First Named Inventor	Edwin S. Olson
	Group Art Unit	1776
	Examiner Name	Amber Orlando
Sheet 1 of 2	Attorney Docket No: 4820.007US4	

US PATENT DOCUMENTS			
Examiner Initial *	**USP Document Number**	**Publication Date**	**Name of Patentee or Applicant of cited Document**

FOREIGN PATENT DOCUMENTS				
Examiner Initial *	**Foreign Document Number**	**Publication Date**	**Name of Patentee or Applicant of cited Document**	**T 1**

OTHER DOCUMENTS – NON PATENT LITERATURE DOCUMENTS		
Examiner Initial *	**Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.**	**T 1**
	"Application Serial No. 15/382,114, Response filed 3-12-19 to Non Final Office Action mailed 12-12-18", 24 pgs	
	"Application Serial No. 15/589,359, Final Office Action mailed 03-01-19", 10 pgs	
	, et al., "Coal Combustion Products (CCPs): Characteristics, Utilization and Beneficiation", Edited by Tom Robl, et al., Woodhead Publishing (Elsevier), (2017), 565 pgs	
	"Control of Mercury Emissions from Coal Fired Electric Utility Boilers: An Update", US EPA Air Pollution Prevention and Control Division, National Risk Management Research Laboratory, Office of Research and Development, (February 18, 2005), 59 pgs	
	"Sorbent Enhancement Additives for Mercury Control", US DOE Office of Fossil Energy, National Energy Technology Laboratory, (June 2008), 4 pgs	
	BENSON, STEVEN A., et al., "JV Task 73 - Mercury Control Technologies for Electric Utilities Burning Subbituminous Coals - Draft Final Report", University of North Dakota Energy and Environmental Research Center, (June 2005), 165 pgs	
	BENSON, STEVEN A., et al., "Pilot-and Full-Scale Demonstration of Advanced Mercury Control Technologies for Lignite-Fired Power Plants", University of North Dakota Energy and Environmental Research Center, (February 2005), 97 pgs	
	BERRY, MARK, et al., "Mercury control evaluation of calcium bromide injection into a PRB-fired furnace with an SCR", Proc. of the Air Quality VI Conference, Arlington, VA, (2007), 9 pgs	
	BROWN, THOMAS D., et al., "Mercury Measurement and Its Control: What We Know, Have Learned, and Need to Further Investigate", Journal of the Air and Waste Management Association, 49(6), (June 1999), 98 pgs	
	FEELEY, THOMAS J., et al., "A Review of DOE/NETL's Mercury Control Technology R and D Program for Coal-Fired Power Plants", DOE/NETL Hg R and D Program Review, (April 2003), 32 pgs	
	FRENCH, CHARLES L., et al., "Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units - Final Report to Congress: Volume 1", US EPA Office of Air Quality Planning and Standards, (February 1998), 502 pgs	

EXAMINER **DATE CONSIDERED**

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Modified form PTO/SB/08A(04-07) OMB 651-0031
US Patent & Trademark Office: U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Substitute for form 1449A/PTO **INFORMATION DISCLOSURE STATEMENT BY APPLICANT** (Use as many sheets as necessary)	*Complete if Known*	
	Application Number	15/978,76●
	Filing Date	May 14, 2●18
	First Named Inventor	Edwin S. Olson
	Group Art Unit	1776
	Examiner Name	Amber Orlando
Sheet 2 of 2	Attorney Docket No: 4820.007US4	

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s): Edwin S. Olson et al.	Examiner: Amber Orlando
Serial No.: 15/978,76●	Group Art Unit: 1776
Filed: May 14, 2●18	Docket: 482●.●●7US4
Customer No.: 21186	Confirmation No.: 6432
Title: SORBENTS FOR THE OXIDATION AND REMOVAL OF MERCURY	

SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT

MS Amendment
Commissioner for Patents
P.O. Box 145●
Alexandria, VA 22313-145●

In compliance with the duty imposed by 37 C.F.R. § 1.56, and in accordance with 37 C.F.R. §§ 1.97 *et. seq.*, the enclosed materials are brought to the attention of the Examiner for consideration in connection with the above-identified patent application. Applicant respectfully requests that this Information Disclosure Statement be entered and the documents listed on the attached PTO 1449 Form be considered by the Examiner and made of record. Pursuant to the provisions of MPEP 6●9, Applicant requests that a copy of the PTO 1449 Form, initialed as being considered by the Examiner, be returned to the Applicant with the next official communication.

Pursuant to 37 C.F.R. § 1.97(b), it is believed that no fee or statement is required with the Information Disclosure Statement. However, if an Office Action on the merits has been mailed after filing of the application or after the filing of the most recent RCE, the Commissioner is hereby authorized to charge the required fees to Deposit Account No. 19-●743 in order to have this Information Disclosure Statement considered.

Pursuant to 37 C.F.R. § 1.98(a)(2), copies of cited U.S. Patents and Published Applications, and Non-Published Applications identifiable by USPTO Serial Number, are no longer required to be provided to the Office. Applicant acknowledges the requirement to submit copies of foreign patent documents and non-patent literature in accordance with 37 C.F.R § 1.98(a)(2).

The Examiner is invited to contact the undersigned at the telephone number indicated if there are any questions regarding this communication.

Respectfully submitted,

SCHWEGMAN LUNDBERG & WOESSNER, P.A.
P.O. Box 2938
Minneapolis, MN 55402
(612) 349-958●

Date March 20, 2●19 By /Nicholas P. Lanzatella/
Nicholas P. Lanzatella
Reg. No. 63,803

NPL:mlr1

REMARKS

This responds to the Final Office Action dated December 26, 2018.

Claims 2, 5, 7-8, and 15 are presently amended. No claims are presently canceled, and claims 1 and 20-21 were canceled previously. New claims 23-33 are presently added. As a result, claims 2-19 and 22-33 are now pending in this application.

Independent claim 2 is presently amended to recite "…the coal comprises added Br_2, HBr, Br^-, or a combination thereof, added to the coal upstream of the combustion chamber, or the combustion chamber comprises added Br_2, HBr, Br^-, or a combination thereof, or a combination thereof…" Claim 7 is amended to recite "…wherein the coal comprises added Br_2, HBr, Br^-, or a combination thereof, added to the coal upstream of the combustion chamber." Support can be found in the application as filed at paragraphs [0123]-[0125], [0138], [●164], and figure 6. At paragraph [●138] the application states that the invention includes a sorbent and a combination of additives to remove pollutants from the gas stream. At paragraph [●164], "[t]he additive can be injected where desired (e.g., before, after, or within the boiler)." Paragraphs [0124]-[0125] state that the "additives" can include those listed in Example 1E, which include HBr and Br_2. HBr includes Br^-. Paragraphs [●088] and [●155] state that the reactive carbon form "can be generated by the addition or bromine, hydrogen bromide, or combinations of bromine and other elements as described herein." Compounds including bromine and other elements are bromide compounds that include Br^-. Paragraph [●144] states that "…a bromine compound…" can be used to form the promoted sorbent; a compound including bromine is a bromide compound that includes Br^-.

Independent claim 2 is presently amended to recite "…~~reacting~~contacting mercury in the mercury-containing gas with the ~~promoted~~ sorbent…." Reacting includes contacting. The application as filed at paragraphs [0●50●], [0076], [●●87], [●134], [●138], [●14●], and [●154] describes contacting the sorbent and the mercury.

Claim 8 is presently amended to recite "…wherein the promoter is ~~reacted~~contacted with the sorbent in vapor form, gaseous form, liquid form, or in an organic solvent." Reacting includes contacting. The application as filed at paragraphs [0021], [0077], [●092], [●124] describes contact between the promoter and the sorbent.

No new matter is added via the amendments herein.

New dependent claim 23 is added, reciting "…wherein the combustion chamber comprises added Br_2, HBr, Br^-, or a combination thereof." New dependent claim 24 is added, reciting "…wherein the coal comprises added sorbent enhancement additive that comprises Br^-." New dependent claim 25 is added, reciting "…wherein the sorbent enhancement additive comprises a bromide compound." Support can be found in the application as filed at paragraphs [●●88], [●123]-[●125], [●138], [●144], [●155], [●164], and figure 6. At paragraph [●138] the application states that the invention includes a sorbent and a combination of additives to remove pollutants from the gas stream. At paragraph [●164], "[t]he additive can be injected where desired (e.g., before, after, or within the boiler)." Paragraphs [●124]-[●125] state that the "additives" can include those listed in Example 1E, which include HBr and Br_2. HBr includes Br^-. Paragraphs [●●88] and [●155] state that the reactive carbon form "can be generated by the addition or bromine, hydrogen bromide, or combinations of bromine and other elements as described herein." Compounds including bromine and other elements are bromide compounds that include Br^-. Paragraph [●144] states that "…a bromine compound…" can be used to form the promoted sorbent; a compound including bromine is a bromide compound that includes Br^-.

Claims 23-25 are dependent on independent claim 2; as such, claims 23-25 incorporate all the features of claim 2 and are therefore patentable for at least the reasons given herein for patentability of independent claim 2.

New independent claim 26 is added, reciting similar language to amended independent claim 2 but omits the monitoring and controlling features. New independent claim 27 is added, reciting similar language to amended independent claim 2 but also including the feature "…such that the activated carbon reacts with the halogen or halide promoter in the mercury-containing gas to form a promoted sorbent…." Also, instead of controlling the sorbent composition, new independent claim 27 recites controlling "…a rate of addition to the coal or the combustion chamber of the added Br_2, HBr, the bromide compound, or a combination thereof…" as supported by the application as filed at paragraphs [●●30] and [●●32]-[●●35]. New independent claims 26-27 are patentable for the reasons given herein for patentability of independent claim 2.

New independent claim 28 is added, reciting similar language to amended independent claim 2 but omitting the monitoring and controlling features, and omitting the feature that the mercury-containing flue gas includes the promoter, which would nonetheless occur due to the combustion of

coal in the combustion chamber, wherein the coal or the combustion chamber includes added Br_2, HBr, or bromide compound. Support for added Br_2, HBr, or bromide compound can be found in the application as filed at paragraphs [0088], [0123]-[0125], [0138], [0144], [0155], [0164], and figure 6. At paragraph [0138] the application states that the invention includes a sorbent and a combination of additives to remove pollutants from the gas stream. At paragraph [0164], "[t]he additive can be injected where desired (e.g., before, after, or within the boiler)." Paragraphs [0124]-[0125] state that the "additives" can include those listed in Example 1E, which include HBr and Br_2. Paragraphs [0088] and [0155] state that the reactive carbon form "can be generated by the addition or bromine, hydrogen bromide, or combinations of bromine and other elements as described herein." Compounds including bromine and other elements are bromide compounds. Paragraph [0144] states that "...a bromine compound..." can be used to form the promoted sorbent; a compound including bromine is a bromide compound. New independent claim 28 is patentable for the reasons given herein for patentability of independent claim 2.

New dependent claims 29 and 30 are added, depending from independent claim 28, reciting "...wherein the coal comprises the added Br_2, HBr, the bromide compound, or a combination thereof, added to the coal upstream of the combustion chamber..." and "...wherein the combustion chamber comprises the added Br_2, HBr, the bromide compound, or a combination thereof." Support can be found in the application as filed at figure 6 and paragraph [0164], "[t]he additive can be injected where desired (e.g., before, after, or within the boiler)."

New dependent claim 31 is added, depending from independent claim 28, reciting:

> monitoring the mercury content of the cleaned gas; and
> controlling, in response to the mercury content of the cleaned gas,
> an injection rate of injecting the sorbent into the mercury-containing gas,
> a rate of addition to the coal or the combustion chamber of the added Br_2, HBr, the bromide compound, or a combination thereof, or
> a combination thereof,
> so that the mercury content of the cleaned gas is maintained at or below a desired level

Support can be found in the application as filed at paragraphs [0030] and [0032]-[0035].

New dependent claim 32 is added, depending from independent claim 28, reciting "...wherein the mercury-containing gas comprises about 1 g to about 30 g of the element bromine

per 100 g of the sorbent." Support can be found in the application as filed at paragraphs [0124]-[0126] and [0171].

New dependent claim 33 is added, depending from independent claim 28, reciting "...wherein the mercury/sorbent composition comprises the element bromine, the sorbent material, and mercury." Support can be found in the application as filed at figure 2.

Dependent claims 29-33 are dependent on independent claim 28; accordingly, these dependent claims incorporate all the features of claim 28 and are patentable for at least the reasons given herein for patentability of independent claim 28.

No new matter is added via the new claims herein.

Summary of Arguments

Response to Examiner's Rejection under 35 USC § 103

The Claims at issue stand rejected over Felsvang in view of Nelson based on the Examiner's assessment that Felsvang teaches in-flight sorbent promotion using a chlorine-based material and Nelson teaches that bromine-based materials are superior for promoting sorbents. This was, respectfully, in error. As explained below, the Examiner has not established a *prima facia* case of obviousness.

The Cited Refences Do Not Provide a Motivation to Attempt In-Flight Promotion With HBr or Br^- Over Pre-Treatment of Sorbents

As an initial matter, while Felsvang does mention supplying chloride to coal and providing activated carbon in flue gas, Felsvang does not teach that this process promotes the activated carbon. The Examiner fails to identify any teaching in the art that exposure of activated carbon to halogen- or halide-containing flue gas (as opposed to, e.g., concentrated halogen or halide gas) would generate a promoted sorbent, as opposed to, for example, the activated carbon and the halogen or halide in the flue gas providing independent, albeit complementary, mechanisms for mercury removal. For example, a person with a cold may expect aspirin and a decongestant to work well together at reducing symptoms, but that does not mean that taking the two compounds together will cause an additional beneficial chemical reaction.

To be sure, writing a decade later, Sidney Nelson acknowledges that chlorine and bromine can be used to promote carbon sorbents in-flight in the flue gas.[1] But, as the Examiner acknowledges, the Nelson reference does not teach in-flight promotion in the flue gas as a way to create a promoted sorbent, nor does Nelson teach adding any chemical to the flue gas would improve mercury removal. Quite the contrary, Nelson describes pre-treating sorbent (i.e., outside of flue gas) as an "essential element" of his invention.[2] He offers specific reasons as to why pre-treatment was viewed as essential. For example, he notes that bromine species can be "quite corrosive,"[3] the carbon should be "uniformly exposed to and reacted with the bromine,"[4] the carbon should be purged of H_2O which interferes with bromination,[5] and he describes a mixing time for HBr and activated carbon of 90 minutes or more[6]. As explained more fully below, a person of ordinary skill in the art would recognize that the combustor and flue gas ductwork are composed of corrodible metal, the concentration of halogen in the flue gas would be low, the flue gas would contain significant H_2O (e.g., 7% as per Nelson)[7], and that in-flight mixing would allow for only several seconds of contact time between the activated carbon and the promoter rather than 90 minutes. Thus, Nelson would motivate a person of ordinary skill in the art to promote sorbents in a controlled setting outside of a flue gas, not to attempt in-flight promotion in a flue gas. At the very least, Examiner has not shown that a person of ordinary skill in the art would be motivated to modify Felsvang in view of Nelson.

Objective Evidence Confirms the Patentability of the Claims

The arguments above are reflected in the story of the claimed invention. Submitted herewith is the 37 CFR § 1.132 declaration by inventor John Pavlish that describes objective evidence of

[1] Declaration A at item 18.
[2] Nelson at paragraph [0040].
[3] Nelson at paragraph [0044].
[4] Nelson at paragraph [0046].
[5] Nelson at paragraphs [0048] and [0051].
[6] Nelson at page 8, paragraph [0087] and the table at the top of the second column. For HBr-treated activated carbon, the adsorption rate was 1 gram of HBr absorbed per 1 kg of activated carbon per minute, or 0.1 wt% HBr absorbed per minute, meaning that to reach the 9 wt% HBr reported in the table required about 90 minutes. Note that Figure 14 reports results for 10 wt% HBr, and Figure 15 reports results for 9 wt% HBr. For Br_2-treated activated carbon, the adsorption rate was 10 grams of Br_2 absorbed per 1 kg of activated carbon per minute, or 1 wt% Br_2 absorbed per minute, meaning that to reach the 15 wt% Br_2 reported in the table required about 15 minutes. Note that Figures 14 and 15 report results for 1.5 wt%, 5 wt%, and 15 wt% Br_2, according to the table requiring about 1.5 to 15 minutes to form.
[7] Nelson at paragraph [0079].

nonobviousness ("Declaration A"). Mr. Pavlish explains—with support from extensive contemporaneous documentation—how the EPA kicked off a race for the development of new mercury removal technologies. From early on though, the conventional wisdom was that sorbents should be pre-treated before injection into the flue gas. While at the Energy & Environmental Research Center ("EERC"), Mr. Pavlish and his co-inventors fought against this conventional wisdom and eventually obtained millions of dollars in federal grant money to develop the claimed invention. Their efforts were so successful that the Department of Energy specifically highlighted their work as a significant achievement. Since then, this technology has been recognized as one of the most widely adopted technologies for mercury control in the U.S.

The claimed invention has had such a significant impact on the industry, that even Sidney Nelson himself (the author of the Nelson reference) eventually touted the benefits of in-flight promotion in the flue gas with bromine. In doing so, he acknowledged that this approach differed from the conventional approach of pre-treating sorbent, and he specifically cited the work of the EERC as demonstrating the benefits of in-flight promotion in the flue gas with bromine. This objective evidence of non-obviousness further establishes the patentability of these claims. *Crocs, Inc. v. Int'l Trade Comm'n*, 598 F.3d 1294, 1310 (Fed. Cir. 2010) (internal quotation marks omitted) (objective evidence "can be the most probative evidence of nonobviousness in the record, and enables the court to avert the trap of hindsight").

What follows is a detailed description of support for the arguments above, rebuttal evidence showing that the presently claimed invention has properties that could not be predicted from any cited reference, and responses to the Examiner's arguments.

Table of contents.

I. Reply to Examiner's response to 37 CFR § 1.132 Declaration by John Pavlish filed with Response of 12/3/2018. 17

II. The Office Action rejected claims 2-19 under 35 U.S.C. § 103(a) over U.S. patent no. 5,435,980 ("Felsvang") in view of U.S. patent publication no. 2004/0003716 ("Nelson"). 23

II(A). A person of ordinary skill in the art would not combine Nelson and Felsvang as alleged. 24

II(A)(1). Br_2 is not HBr and does not include HBr, and Cl_2 is not HCl and does not include HCl; also, Br_2 is not and does not include Br^-, and Cl_2 is not and does not include Cl^-. 24

II(A)(2). There would be no motivation for a person of ordinary skill in the art to use Nelson's HBr in place of Felsvang's HCl or Cl^- in Felsvang's process. 26

II(A)(2)(a). Felsvang focuses on HCl or Cl^- concentration in the flue gas. 26

II(A)(2)(b). A person of ordinary skill in the art would not combine Nelson with Felsvang as alleged because they would not know or expect in-flight promotion of the activated carbon sorbent would occur. 27

II(A)(2)(b)(i). A person of ordinary skill in the art would not combine Nelson with Felsvang as alleged because Felsvang fails to describe or suggest in-flight promotion can occur. 27

II(A)(2)(b)(ii). Promoter concentration in flue gas is low compared to during treatment outside of flue gas. 29

II(A)(2)(b)(iii). Contact time between promotors in the flue gas and activated carbon is very short compared to treatment outside the flue gas. 30

II(A)(2)(b)(iv). Consumption of hydrogen halides in the flue gas via corrosion or scavenging. 31

II(A)(2)(c). A person of ordinary skill in the art would not be motivated to use Felsvang's process with activated carbon. 31

II(A)(2)(d). Nelson provides no motivation to replace Felsvang's HCl or Cl^- treatment with Nelson's HBr treatment. 33

II(A)(3). Reply to Examiner's response to arguments. 53

II(B). In-flight promotion versus treatment outside the flue gas. 65

II(B)(1). In-flight promotion with HBr or Br^- promoters is more effective for mercury removal than treating the sorbent with HBr, Br^-, or Br_2 outside the mercury-containing gas. 65

II(B)(2). There is no way a person of ordinary skill in the art could predict that in-flight promotion of a sorbent with HBr or Br^- promoters is more effective for mercury removal than use of a sorbent that is treated with the same promoters outside the flue gas. 69

II(B)(3). Reply to Examiner's response to arguments. 71

II(C). In-flight promotion with HBr or Br^- versus HCl or Cl^- 75

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I. Reply to Examiner's response to 37 CFR § 1.132 Declaration by John Pavlish filed with Response of 12/3/2018.

The Office Action states:

> The Declaration under 37 CFR 1.132 filed 12/03/2018 is insufficient to overcome the rejection of claims based upon pre-AIA 35 U.S.C 103(a), Feiwang et al. US 5,435,80 in view of Nelson Jr. US 2004/0003716 as set forth in the last Office action because: the facts presented are not germane to the rejection at issues and the showings are not commensurate in scope with the claims.

Applicant respectfully disagrees. Herein, Applicant responds to each statement of the Office Action. A new 37 CFR § 1.132 declaration by John Pavlish is submitted herewith that describes objective evidence of nonobviousness ("Declaration A"). The 37 CFR § 1.132 declaration by John Pavlish submitted with the last response is revised and is submitted herewith ("Declaration B"). A new 37 CFR § 1.132 declaration by John Pavlish and Nicholas Lentz is submitted herewith that explains that Br_2 is not HBr and does not include HBr, and Cl_2 is not HCl and does not include HCl; that Br_2 is not and does not include Br^-, and Cl_2 is not and does not include Cl^-; NaBr is a salt that includes Na^+ ions and Br^- ions; and that NaCl is a salt that includes Na^+ ions and Cl^- ions ("Declaration C"). A new 37 CFR § 1.132 declaration by John Pavlish is submitted herewith that explains that data from Nelson's experimental setup and from the pilot-scale unit of item 8 of Declaration B are validly comparable ("Declaration D").

The Office Action states:

> Sections 2-5 details the Nelson reference.
>
> Section 6 details a bromine treated activated carbon.
>
> Section 7 details an HCl-treated activated carbon.
>
> Section 8-10 detail an experiment and results of combusting coal and then exposing the exhaust of the combustion to bromine activated carbon, only activated carbon and HCl treated activated carbon.
>
> Section 11 discloses a graph comparing NaBr on coal, AC treated with 5wt% bromine gas and untreated AC.
>
> Section 12, the declarant contends that the data provided show that NaBr added to coal prior to introduction to the furnace in the current invention provided a higher percent of mercury removal than compared to the activated carbon treated the Br2 outside of the flue gas as in the Nelson reference.

In response this contention does not overcome the rejection of record as these unexpected results are not commensurate with the scope of the claims. The applicant is claiming HBr and Br- while the graph only demonstrates HBr and not NaBr as asserted. The applicants data is unclear as to if either HBr (as specified in the actual graph) or NaBr (as specified in the legend). Further the 18.2 data point has no labeling on what the promoter is. None of the data points include what amount is being specified, wt%, vol% etc. Further the comparisons between the prior art and that of the current invention do no demonstrate unexpected results. The results would be expected by one having ordinary skill in the art as the wt% (if we are to assume the amount specified is wt%) at the amount supported on the upper most line is greater than that of the wt% on the middle trending line. The results are not commensurate with the scope of the claim as the claims do not include NaBr on coal. Lastly is unclear if the results are because of the different components being measured or because of the different method being used. In order to establish that the method being used has unexpected results the components used must be the same for both methods

As explained in Declaration C at item 28, when NaBr is added to coal, gaseous NaBr is formed in the flue gas, and HBr is formed in the flue gas. As explained in Declaration C at item 33, NaBr is a salt that includes Na^+ and Br^-. Therefore, placing NaBr on the coal (as specified in the legend of the plot given at item 11 of Declaration B) results in formation of HBr and Br^- in the flue gas (as specified in the graph), and the results shown are commensurate with the scope of the claims. In the graphs in Declaration B all halides in the flue gas formed from halide salts placed on the coal are assumed to be in the form of the respective hydrogen halide for comparative purposes, although these could be in the form of the gaseous halide salt or the hydrogen halide—this assumption is made for consistency across all the graphs in Declaration B. As the graphs show trends between %Hg removal and halide content of the flue gas, so long as the amounts of the different halides present in the flue gas are compared in a consistent way it does not matter whether they are in the form of the hydrogen halide or the halide ion in the flue gas for purposes of comparing relative %Hg removal.

The data table at item 10 of Declaration B shows that the 18.2 data point of the plot shown at item 11 corresponds to 18.2 wt% HBr, and that all of the labels on the data set "NaBr on coal with AC injected into flue gas" indicate wt% HBr. Additionally, for increased clarity, Declaration B is revised to indicate wt% and that properly labels the 18.2 data point in the plot shown at item 11.

The Office Action states that the results would be expected by one having ordinary skill in the art because the amount of HBr on the upper line, representing NaBr on coal with AC injected into the flue gas, are greater than the wt% of the middle trending line, representing AC treated with 5 wt% bromine outside the flue gas as per the Nelson procedure. Applicant does not agree that the results are expected. The unexpected results described in the Response are that in-flight promotion of a sorbent with HBr or Br^- promoters is more effective for mercury removal than use of a sorbent that is treated with the same promoters outside the flue gas (as explained herein at **II(B)**), and that in-flight promotion with HBr or Br^- promoters is more effective for mercury removal than in-flight promotion with HCl or Cl^- promoters (as explained herein at **II(C)**). Applicant included the plot at item 11 primarily to show that adding NaBr to coal and injecting untreated AC into the flue gas is an effective way to remove mercury.

The Office Action states that it is not clear whether the results are because of different components being reacted or because of the different method being used. However, all of the data shown in the plot at item 11 of Declaration B is shown in the tables at items 9 and 10 of Declaration A, which is all derived from the same pilot-scale test unit described at item 8 of Declaration B, using the same components, the same type of AC, and the same method, with the only variations between the data sets being the type of treatment of the AC (i.e., no treatment, treatment with Br_2 outside the flue gas prior to injection, and adding NaBr to coal while injecting untreated AC into the flue gas); item 11 of Declaration B has been revised to clarify this point.

The Office Action states:

> [section 13 details the percent mercury removal per 1 wt% HBr or HCl and Milligrams of HBr/MMacf per 1@ Hg removed.
>
> Section 14, the declarant contends that the NaBr added to coal prior to introduction to the furnace results in a significantly higher percent mercury removal than that of Nelson's activated carbon treated with HBr outside of the flue gas. The declarant further contends that NaBr added to coal prior to introduction to the furnace provided a significantly lower milligrams of HBr/MMacf per 1% mercury removal when compared to Nelsons activated carbon treated with HBr outside of the flue gas.

The examiner asserts that these results do not overcome the rejection as claimed as they are not commensurate with the scope of the claim and do not present factual evidence germane to the patentability. The first graph has HBr treated AC compared to NaCl on coal with AC injected into flue gas. It is unclear if the results are because of the different components being reacted or because of the different method being used. In order to establish that the method being used has unexpected results the components used must be the same for both methods. Further the examiner points to the y axis which has NO or HBr which is not included in one set (NaCl) of the data points so it is unclear how the data points are being obtained. The second graph includes Nelson's HBr treated AC compared to NaBr on coal with AC injected into flue gas. Clearly the amount of HBr (y-axis) would be lower for the NaBr as NaBr on coal with AC injected into flue gas does not include HBr, it is unclear how the NaBr on coal with AC inject into flue gas has any amount of HBr. Lastly it is unclear if the results are because of the different components being reacted or because of the different method being used. In order to establish that the method being used has unexpected results the components used must be the same for both methods.

The Office Action states that in order to establish that the method being used has unexpected results the components used must be the same for both methods. However, in the first and second graphs at item 13 of Declaration B, the data sets "NaBr on coal with AC injected into flue gas" and "NaCl on coal with AC injected into flue gas" are both shown in the table in item 10. All of the data in the table at item 10 of Declaration B is derived from the same pilot-scale test unit described at item 8 of Declaration B, using the same components, the same type of AC, and the same method, with the only variations between the data sets being the type of treatment of the AC (i.e., adding NaBr to coal while injecting untreated AC into the flue gas, or adding NaCl to coal while injecting untreated AC into the flue gas); item 13 of Declaration B has been revised to clarify this point. Although the data set "Nelson's HBr-treated AC" is from Nelson, and Nelson used a different experimental setup than described at item 8 of Declaration B, Nelson's data is only compared to the data gathered from the pilot-scale test unit of item 8 at part **II(B)** of the Response, with parts **II(C)** and **II(D)** only comparing data gathered from the pilot-scale unit of item 8. Further, as explained at item 9 of Declaration D and at **II(B)(1)** herein, data from Nelson's experimental setup and from the pilot-scale unit of item 8 of Declaration B are validly comparable—further, Nelson's conditions used in Examples 5 and 7 allow for easier mercury removal than in the pilot-scale unit of item 8 of Declaration B, such that if Nelson's Example 5 and 7 HCl and mercury concentrations were

changed to match those of the pilot-scale setup described at item 8 of Declaration B, Nelson's sorbents would remove a lower percentage of mercury than found in Nelson's Examples 5 and 7.

With regard to the second plot at item 13 of Declaration B, the Office Action states that the amount of HBr would be lower for the NaBr as NaBr on coal with AC injected into the flue gas does not include HBr, and that it is unclear how the NaBr on coal with AC injected into flue gas has any amount of HBr. However, as explained in Declaration C at item 28, when NaBr is added to coal, gaseous NaBr is formed in the flue gas, and HBr is formed in the flue gas. NaBr is a salt that includes Na^+ and Br^-. Therefore, placing NaBr on the coal results in formation of HBr and Br^- in the flue gas, and the results shown are commensurate with the scope of the claims. In the graphs in Declaration B all halides in the flue gas formed from halide salts placed on the coal are assumed to be in the form of the respective hydrogen halide for comparative purposes, although these could be in the form of the gaseous halide salt or the hydrogen halide—this assumption is made for consistency across all the graphs in Declaration B. As the graphs show trends between %Hg removal and halide content of the flue gas, so long as the amounts of the different halides present in the flue gas are compared in a consistent way it does not matter whether they are in the form of the hydrogen halide or the halide ion in the flue gas for purposes of comparing relative %Hg removal.

With regard to the first plot at item 13 of Declaration B, the Office Action states that the y-axis has HCl or HBr which is not included in one set (NaCl) of the data points so it is unclear how the data points are being obtained. However, the y-axis in this plot is used to designate HCl in the flue gas formed from the NaCl on coal, or to designate HBr in the flue gas formed from the NaBr on coal or HBr added to the AC outside the flue gas prior to injecting the AC into the flue gas, in order to clearly compare the relative mercury removal of HBr and HCl under various conditions (e.g., it would be harder to see the difference if HBr and HCl were given on separate plots). The data shown in the first plot at item 13 of Declaration B is shown in the table at item 10 which clearly shows the data plotted. Further, in order to increase clarity, the title of the first plot at item 13 has been changed to "%Hg Removal Per 1 wt% HBr (from NaBr on coal or directly added to AC prior to injection) or HCl (from NaCl on coal)."

The Office Action states:

> Section 15 details the % Hg Removal Per 1wt% HCl and Milligram of HCl/Mmacf per 1% Hg Removed.

> Section 16. The declarant contends that activated carbon treated with HCl outside the flue gas provided a much higher percent of mercury removal than compared to NaCl added to coal prior to introduction to the furnace. The declarant further contends that the milligrams of HCl/MMacf per 1% mercury removal versus the sorbent injection rate with NaCl added to coal prior to introduction to the furnace with injection of untreated activated carbon in the flue gas was higher than that of activated carbon treated with HCl outside the flue gas.
>
> The examiner asserts that these results do not overcome the rejection as claimed as they are not commensurate with the scope of the claim and do not present factual evidence germane to the patentability. The graphs have NaCl compared to HCl. It is unclear if the results are because of the different components being reacted or because of the different method being used. In order to establish that the method being used has unexpected results the components used must be the same for both methods. Further the examiner points to the y-axis, which has HCl which is not included in one set (NaCl) of the data points, so it is unclear how the data points are being obtained.

The Office Action states that the y-axis has HCl which is not included in one set (NaCl) of the data points so it is unclear how the data points are being obtained. However, as explained in Declaration C at item 28, when NaCl is added to coal, gaseous NaCl is formed in the flue gas, and HCl is formed in the flue gas. NaCl is a salt that includes Na^+ and Cl^-. Therefore, placing NaCl on the coal results in formation of HCl and Cl^- in the flue gas. In the graphs in Declaration B all halides in the flue gas formed from halide salts placed on the coal are assumed to be in the form of the respective hydrogen halide for comparative purposes, although these could be in the form of the gaseous halide salt or the hydrogen halide—this assumption is made for consistency across all the graphs in Declaration B. As the graphs show trends between %Hg removal and halide content of the flue gas, so long as the amounts of the different halides present in the flue gas are compared in a consistent way it does not matter whether they are in the form of the hydrogen halide or the halide ion in the flue gas for purposes of comparing relative %Hg removal.

The Office Action states that the components used must be the same for both methods. However, the data sets in the first and second plots at item 15 of Declaration B were taken from the table at item 10, which was produced using the same pilot-scale setup described at item 8, using the same components, the same type of AC, and the same method, with the only variations between the data sets being the type of treatment of the AC (i.e., AC treated with 5 wt% HCl outside the flue gas

prior to injection into the flue gas, or placing NaCl on the coal and injection of untreated AC into the flue gas); item 15 of Declaration B has been revised to clarify this point.

The Office Action states that the results shown in the graphs at item 15 of Declaration B do not present factual evidence germane to patentability. However, as explained herein at **II(A)(2)(c)** and **II(D)**, Felsvang fails to describe or suggest that in-flight promotion of activated carbon with HCl or Cl^- in the flue gas provides better mercury removal than treatment of activated carbon outside the flue gas with HCl or Cl^-. The data in the graphs at item 15 of Declaration B demonstrate that if one of ordinary skill in the art were to investigate Felsvang's embodiments including activated carbon and compare the relative mercury-removal ability to that of activated carbon treated with HCl outside the flue gas, they would find that treatment of activated carbon outside the flue gas with HCl as per Nelson's process actually provides more effective mercury removal per wt% HCl than treatment of activated carbon with HCl or Cl^- in the flue gas, which would lead one of ordinary skill in the art away from using in-flight promotion in the first place. Therefore, the data in the graphs at item 15 of Declaration B are germane to patentability because they show evidence that a person of ordinary skill in the art hypothetically having Felsvang and Nelson in-hand would not select the Felsvang process to follow or modify and therefore would not be motivated to combine Felsvang and Nelson as alleged.

The Rejection of Claims Under §103

II. The Office Action rejected claims 2-19 under 35 U.S.C. § 103(a) over U.S. patent no. 5,435,980 ("Felsvang") in view of U.S. patent publication no. 2004/0003716 ("Nelson").

This rejection is respectfully traversed.

As explained herein at **II(A)**, a person of ordinary skill in the art would not combine Nelson and Felsvang as alleged. Part **II(B)** discusses in-flight promotion with HBr or Br^- in the flue gas versus treatment outside the flue gas. As explained herein at **II(B)(1)**, in-flight promotion with HBr or Br^- promoters is more effective for mercury removal than treating the sorbent with HBr, Br^-, or Br_2 outside the mercury-containing gas, and as explained herein at **II(B)(2)**, there would be no way for a person of ordinary skill in the art to predict this advantage from the cited references. Part **II(C)** discusses in-flight promotion in the flue gas with HBr or Br^- versus HCl or Cl^-. As explained herein at **II(C)(1)**, in-flight promotion with HBr or Br^- promoters is more effective for mercury

removal than in-flight promotion with HCl or Cl^- promoters, and as explained herein at **II(C)(2)**, there would be no way for a person of ordinary skill in the art to predict this advantage from the cited references. Part **II(D)** explains that a person of ordinary skill in the art would find that treatment of activated carbon outside the flue gas with HCl as per Nelson's process actually provides more effective mercury removal per wt% HCl than treatment of activated carbon with HCl or Cl^- in the flue gas. As explained herein at **II(D)(1)**, even if a person of ordinary skill in the art compared the mercury removal of activated carbons promoted with HCl or Cl^- in the flue gas to activated carbons treated with HCl outside of the flue gas, they would not determine that in-flight promotion provides the same or better mercury removal properties per wt% HCl. Section **II(E)** discusses objective evidence of non-obviousness of the claimed invention. Sections **II(A)(3)**, **II(B)(3)**, **II(C)(3)**, and **II(D)(2)** reply to the Examiner's responses to arguments made in the Response of 12/3/2018.

II(A). A person of ordinary skill in the art would not combine Nelson and Felsvang as alleged.

As explained herein at **II(A)(1)**, Br_2 is not HBr and does not include HBr, and Cl_2 is not HCl and does not include HCl; also, Br_2 is not and does not include Br^-, and Cl_2 is not and does not include Cl^-. As explained herein at **II(A)(2)**, there would be no motivation for a person of ordinary skill in the art to use Nelson's HBr in place of Felsvang's HCl or Cl^- in Felsvang's process. Section **II(A)(3)** includes replies to the Examiner's responses to arguments in the Response of 12/3/2018.

II(A)(1). Br_2 is not HBr and does not include HBr, and Cl_2 is not HCl and does not include HCl; also, Br_2 is not and does not include Br^-, and Cl_2 is not and does not include Cl^-.

As explained in Declaration C at item 17, hydrogen halides are diatomic molecules including a halogen atom and a hydrogen atom; in contrast, elemental halogens are diatomic molecules including two of the same halogen atom. HBr and HCl each include a hydrogen atom and one halogen atom, while Br_2 and Cl_2 each include two halogen atoms. Hydrogen halides have different properties than elemental halogens and are therefore different compounds. HBr has a molecular weight of 80.91 g/mol, while Br_2 has a molecular weight of 159.81 g/mol; HBr has a boiling point of -67 °C, while Br_2 has a boiling point of 58.8 °C; HBr has a melting point of -87 °C, while Br_2 has a melting point of -7.2 °C. HCl has a molecular weight of 36.46 g/mol, while Cl_2 has

a molecular weight of 70.91 g/mol; HCl has a boiling point of -85 °C, while Cl_2 has a boiling point of 70.91 g/mol; HCl has a melting point of -114 °C, while Cl_2 has a melting point of -101 °C. Hydrogen halides are not part of and cannot be extracted or isolated from elemental halides; rather, only via a chemical reaction that results in a chemical and structural change can hydrogen halides be formed from elemental halides. Hydrogen bromide is produced by reacting hydrogen and Br_2 at about 200-400 °C, a reaction that is typically catalyzed by platinum or asbestos. Hydrogen chloride is produced by reacting hydrogen and chlorine with one another. Therefore, elemental halogens are not hydrogen halides, and do not include hydrogen halides—Br_2 is not HBr and does not include HBr, and Cl_2 is not HCl and does not include HCl.

As explained in Declaration C at item 18, chlorine has an atomic number of 17, meaning it has 17 protons and 17 electrons, giving it an electron configuration of $1s^2 2s^2 2p^6 3s^2 3p^5$, having 7 electrons in its outer shell. Bromine has an atomic number of 35, meaning it has 35 protons and 35 electrons, giving it an electron configuration of $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^5$, also having 7 electrons in its outer shell. According to the octet rule, a halogen atom desires to fill its outer shell with 8 electrons total by gaining one electron. A halide ion is a halogen atom that has accepted an electron from an electron doner, in the case of chloride (Cl^-) giving it 18 total electrons to give a total charge of -1, and in the case of bromide (Br^-) giving it 36 total electrons to give a total charge of -1. Halogen atoms do not donate electrons to other atoms, because this would result in a halogen atom losing an electron to have 6 electrons in its outer shell, an unstable configuration according to the octet rule. In the case of an elemental halogen, which exists as a diatomic molecule, instead of donating electrons to one another, each halogen atom shares one of its electrons in the outer shell with the other halogen atom via overlapping electron orbitals in a covalent bond, allowing each halogen atom to have a filled octet while the diatomic molecule remains neutrally charged. Therefore, a halogen atom does not donate electrons to another halogen atom to form a halide, and a diatomic halogen molecule never includes a halide; Br_2 is not and does not include Br^-, and Cl_2 is not and does not include Cl^-.

II(A)(2). There would be no motivation for a person of ordinary skill in the art to use Nelson's HBr in place of Felsvang's HCl or Cl^- in Felsvang's process.

Independent claim 2 recites "…a halogen or halide promoter comprising HBr, Br^-, or a combination thereof…."

The Office Action admits that Felsvang fails to describe or suggest a halogen or halide promoter that is Br_2, HBr, or Br^-. Nelson fails to describe or suggest in-flight promotion of activated carbon with a halide or hydrogen halide in the flue gas. The Office Action alleges that one of ordinary skill in the art would replace Felsvang's HCl or Cl^- with Nelson's HBr to accomplish the presently claimed method, stating that such a modification of Felsvang would be made "…to promote activated carbon (Nelson paragraphs [0017] and [0041]) so as to provide an effective carbon sorbent for mercury." (Office Action, page 4, last sentence of second full paragraph). Applicant respectfully disagrees. As explained below, a person of ordinary skill in the art would not be motivated to use Nelson's HBr in Felsvang's process, because Nelson fails to describe or suggest that HBr-treatment of activated carbon provides similar, let alone improved, mercury-removal ability as compared to HCl or Cl^--treatment of activated carbon.

As explained herein at **I(A)(2)(a)**, Felsvang focuses on HCl or Cl^- concentration in the flue gas. As explained herein at **I(A)(2)(b)**, a person of ordinary skill in the art would not combine Nelson with Felsvang as alleged because Felsvang fails to describe or suggest in-flight promotion can occur. As explained herein at **I(A)(2)(c)**, a person of ordinary skill in the art would not be motivated to use Felsvang's process with activated carbon. As explained herein at **II(A)(2)(d)**, Nelson provides no motivation to replace Felsvang's HCl or Cl^- treatment with Nelson's HBr treatment.

II(A)(2)(a). Felsvang focuses on HCl or Cl^- concentration in the flue gas.

Felsvang is directed to adding chlorine (Cl_2) or chloride (Cl^-) materials to the coal or combustion products. Felsvang makes clear that addition of chlorine or chloride material increases the amount of chloride supplied to the flue gas, or to the drying-absorption zone, see, Abstract and col. 3, lines 40-44. Felsvang states at col. 3, line 67 bridging to col. 4, line 4: "[i]t has been experienced that the increase of the Hg-removing effect of chloride addition to the drying-absorption zone in a process treating flue gases of low chloride content is especially remarkable

when activated carbon is present...." Felsvang states at col. 4, lines 51-55: "...most chloride or chlorine containing compounds will release gaseous chlorides when introduced into the combustion zone of a coal fired boiler...." Felsvang states at col. 6, lines 3-11:

> **If the chloride content is found to be below a certain value as defined above and in the attached claims arrangements are taken according to the invention for increasing the gas chloride content. This may be done in connection with an introduction of activated carbon which in itself also has a Hg removing effect and together with chloride addition exihibts a synergistic effect enabling an extremely efficient Hg removal.**

At column 3, lines 53-55, Felsvang states that "[t]he term 'chloride' is intended to mean chloride ions as such or gaseous hydrogene chloride or compounds which by heating in the presence of coal forms Cl^- or HCl." Thus, Felsvang gives a definition of "chloride" that includes both HCl and Cl^-.

II(A)(2)(b). A person of ordinary skill in the art would not combine Nelson with Felsvang as alleged because they would not know or expect in-flight promotion of the activated carbon sorbent would occur.

As explained herein at **II(A)(2)(b)(i)**, a person of ordinary skill in the art would not combine Nelson with Felsvang as alleged because Felsvang fails to describe or suggest in-flight promotion can occur. As explained herein at **II(A)(2)(b)(ii)**, promoter concentration in flue gas is low compared to during treatment outside of flue gas. As explained herein at **II(A)(2)(b)(iii)**, contact time between promotors in the flue gas and activated carbon is very short compared to treatment outside the flue gas. As explained herein at **II(A)(2)(b)(iv)**, a person of ordinary skill in the art would believe that hydrogen halides in the flue gas would be consumed via corrosion or scavenging.

II(A)(2)(b)(i). A person of ordinary skill in the art would not combine Nelson with Felsvang as alleged because Felsvang fails to describe or suggest in-flight promotion can occur.

Felsvang fails to describe or suggest that any reaction occurs between activated carbon and HCl in the flue gas. Felsvang's primary focus is the enhancement of HCl or Cl^- concentration in the

flue gas, with addition of activated carbon being optional and not required to experience the effect of the invention. At col. 6, lines 29-33, Felsvang states "...the chloride introduction may alternatively be performed separately from the introduction of activated carbon or it may be performed without using activated carbon." At col. 6, lines 8-11, Felsvang explains that, in addition to increasing the chloride content, (emphasis added) "[t]his may be done in connection with an introduction of activated carbon which in itself also has a Hg removing effect and together with chloride addition exhibits a synergistic effect enabling an extremely efficient Hg removal." Felsvang therefore describes that activated carbon removes mercury, and that increasing HCl or Cl^- content removes mercury, and when the two are used together they operate side-by-side, failing to describe or suggest any reaction that occurs between the HCl or Cl^- and the activated carbon. Only a portion of Felsvang's Example 4 demonstrates the use of activated carbon with HCl or Cl^-, finding only a small increase in mercury-removal activity (discussed herein at **II(A)(2)(c)**), while the majority of Felsvang's Examples (1-3) are devoid of any mention of activated carbon.

In contrast, Nelson describes a chemical reaction that occurs between the halogens and the activated carbon, and disparages simple impregnation or physical adsorption of halogens onto the activated carbon, explaining at paragraphs [0017] and [0044] that physical adsorption leads to desorption from the activated carbon. Nelson explains at paragraphs [0044] and [0053] that elevated temperatures should be used during the treatment of the activated carbon with the bromine gas to minimize physical absorption and maximize chemical reaction between the bromine and the activated carbon which avoids desorption of the bromine during transport, storage, and upon injection into a hot gas stream.

A person of ordinary skill in the art would have to understand that a reaction can occur between Felsvang's HCl or Cl^- and the activated carbon in Felsvang's flue gas in order to understand that Nelson's bromine-treated sorbents have any similarity to the sorbents of Felsvang. With Felsvang's failure to describe or suggest any chemical reaction between the activated carbon and the HCl or Cl^- in the flue gas, a person of ordinary skill in the art would have no idea that Nelson's hydrogen bromide could be used in place of Felsvang's HCl or Cl^-. Therefore, a person of ordinary skill in the art would not replace Felsvang's HCl or Cl^- with HBr or Br^-. Independent claim 2 is patentable for at least this reason.

Merely for the sake of argument, if a person of ordinary skill in the art were to simply inject Nelson's HBr-treated activated carbon into Felsvang's flue gas, the resulting process would not be encompassed by the present claims. Independent claim 2 recites "...the mercury-containing gas comprises a halogen or halide promoter comprising HBr, Br^-, or a combination thereof ...; injecting a sorbent material comprising activated carbon into the mercury-containing gas downstream of the combustion chamber such that the activated carbon reacts with the halogen or halide promoter in the mercury-containing gas to form a promoted sorbent...." Felsvang's flue gas is not described or suggested to include a halogen or halide promoter including HBr, Br^-, or a combination thereof, and no such promoter would enter the flue gas from Nelson's sorbent because the HBr is chemically reacted with the activated carbon and therefore not desorbable from Nelson's sorbent. In addition, no reaction would occur in the flue gas between the activated carbon and the HBr used to treat Nelson's activated carbon because the materials would have already been heated together outside the flue gas to maximize chemical reactions therebetween. Independent claim 2 also recites "...the coal comprises added Br_2, HBr, Br^-, or a combination thereof, added to the coal upstream of the combustion chamber, or the combustion chamber comprises added Br_2, HBr, Br^-, or a combination thereof, or a combination thereof...", not described or suggested by Nelson or Felsvang.

II(A)(2)(b)(ii). Promoter concentration in flue gas is low compared to during treatment outside of flue gas.

At paragraph [0051] Nelson gives a preference for the use of pure Br_2 or HBr to treat the activated carbon. Nelson's Examples do not mention the use of a carrier gas to dilute the halogen gases used to prepare the treated sorbents used therein.

Forming HBr or Br^- in the flue gas from bromide salts such as NaBr on coal gives a very low concentration of HBr/Br^- in the flue gas compared to pure HBr. A person of ordinary skill in the art would believe the concentration of HBr/Br^- in the flue gas would be too low to result in effective treatment of activated carbon injected into the flue gas, especially considering the short contact time between the HBr/Br^- and the activated carbon as discussed herein at **II(A)(2)(b)(iii)**.

II(A)(2)(b)(iii).Contact time between promotors in the flue gas and activated carbon is very short compared to treatment outside the flue gas.

As explained in Declaration A at item 10, Nelson states repeatedly that the bromine-containing gas is to be contacted with the activated sorbent "for a sufficient time" to increase the ability of the activated carbon to adsorb mercury. See, e.g., Abstract and paragraphs [0023] and [0028]. Nelson at page 8, paragraph [0087] and the table at the top of the second column describes contact times required to form HBr- and Br_2-treated activated carbons. For HBr-treated activated carbon, the adsorption rate was 1 gram of HBr absorbed per 1 kg of activated carbon per minute, or 0.1 wt% HBr absorbed per minute, meaning that to reach the 9 wt% HBr reported in the table required about 90 minutes. Note that Figure 14 reports results for 10 wt% HBr, and Figure 15 reports results for 9 wt% HBr. For Br_2-treated activated carbon, the adsorption rate was 10 grams of Br_2 absorbed per 1 kg of activated carbon per minute, or 1 wt% Br_2 absorbed per minute, meaning that to reach the 15 wt% Br_2 reported in the table required about 15 minutes. Note that Figures 14 and 15 report results for 1.5 wt%, 5 wt%, and 15 wt% Br_2, according to the table requiring about 1.5 to 15 minutes to form. In contrast, as explained in Declaration A at item 10, contact times between a promoter in the flue gas and activated carbon injected therein are generally less than 10 seconds.

As explained in Declaration A at item 8, before the priority date of the present claims, the EPA did not recommend in-flight sorbent enhancement in the flue gas by spraying additives on coal or injecting halogens into the boiler. Rather, it described research into methods for *pre-treating* sorbents with various additives, including chlorine, and then injecting those pre-treated sorbents downstream from the boiler. This approach ensured that the sorbent additive would have plenty of time to react with the sorbent—the EPA explained that, for many plants, injected sorbents would have only a few seconds to find and react with mercury present in the flue gas, with high and costly carbon-to-Hg ratios needed to achieve adequate mercury removal.

A person of ordinary skill in the art would believe the contact time between HBr/Br^- in the flue gas would be too short to increase the ability of the activated carbon injected into the flue gas to adsorb mercury, especially considering the low concentration of HBr/Br^- in the flue gas as discussed herein at **II(A)(2)(b)(ii)**.

II(A)(2)(b)(iv).Consumption of hydrogen halides in the flue gas via corrosion or scavenging.

As explained in Declaration A at item 10, Nelson states at paragraph [0044] that a corrosion-resistant material should line the equipment used to mix the bromine gas and the activated carbon "...because the bromine species can be quite corrosive." Nelson states at paragraph [0051] that "[i]t it not a preferred embodiment of this invention to include water with the bromine gas vapor if this causes corrosion problems in the processing equipment that outweigh any advantages."

As explained in Declaration A at item 8, before the priority date of the presently claimed invention, the EPA did not recommend in-flight sorbent enhancement in the flue gas by spraying additives on coal or injecting halogens into the boiler. Rather, it described research into methods for *pre-treating* sorbents with various additives, including chlorine, and then injecting those pre-treated sorbents downstream from the boiler. This approach ensured that, e.g., chlorinating agents could react with the sorbent material without being "scavenged" by other chemicals present in the boiler.

A person of ordinary skill in the art would believe that HBr in the flue gas would be consumed via corrosion of the combustion chamber and other metallic areas of the coal-combustion plant in contact with the flue gas, or via scavenging by other species present in the flue gas. As a result, a person of ordinary skill in the art would believe that an inadequate concentration of HBr would be present for reaction with activated carbon injected into the flue gas, especially considering the low concentration of HBr/Br^- in the flue gas as discussed herein at **II(A)(2)(b)(ii)**, and the short contact time between the HBr/Br^- and the activated carbon as discussed herein at **II(A)(2)(b)(iii)**.

II(A)(2)(c). A person of ordinary skill in the art would not be motivated to use Felsvang's process with activated carbon.

Felsvang gives no data showing that the addition of HCl or Cl^- additives to coal can produce enhanced HCl or Cl^- concentrations in the activated carbon. Felsvang includes only a single Example showing the use of activated carbon for mercury removal, Example 4, the relevant portions of which are reproduced below (col. 9, lines 21-46):

HCl concentration in the flue gas was 142 mg/Nm^3. Mercury was measured in and out of the system. The following results were achieved:

Inlet μgHg/Nm^3 at 5% O_2	Outlet μgHg/Nm^3 at 5% O_2	% Removal
5.4	0.14	97
5.2	0.18	97
5.0	0.20	96
4.7	0.18	96

Average removal with this system is 96%.

The above process was modified by adding activated carbon through conduit 14 to the stream of flue gas in duct 4 upstream of the drying chamber. Mercury was measured in and out of the system.

The following results were achieved:

Amount of carbon mg/Nm^3	Inlet μgHg/Nm^3 at 5% O_2	Outlet μgHg/Nm^3 at 5% O_2	% Removal
8	4.0	0.10	98
8	4.4	<0.01	>99.8
36	6.2	0.01	99.8
36	5.6	<0.01	>99.7

Felsvang finds in Example 4 that HCl alone provided 96-97% mercury removal, while the addition of activated carbon provided 98-99.8% mercury removal, an improvement of only 1-3.8%. In contrast, Felsvang's Comparative Examples 1-3, performed with no added HCl or Cl^- in the flue gas and no activated carbon, had a mercury removal of 1-37%. The activated carbon in Example 4 provided scarcely any improvement, with the vast majority of mercury removal improvement occurring in the presence of HCl alone without activated carbon. An improvement of 1-3.8% does not demonstrate a synergistic effect between HCl and activated carbon, especially in view of the 60-96% improvement in mercury removal achieved by HCl alone when Example 4 is compared to Comparative Examples 1-3. One of ordinary skill in the art would know that such a small

improvement could have been caused by variability in combustion gas conditions and the accuracy of the measurements---evidence for any improvement from the use of activated carbon with the HCl in Felsvang is very weak and may not have occurred at all.

In addition, Felsvang fails to describe or suggest that in-flight promotion of activated carbon with HCl or Cl^- in the flue gas provides better mercury removal than treatment of activated carbon outside the flue gas with HCl. If one of ordinary skill in the art were hypothetically considering whether to use Felsvang's HCl or Cl^- treatment of activated carbon in the flue gas or Nelson's treatment of activated carbon outside the flue gas to remove mercury, that person would pick the process that results in the best mercury removal. As an initial matter, before considering modifying either one of the references, the person of ordinary skill would notice the extremely poor improvement (if any improvement actually occurred) caused by addition of activated carbon in Felsvang's sole Example showing the use of activated carbon (Example 4) and would question whether Felsvang's process is an efficient way to use activated carbon for mercury removal as compared to Nelson's process. If one of ordinary skill in the art were to investigate Felsvang's embodiments including activated carbon and compare the relative mercury-removal ability to that of activated carbon treated with HCl outside the flue gas, as shown herein at **II(D)**, they would find that treatment of activated carbon outside the flue gas with HCl as per Nelson's process actually provides more effective mercury removal per wt% HCl than treatment of activated carbon with HCl or Cl^- in the flue gas, which would lead one of ordinary skill in the art away from using Felsvang's process in the first place.

Therefore, a person of ordinary skill in the art hypothetically having Felsvang and Nelson in-hand would not select the Felsvang process to follow or modify and therefore would not be motivated to combine Felsvang and Nelson as alleged. Independent claim 2 is patentable over Felsvang and Nelson for this additional reason.

II(A)(2)(d). Nelson provides no motivation to replace Felsvang's HCl or Cl^- treatment with Nelson's HBr treatment.

For a person of ordinary skill in the art to be motivated to replace Felsvang's HCl- or Cl^--treatment with treatment by another material to provide an effective activated carbon sorbent for mercury removal, that person would need to think that the material they are using to replace the HCl

or Cl^- would result in the same or better mercury-removal efficiency. However, as explained below, Nelson fails to describe or suggest that treatment of activated carbon with HBr provides the same, let alone better, mercury removal efficiency as activated carbon treated with HCl or Cl^-.

At paragraph [0017], Nelson states:

> **[0017]** The particular advantages of using bromine, rather than iodine or iodides, or chlorine or chlorides, with activated carbons for mercury control have not been previously appreciated. Gaseous bromine and hydrogen bromide have been combined with carbon substrates before, but not to sequester mercury from hot combustion-gas streams. For example, Greinke U.S. Pat. No. 5,372,619 found that bromine-treated carbon can make a superior natural-gas storage medium. In another example, SKC Inc. sells a small tube with hydrobromic acid-treated charcoal to sample air for ethylene oxide. However, with both of these uses it is important that the adsorption targets, natural gas and ethylene oxide, be easily desorbable from the carbon, the exact opposite of what is required in a mercury vapor sequestration application. In a similar vein, in U.S. Pat. No. 6,475,461 Ohsaki describes a process for treating carbon substrates with gaseous bromine or chlorine, but then explicitly desorbs them to achieve his desired product. Seki U.S. Pat. No. 3,961,020; Yoshida and Seki et al. U.S. Pat. No. 4,174,373; and Knoblauch et al. U.S. Pat. No. 5,179,058 impregnate activated carbon with bromine to produce a catalyst for reacting nitrogen oxide with ammonia to form nitrogen and water. In this application too, the bromine of the carbon does not act as a sequestration agent, permanently tying up its target. Rather, it serves as a catalyst, taking part in a repeated series of desired chemical reactions, but not becoming permanently consumed by any of them. Perhaps it is understandable that the tenacity of carbon-bromine-mercury complexes could be overlooked.

The first sentence of paragraph [0017] refers to the "…particular advantages of using bromine…" for treatment of activated carbons for mercury control, which must mean either elemental bromine (Br_2) or the element bromine generally, and is not a specific reference to bromides (Br^-). The "…particular advantages of using bromine…" is compared to iodine (I_2),

iodides (I^-), chlorine (Cl_2), and chlorides (Cl^-), but no specific comparison is made between bromides (Br^-) and chlorides (Cl^-). However, it does not make sense for Nelson to refer to the element bromine generally while specifically distinguishing between chlorine (Cl_2) and chlorides (Cl^-), and iodine (I_2) and iodides (I^-) in the same sentence. If Nelson wanted to compare both elemental bromine (Br_2) and hydrogen bromide (HBr) to the other halides specifically disclosed in the first sentence, Nelson would have specifically distinguished between bromine (Br_2) and bromides (Br^-); therefore, "…bromine…" in the first sentence of paragraph [0017] would be interpreted as elemental bromine (Br_2), and not as the element bromine generally.

No "…particular advantages of using bromine…" are explicitly described in paragraph [0017], with the remainder of the paragraph focusing on the failure of the prior art to use bromine with activated carbon for mercury control, describing various disadvantages of other processes, such as the desorbability of Br_2, HBr, or Cl_2 from the activated carbon, or the failure of the Br_2 or HBr to act as a mercury sequestration agent. The paragraph concludes with a statement that it is understandable that "…the tenacity of carbon-bromine-mercury complexes…" could be overlooked, which must refer to complexes including either elemental bromine (Br_2) or the element bromine generally, with no specific reference to bromide (Br^-) or complexes formed therefrom. The concluding statement of paragraph [0017] is directed toward the discussion in the bulk of paragraph [0017]—the prior art fails to use bromine with activated carbon for mercury control and therefore fails to generate carbon-bromine-mercury complexes—rather than as a statement of any relative advantage of bromine over other halogens or halides. The "…tenacity of carbon-bromine-mercury complexes…" is not specifically compared to the strength of any other complexes, such as carbon-chlorine-mercury complexes, carbon-chloride-mercury complexes, carbon-iodine-mercury complexes, or carbon-iodide-mercury complexes; therefore, at best, the "…tenacity…" of the complexes described in the last sentence of paragraph [0017] can be regarded as a general statement, rather than as a comparative one. Paragraph [0017] fails to attribute any advantage of Nelson's invention specifically to HBr or Br^-, and, moreover, fails to describe or suggest that HBr or Br^- treatment of activated carbon could provide equal, let alone better, mercury removal than HCl or Cl^- treatment of the activated carbon.

At paragraphs [0019]-[0022], Nelson states:

> **[0019]** Accordingly, it is an object of the present invention to provide a sorbent material that can be injected into a hot mercury-containing combustion gas, so that a significant portion of the mercury is adsorbed onto the sorbent and removed from the flue gas with the combustion fly ash.
>
> **[0020]** Further, it is an object of the present invention to provide a flexible, retrofitable mercury-control method that can be applied to a number of combustion gas streams and a wide range of exhaust system equipment configurations.
>
> **[0021]** In addition, it is an object of the present invention to provide a mercury sorbent material that is simple and inexpensive to manufacture and use.
>
> **[0022]** It is also an object of the present invention to provide a mercury sorbent material that causes the adsorbed gas-phase mercury to become essentially permanently-sequestered from future interactions with the environment.

Paragraphs [●●19]-[●●22] describe several general advantages of Nelson's activated carbon treatment, including the ability to remove mercury from a hot mercury-containing combustion gas, a flexible and retrofittable method that can be applied to a wide range of equipment configurations, simplicity and ease of use, and permanent sequestration of the mercury from environmental interactions. None of the advantages include equal or greater mercury-removal ability of HBr- or Br^--treated activated carbon as compared to HCl- or Cl^--treated activated carbon.

At paragraphs [●●23]-[●●24], similarly to what is stated in the Abstract and paragraphs [●●28]-[●●29], Nelson states:

> The mercury sorbent is prepared by treating a carbonaceous substrate with an effective amount of a bromine-containing gas for a sufficient time to increase the ability of the carbonaceous substrate to adsorb mercury and mercury-containing compounds.
>
> **[0024]** In some aspects of the invention, the bromine-containing gas comprises at least one of: elemental bromine and hydrogen bromide. In some aspects of the invention, the carbonaceous substrate comprises activated carbon.

Nelson therefore states that elemental bromine (Br_2) or hydrogen bromide (HBr) can be used to treat an activated carbon outside of a flue gas to increase the ability of the activated carbon to absorb mercury.

At paragraph [0041], Nelson states:

> **[0041]** I have discovered that the simple act of exposing a carbonaceous material, preferably powdered activated carbon (PAC), to gaseous bromine, $Br_2(g)$, or to gaseous hydrogen bromide, HBr(g), significantly increases the carbonaceous material's ability to remove mercury species when injected into high-temperature coal-fired flue-gas compositions. Surprisingly, gaseous bromine produces a much more effective and appropriate carbon sorbent for mercury in hot combustion gases than do iodine or iodide species, or chlorine or chloride species, in contrast to what has been taught in the prior art.

Paragraph [0041] begins by stating that gaseous bromine (defined as Br_2) or hydrogen bromide (HBr) increases the mercury absorption capacity of activated carbon. Then, paragraph [0041] goes on to explicitly state that gaseous bromine, defined as Br_2 in the prior sentence, produces a more effective mercury-absorbing carbon sorbent than iodine (I_2), iodide (I^-), chlorine (Cl_2), or chloride (Cl^-). With the precise definitions given for gaseous bromine and hydrogen bromide, and then reference only to gaseous bromine in the next sentence, Nelson makes clear that the comparison of efficacy is only with respect to elemental bromine (Br_2) and not hydrogen bromide. Like paragraph [0017], paragraph [0041] also fails to describe or suggest that hydrogen bromide treatment of activated carbons is more effective for mercury removal than HCl or Cl^- treatment of activated carbons.

At paragraph [0042], Nelson states:

> **[0042]** The combination of carbon and gaseous bromine produces an inexpensive sorbent material that can be simply injected into the ductwork of a power plant ahead of an existing electrostatic precipitator, without the need for large volumes of sorbent, retrofitted flue-gas cooling, or extended sorption time on an additional fabric filter.

Paragraph [●●42]'s reference to "gaseous bromine" refers only to elemental bromine (Br_2) due to the explicit definition given in the preceding paragraph [●●41]. Paragraph [●●42] expands on the advantage mentioned at paragraphs [●●20●]-[●●21], stating that an advantage of the invention includes simple injection of the treated activated carbon sorbent into the ductwork ahead of an ESP, without the need for large volumes of sorbent, retrofitted flue-gas cooling, or extended sorption time on a filter.

At paragraph [●●43], Nelson states:

> **[0043]** While not intending to be limited by hypothesized chemistry, it appears that in exposing PAC to concentrated bromine gas, a relatively large quantity of the bromine reacts with the carbon, forming surface compounds on the large surface-area of the carbon. When the PAC is then injected into the flue gas, the elemental mercury and oxidized mercury species there appear to react with at least one form of the bromine-carbon surface compounds that were created and are held fast. When the carbon particles are removed from the flue gas along with the fly ash by the electrostatic precipitator (ESP) or fabric filter, the mercury is removed with them. The mercury sorbents are then disposed of with the fly ash. Because the mercury has been chemically adsorbed, rather than just physically adsorbed, the captured mercury appears to be very stable and does not revolatilize or leach.

Paragraph [●●43] expands on the general advantage described in paragraph [●●22] of permanent sequestration of the mercury from environmental interactions. The advantage is not described or suggested to include equal or greater mercury-removal ability of HBr- or Br^--treated activated carbon as compared to HCl- or Cl^--treated activated carbon.

At paragraph [●●44], Nelson states:

> [0044] Production of the new mercury sorbent materials is simple and inexpensive. The carbon material and the bromine gas need simply be contacted with each other for the advantageous mercury-reactive surface compounds to quickly form. Elemental bromine is a liquid at ambient temperature, but turns to a gas at only a modestly elevated temperature. Hydrogen bromide is a gas at even ambient temperature. Using a gas-phase carbon reactant considerably simplifies the production of the sorbent and leads to the low costs which are a requirement for a sorbent to be used as a once-through duct injectant. Any common mixing method and equipment can be use to contact the gaseous bromine species with the carbon-based substrates, although it is preferably lined with corrosion-resistant material, because the bromine species can be quite corrosive. It is also preferable that the mixing of bromine gas and carbon be done at an elevated temperature. This keeps the bromine gas in the gaseous form, but also minimizes the amount of any bromine physically-adsorbed into the pores of the carbon. Such physically adsorbed bromine is not chemically bound to the carbon lattice and can be emitted in handling, in storage, and especially, when the sorbent is injected into a hot flue gas.

Paragraph [0044] expands on the general advantage described in paragraph [0021] of simple and inexpensive generation and use of the treated activated carbon sorbent. Paragraph [0044] also describes that elevated temperature during treatment can provide an advantage of reduced physical-adsorption of the elemental bromine or the hydrogen bromide, which helps to avoid emission during handling, storage, and during injection into a hot flue gas. The advantages are not described or suggested to include equal or greater mercury-removal ability of HBr- or Br^--treated activated carbon as compared to HCl- or Cl^--treated activated carbon.

At paragraph [0047], Nelson states:

> the process. An example would be a powdered activated carbon (PAC). Such a material would already have some gas-phase mercury adsorption capability which the treatment process of this invention will greatly amplify.

Nelson therefore states that the treatment process therein amplifies the mercury absorption capabilities of activated carbon. The advantage is not described or suggested to include equal or

greater mercury-removal ability of HBr- or Br^--treated activated carbon as compared to HCl- or Cl^--treated activated carbon.

At paragraph [●●49], Nelson states:

> **[0049]** A critical element in the process is that a bromine-containing gas **3** is used to treat the carbonaceous substrate. Preferably this gas comprises elemental bromine, $Br_2(g)$, although other bromine-containing gases, such as hydrogen bromide, HBr, will also have the advantageous effect of the invention.

Nelson therefore states that elemental bromine (Br_2) or hydrogen bromide (HBr) gas can be used to treat an activated carbon outside of a flue gas. Nelson also states that use HBr to treat the activated carbon "…will also have the advantageous effect of the invention." Nelson uses the singular "…effect…" and does not state that HBr can have all of the advantageous effects of Br_2 described therein; however, which particular advantageous effect does Nelson refer to? Further, Nelson refers generally to the advantageous effect of "…the advantageous effect of the invention…" but does not state that HBr can have all the advantageous effects of elemental bromine (Br_2); rather, Nelson states that HBr, like Br_2, can have "…the advantageous effect of the invention." By "…advantageous effect of the invention…" Nelson refers to general advantages of "…the invention…" and not specifically to advantages of Br_2; therefore, advantages specifically attributed to Br_2 in Nelson would not be imputed to HBr by the last sentence of paragraph [●●49].

Nelson describes several general advantages at paragraph [●●19]-[●●22] that are not attributed specifically to Br_2 and that could be referred to by paragraph [●●49]'s general reference to "…the advantageous effect of the invention…", such as the ability to remove mercury from a hot mercury-containing combustion gas (expanded on at paragraph [●●47]), a flexible and retrofittable method that can be applied to a wide range of equipment configurations (expanded on at paragraph [●●42]), simplicity and ease of use (expanded on at paragraphs [●●42] and [●●44]), and permanent sequestration of the mercury from environmental interactions (expanded on at paragraph [●●43]). Paragraphs [●●44] and [●●53] also describe that elevated temperature during treatment can provide an advantage of reduced physical-adsorption of the elemental bromine or the hydrogen bromide, which helps to avoid emission during handling, storage, and during injection into a hot flue gas. Paragraph [●●62] states that mercury sorbents prepared according to Nelson's invention can capture

mercury in at least the lower range of 3●● °C to 4●● °C. Paragraph [●●65] states that injection of the treated activated carbon prior to a fabric filter can provide a longer residence time of the sorbent, higher utilization levels, as well as the possibility of recovering and reinjecting the sorbent at lower costs.

Paragraph [●●17] refers to the "…particular advantages of using bromine, rather than iodine or iodides, or chlorine or chlorides, with activated carbon…" but, as explained herein, "…bromine…" would be interpreted as elemental bromine (Br_2); moreover, paragraph [●●17] fails to describe or suggest any "…particular advantages of using bromine…." Paragraph [●●17]'s concluding statement referring to the "…tenacity of carbon-bromine-mercury complexes…" fails to compare the strength of such complexes to the strength of any other complexes, such as carbon-chlorine-mercury complexes, carbon-chloride-mercury complexes, carbon-iodine-mercury complexes, or carbon-iodide-mercury complexes; therefore, at best, the "…tenacity…" of the complexes described in the last sentence of paragraph [●●17] can be regarded as a general statement, rather than as a comparative one.

Paragraph [●●41] begins by stating that gaseous bromine (defined as Br_2) or hydrogen bromide (defined as HBr) increases the mercury absorption capacity of activated carbon. Then, paragraph [●●41] goes on to explicitly state that gaseous bromine, defined as Br_2 in the prior sentence, produces a more effective mercury-absorbing carbon sorbent than iodine (I_2), iodide (I^-), chlorine (Cl_2), or chloride (Cl^-). With the precise definitions given for gaseous bromine (Br_2) and hydrogen bromide, and then reference only to gaseous bromine (Br_2) in the next sentence, Nelson makes clear that the comparison of efficacy is only with respect to elemental bromine (Br_2) and not hydrogen bromide. Paragraph [●●41] fails to describe a general advantage of Nelson's invention; instead, paragraph [●●41] specifically and particularly describes an advantage of elemental bromine (Br_2), which cannot be regarded as a general advantageous effect of "…the invention…" as it only applies to elemental bromine (Br_2). Accordingly, advantages explicitly attributed to Br_2 in paragraph [●●41] of Nelson cannot be imputed to HBr by the last sentence of paragraph [●●49].

Therefore, paragraph [●●49] fails to describe or suggest that hydrogen bromide treatment of activated carbons is more effective for mercury removal than HCl or Cl^- treatment of activated carbons.

At paragraph [●●5●], Nelson states:

> **[0050]** In the liquid form at ambient temperatures, elemental bromine is dense and compact, with advantages in transport and storage. To be utilized in this invention, however, it must first be heated to at least about 60° C. and turned into a gaseous state. In such a state it can more uniformly treat the carbonaceous materials at low levels and provide the desired effect of increasing their mercury sequestration capabilities. A preferred method of converting the liquid bromine to a bromine-containing gas is to use a heated lance. Liquid bromine can be metered into such a heated-lance system at one end and be distributed as a gas to the substrate materials at the other end.

Nelson therefore states that an advantage of elemental bromine (Br_2) is that it is dense and compact which provides advantages in transport and storage.

At paragraph [0051], Nelson states:

> **[0051]** In some applications it may be beneficial to utilize a diluting carrier gas to better distribute the $Br_2(g)$ or HBr(g) among the carbonaceous substrate particles. However, if the process of this invention is practiced in a batch mode, it can be preferable to use pure $Br_2(g)$ or HBr(g). These can be

Nelson therefore states that elemental bromine (Br_2) or hydrogen bromide can be dispersed in a carrier gas during the treatment of the activated carbon.

At paragraph [0053], Nelson states:

> reactive towards mercury. By exposing the carbon to the bromine at an elevated temperature, less of the bromine species will volatilize off from the sorbents during their transport and storage or upon their injection into the hot combustion stream.

Paragraph [0053] describes that elevated temperature during treatment can provide an advantage of reduced volatilization during transport, storage, or during injection into the hot flue gas, expanding on the advantage described at paragraph [0044].

At paragraph [0054], Nelson states:

> **[0054]** Any level of bromination of carbonaceous substrates appears to increase their mercury-removal performance. While over 30 wt % of $Br_2(g)$ can be adsorbed into some powdered activated carbons, for example, significant increases in mercury reactivity will be observed with only about 1 wt % $Br_2(g)$ in the PAC. Greater degrees of bromination do correlate with greater maximum mercury capacities for a particular carbonaceous substrate. However, with the sorbent-injection application of this invention, only a fraction of a material's maximum possible mercury capacity is typically utilized, so the optimum level of bromine to combine with the carbon substrate may vary with the particular situation. If a PAC substrate is used, brominating to 1 wt % provides a highly-capable mercury sorbent, although a 5 wt % material performs better and may be preferable. Brominating to 15 wt % Br_2 generally produces an even more capable mercury sorbent, but as some of the bromine is held at less-energetic sites, there is a greater possibility that some degree of bromine may evolve off under some circumstances. Mercury sorbents with higher bromine concentrations will take longer to produce and cost more as well.

Paragraph [0054] refers to bromination of activated carbon, referring only to specific amounts of Br_2 used to treat the activated carbon and not giving any reference to, let alone specific amounts of, hydrogen bromide.

At paragraph [0062], Nelson states:

> **[0062]** **FIG. 4** describes the possible application of the sorbents to a plant which has a "hot-side" ESP, a particularly difficult situation for mercury control. In this equipment arrangement, the air preheater **22** follows the ESP **32**, so the temperature of the mercury-containing flue gas in the ductwork **64** before the particulate collection is very high, in the range of 300-to-400° C. Plain powdered activated carbons do not capture any mercury at these temperatures and PACs impregnated with iodine or sulfur lose their impregnates. Surprisingly, the mercury sorbents prepared according to the process of this invention appear to capture mercury in at

> least the lower end of this temperature range. Consequently, the sorbents from bin **71** can be useful even when injected at **72** into the very hot, low-oxygen, mercury-containing gases in ductwork **64**. The sorbents would be collected with the other gas stream particulates in the hot-side ESP **32** and the cleaned gas would proceed through ductwork **65** to the smokestack.

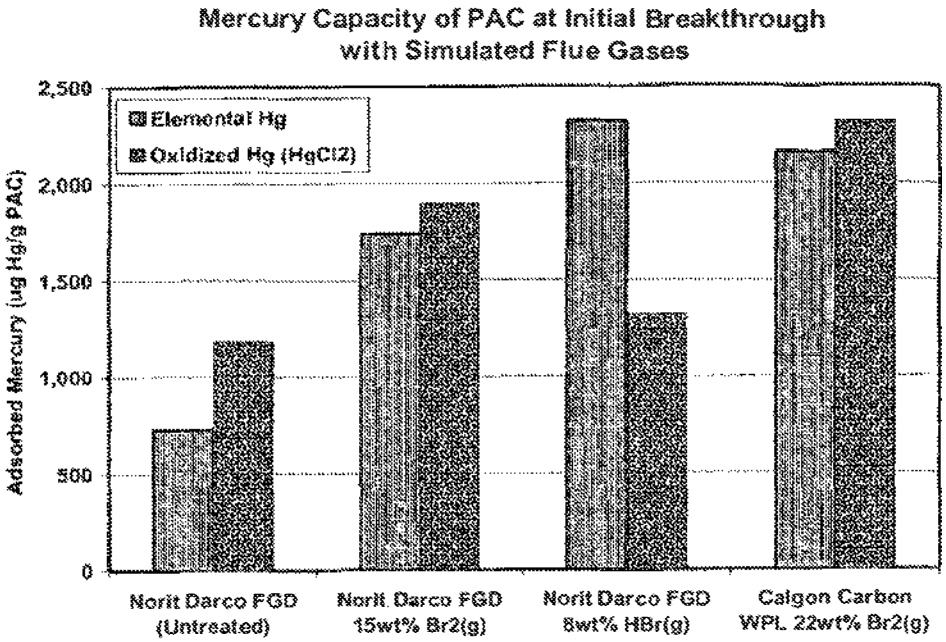
Paragraph [●●62] states that mercury sorbents prepared according to Nelson's invention can capture mercury in at least the lower range of 3●● °C to 4●● °C, unlike activated carbons impregnated with iodine or sulfur.

At paragraph [●●65], Nelson states:

> **[0065]** Two such arrangements bear particular mention. **FIG. 5** applies the sorbents in a "TOXECON®" arrangement. Here the mercury sorbents **71** are injected after an ESP **32** into the almost particulate-free ductwork **67** before a small, high-velocity fabric filter **33**. In this manner the fly ash **80** does not become mixed with the carbonaceous sorbents, allowing the fly ash to be sold for concrete use. Moreover, the filter cake of fabric filter **33** would predominantly be mercury sorbent, allowing a longer residence time, higher utilization levels, and the possibility of recovering and reinjecting the sorbent to lower costs. The superior reactivity and capacities of the mercury sorbents of this invention make them prime candidates for use in such an arrangement.

Paragraph [●●65] states that injection of the treated activated carbon prior to a fabric filter can provide a longer residence time of the sorbent, higher utilization levels, as well as the possibility of recovering and reinjecting the sorbent at lower costs.

Figure 12 of Nelson is reproduced below.



Paragraph [0080], discussing figure 12, states that:

> ...the brominated carbons adsorbed considerably more mercury species than the untreated version, with the improvements averaging about 100%. Importantly, the bromine-gas-treated sorbents removed about as much oxidized mercury-chloride from the test gases as elemental mercury, indicating performance improvements with both kinds of common flue-gas mercury species.

Both of the Br_2-treated activated carbons in figure 12 showed increased removal of both elemental mercury and oxidized mercury as compared to the untreated activated carbon. However, the HBr-treated activated carbon in figure 12 had hardly any improvement in removal of oxidized Hg compared to the untreated activated carbon, which paragraph [0080] describes as one of two common flue-gas mercury species, and that the removal of both of these species is "important."

The majority of Nelson's Examples (1-4 and 8) focus only on Br_2. Nelson's Examples 5-7 demonstrate the use of HBr-treated sorbent; however, none of these Examples or any other parts of Nelson compare the mercury-absorption performance of HBr-treated activated carbon to HCl-treated activated carbon. Although figures 14 and 15 illustrate HBr-treated activated carbon and

Cl_2-treated activated carbon, Cl_2-treated activated carbon is not HCl-treated or Cl^--treated carbon and these figures fail to show any comparison to HCl- or Cl^--treated activated carbon.

At paragraph [●●85], Nelson states:

> sorbents of this invention. See **FIG. 14**. About three times as much chlorine-gas treated PAC was required to achieve the same degree of mercury removal as with bromine. The

Figure 14 of Nelson is reproduced below:

Figure 14.

Duct-Injection Pilot Plant with ESP

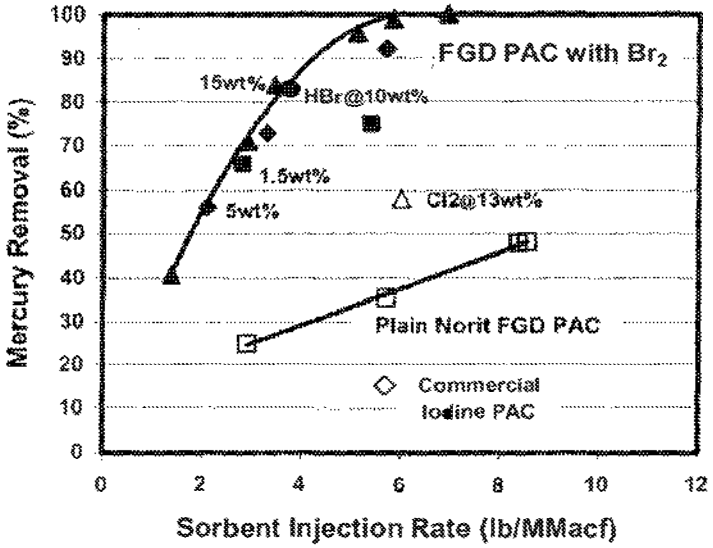


Figure 14 shows mercury removal percent from seven different types of activated carbons: commercial iodine activated carbon, plain Norit activated carbon, 13 wt% Cl_2-treated activated carbon, 1● wt% HBr-treated activated carbon, 1.5 wt% Br_2-treated activated carbon, 5 wt% Br_2-treated activated carbon, and 15 wt% Br_2-treated activated carbon. No HCl- or Cl^--treated activated carbon is shown in Figure 14 or described in any of Examples 5-7 (the only Examples demonstrating the use of HBr-treated activated carbon). Paragraph [●●85] states that about three times as much chlorine-gas treated activated carbon was required to achieve the same degree of mercury removal as with bromine, which can only be a comparison between the 13 wt% Cl_2-treated

activated carbon and the 5 wt% Br_2-treated activated carbon which had a percent mercury removal that was about the same. Further, with regard to figure 14, Nelson states at paragraph [●●84] that "[t]here was not much difference in performance between the various brominated samples, probably because in the duct-injection mode they only used a small fraction of their available mercury-adsorption capacity." Therefore, Nelson states that figure 14 does not provide an accurate comparison between the brominated samples, because the full mercury-adsorption capacity was not utilized.

At paragraph [●●87], and the following table, Nelson states:

> **[0087]** Manufacture of the elemental bromine sorbents was much faster than for the others. The elemental bromine was adsorbed and reacted with the PACs much faster than was the elemental chlorine, for example—one-hundred-times faster. This allowed for quick and inexpensive manufacture of these sorbents. See the table below with rate data in terms of grams of gas adsorbed per kilogram of PAC per minute. The PAC adsorption of gaseous hydrogen bromide, HBr(g), was ten times faster than it was for chlorine.

Gaseous Halogen	Final Loading on FGD PAC (wt %)	Adsorption Rate (gm of gas) (kg PAC = min)	Concentration in Storage Vessel (ppm)
Br_2 (g)	5%	10	0
Br_2 (g)	15%	10	0.5
HBr (g)	9%	1	N.A.
Cl_2 (g)	13%	0.1	>40

Paragraph [●●87] states that the activated carbon adsorbed elemental bromine (Br_2) and hydrogen bromide (HBr) faster than chlorine (explicitly shown as Cl_2 in the Table). The table shows the amount of treatment material (Br_2, HBr, or Cl_2) absorbed on the activated carbon and the rate of adsorption of the treatment material on the activated carbon. Paragraph [●●87] and the table that follows make no statements describing or suggesting mercury removal rates of the treated activated carbon.

Figure 15 of Nelson is reproduced below:

Figure 15.

Lausche Plant Duct-Injection ESP Trials

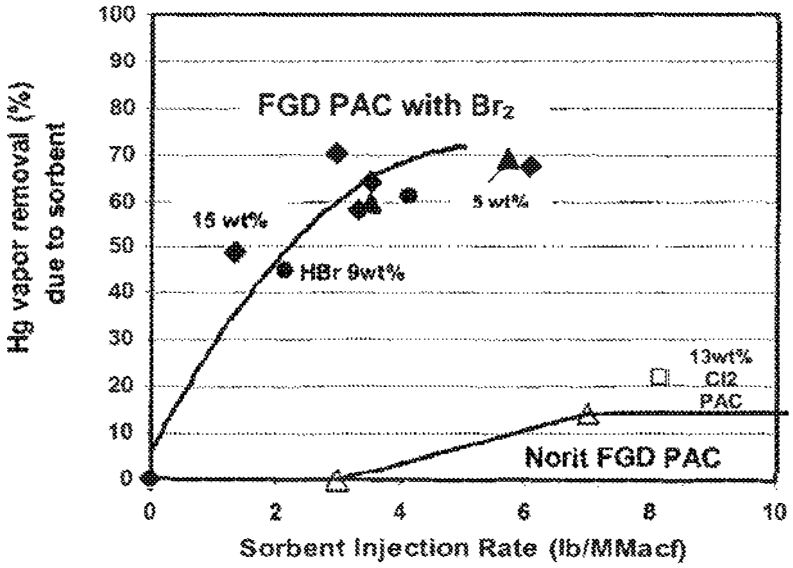


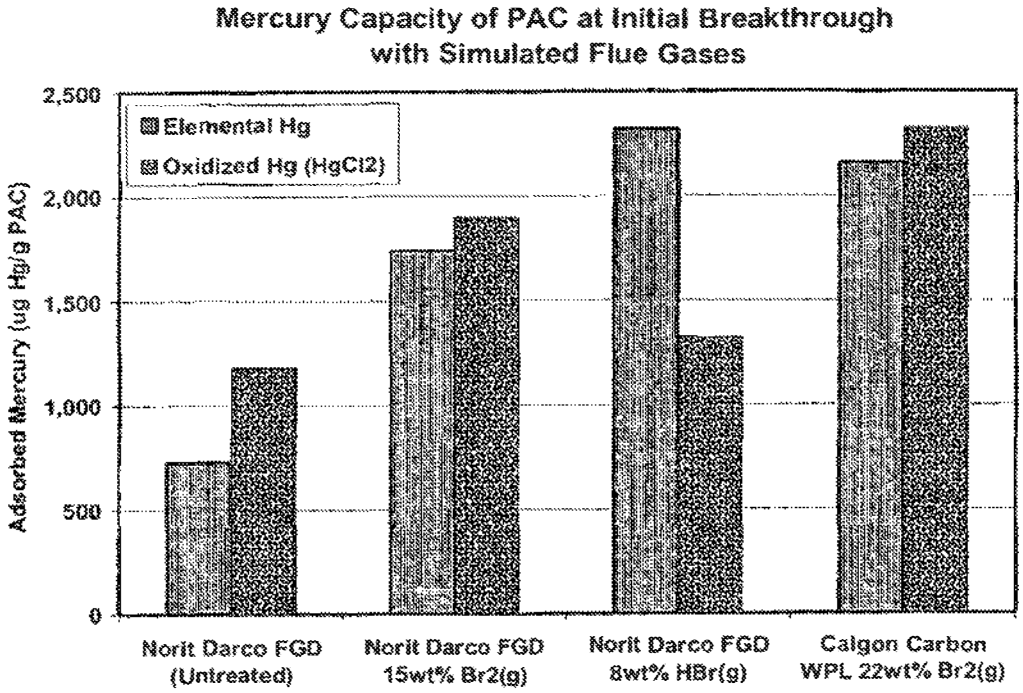
Figure 15 shows mercury removal percent from five different types of activated carbons: Norit activated carbon, 13 wt% Cl_2-treated activated carbon, 9 wt% HBr-treated activated carbon, 5 wt% Br_2-treated activated carbon, and 15 wt% Br_2-treated activated carbon. No HCl- or Cl^--treated activated carbon is shown in Figure 15 or described in any of Examples 5-7 (the only Examples demonstrating the use of HBr-treated activated carbon). For all data points showing HBr-treated activated carbon, a higher sorbent injection rate was needed to achieve equivalent mercury-removal performance as the Br_2-treated activated carbons (i.e., the HBr data points for a given mercury-removal percentage are always to the right of the Br_2 data points for that mercury-removal percentage), indicating HBr-treated activated carbon to have less mercury-removal ability than Br_2-treated activated carbons.

At paragraph [●●92], Nelson states:

> [0092] The brominated sorbents of this invention, on the other hand, performed very well with this difficult flue gas, achieving about 50% mercury removal with only 2 lb/MMacf of sorbent consumption and almost 70% removal at an injection rate of 4 lb/MMacf. PACs brominated with Br_2 to 5 wt % and 15 wt %, and with HBr to 9 wt % all performed similarly.

Paragraph [0092] refers to the data shown in Figure 15. However, Figure 15 shows mercury removal percent from five different types of activated carbons: Norit activated carbon, 13 wt% Cl_2-treated activated carbon, 9 wt% HBr-treated activated carbon, 5 wt% Br_2-treated activated carbon, and 15 wt% Br_2-treated activated carbon. No HCl- or Cl^--treated activated carbon is shown in Figure 15 or described in any of Examples 5-7 (the only Examples demonstrating the use of HBr-treated activated carbon).

Taken in the context of the entire document, figures 14-15 and paragraph [0092] fails to describe or suggest equivalent mercury-removal performance of HBr-treated activated carbon and Br_2-treated activated carbon. With regard to figure 14, Nelson states at paragraph [0084] that "[t]here was not much difference in performance between the various brominated samples, probably because in the duct-injection mode they only used a small fraction of their available mercury-adsorption capacity." Therefore, Nelson states that figure 14 does not provide an accurate comparison between the brominated samples, because the full mercury-adsorption capacity was not utilized. In figure 15, for all data points showing HBr-treated activated carbon, a higher sorbent injection rate was needed to achieve equivalent mercury-removal performance as the Br_2-treated activated carbons (i.e., the HBr data points for a given mercury-removal percentage are always to the right of the Br_2 data points for that mercury-removal percentage), indicating HBr-treated activated carbon to have less mercury-removal ability than Br_2-treated activated carbons. In figure 12, reproduced below, Nelson compares the mercury capacity of untreated activated carbon, 15 wt% Br_2-treated activated carbon, 8 wt% HBr-treated activated carbon, and 22 wt%Br_2-treated activated carbon.



Paragraph [●●8●], discussing figure 12, states that:

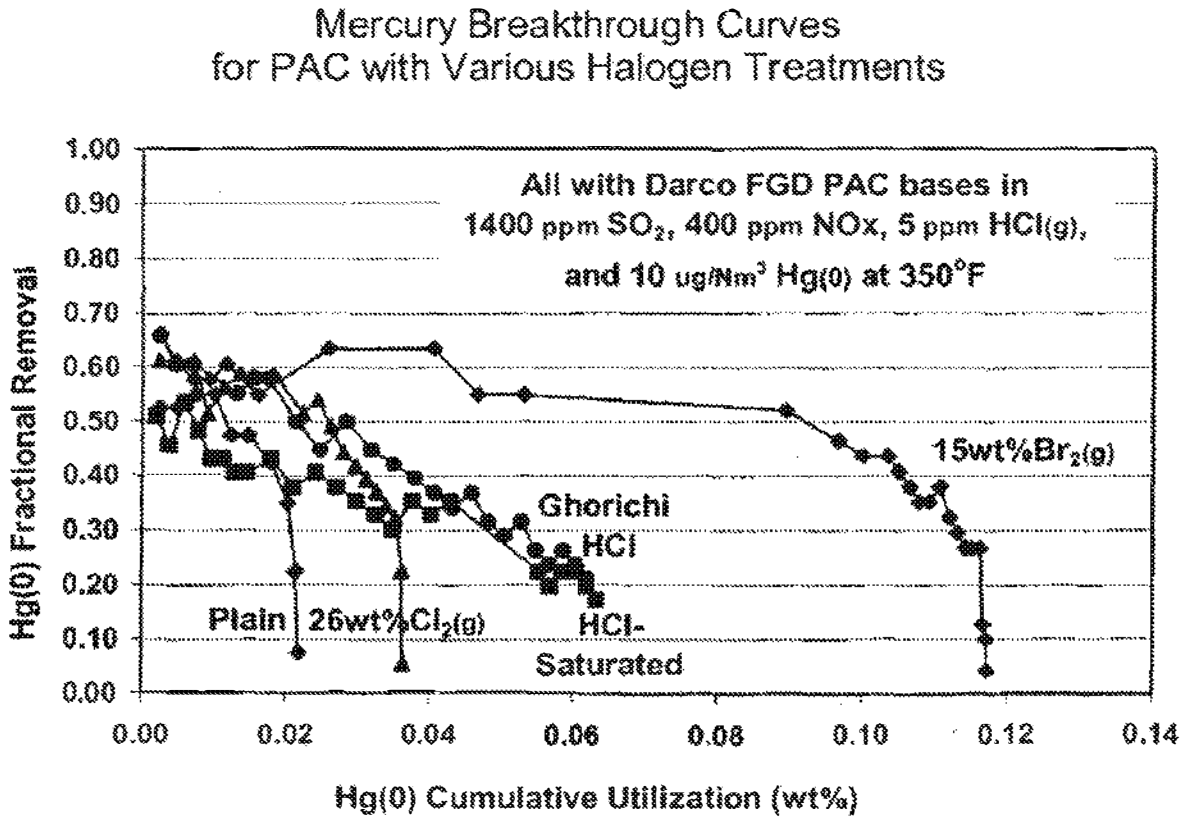
> …the brominated carbons adsorbed considerably more mercury species than the untreated version, with the improvements averaging about 1●●%. Importantly, the bromine-gas-treated sorbents removed about as much oxidized mercury-chloride from the test gases as elemental mercury, indicating performance improvements with both kinds of common flue-gas mercury species.

Both of the Br_2-treated activated carbons in figure 12 showed increased removal of both elemental mercury and oxidized mercury as compared to the untreated activated carbon. However, the HBr-treated activated carbon in figure 12 had hardly any improvement in removal of oxidized Hg compared to the untreated activated carbon, which paragraph [●●8●] describes as one of two common flue-gas mercury species, and that the removal of both of these species is "important."

Nelson does not portray the mercury removal abilities of activated carbon treated with Cl_2 outside the flue gas as equivalent to that of activated carbon treated with HCl outside the flue gas.

At figure 11, reproduced below, Nelson shows mercury breakthrough curves for elemental mercury removal from a non-flue gas "mercury-challenge gas" for powdered activated carbon with various halogen treatments performed outside the flue gas.

Figure 11.



At paragraph [●●77], reproduced below, Nelson discusses figure 11.

> [0077] The sample that had been exposed to gaseous chlorine, $Cl_2(g)$, exhibited some improvement in mercury removal performance relative to the plain, untreated PAC. Two samples of HCl-treated PACs showed even higher ultimate mercury capacities, but poorer kinetics. One of these samples had been pretreated by flowing gas-phase HCl through the PAC sample until it no longer added mass. The other, acquired from Ghorishi et al., was produced by a dilute liquid-phase HCl treatment described in their publications. The elemental mercury breakthrough curves of the two HCl-treated PACs were very similar, exhibiting a slow and steady drop-off in performance, indicative of poor mercury adsorption kinetics. In contrast, the brominated sample of this invention broke through very sharply and captured more than five times the elemental mercury of the untreated PAC.

At paragraph [0077], Nelson states that the HCl-treated powdered activated carbons had higher capacities for elemental mercury, but showed poorer kinetics. Although some information about how the Cl_2- and HCl-treated activated carbons would behave in a flue gas can be learned from figure 11, a flue gas contains additional species that were not present in the "mercury challenge gas", and, further, can include other forms of mercury other than the elemental mercury measured by the breakthrough test of figure 11, such as oxidized mercury. Nelson does not perform mercury-removal testing of HCl-treated activated carbons in a flue gas. However, Nelson in figure 11, paragraph [0077], and paragraph [0012] refers to HCl-treated activated carbon from Ghorishi et al., which had about the same performance in figure 11 as the HCl-saturated activated carbon prepared by Nelson. At paragraph [0012] Nelson describes a publication by this author, Ghorishi, S.B., Keeney, R.M., Jozewicz, W.S., Serre, S.D. and Gullett, B.K., 2001, In-flight capture of elemental mercury by a chlorine-impregnated activated carbon, Annual Air and Waste Management Association(AWMA) Conference, Orlando, FL, Vol. 24, No. 28 ("Ghorishi").

Ghorishi's conclusion at page 11 states that over 80% mercury removal was accomplished from a flue gas using activated carbon treated outside the flue gas with HCl. Comparing these results to Nelson's results shown in figures 14 and 15, 80% mercury removal is better than the about 58% removal by Cl_2-treated activated carbon in figure 14, is better than the about 22% removal by Cl_2-treated activated carbon in figure 15, and is better than the maximum mercury removal of HBr-

or Br_2-treated activated carbons in figure 15. Therefore, one of ordinary skill in the art hypothetically reviewing Nelson would not only conclude that activated carbon treated outside the flue gas with HCl not only has higher capacity for elemental mercury than Cl_2-treated activated carbon as shown in Nelson's figure 11, but also from comparing Ghorishi to Nelson that activated carbon treated outside the flue gas with HCl has better mercury removal performance in flue gas than Cl_2-treated activated carbon. Accordingly, even if, merely for the sake of argument, one of ordinary skill in the art were to conclude from Nelson's statements at paragraph [0092] that activated carbon treated with HBr or Br_2 outside the flue gas have similar mercury removal abilities, this would not lead to the conclusion that activated carbon treated with HBr outside the flue gas has better mercury removal abilities than activated carbon treated with HCl outside the flue gas.

Nelson never directly compares the mercury-removal ability of HBr-treated activated carbon with HCl-treated activated carbon. With Nelson clearly indicating that HBr-treated activated carbon has inferior mercury-removal ability as compared to Br_2-treated activated carbon, and that HCl-treated activated carbon has superior mercury-removal ability as compared to Cl_2-treated activated carbon, there is no way that one of ordinary skill in the art hypothetically considering Nelson could conclude that HBr-treated activated carbon has equivalent or superior mercury-removal ability compared to HCl-treated activated carbon.

No part of Nelson describes or suggests that HBr or Br^- even have the same effectiveness for mercury sequestration when used to treat activated carbons as HCl or Cl^-, let alone that HBr or Br^- are more effective for mercury sequestration when used to treat activated carbons than HCl or Cl^-. A person of ordinary skill in the art would have no reason to modify Felsvang's HCl or Cl^- process with a different promoter to form an effective carbon sorbent for mercury removal if the resulting mercury-removal efficiency could not be reasonably predicted to be the same or greater as that of Felsvang's original process. Therefore, a person of ordinary skill in the art would not be motivated to replace Felsvang's HCl or Cl^- treatment of activated carbon with Nelson's HBr treatment. Independent claim 2 is patentable for at least this reason.

II(A)(3). Reply to Examiner's response to arguments.

The Office Action states:

> II A. The applicant traverses the combination of Felsvang and Nelson combination stating that there is no motivation for a person of ordinary skill in the art to use Nelson's bromide additives in Felsvang's process. The applicant contends that one having ordinary skill in the art would not be motivated to replace Felsvang's chloride-treatment with treatment by another material as the prior art does not disclose the bromide additives performing the same or better mercury-removal efficiency.
>
> The examiner disagrees. See Fig. 14 of Nelson which shows that about 3 times the amount of chlorine treated PAC was required to achieve the same degree of mercury removal as with bromine, (paragraph [0085]). Also see the absorption rate in the table on page 8. Further as the rejection above states, both chlorine and bromine are known within the art to treat activated carbon and therefore it would be well within the capability of one having ordinary skill in the art to *either replace the Cl with or include in addition to* the halogen or halide promoter comprising HBr, Br$_2$, or a combination thereof to promote activated carbon (Nelson paragraphs [0017] and [0061]) so as to provide an effective carbon sorbent for mercury.

The Office Action states that Fig. 14 of Nelson shows that about 3 times the amount of chlorine treated PAC was required to achieve the same degree of mercury removal as with bromine, citing to paragraph [0085]. The Office Action also cites to the absorption rate in the table on page 8.

Although figures 14 and 15 illustrate HBr-treated activated carbon and Cl_2-treated activated carbon, Cl_2-treated activated carbon is not HCl- or Cl^--treated carbon and these figures fail to show any comparison to HCl- or Cl^--treated activated carbon.

At paragraph [0085], Nelson states:

> sorbents of this invention. See **FIG. 14**. About three times as much chlorine-gas treated PAC was required to achieve the same degree of mercury removal as with bromine. The

Figure 14 of Nelson is reproduced below:

Figure 14.

Duct-Injection Pilot Plant with ESP

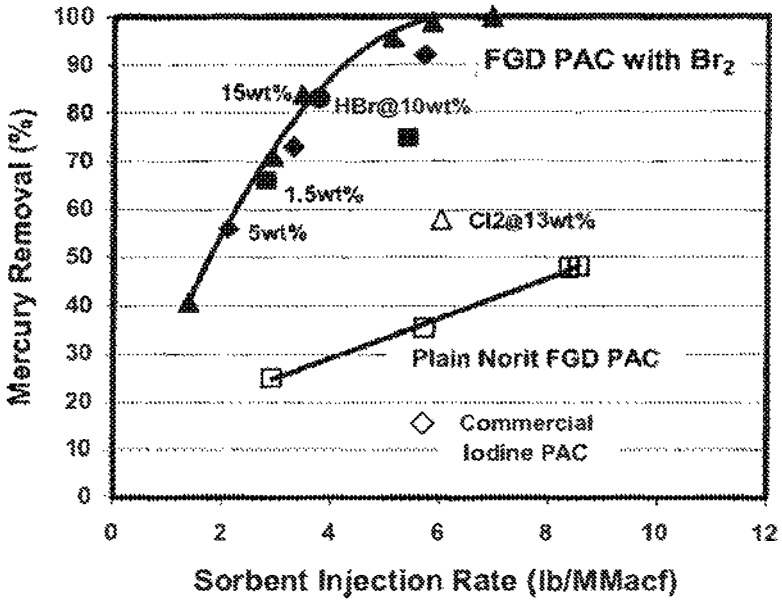


Figure 14 shows mercury removal percent from seven different types of activated carbons: commercial iodine activated carbon, plain Norit activated carbon, 13 wt% Cl_2-treated activated carbon, 10 wt% HBr-treated activated carbon, 1.5 wt% Br_2-treated activated carbon, 5 wt% Br_2-treated activated carbon, and 15 wt% Br_2-treated activated carbon. No HCl- or Cl^--treated activated carbon is shown in Figure 14 or described in any of Examples 5-7 (the only Examples demonstrating the use of HBr-treated activated carbon). Paragraph [0085] states that about three times as much chlorine-gas treated activated carbon was required to achieve the same degree of mercury removal as with bromine, which can only be a comparison between the 13 wt% Cl_2-treated activated carbon and the 5 wt% Br_2-treated activated carbon which had a percent mercury removal that was about the same.

At paragraph [0017], Nelson states:

> **[0017]** The particular advantages of using bromine, rather than iodine or iodides, or chlorine or chlorides, with activated carbons for mercury control have not been previously appreciated. Gaseous bromine and hydrogen bromide have been combined with carbon substrates before, but not to sequester mercury from hot combustion-gas streams. For example, Greinke U.S. Pat. No. 5,372,619 found that bromine-treated carbon can make a superior natural-gas storage medium. In another example, SKC Inc. sells a small tube with hydrobromic acid-treated charcoal to sample air for ethylene oxide. However, with both of these uses it is important that the adsorption targets, natural gas and ethylene oxide, be easily desorbable from the carbon, the exact opposite of what is required in a mercury vapor sequestration application. In a similar vein, in U.S. Pat. No. 6,475,461 Ohsaki describes a process for treating carbon substrates with gaseous bromine or chlorine, but then explicitly desorbs them to achieve his desired product. Seki U.S. Pat. No. 3,961,020; Yoshida and Seki et al. U.S. Pat. No. 4,174,373; and Knoblauch et al. U.S. Pat. No. 5,179,058 impregnate activated carbon with bromine to produce a catalyst for reacting nitrogen oxide with ammonia to form nitrogen and water. In this application too, the bromine of the carbon does not act as a sequestration agent, permanently tying up its target. Rather, it serves as a catalyst, taking part in a repeated series of desired chemical reactions, but not becoming permanently consumed by any of them. Perhaps it is understandable that the tenacity of carbon-bromine-mercury complexes could be overlooked.

The first sentence of paragraph [0017] refers to the "...particular advantages of using bromine..." for treatment of activated carbons for mercury control, which must mean either elemental bromine (Br_2) or the element bromine generally, and is not a specific reference to bromides (Br^-). The "...particular advantages of using bromine..." is compared to iodine (I_2), iodides (I^-), chlorine (Cl_2), and chlorides (Cl^-), but no specific comparison is made between bromides (Br^-) and chlorides (Cl^-). However, it does not make sense for Nelson to refer to the element bromine generally while specifically distinguishing between chlorine (Cl_2) and chlorides (Cl^-), and iodine (I_2) and iodides (I^-) in the same sentence. If Nelson wanted to compare both

elemental bromine (Br_2) and hydrogen bromide (HBr) to the other halides specifically disclosed in the first sentence, Nelson would have specifically distinguished between bromine (Br_2) and bromides (Br^-); therefore, "…bromine…" in the first sentence of paragraph [●●17] would be interpreted as elemental bromine (Br_2), and not as the element bromine generally.

No "…particular advantages of using bromine…" are explicitly described in paragraph [●●17], with the remainder of the paragraph focusing on the failure of the prior art to use bromine with activated carbon for mercury control, describing various disadvantages of other processes, such as the desorbability of Br_2, HBr, or Cl_2 from the activated carbon, or the failure of the Br_2 or HBr to act as a mercury sequestration agent. The paragraph concludes with a statement that it is understandable that "…the tenacity of carbon-bromine-mercury complexes…" could be overlooked, which must refer to complexes including either elemental bromine (Br_2) or the element bromine generally, with no specific reference to bromide (Br^-) or complexes formed therefrom. The concluding statement of paragraph [●●17] is directed toward the discussion in the bulk of paragraph [●●17]—the prior art fails to use bromine with activated carbon for mercury control and therefore fails to generate carbon-bromine-mercury complexes—rather than as a statement of any relative advantage of bromine over other halogens or halides. The "…tenacity of carbon-bromine-mercury complexes…" is not specifically compared to the strength of any other complexes, such as carbon-chlorine-mercury complexes, carbon-chloride-mercury complexes, carbon-iodine-mercury complexes, or carbon-iodide-mercury complexes; therefore, at best, the "…tenacity…" of the complexes described in the last sentence of paragraph [●●17] can be regarded as a general statement, rather than as a comparative one. Paragraph [●●17] fails to attribute any advantage of Nelson's invention specifically to HBr or Br^-, and, moreover, fails to describe or suggest that HBr or Br^- treatment of activated carbon could provide equal, let alone better, mercury removal than HCl or Cl^- treatment of the activated carbon.

At paragraph [●●44], Nelson states:

> [0044] Production of the new mercury sorbent materials is simple and inexpensive. The carbon material and the bromine gas need simply be contacted with each other for the advantageous mercury-reactive surface compounds to quickly form. Elemental bromine is a liquid at ambient temperature, but turns to a gas at only a modestly elevated temperature. Hydrogen bromide is a gas at even ambient temperature. Using a gas-phase carbon reactant considerably simplifies the production of the sorbent and leads to the low costs which are a requirement for a sorbent to be used as a once-through duct injectant. Any common mixing method and equipment can be use to contact the gaseous bromine species with the carbon-based substrates, although it is preferably lined with corrosion-resistant material, because the bromine species can be quite corrosive. It is also preferable that the mixing of bromine gas and carbon be done at an elevated temperature. This keeps the bromine gas in the gaseous form, but also minimizes the amount of any bromine physically-adsorbed into the pores of the carbon. Such physically adsorbed bromine is not chemically bound to the carbon lattice and can be emitted in handling, in storage, and especially, when the sorbent is injected into a hot flue gas.

Paragraph [0044] expands on the general advantage described in paragraph [0021] of simple and inexpensive generation and use of the treated activated carbon sorbent. Paragraph [0044] also describes that elevated temperature during treatment can provide an advantage of reduced physical-adsorption of the elemental bromine or the hydrogen bromide, which helps to avoid emission during handling, storage, and during injection into a hot flue gas. The advantages are not described or suggested to include equal or greater mercury-removal ability of HBr- or Br^--treated activated carbon as compared to HCl- or Cl^--treated activated carbon.

The Office Action states:

The applicant contends that the Nelson reference does not disclose HBr and Br being more effective with activated carbons than chlorides.

The examiner disagrees. The Nelson reference discloses that HBr is used to provide bromide to the system. Example 5, paragraph [0083] states that the brominated PACs were treated with HBr or Br2. Figures 14 and 15 disclose that HBr treated PAC performs better than chlorine treated PAC. Further one having ordinary skill in the art would expect PAC treated with HBr or Br2 would result in a very similar modified PAC as they both include bromide (see paragraph [0092] which discloses that each of the brominated PACs performed similarly). The examiner also points to paragraph [0087] of Nelson which discloses that PAC adsorption of gaseous hydrogen bromide being ten times faster than it was for chlorine.

The Office Action states that the Nelson reference discloses that HBr is used to provide bromide to the system, and that Example 5, paragraph [0083] states that brominated PACs were treated with HBr or Br_2. Applicant cannot find the language of providing HBr "to the system" in Nelson; paragraph [0083] in Example 5 describes treating powdered activated carbons with different amounts of gaseous $Br_2(g)$ or HBr prior to injecting the activated carbons into the flue gas. However, Nelson fails to describe or suggest that treatment of activated carbon with HBr provides the same, let alone better, mercury removal efficiency as activated carbon treated with HCl or Cl^-.

With regard to figures 14 and 15, as explained above, although figures 14 and 15 illustrate HBr-treated activated carbon and Cl_2-treated activated carbon, Cl_2-treated activated carbon is not HCl- or Cl^--treated carbon and these figures fail to show any comparison to HCl- or Cl^--treated activated carbon. Figure 14 shows mercury removal percent from seven different types of activated carbons: commercial iodine activated carbon, plain Norit activated carbon, 13 wt% Cl_2-treated activated carbon, 10 wt% HBr-treated activated carbon, 1.5 wt% Br_2-treated activated carbon, 5 wt% Br_2-treated activated carbon, and 15 wt% Br_2-treated activated carbon. No HCl- or Cl^--treated activated carbon is shown in Figure 14 or described in any of Examples 5-7 (the only Examples demonstrating the use of HBr-treated activated carbon). Paragraph [0085] states that about three times as much chlorine-gas treated activated carbon was required to achieve the same degree of mercury removal as with bromine, which can only be a comparison between the 13 wt% Cl_2-treated activated carbon and the 5 wt% Br_2-treated activated carbon which had a percent mercury removal that was about the same. Figure 15 shows mercury removal percent from five different types of activated carbons: Norit activated carbon, 13 wt% Cl_2-treated activated carbon, 9 wt% HBr-treated

activated carbon, 5 wt% Br_2-treated activated carbon, and 15 wt% Br_2-treated activated carbon. No HCl- or Cl^--treated activated carbon is shown in Figure 15 or described in any of Examples 5-7 (the only Examples demonstrating the use of HBr-treated activated carbon).

The Office Action states that paragraph [●●87] of Nelson discloses that PAC adsorption of gaseous hydrogen bromide was ten times faster than it was for chlorine. At paragraph [●●87], and the following table, Nelson states:

> **[0087]** Manufacture of the elemental bromine sorbents was much faster than for the others. The elemental bromine was adsorbed and reacted with the PACs much faster than was the elemental chlorine, for example—one-hundred-times faster. This allowed for quick and inexpensive manufacture of these sorbents. See the table below with rate data in terms of grams of gas adsorbed per kilogram of PAC per minute. The PAC adsorption of gaseous hydrogen bromide, HBr(g), was ten times faster than it was for chlorine.

Gaseous Halogen	Final Loading on FGD PAC (wt %)	Adsorption Rate (gm of gas) (kg PAC = min)	Concentration in Storage Vessel (ppm)
Br_2 (g)	5%	10	0
Br_2 (g)	15%	10	0.5
HBr (g)	9%	1	N.A.
Cl_2 (g)	13%	0.1	>40

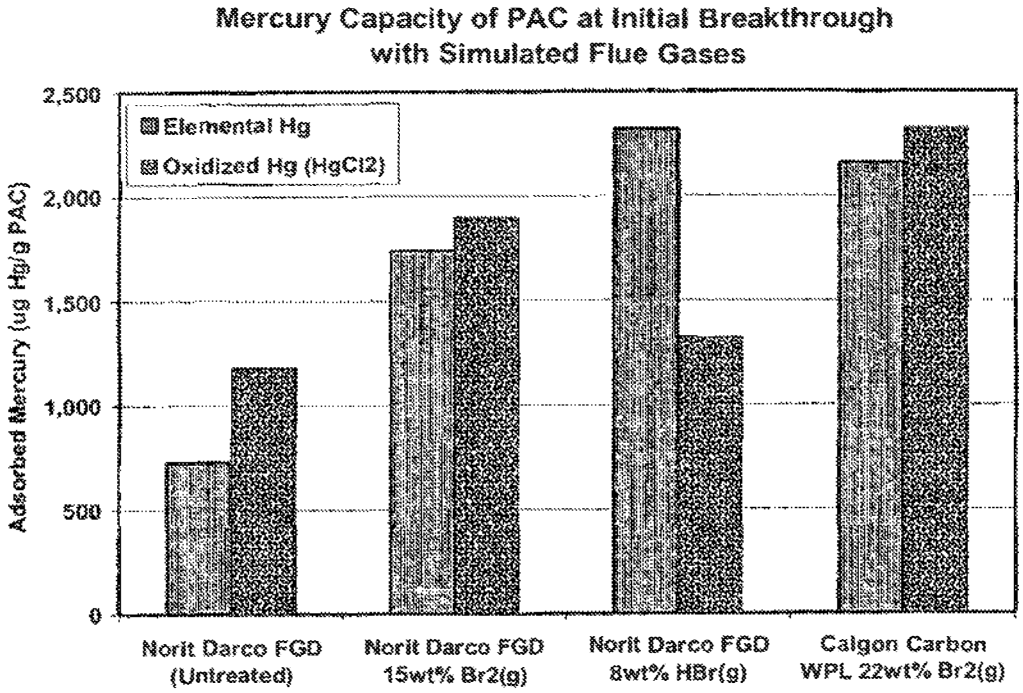
Paragraph [●●87] states that the activated carbon adsorbed elemental bromine (Br_2) and hydrogen bromide (HBr) faster than chlorine (explicitly shown as Cl_2 in the Table). The table shows the amount of treatment material (Br_2, HBr, or Cl_2) absorbed on the activated carbon and the rate of adsorption of the treatment material on the activated carbon. Paragraph [●●87] and the table that follows make no statements describing or suggesting mercury removal rates of the treated activated carbon.

The Office Action states that one having ordinary skill in the art would expect activated carbon treated with HBr or Br_2 would result in a very similar modified PAC as they both include bromide, citing to paragraph [●●92] as allegedly disclosing that each of the brominated PACs performed similarly. Applicant notes Declaration C at item 18 which explains that Br_2 is not and does not include Br^-. At paragraph [●●92], Nelson states:

> [0092] The brominated sorbents of this invention, on the other hand, performed very well with this difficult flue gas, achieving about 50% mercury removal with only 2 lb/MMacf of sorbent consumption and almost 70% removal at an injection rate of 4 lb/MMacf. PACs brominated with Br_2 to 5 wt % and 15 wt %, and with HBr to 9 wt % all performed similarly.

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Taken in the context of the entire document, figures 14-15 and paragraph [0092] fails to describe or suggest equivalent mercury-removal performance of HBr-treated activated carbon and Br_2-treated activated carbon. With regard to figure 14, Nelson states at paragraph [0084] that "[t]here was no much difference in performance between the various brominated samples, probably because in the duct-injection mode they only used a small fraction of their available mercury-adsorption capacity." Therefore, Nelson states that figure 14 does not provide an accurate comparison between the brominated samples, because the full mercury-adsorption capacity was not utilized. In figure 15, for all data points showing HBr-treated activated carbon, a higher sorbent injection rate was needed to achieve equivalent mercury-removal performance as the Br_2-treated activated carbons (i.e., the HBr data points for a given mercury-removal percentage are always to the right of the Br_2 data points for that mercury-removal percentage), indicating HBr-treated activated carbon to have less mercury-removal ability than Br_2-treated activated carbons. In figure 12, reproduced below, Nelson compares the mercury capacity of untreated activated carbon, 15 wt% Br_2-treated activated carbon, 8 wt% HBr-treated activated carbon, and 22 wt%Br_2-treated activated carbon.



Paragraph [●●8●], discussing figure 12, states that:

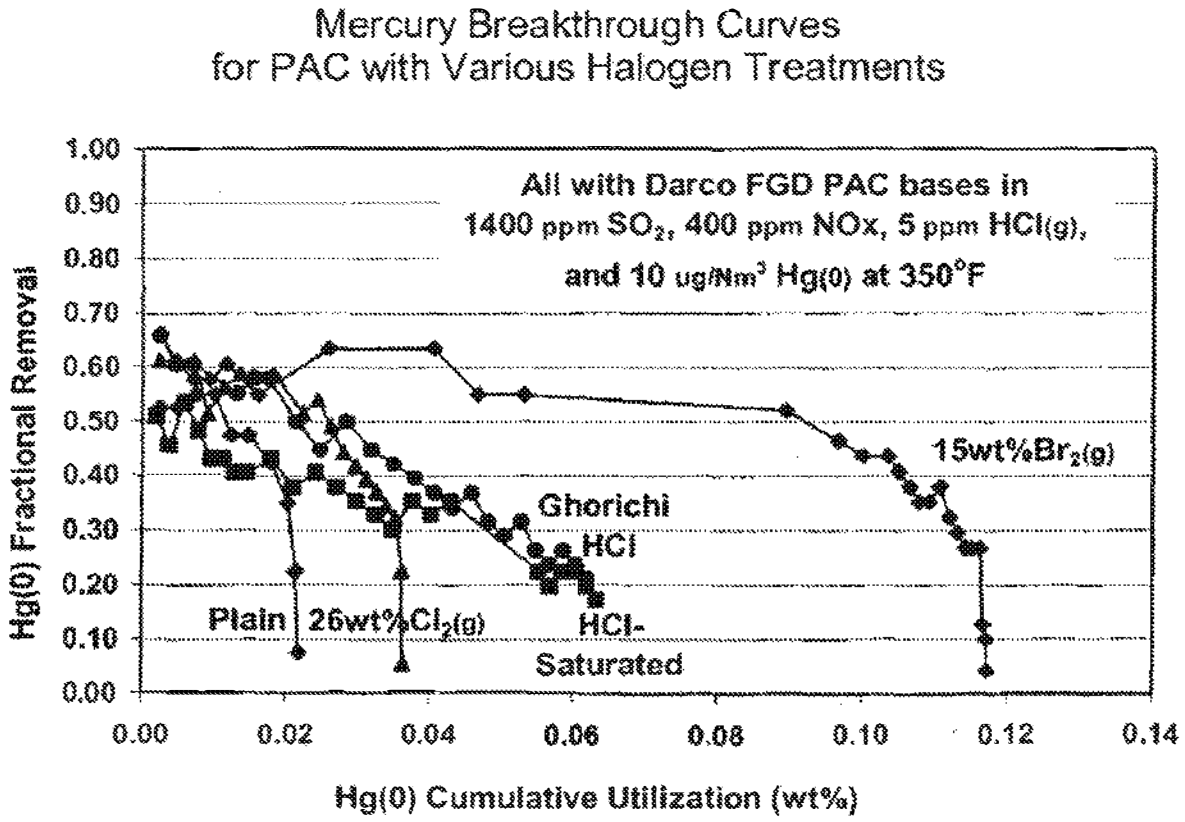
> …the brominated carbons adsorbed considerably more mercury species than the untreated version, with the improvements averaging about 1●●%. Importantly, the bromine-gas-treated sorbents removed about as much oxidized mercury-chloride from the test gases as elemental mercury, indicating performance improvements with both kinds of common flue-gas mercury species.

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Nelson does not portray the mercury removal abilities of activated carbon treated with Cl_2 outside the flue gas as equivalent to that of activated carbon treated with HCl outside the flue gas.

At figure 11, reproduced below, Nelson shows mercury breakthrough curves for elemental mercury removal from a non-flue gas "mercury-challenge gas" for powdered activated carbon with various halogen treatments performed outside the flue gas.

Figure 11.



At paragraph [●●77], reproduced below, Nelson discusses figure 11.

> [0077] The sample that had been exposed to gaseous chlorine, $Cl_2(g)$, exhibited some improvement in mercury removal performance relative to the plain, untreated PAC. Two samples of HCl-treated PACs showed even higher ultimate mercury capacities, but poorer kinetics. One of these samples had been pretreated by flowing gas-phase HCl through the PAC sample until it no longer added mass. The other, acquired from Ghorishi et al., was produced by a dilute liquid-phase HCl treatment described in their publications. The elemental mercury breakthrough curves of the two HCl-treated PACs were very similar, exhibiting a slow and steady drop-off in performance, indicative of poor mercury adsorption kinetics. In contrast, the brominated sample of this invention broke through very sharply and captured more than five times the elemental mercury of the untreated PAC.

At paragraph [0077], Nelson states that the HCl-treated powdered activated carbons had higher capacities for elemental mercury, but showed poorer kinetics. Although some information about how the Cl_2- and HCl-treated activated carbons would behave in a flue gas can be learned from figure 11, a flue gas contains additional species that were not present in the "mercury challenge gas", and, further, can include other forms of mercury other than the elemental mercury measured by the breakthrough test of figure 11, such as oxidized mercury. Nelson does not perform mercury-removal testing of HCl-treated activated carbons in a flue gas. However, Nelson in figure 11, paragraph [0077], and paragraph [0012] refers to HCl-treated activated carbon from Ghorishi et al., which had about the same performance in figure 11 as the HCl-saturated activated carbon prepared by Nelson. At paragraph [0012] Nelson describes a publication by this author, Ghorishi, S.B., Keeney, R.M., Jozewicz, W.S., Serre, S.D. and Gullett, B.K., 2001, In-flight capture of elemental mercury by a chlorine-impregnated activated carbon, Annual Air and Waste Management Association(AWMA) Conference, Orlando, FL, Vol. 24, No. 28 ("Ghorishi").

Ghorishi's conclusion at page 11 states that over 80% mercury removal was accomplished from a flue gas using activated carbon treated outside the flue gas with HCl. Comparing these results to Nelson's results shown in figures 14 and 15, 80% mercury removal is better than the about 58% removal by Cl_2-treated activated carbon in figure 14, is better than the about 22% removal by Cl_2-treated activated carbon in figure 15, and is better than the maximum mercury removal of HBr-

or Br_2-treated activated carbons in figure 15. Therefore, one of ordinary skill in the art hypothetically reviewing Nelson would not only conclude that activated carbon treated outside the flue gas with HCl not only has higher capacity for elemental mercury than Cl_2-treated activated carbon as shown in Nelson's figure 11, but also from comparing Ghorishi to Nelson that activated carbon treated outside the flue gas with HCl has better mercury removal performance in flue gas than Cl_2-treated activated carbon. Accordingly, even if, merely for the sake of argument, one of ordinary skill in the art were to conclude from Nelson's statements at paragraph [0092] that activated carbon treated with HBr or Br_2 outside the flue gas have similar mercury removal abilities, this would not lead to the conclusion that activated carbon treated with HBr outside the flue gas has better mercury removal abilities than activated carbon treated with HCl outside the flue gas.

Nelson never directly compares the mercury-removal ability of HBr-treated activated carbon with HCl-treated activated carbon. With Nelson clearly indicating that HBr-treated activated carbon has inferior mercury-removal ability as compared to Br_2-treated activated carbon, and that HCl-treated activated carbon has superior mercury-removal ability as compared to Cl_2-treated activated carbon, there is no way that one of ordinary skill in the art hypothetically considering Nelson could conclude that HBr-treated activated carbon has equivalent or superior mercury-removal ability compared to HCl-treated activated carbon.

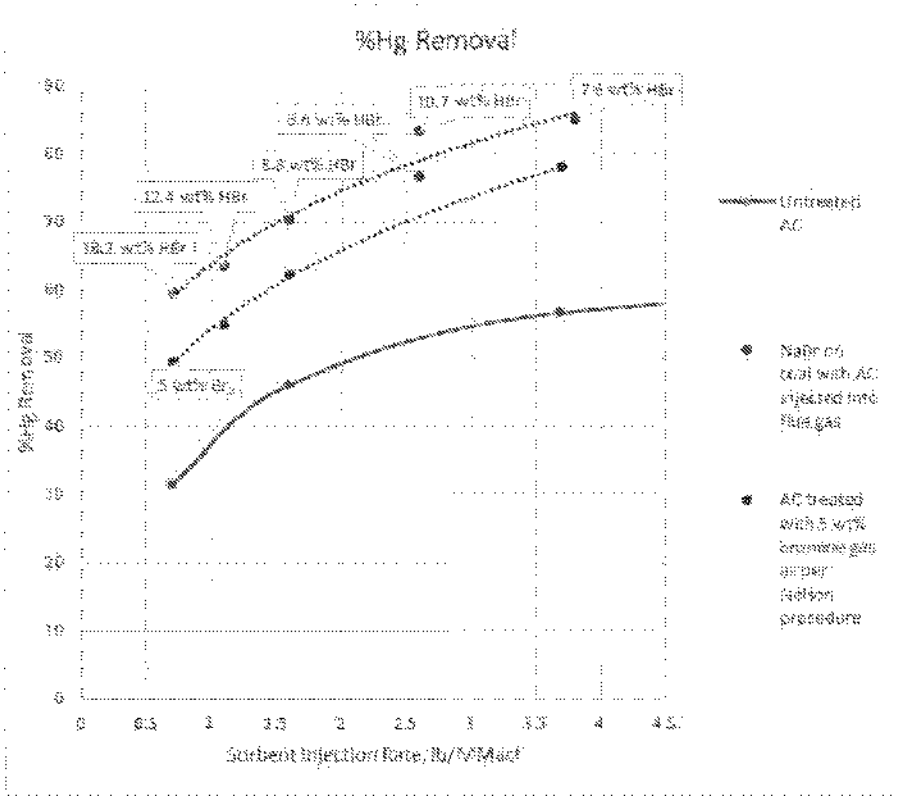
II(B). In-flight promotion versus treatment outside the flue gas.

II(B)(1). In-flight promotion with HBr or Br^- promoters is more effective for mercury removal than treating the sorbent with HBr, Br^-, or Br_2 outside the mercury-containing gas.

The inventors of the present application have discovered that by combusting coal in the presence of a HBr or Br^- promoter, and by placing an activated carbon sorbent in the mercury-containing gas, as presently claimed, the activated carbon can be promoted by the promoter in-flight in the mercury-containing gas, and further, that in-flight HBr or Br^- promotion of the activated carbon is more effective for mercury removal than use of an activated carbon that is treated with HBr, Br^-, or Br_2 outside the flue gas.

As explained in Declaration B, pilot-scale testing was performed with activated carbon alone (untreated) injected into the flue gas, the activated carbon treated with Br_2 outside the flue gas as per

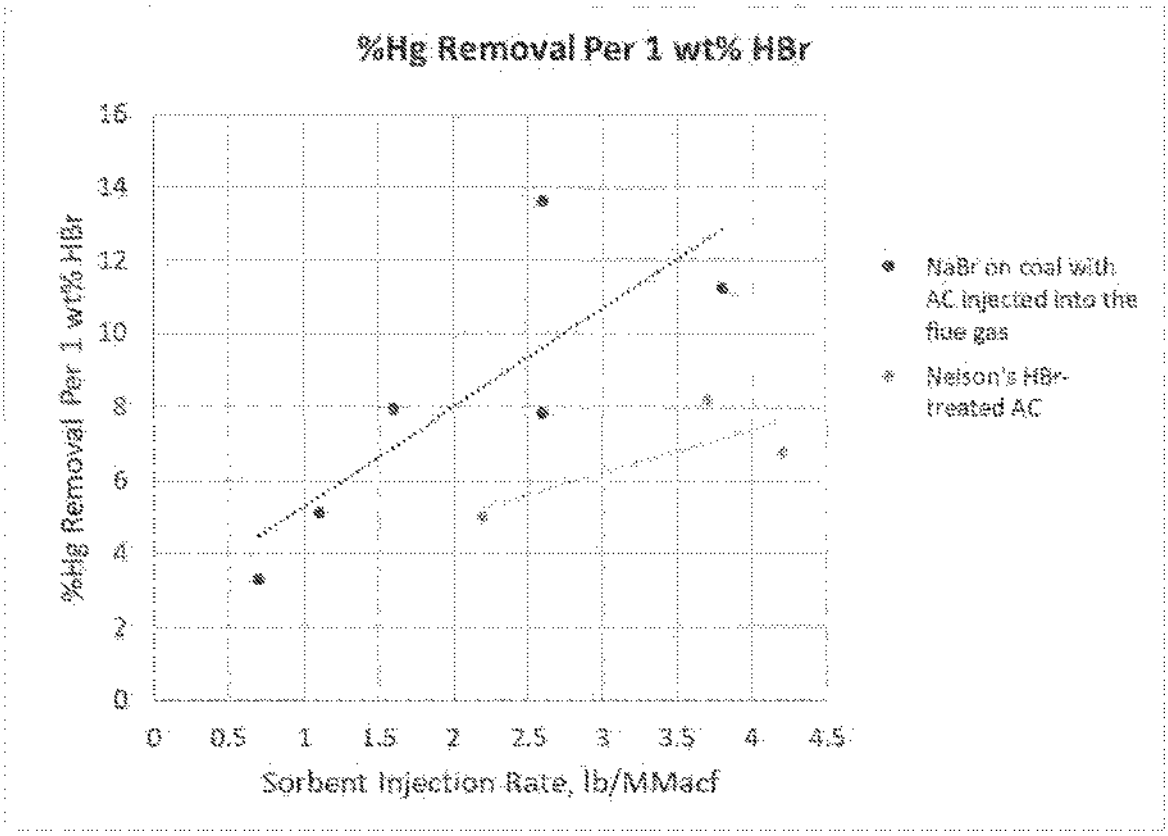
the Nelson procedure (see, Declaration B at item 7), and with NaBr added to coal prior to introduction to the furnace with injection of untreated activated carbon into the flue gas. The same activated carbon was used for each sample. See, Declaration B at items 8-11. The plot given in Declaration B at item 11 is reproduced below.



The data in the plot above from item 11 of Declaration B show that the NaBr added to coal prior to introduction to the furnace with injection of untreated activated carbon into the flue gas (in-flight promotion with Br^-) provided a higher percent of mercury removal at all tested sorbent injection rates as compared to the activated carbon alone (untreated) and compared to the activated carbon treated with Br_2 outside the flue gas described herein at item 6 as per the Nelson procedure. With NaBr added to the coal and activated carbon injected into the flue gas, there was a significant reduction in the amount of sorbent required to acheive similar mercury removal compared to the

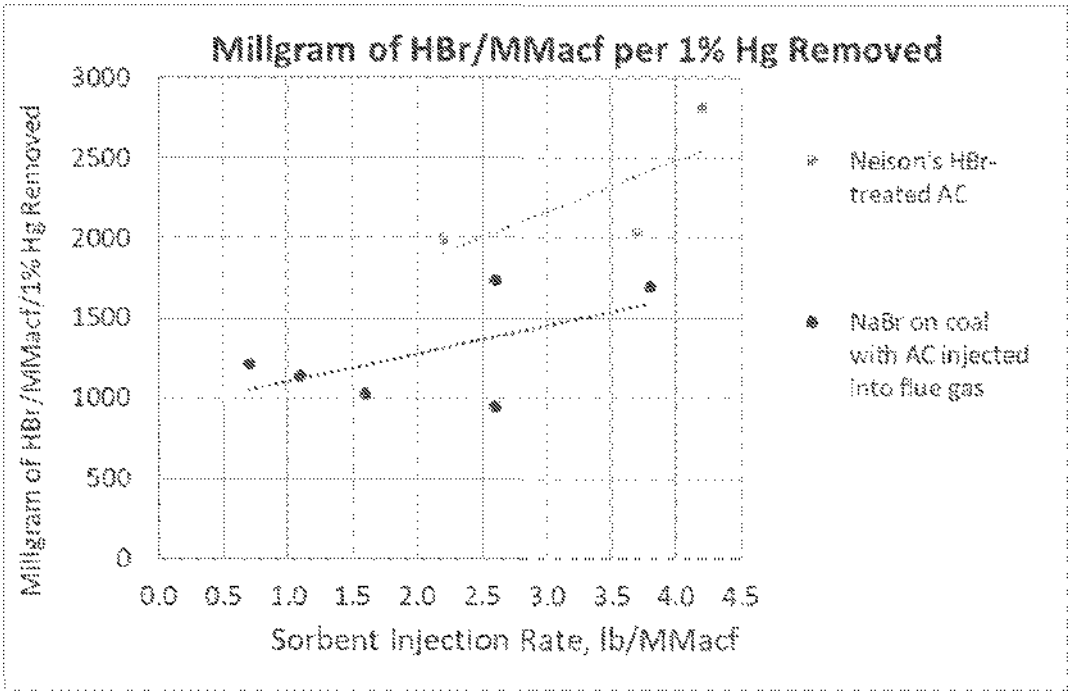
activated carbon treated with Br_2 outside the flue gas. For example, to acheive 70% mercury removal, 2.5 lb/MMacf of Br_2-treated carbon was required, as compared to 1.6 lb/MMacf with NaBr added to the coal and activated carbon injected into the flue gas; an additional (2.5-1.6/1.6)*100% or 56% treated sorbent was required to achieve the same leval of mercury removal. See, Declaration B at items 2-5 and 12.

The percent mercury removal per 1 wt% HBr versus the sorbent injection rate was compared with NaBr added to coal prior to introduction to the furnace with injection of untreated activated carbon into the flue gas using the pilot-scale plant, and with Nelson's activated carbon treated with HBr outside the flue gas. The data for Nelson's activated carbon treated with HBr outside the flue gas was taken directly from Nelson. The first plot given in Declaration B at item 13 is reproduced below, but only showing the HBr data.



The data in the plot above, derived from the first plot at item 13 of Declaration B, show that the NaBr added to coal prior to introduction to the furnace with injection of untreated activated carbon into the flue gas provided a significantly higher (about 2x) percent mercury removal per 1 wt% HBr at all tested sorbent injection rates as compared to Nelson's activated carbon treated with HBr outside the flue gas. See, Declaration B at item 14.

The data from the pilot-scale plant was also plotted to show the milligrams of HBr/MMacf per 1% mercury removal versus the sorbent injection rate with NaBr added to coal prior to introduction to the furnace with injection of untreated activated carbon into the flue gas, and for Nelson's activated carbon treated with HBr outside the flue gas. The second plot given in Declaration B at item 13 is reproduced below.



The data in the plot above, derived from the second plot at item 13 of Declaration B, show that NaBr added to coal prior to introduction to the furnace with injection of untreated activated carbon into the flue gas provided a significantly lower milligrams of HBr/MMacf per 1% mercury

removal at all tested sorbent injection rates as compared to Nelson's activated carbon treated with HBr outside the flue gas, indicating more efficient (approximately 2x) use of HBr for mercury removal during in-flight promotion of activated carbon than treatment of activated carbon outside the flue gas. See, Declaration B at item 14.

As explained at item 9 of Declaration D, Nelson's experimental setup in Examples 5 and 7 and the experimental setup described at item 8 of Declaration B inject activated carbon sorbent into a flue gas upstream of an ESP and use no scrubber, making the procedures comparable. However, the higher HCl concentration in Nelson's Example 7 flue gas allows for easier mercury removal, due to HCl acting as a promotor of the activated carbon, as compared to the pilot-scale setup described at item 8 of Declaration B. Further, the higher mercury concentration in Nelson's Example 5 makes it easier for Nelson's sorbents to remove the same overall percentage of mercury from the flue gas, as compared to the pilot-scale setup described at item 8 of Declaration B. Therefore, if Nelson's Example 5 and 7 HCl and mercury concentrations were changed to match those of the pilot-scale setup described at item 8 of Declaration B, Nelson's sorbents would remove a lower percentage of mercury than found in Nelson's Examples 5 and 7, meaning that Nelson's sorbents would exhibit an even lower (and less efficient) percent mercury removal per 1 wt% HBr at any sorbent injection rate than shown in the second plot above (derived from the first plot at item 13 of Declaration B), and would exhibit an even higher (and less efficient) milligrams of HBr/MMacf per 1% mercury removal at any sorbent injection rate than shown in the third plot above (derived from the second plot at item 13 of Declaration B).

II(B)(2). There is no way a person of ordinary skill in the art could predict that in-flight promotion of a sorbent with HBr or Br^- promoters is more effective for mercury removal than use of a sorbent that is treated with the same promoters outside the flue gas.

The M.P.E.P. at the beginning of § 2143.02 states (emphasis added) "[a] rationale to support a conclusion that a claim would have been obvious is that all the claimed elements were known in the prior art and one skilled in the art could have combined the elements as claimed by known methods with no change in their respective functions, *and the combination would have yielded nothing more than predictable results to one of ordinary skill in the art.*"

As admitted by the Office Action, Felsvang fails to describe or suggest HBr or Br^- promoters. Felsvang also fails to describe or suggest that treatment of an activated carbon with a HCl or Cl^- additive outside of flue gas has any advantages over in-flight promotion of an activated carbon with an HCl or Cl^- promoter. Further, as shown herein at **II(D)**, treatment of activated carbon outside the flue gas with HCl provides better mercury removal than in-flight promotion of activated carbon with HCl or Cl^-. Therefore, a person of ordinary skill in the art hypothetically having Felsvang in-hand would have no clue that in-flight promotion of activated carbon with a halide could give the same or better percent mercury removal over halide treatment outside of the flue gas, and would be led away from Felsvang's process if they investigated the relative mercury removal of treatment of the activated carbon with HCl or Cl^- outside the flue gas versus in-flight treatment with HCl or Cl^- in the flue gas.

Nelson mentions treating activated carbon outside of flue gas, and then adding the activated carbon to flue gas. Nelson fails to describe or suggest in-flight promotion of an activated carbon with a halide in the flue gas. Therefore, a person of ordinary skill in the art hypothetically having Nelson in-hand would *also* have no idea that in-flight promotion of activated carbon with a halide could have any advantages over halide treatment outside of the flue gas.

There is no way to predict from the presently cited references the superior mercury capture discovered by the present inventors that occurs when activated carbon is promoted with HBr or Br^- promoters in-flight in the mercury-containing gas, as occurs when following the present claims. The Office Action states at the end of the second full paragraph on page 4 that Nelson's additives would be combined with Felsvang's process "...so as to provide an effective carbon sorbent for mercury." However, a person of ordinary skill in the art would have no idea that in-flight promotion with HBr or Br^- promoters could work better than Nelson's HBr-treatment outside the flue gas. Felsvang fails to describe or suggest that in-flight promotion provides a sorbent with even the same (let alone superior) properties as a sorbent treated outside the flue gas, and, as explained herein at **II(D)**, treatment of activated carbon outside the flue gas with HCl actually provides better mercury removal than in-flight promotion of activated carbon with HCl or Cl^-; similarly, Nelson fails to describe in-flight promotion, let alone that in-flight promotion provides the same or superior mercury removal ability as compared to treatment outside the flue gas.

The only way that a person of ordinary skill in the art could discover that in-flight promotion of activated carbon with HBr or Br^- promoters is more effective for mercury removal than HBr treatment outside the flue gas would not be from the cited references alone; instead, the person of ordinary skill would need to actually modify Felsvang with Nelson as alleged, and then compare the mercury removal of Felsvang's modified process to Nelson's sorbent treated outside the flue gas.[8] However, the person of ordinary skill carrying out such a combination would be surprised to find that in-flight promotion with HBr or Br^- is more effective for mercury removal than HBr treatment of the sorbent outside the flue gas. The process giving rise to these surprising results was discovered by the inventors of the present application. Surprising results are a hallmark of patentability; only by having the present application in-hand could such results be predicted, and a need to resort to hindsight analysis to predict the advantages of the combination asserted by the Office Action is indicative that the presently claimed invention is not obvious over the cited references. Accordingly, independent claim 2 is patentable over Felsvang in view of Nelson for at least this additional reason.

II(B)(3). Reply to Examiner's response to arguments.

The Office Action states:

> II(B)(1) The applicant contends that the bromide promoters are more effective for mercury removal than treating the sorbent with bromide or bromine additives outside the mercury-containing gas. The applicant further provides a graph to demonstrate these unexpected results.

[8] In the event the Examiner intends to argue that such advantages are inherent in the cited art, Applicant notes that the claimed invention is not specifically disclosed in the prior art. The Examiner cannot reason inherency in a §103 context based on a mere proposed or hypothetical combination of features from cited references. Such reasoning would merely reflect the Examiner's reliance on impermissible hindsight. See, M.P.E.P. § 2112(IV).

These unexpected results are not commensurate with the scope of the claims. The applicant is claiming HBr and Br- while the graph only demonstrates HBr. Further the comparisons between the prior art and that of the current invention do no demonstrate unexpected results. The applicant's data is unclear as it is stating HBr (as specified in the actual graph) or NaBr (as specified in the legend). Further the 18.2 data point has no labelling on what the parameter is. None of the data point include what amount is being specified, wt%, vol% etc. The results would be expected by one having ordinary skill in the art as the wt% (if we are to assume the amount specified is wt) of the amount reported on the upper most line is greater than that of the wt% on the middle trending line. Further claim 1 does not include NaBr on coal. Lastly it unclear if the results are because of the different components being reacted or because of the different method being used. In order to establish that the method being used has unexpected results the components used must be the same for both methods.

As explained in Declaration C at item 28, when NaBr is added to coal, gaseous NaBr is formed in the flue gas, and HBr is formed in the flue gas. As explained in Declaration C at item 33, NaBr is a salt that includes Na^+ and Br^-. Therefore, placing NaBr on the coal (as specified in the legend of the plot given at item 11 of Declaration B) results in formation of HBr and Br^- in the flue gas (as specified in the graph), and the results shown are commensurate with the scope of the claims. In the graphs in Declaration B all halides in the flue gas formed from halide salts placed on the coal are assumed to be in the form of the respective hydrogen halide for comparative purposes, although these could be in the form of the gaseous halide salt or the hydrogen halide—this assumption is made for consistency across all the graphs in Declaration B. As the graphs show trends between %Hg removal and halide content of the flue gas, so long as the amounts of the different halides present in the flue gas are compared in a consistent way it does not matter whether they are in the form of the hydrogen halide or the halide ion in the flue gas for purposes of comparing relative %Hg removal.

The data table at item 10 of Declaration B shows that the 18.2 data point of the plot shown at item 11 corresponds to 18.2 wt% HBr, and that all of the labels on the data set "NaBr on coal with AC injected into flue gas" indicate wt% HBr. Additionally, for increased clarity, Declaration B is revised to indicate wt% and properly labels the 18.2 data point in the plot shown at item 11.

The Office Action states that the results would be expected by one having ordinary skill in the art because the amount of HBr on the upper line, representing NaBr on coal with AC injected into the flue gas, are greater than the wt% of the middle trending line, representing AC treated with

5 wt% bromine outside the flue gas as per the Nelson procedure. Applicant does not agree that the results are not unexpected. The unexpected results described in the Response are that in-flight promotion of a sorbent with HBr or Br^- promoters is more effective for mercury removal than use of a sorbent that is treated with the same promoters outside the flue gas (as explained herein at **II(B)**, using the first and second plots from item 13 of Declaration B), and that in-flight promotion with HBr or Br^- promoters is more effective for mercury removal than in-flight promotion with HCl or Cl^- promoters (as explained herein at **II(C)**). Applicant included the plot at item 11 primarily to show that adding NaBr to coal and injecting untreated AC into the flue gas is an effective way to remove mercury.

The Office Action states that it is not clear whether the results are because of different components being reacted or because of the different method being used. However, all of the data shown in the plot at item 11 of Declaration B is shown in the tables at items 9 and 10 of Declaration B, which is all derived from the same pilot-scale test unit described at item 8 of Declaration B, using the same components, the same type of AC, and the same method, with the only variations between the data sets being the type of treatment of the AC (i.e., no treatment, treatment with Br_2 outside the flue gas prior to injection, and adding NaBr to coal while injecting untreated AC into the flue gas); item 11 of Declaration B has been revised to clarify this point.

The Office Action states:

> The second graph on page 12 comparing NaBr on coal to HBr treated AC and it is unclear if the results are because of the different components being reacted or because of the different method being used. In order to establish that the method being used has unexpected results the components used must be the same for both methods. To do that the graph would have to be comparing HBr in the present method to HBr in the prior art method. Further the applicant has not shown the amount of oxidation supported by each (wt%) data point. Lastly claim 1 does not include NaBr on coal.

The second graph on page 12 of the last Response was the first graph from item 13 of Declaration B. The Office Action states that the components used must be the same for both methods, such that the graph compares HBr in the present method to HBr in the prior art method. However, as explained in Declaration C at item 28, when NaBr is added to coal, gaseous NaBr is formed in the flue gas, and HBr is formed in the flue gas. As explained in Declaration C at item 33, NaBr is a salt that includes Na^+ and Br^-. Therefore, placing NaBr on the coal results in formation of

HBr and Br^- in the flue gas. All of the NaBr is assumed to be converted to HBr in the graph, such that the components being compared are the same for both methods.

Although the data set "NaBr on coal with AC injected into flue gas" is shown in the table in item 10 and is derived from the pilot-scale test unit described at item 8 of Declaration B, while the data set "Nelson's HBr-treated AC" is from Nelson, as explained at item 9 of Declaration D and at **II(B)(1)** herein, data from Nelson's experimental setup and from the pilot-scale unit of item 8 of Declaration B are validly comparable—further, Nelson's conditions used in Examples 5 and 7 allow for easier mercury removal than in the pilot-scale unit of item 8 of Declaration B, such that if Nelson's Example 5 and 7 HCl and mercury concentrations were changed to match those of the pilot-scale setup described at item 8 of Declaration B, Nelson's sorbents would remove a lower percentage of mercury than found in Nelson's Examples 5 and 7.

The Office Action states that "the application has not shown the amount of promoter supported by each (wt%) data point." However, the y-axis indicates the percent mercury removal per 1 wt% HBr; therefore, the wt% promoter data is part of what is shown on the graph. Further, the table at item 10 indicates the specific amount of HBr for each data point.

The Office Action states:

> The third graph on page 13 compares HBr treated AC and NaBr on coal with AC injected into flue gas. The graph states Milligram of HBr/Mmacf/3%Hg Removed. As HBr is not a part of the current application data points, it is unclear how to interpret this graph. Claim 1 does not include NaBr on coal. Further it is unclear if the results are because of the different components being reacted or because of the different method being used. In order to establish that the method being used has unexpected results the components used must be the same for both methods.

The third graph on page 13 of the last Response was the second graph from item 13 of Declaration B. The Office Action states that HBr is not a part of the current application data points, and that claim 1 does not include NaBr on coal. However, as explained in Declaration C at item 28, when NaBr is added to coal, gaseous NaBr is formed in the flue gas, and HBr is formed in the flue gas. As explained in Declaration C at item 33, NaBr is a salt that includes Na^+ and Br^-. Therefore, placing NaBr on the coal results in formation of HBr and Br^- in the flue gas. All of the NaBr is assumed to be converted to HBr in the graph, such that the components being compared are the same for both methods.

Although the data set "NaBr on coal with AC injected into flue gas" is shown in the table in item 10 and is derived from the pilot-scale test unit described at item 8 of Declaration B, while the data set "Nelson's HBr-treated AC" is from Nelson, as explained at item 9 of Declaration D and at **II(B)(1)** herein, data from Nelson's experimental setup and from the pilot-scale unit of item 8 of Declaration B are validly comparable—further, Nelson's conditions used in Examples 5 and 7 allow for easier mercury removal than in the pilot-scale unit of item 8 of Declaration B, such that if Nelson's Example 5 and 7 HCl and mercury concentrations were changed to match those of the pilot-scale setup described at item 8 of Declaration B, Nelson's sorbents would remove a lower percentage of mercury than found in Nelson's Examples 5 and 7.

The Office Action states:

> II(B)(2) The applicant contends that there is no way a person of ordinary skill in the art could predict from the cited references that in-flight promotion of a sorbent with bromide promoters is more effective for mercury removal
>
> The examiner contends that the applicant has not established that it is more effective.

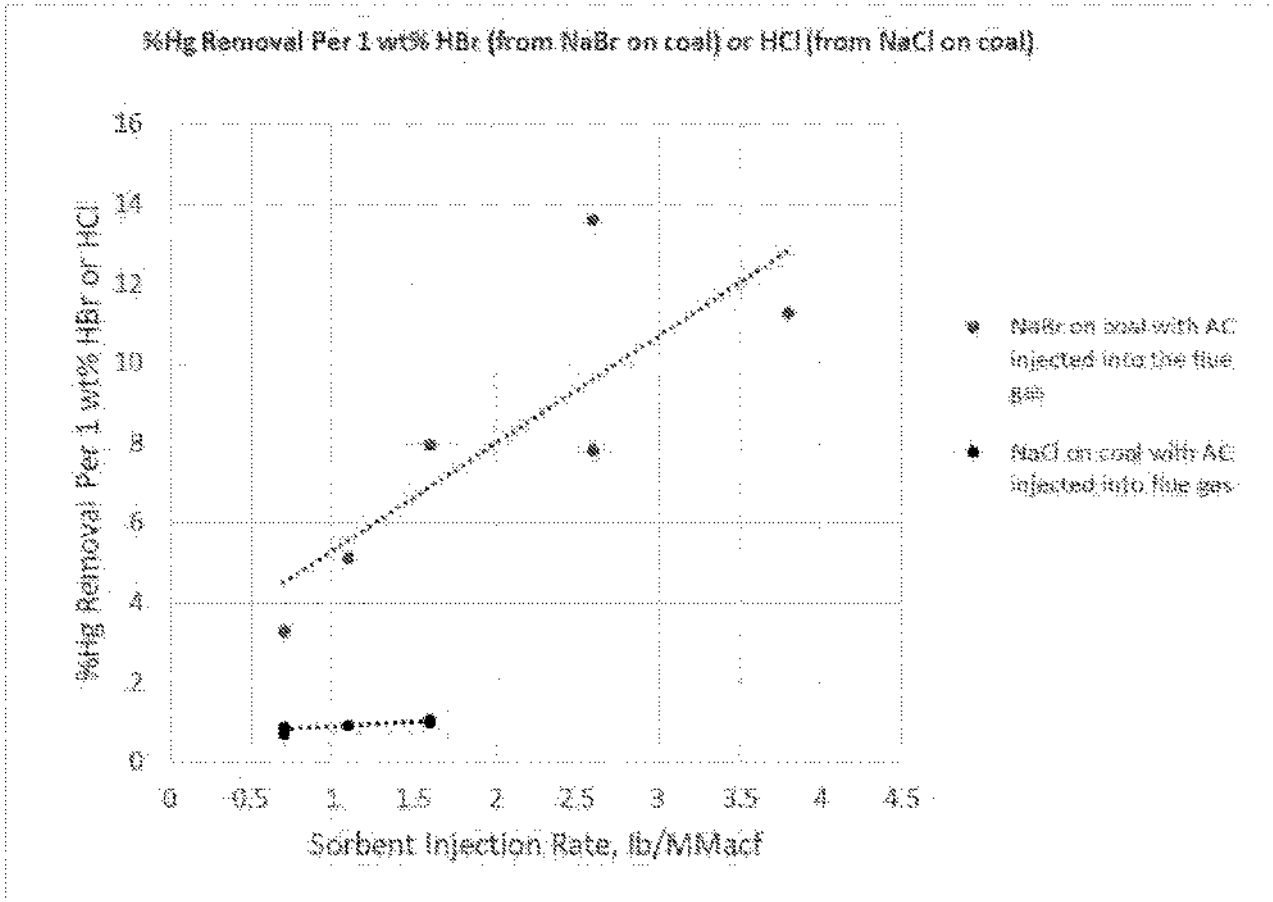
Applicant respectfully disagrees. As explained above, the data does provide evidence that in-flight promotion of a sorbent with HBr or Br^- promoters is more effective for mercury removal than use of a sorbent that is treated with the same promoters outside the flue gas.

II(C). In-flight promotion with HBr or Br^- versus HCl or Cl^-.

II(C)(1). In-flight promotion with HBr or Br^- promoters is more effective for mercury removal than in-flight promotion with HCl or Cl^- promoters.

The inventors of the present application have discovered that that in-flight HBr or Br^- promotion of an activated carbon in a mercury-containing flue gas is significantly more effective for mercury removal than in-flight HCl or Cl^- promotion of an activated carbon.

As explained in Declaration B, pilot-scale testing was performed with NaBr or NaCl added to coal prior to introduction to the furnace with injection of untreated activated carbon into the flue gas. The same activated carbon was used for each sample. See, Declaration B at items 8-10. The first plot given in Declaration B at item 13 is reproduced below, but not showing the data from Nelson's HBr-treated AC.



The data in the plot above, derived from the first plot at item 13 of Declaration B, show that the NaBr added to coal prior to introduction to the furnace with injection of untreated activated carbon into the flue gas provided a significantly higher (about 6-8x) percent mercury removal per 1 wt% HBr or HCl at all tested sorbent injection rates compared to the NaCl added to coal prior to introduction to the furnace with injection of untreated activated carbon into the flue gas. See, Declaration B at item 14.

II(C)(2). There would be no way for a person of ordinary skill in the art to predict this advantage from the from the cited references.

As explained herein at **II(A)(2)(d)**, Nelson fails to describe or suggest that treatment of activated carbon with HBr or Br^- could provide any mercury-removal improvement, or even the same mercury-removal activity, compared to Felsvang.

The only way that a person of ordinary skill in the art could discover that in-flight promotion with HBr or Br^- promoters is more effective for mercury removal than in-flight promotion with HCl or Cl^- promoters would not be from the cited references alone; instead, the person of ordinary skill would need to actually modify Felsvang with Nelson as alleged, and then to compare the mercury removal of Felsvang's modified process to Felsvang's original process.[9] However, the person of ordinary skill carrying out such a combination would be surprised to find that promotion of activated carbon with HBr or Br^- could provide any mercury-removal improvement, or even the same mercury-removal activity, compared to Felsvang. The process giving rise to these surprising results was discovered by the inventors of the present application. Surprising results are a hallmark of patentability; only by having the present application in-hand could such results be predicted, and a need to resort to hindsight analysis to predict the advantages of the combination asserted by the Office Action is indicative that the presently claimed invention is not obvious over the cited references. Accordingly, independent claim 2 is patentable over Felsvang in view of Nelson for at least this additional reason.

II(C)(3). Reply to Examiner's response to arguments.

The Office Action states:

[9] In the event the Examiner intends to argue that such advantages are inherent in the cited art, Applicant notes that the claimed invention is not specifically disclosed in the prior art. The Examiner cannot reason inherency in a §103 context based on a mere proposed or hypothetical combination of features from cited references. Such reasoning would merely reflect the Examiner's reliance on impermissible hindsight. See, M.P.E.P. § 2112(IV).

II(C)(1). The applicant contends that one having ordinary skill in the art would not have predicted in-flight chloride promotion of activated carbon to be more effective for mercury removal that in-flight chloride promotion.

The examiner disagrees. Nelson discloses that bromide is a better promoter of AC for the purpose of mercury removal as shown above. Therefore one having ordinary skill in the art would expect an in-flight bromide promoted sorbent to superior to and in-flight chloride promoted sorbent.

II(C)(2). The applicant argues that one having ordinary skill in the art would not predict this advantage from the cited references.

The examiner disagrees for the reasons stated above.

However, as explained herein at **II(A)(2)(d)** and **II(A)(3)**, Nelson fails to describe or suggest that HBr-treatment of activated carbon provides better mercury removal ability than HCl-treated activated carbon; therefore, there is no way one of ordinary skill in the art could reasonably predict from Felsvang and Nelson that treatment of activated carbon with HBr or Br^- could provide any mercury-removal improvement, or even the same mercury-removal activity, compared to Felsvang.

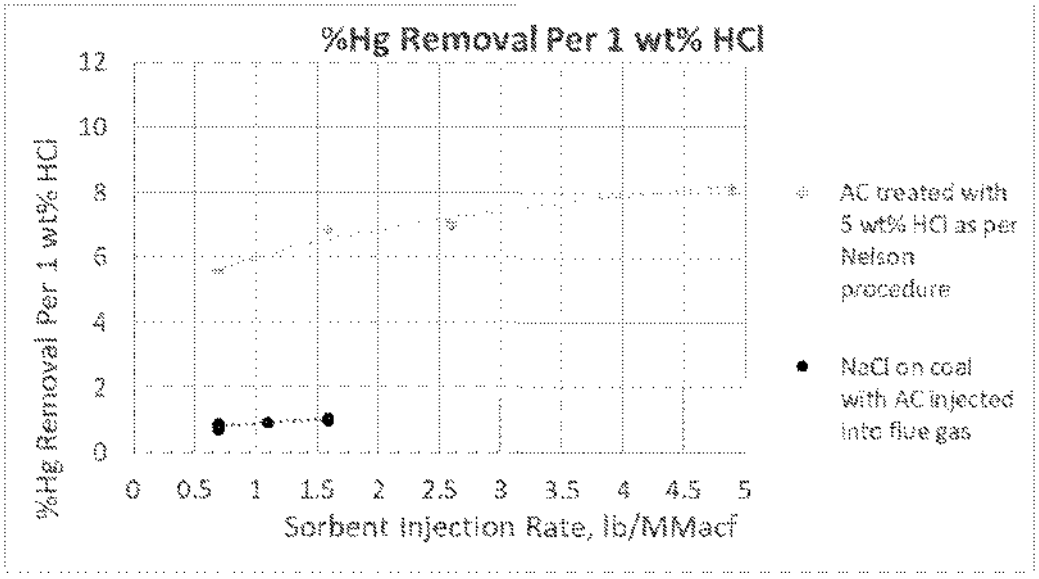
II(D). A person of ordinary skill in the art would find that treatment of activated carbon outside the flue gas with HCl as per Nelson's process actually provides more effective mercury removal per wt% HCl than treatment of activated carbon with HCl or Cl^- in the flue gas.

II(D)(1). Even if a person of ordinary skill in the art compared the mercury removal of Felsvang to activated carbons treated with HCl outside of the flue gas, they would not determine that in-flight promotion provides the same or better mercury removal properties per wt% HCl.

As explained herein at **II(A)(2)(c)**, Felsvang fails to describe or suggest that in-flight promotion of activated carbon with HCl or Cl^- in the flue gas provides better mercury removal than treatment of activated carbon outside the flue gas with HCl. A person of ordinary skill would notice the extremely poor improvement (if any improvement actually occurred) caused by addition of activated carbon in Felsvang's sole Example showing the use of activated carbon (Example 4) (see **II(A)(2)(c)** herein) and would question whether Felsvang's process is an efficient way to use activated carbon for mercury removal as compared to Nelson's process. Merely for the sake of

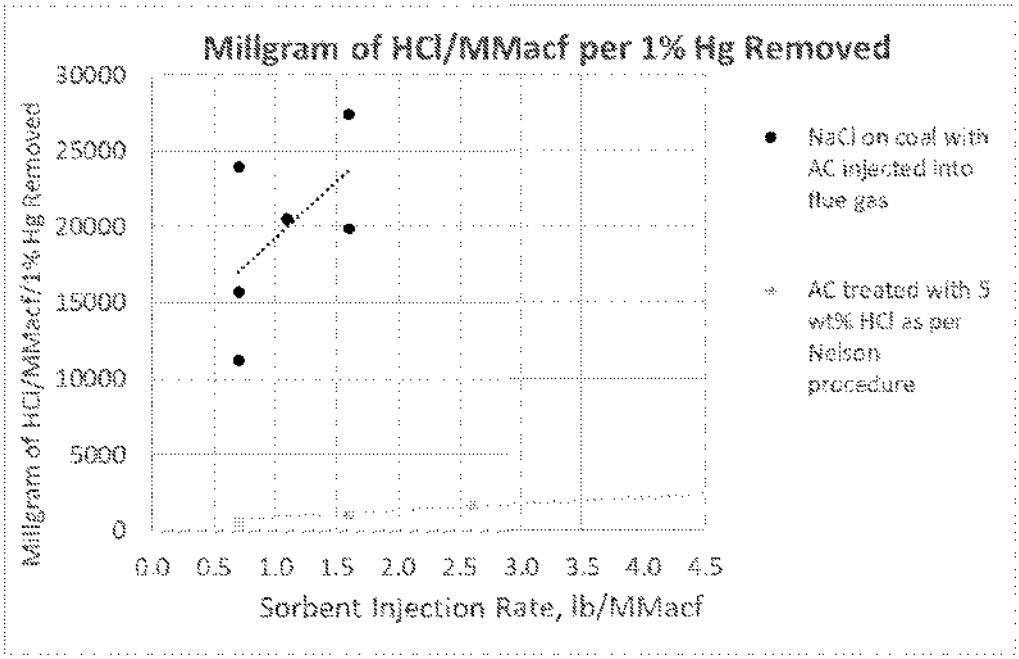
argument, if one of ordinary skill in the art were to investigate Felsvang's embodiments including activated carbon and compare the relative mercury-removal ability to that of activated carbon treated with HCl outside the flue gas, as explained below, they would find that treatment of activated carbon outside the flue gas with HCl as per Nelson's process actually provides more effective mercury removal per wt% HCl than treatment of activated carbon with HCl or Cl^- in the flue gas, which would lead one of ordinary skill in the art away from using Felsvang's process.

As explained in Declaration B, pilot-scale testing was performed with activated carbon treated with HCl outside the flue gas as per the Nelson procedure (see, Declaration B at item 7), and with NaCl added to coal prior to introduction to the furnace with injection of untreated activated carbon into the flue gas. The same activated carbon was used for each sample. See, Declaration B at items 8-10. The first plot given in Declaration B at item 15 is reproduced below.



The data in the plot above from the item 15 of the Declaration B show that activated carbon treated with HCl outside the flue gas as per the Nelson procedure provided a much higher percent of mercury removal per 1 wt% HCl at all tested sorbent injection rates as compared to NaCl added to coal prior to introduction to the furnace with injection of untreated activated carbon into the flue gas. See, Declaration B at item 16.

The pilot-scale data was also plotted to show the milligrams of HCl/MMacf per 1% mercury removal versus the sorbent injection rate with NaCl added to coal prior to introduction to the furnace with injection of untreated activated carbon into the flue gas, and for the activated carbon treated with HCl outside the flue gas described herein at item 7 as per the Nelson procedure. The second plot given in Declaration B at item 15 is reproduced below.



The data in the second plot above from item 15 of Declaration B show that the milligrams of HCl/MMacf per 1% mercury removal versus the sorbent injection rate with NaCl added to coal prior to introduction to the furnace with injection of untreated activated carbon into the flue gas was significantly higher as compared to the activated carbon treated with HCl outside the flue gas described herein at item 7 as per the Nelson procedure, indicating more efficient use of HCl for mercury removal by treatment of activated carbon outside the flue gas than by promotion in-flight.

II(D)(2). Reply to response to arguments.

The Office Action states:

II(D)(2): The applicant contends that "Even if a person of ordinary skill in the art compared the mercury removal of Felsvang's activated carbons promoted with Chloride in the flue gas to activated carbons treated with HCl outside of the flue gas, they would not determine that in-flight promotion provides the same or better mercury removal properties".

This appears to be merely conjecture by the applicant as no factual evidence has been presented.

The graphs on pages 28 and 29, has NaCl compared to HCl. It is unclear if the results are because of the different components being reacted or because of the different method being used. In order to establish that the method being used has unexpected results the components used must be the same for both methods. Further the examiner points to the y-axis which has HCl which is not included in one set (NaCl) of the data points so it is unclear how the data points are being obtained.

The Office Action states that Applicant's contention that a person of ordinary skill in the art comparing Felsvang's process to treatment of activated carbon with HCl outside the flue gas would find that in-flight promotion provides less mercury removal is conjecture and is unsupported by factual evidence. However, Applicant's contention is not conjecture and is supported by data provided in Declaration B, as described herein at **II(D)(1)**; therefore, Applicant does not understand this statement of the Office Action.

The Office Action states that the graphs have NaCl compared to HCl, and that the y-axis has HCl which is not included in one set (NaCl) of the data points so it is unclear how the data points are being obtained. However, as explained in Declaration C at item 28, when NaCl is added to coal, gaseous NaCl is formed in the flue gas, and HCl is formed in the flue gas. NaCl is a salt that includes Na^+ and Cl^-. Therefore, placing NaCl on the coal results in formation of HCl and Cl^- in the flue gas. In the graphs in Declaration B all halides in the flue gas formed from halide salts placed on the coal are assumed to be in the form of the respective hydrogen halide for comparative purposes, although these could be in the form of the gaseous halide salt or the hydrogen halide----this assumption is made for consistency across all the graphs in Declaration B. As the graphs show trends between %Hg removal and halide content of the flue gas, so long as the amounts of the different halides present in the flue gas are compared in a consistent way it does not matter whether they are in the form of the hydrogen halide or the halide ion in the flue gas for purposes of comparing relative %Hg removal.

The Office Action states that in order to establish that the method being used has unexpected results the components used must be the same for both methods. However, the data sets in the first and second plots at item 15 of Declaration B were taken from the table at item 10, which was produced using the same pilot-scale setup described at item 8, using the same components, the same type of AC, and the same method, with the only variations between the data sets being the type of treatment of the AC (i.e., AC treated with 5 wt% HCl outside the flue gas prior to injection into the flue gas, or placing NaCl on the coal and injection of untreated AC into the flue gas); item 15 of Declaration B has been revised to clarify this point.

Dependent claims 3-19 are directly or indirectly dependent on independent claim 2. As such, these claims incorporate all the features of claim 2. Accordingly, claims 3-19 are patentable for at least the reasons given herein for patentability of independent claim 2.

Applicant therefore respectfully requests reconsideration and withdrawal of the rejection of claims 2-19 under 35 U.S.C. § 103(a) over Felsvang in view of Nelson.

II(E). Objective evidence of non-obviousness of the claimed invention.

Applicant herein discusses objective evidence of nonobviousnesss presented in Declaration A. The M.P.E.P. at §716.01(a) states that:

> Affidavits or declarations, when timely presented, containing evidence of criticality or unexpected results, commercial success, long-felt but unsolved needs, failure of others, skepticism of experts, etc., must be considered by the examiner in determining the issue of obviousness of claims for patentability under 35 U.S.C. 103.

The M.P.E.P. at §716.01(d) states that:

> When an applicant timely submits evidence traversing a rejection, the examiner must reconsider the patentability of the claimed invention. The ultimate determination of patentability must be based on consideration of the entire record, by a preponderance of evidence, with due consideration to the persuasiveness of any arguments and any secondary evidence.

As explained in Declaration A at items 1-6, before the priority date of the presently claimed invention, the EPA called for new mercury removal technology in the 1990s, evidencing recognition of a problem and long-felt but unsolved needs that the presently claimed invention provides a solution for.

As explained in Declaration A at items 7-8, before the priority date of the presently claimed invention, the EPA espoused the conventional wisdom in favor of pre-treated sorbents, not in-flight sorbent enhancement in the flue gas, evidencing a teaching away from the presently claimed invention by others.

As explained in Declaration A at items 9-11, before the priority date of the presently claimed invention, Sidney Nelson touted brominated sorbent, not in-flight sorbent enhancement in the flue gas, evidencing a teaching away from the presently claimed invention by others.

As explained in Declaration A at items 12-13, after the priority date of the presently claimed invention, the EPA continued to teach away from in-flight sorbent enhancement in the flue gas, evidencing a teaching away from the presently claimed invention by others and skepticism by experts that the presently claimed invention could provide effective and efficient mercury control.

As explained in Declaration A at items 14-15, before the priority date of the presently claimed invention, the Department of Energy funded research into in-flight sorbent enhancement in the flue gas, evidencing recognition of a problem and long-felt but unsolved needs that the presently claimed invention provides a solution for.

As explained in Declaration A at item 16, after the priority date of the presently claimed invention, in-flight sorbent enhancement in the flue gas was finally recognized as a critical advancement, evidencing praise by others for the presently claimed invention.

As explained in Declaration A at items 17-19, after the priority date of the presently claimed invention, in-flight sorbent enhancement in the flue gas experienced commercial success and was copied by Sidney Nelson and other competitors, evidencing copying of the presently claimed invention by others.

Double Patenting Rejections

III. Double patenting rejections.

III(A). The Office Action rejected claims 2-19 for nonstatutory double patenting over claims 1-30 of U.S. patent no. 7,435,286 in view of U.S. patent no. 5,435,980 ("Felsvang").

This rejection is respectfully traversed. Applicant does not admit that claims 2-19 are obvious over claims 1-30 of U.S. patent no. 7,435,286 in view of Felsvang.

As the current pending claims stand rejected on other grounds and are still subject to amendment, Applicant takes note of these rejections but do not take further action at this time inasmuch as no pending claim has yet to be allowed. Applicant will re-evaluate this rejection, upon an indication of allowable claims.

III(B). The Office Action rejected claims 2-19 were rejected for nonstatutory double patenting over claims 1-25 of U.S. patent no. 8,168,147 in view of U.S. patent no. 5,435,980 ("Felsvang").

This rejection is respectfully traversed. Applicant does not admit that claims 2-19 are obvious over claims 1-25 of U.S. patent no. 8,168,147 in view of Felsvang.

As the current pending claims stand rejected on other grounds and are still subject to amendment, Applicant takes note of these rejections but do not take further action at this time inasmuch as no pending claim has yet to be allowed. Applicant will re-evaluate this rejection, upon an indication of allowable claims.

III(C). The Office Action rejected claims 2-19 were rejected for nonstatutory double patenting over claims 1-60 of U.S. patent no. 8,512,655 in view of U.S. patent no. 5,435,980 ("Felsvang").

This rejection is respectfully traversed. Applicant does not admit that claims 2-19 are obvious over claims 1-60 of U.S. patent no. 8,512,655 in view of Felsvang.

As the current pending claims stand rejected on other grounds and are still subject to amendment, Applicant takes note of these rejections but do not take further action at this time inasmuch as no pending claim has yet to be allowed. Applicant will re-evaluate this rejection, upon an indication of allowable claims.

III(D). The Office Action rejected claims 2-19 were rejected for nonstatutory double patenting over claims 1-60 of U.S. patent no. 8,821,819 in view of U.S. patent no. 5,435,980 ("Felsvang").

This rejection is respectfully traversed. Applicant does not admit that claims 2-19 are obvious over claims 1-60 of U.S. patent no. 8,821,819 in view of Felsvang.

As the current pending claims stand rejected on other grounds and are still subject to amendment, Applicant takes note of these rejections but do not take further action at this time

inasmuch as no pending claim has yet to be allowed. Applicant will re-evaluate this rejection, upon an indication of allowable claims.

III(E). The Office Action rejected claims 2-19 were rejected for nonstatutory double patenting over claims 1-33 of U.S. patent no. 9,757,689 in view of U.S. patent no. 5,435,98● ("Felsvang").

This rejection is respectfully traversed. Applicant does not admit that claims 2-19 are obvious over claims 1-33 of U.S. patent no. 9,757,689 in view of Felsvang.

As the current pending claims stand rejected on other grounds and are still subject to amendment, Applicant takes note of these rejections but do not take further action at this time inasmuch as no pending claim has yet to be allowed. Applicant will re-evaluate this rejection, upon an indication of allowable claims.

III(F). The Office Action rejected claims 2-19 were rejected for nonstatutory double patenting over claims 1-2● of U.S. patent no. 9,468,886 in view of U.S. patent no. 5,435,98● ("Felsvang").

This rejection is respectfully traversed. Applicant does not admit that claims 2-19 are obvious over claims 1-2● of U.S. patent no. 9,468,886 in view of Felsvang.

As the current pending claims stand rejected on other grounds and are still subject to amendment, Applicant takes note of these rejections but do not take further action at this time inasmuch as no pending claim has yet to be allowed. Applicant will re-evaluate this rejection, upon an indication of allowable claims.

III(G). The Office Action rejected claims 2-19 were rejected for nonstatutory double patenting over claims 1-3● of U.S. Patent No. 8,652.235 in view of U.S. patent no. 5,435,98● ("Felsvang").

This rejection is respectfully traversed. Applicant does not admit that claims 2-19 are obvious over claims 1-3● of U.S. Patent No. 8,652,235 in view of Felsvang.

As the current pending claims stand rejected on other grounds and are still subject to amendment, Applicant takes note of these rejections but do not take further action at this time inasmuch as no pending claim has yet to be allowed. Applicant will re-evaluate this rejection, upon an indication of allowable claims.

III(H). The Office Action rejected claims 2-19 were provisionally rejected for nonstatutory double patenting over claims 1-16 of copending application no. 15/295594.

This rejection is respectfully traversed. Applicant does not admit that claims 2-19 are obvious over claims 1-16 of copending application no. 15/295594.

As the current pending claims stand rejected on other grounds and are still subject to amendment, Applicant takes note of these rejections but do not take further action at this time inasmuch as no pending claim has yet to be allowed. Applicant will re-evaluate this rejection, upon an indication of allowable claims.

III(I). The Office Action rejected claims 2-19 were provisionally rejected for nonstatutory double patenting over claims 8-20 of copending application no. 15/589359 in view of U.S. patent no. 5,435,980 ("Felsvang").

This rejection is respectfully traversed. Applicant does not admit that claims 2-19 are obvious over claims 8-20 of copending application no. 15/589359 in view of Felsvang.

As the current pending claims stand rejected on other grounds and are still subject to amendment, Applicant takes note of these rejections but do not take further action at this time inasmuch as no pending claim has yet to be allowed. Applicant will re-evaluate this rejection, upon an indication of allowable claims.

III(J). The Office Action rejected claims 2-19 were provisionally rejected for nonstatutory double patenting over claims 1-20 of copending application no. 15/853029.

This rejection is respectfully traversed. Applicant does not admit that claims 2-19 are obvious over claims 1-20 of copending application no. 15/853029.

As the current pending claims stand rejected on other grounds and are still subject to amendment, Applicant takes note of these rejections but do not take further action at this time inasmuch as no pending claim has yet to be allowed. Applicant will re-evaluate this rejection, upon an indication of allowable claims.

III(K). The Office Action rejected claims 2-19 were provisionally rejected for nonstatutory double patenting over claims 1-20 of copending application no. 14/712558.

This rejection is respectfully traversed. Applicant does not admit that claims 2-19 are obvious over claims 1-20 of copending application no. 14/712558.

As the current pending claims stand rejected on other grounds and are still subject to amendment, Applicant takes note of these rejections but do not take further action at this time inasmuch as no pending claim has yet to be allowed. Applicant will re-evaluate this rejection, upon an indication of allowable claims.

III(L). The Office Action rejected claims 2-19 were provisionally rejected for nonstatutory double patenting over claims 1-20 of copending application no. 15/951970.

This rejection is respectfully traversed. Applicant does not admit that claims 2-19 are obvious over claims 1-20 of copending application no. 15/951970.

As the current pending claims stand rejected on other grounds and are still subject to amendment, Applicant takes note of these rejections but do not take further action at this time inasmuch as no pending claim has yet to be allowed. Applicant will re-evaluate this rejection, upon an indication of allowable claims.

III(M). The Office Action rejected claims 2-19 were provisionally rejected for nonstatutory double patenting over claims 1-20 of copending application no. 15/382114 in view of U.S. patent no. 5,435,980 ("Felsvang").

This rejection is respectfully traversed. Applicant does not admit that claims 2-19 are obvious over claims 1-20 of copending application no. 15/382114 in view of Felsvang.

As the current pending claims stand rejected on other grounds and are still subject to amendment, Applicant takes note of these rejections but do not take further action at this time inasmuch as no pending claim has yet to be allowed. Applicant will re-evaluate this rejection, upon an indication of allowable claims.

III(N). The Office Action rejected claims 2-19 were provisionally rejected for nonstatutory double patenting over claims 1-20 of copending application no. 15/853029.

This rejection is respectfully traversed. Applicant does not admit that claims 2-19 are obvious over claims 1-2● of copending application no. 15/853●29. Applicant notes that this rejection is identical to the one reported herein at **III(J)**.

As the current pending claims stand rejected on other grounds and are still subject to amendment, Applicant takes note of these rejections but do not take further action at this time inasmuch as no pending claim has yet to be allowed. Applicant will re-evaluate this rejection, upon an indication of allowable claims.

CONCLUSION

It is respectfully submitted that the claims are in condition for allowance, and notification to that effect is earnestly requested. The Examiner is invited to telephone the undersigned at (612) 349-9580 to facilitate prosecution of this application.

If necessary, please charge any additional fees or deficiencies, or credit any overpayments to Deposit Account No. 19-0743.

Respectfully submitted,

SCHWEGMAN LUNDBERG & WOESSNER, P.A.
P.O. Box 2938
Minneapolis, MN 55402-0938
(612) 373-6900

Date March 20, 2019

By /Nicholas P. Lanzatella/

Nicholas P. Lanzatella
Reg. No. 63,803

IN THE CLAIMS

Please amend the claims as follows:

1. (Canceled)

2. (Currently Amended) A method of separating mercury from a mercury-containing gas, the method comprising:

combusting coal in a combustion chamber, to provide the mercury-containing gas, wherein the mercury-containing gas comprises a halogen or halide promoter comprising HBr, Br^-, or a combination thereof, wherein

the coal comprises added Br_2, HBr, Br^-, or a combination thereof, added to the coal, upstream of the combustion chamber, or

the combustion chamber comprises added Br_2, HBr, Br^-, or a combination thereof, or a combination thereof;

injecting a sorbent material comprising activated carbon into the mercury-containing gas downstream of the combustion chamber ~~such that the activated carbon reacts with the halogen or halide promoter in the mercury-containing gas to form a promoted sorbent~~;

~~reacting~~contacting mercury in the mercury-containing gas with the ~~promoted~~ sorbent, to form a mercury/sorbent composition;

separating the mercury/sorbent composition from the mercury-containing gas, to form a cleaned gas;

monitoring the mercury content of the cleaned gas; and

controlling, in response to the monitored mercury content of the cleaned gas, an injection rate of injecting the sorbent into the mercury-containing gas, the sorbent composition, or a combination thereof, so that the mercury content of the cleaned gas is maintained at or below a desired level.

3. (Previously Presented) The method of claim 2, comprising removing greater than 70 wt% of the mercury in the mercury-containing gas.

4. (Previously Presented) The method of claim 2, comprising removing greater than 70 wt% of the mercury in the mercury-containing gas on the sorbent.

5. (Currently Amended) The method of claim 2, wherein the ~~promoted~~ sorbent in the mercury-containing gas comprises about 1 g to about 30 g of the halogen or halide promoter per 100 g of the sorbent material.

6. (Previously Presented) The method of claim 2, wherein the combustion chamber comprises the halogen or halide promoter.

7. (Currently Amended) The method of claim 2, wherein the coal comprises added Br_2, HBr, Br^-, or a combination thereof, added to the coal upstream of the combustion chamber.

8. (Currently Amended) The method of claim 2, wherein the promoter is ~~reacted~~contacted with the sorbent in vapor form, gaseous form, liquid form, or in an organic solvent.

9. (Previously Presented) The method of claim 2, further comprising injecting a secondary material into the mercury-containing gas downstream of the combustion chamber.

10. (Previously Presented) The method of claim 9, wherein the secondary material comprises a halogen, a compound derived from a halogen, a hydrohalide, a compound comprising a Group V or Group VI element and a molecular halogen, or a combination thereof.

11. (Previously Presented) The method of claim 2, wherein the sorbent material injected into the mercury-containing gas further comprises a non-carbon sorbent material.

12. (Previously Presented) The method of claim 11, wherein the non-carbon sorbent material comprises at least one of a porous felsic material, a vesicular felsic material, a porous basaltic material, a vesicular basaltic material, a clay-based compound, an alkaline compound, a calcium hydroxide compound, a sodium acetate compound, and a bicarbonate compound.

13. (Previously Presented) The method of claim 2, wherein the activated carbon comprises powdered activated carbon, granular activated carbon, or a combination thereof.

14. (Previously Presented) The method of claim 2, wherein the sorbent material injected into the mercury-containing gas is substantially free of halogen and halide promotion.

15. (Currently Amended) The method of claim 2, wherein the sorbent material injected into the mercury-containing gas is a ~~product-~~promoted sorbent obtained by ~~reaction of~~contacting a base sorbent with another halogen or halide promoter.

16. (Previously Presented) The method of claim 2, wherein the combustion chamber comprises a boiler.

17. (Previously Presented) The method of claim 2, wherein the mercury-containing gas is a flue gas.

18. (Previously Presented) The method of claim 2, wherein the injection of the sorbent material into the mercury-containing gas occurs upstream of an air pre-heater.

19. (Previously Presented) The method of claim 2, wherein the injection of the sorbent material into the mercury-containing gas occurs upstream of a particulate separator or a scrubber.

20.-21. (Canceled)

22. (Previously Presented) The method of claim 2, wherein the coal comprises added halide sorbent enhancement additive.

23. (New) The method of claim 2, wherein the combustion chamber comprises added Br_2, HBr, Br^-, or a combination thereof.

24. (New) The method of claim 2, wherein the coal comprises added sorbent enhancement additive that comprises Br^-.

25. (New) The method of claim 24, wherein the sorbent enhancement additive comprises a bromide compound.

26. (New) A method of separating mercury from a mercury-containing gas, the method comprising:

combusting coal in a combustion chamber, to provide the mercury-containing gas, wherein the mercury-containing gas comprises a halogen or halide promoter comprising HBr, Br^-, or a combination thereof, wherein

the coal comprises added Br_2, HBr, Br^-, or a combination thereof, added to the coal upstream of the combustion chamber, or

the combustion chamber comprises added Br_2, HBr, Br^-, or a combination thereof, or a combination thereof;

injecting a sorbent material comprising activated carbon into the mercury-containing gas downstream of the combustion chamber;

contacting mercury in the mercury-containing gas with the sorbent, to form a mercury/sorbent composition; and

separating the mercury/sorbent composition from the mercury-containing gas, to form a cleaned gas.

27. (New) A method of separating mercury from a mercury-containing gas, the method comprising:

combusting coal in a combustion chamber, to provide the mercury-containing gas, wherein the mercury-containing gas comprises a halogen or halide promoter comprising HBr, Br^-, or a combination thereof, wherein

the coal comprises added Br_2, HBr, Br^-, or a combination thereof, added to the coal upstream of the combustion chamber, or

the combustion chamber comprises added Br_2, HBr, Br^-, or a combination thereof, or

a combination thereof;

injecting a sorbent material comprising activated carbon into the mercury-containing gas downstream of the combustion chamber such that the activated carbon reacts with the halogen or halide promoter in the mercury-containing gas to form a promoted sorbent;

contacting mercury in the mercury-containing gas with the promoted sorbent, to form a mercury/sorbent composition;

separating the mercury/sorbent composition from the mercury-containing gas, to form a cleaned gas;

monitoring the mercury content of the cleaned gas; and

controlling, in response to the mercury content of the cleaned gas,

an injection rate of injecting the sorbent into the mercury-containing gas,

a rate of addition to the coal or the combustion chamber of the added Br_2, HBr, the bromide compound, or a combination thereof, or

a combination thereof,

so that the mercury content of the cleaned gas is maintained at or below a desired level.

28. (New) A method of separating mercury from a mercury-containing gas, the method comprising:

combusting coal in a combustion chamber, to provide the mercury-containing gas, wherein

the coal comprises added Br_2, HBr, a bromide compound, or a combination thereof, added to the coal upstream of the combustion chamber, or

the combustion chamber comprises added Br_2, HBr, a bromide compound, or a combination thereof, or

a combination thereof;

injecting a sorbent material comprising activated carbon into the mercury-containing gas downstream of the combustion chamber;

contacting mercury in the mercury-containing gas with the sorbent, to form a mercury/sorbent composition; and

separating the mercury/sorbent composition from the mercury-containing gas, to form a cleaned gas.

29. (New) The method of claim 28, wherein the coal comprises the added Br_2, HBr, the bromide compound, or a combination thereof, added to the coal upstream of the combustion chamber.

30. (New) The method of claim 28, wherein the combustion chamber comprises the added Br_2, HBr, the bromide compound, or a combination thereof.

31. (New) The method of claim 28, further comprising

monitoring the mercury content of the cleaned gas; and

controlling, in response to the mercury content of the cleaned gas,

an injection rate of injecting the sorbent into the mercury-containing gas,

a rate of addition to the coal or the combustion chamber of the added Br_2, HBr, the bromide compound, or a combination thereof, or

a combination thereof,

so that the mercury content of the cleaned gas is maintained at or below a desired level.

32. (New) The method of claim 28, wherein the mercury-containing gas comprises about 1 g to about 30 g of the element bromine per 100 g of the sorbent.

33. (New) The method of claim 28, wherein the mercury/sorbent composition comprises the element bromine, the sorbent material, and mercury.

A/N 15/978,76● **PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s): Edwin S. Olson et al.	Examiner: AMBER ROSE ORLANDO
Application No.: 15/978,76●	Group Art Unit: 1776
Filed: May 14, 2●18	Docket No.: 482●.●●7US4
Confirmation No.: 6432	
Title: SORBENTS FOR THE OXIDATION AND REMOVAL OF MERCURY	

AMENDMENT & RESPONSE UNDER 37 C.F.R. § 1.116

Mail Stop RCE
Commissioner for Patents
P.O. Box 145●
Alexandria, VA 22313-145●

Applicant has received the Final Office Action dated December 26, 2●18. Please enter the following.

Amended PTO/AIA/82B (07-13)
Approved for use through 11/30/2014. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date

☒ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above: 21186

OR

☐ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter to:

☒ The address associated with the above mentioned Customer Number.

OR

☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name				
Address				
City		State		Zip
Country				
Telephone		Email		

I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

Midwest Energy Emissions Corp.

☐ Inventor or Joint Inventor (title not required below)

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)

☒ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)

☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature	John Pavlish	Date (Optional)	6/9/2017
Name	John Pavlish		
Title	Chief Technology Officer		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

☒ * Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s): Edwin S. Olson et al. Examiner: AMBER ROSE ORLANDO
Application No.: 15/978,760 Group Art Unit: 1776
Filed: May 14, 2018 Docket No.: 4820.007US4
Confirmation No.: 6432
Title: SORBENTS FOR THE OXIDATION AND REMOVAL OF MERCURY

DECLARATION UNDER 37 C.F.R. § 1.132

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

DECLARATION D

I, John Pavlish, declare and say as follows:

1. I have been the Chief Technology Officer and Senior Vice President of Midwest Energy Emissions Corporation since November 16, 2014. Prior to this, I served as an Executive Consultant Advisor to Midwest Energy Emissions Corporation. Prior to joining Midwest Energy Emissions Corporation, I was a Senior Research Advisor and the Director of the Center for Air Toxic Metals Program at the Energy & Environmental Research Center in Grand Forks, North Dakota. I have over 25 years of mercury-related experience and am regarded as an international expert on the topic of mercury. My primary areas of interest and expertise include research, technical consultation and development of mercury control technologies, in particular, for coal combustion and gasification systems. I am an inventor of a number of patented mercury control technologies and have years of experience in development and testing of these technologies for commercial applications. Over the last 15 years, I have spent much time evaluating the efficacy of a number of different mercury control technologies/approaches and their cost competitiveness in the commercial market. I also have years of power plant experience and have worked for an engineering/consulting company, Black & Veatch, where I served as Unit Leader/System Engineer. I am a professional engineer, a member of the American Society of Mechanical Engineers, and a member of the Air & Waste Management Association (A&WMA). I serve on numerous professional and

technical committees and am a U.S. Representative on the Mercury Emissions from Coal International Experts Working Group on Reducing Emissions from Coal and a member of the United Nations Environment Programme Global Mercury Partnership, Reduction of Mercury Releases from Coal Combustion. I have published over 200 papers, articles, and reports on various mercury-related topics and issues.

2. Declaration B at item 8 describes that a pilot-scale 550,000-Btu/hr pulverized coal (pc)-fired test unit was used to combust subbituminous coal and test mercury control using various sorbents. The coal combustion flue gas exiting the pilot unit was cooled down to a nominal temperature of 149°C (300°F) and then was introduced into a single wire tubular ESP unit. Activated carbon sorbents were fed with a K-Tron dual-screw feeder upstream of the ESP. The feeder was calibrated prior to the start of each carbon injection test. No scrubber was used. Before Hg control testing began, a baseline condition was established with the pilot-scale unit, and flue gas mercury content was measured before each test as about 6-10 $\mu g/m^3$. The flue gas HCl concentration, with no additives on the coal, as calculated by the chlorine measured in the coal, was 2-5 ppm.

3. U.S. patent publication no. 2004/0003716 ("Nelson") describes treatment of activated carbon outside the flue gas with hydrogen bromide (HBr), and describes testing to measure the percent mercury removal when the treated activated carbon was injected into either simulated or actual flue gas at various injection rates. Specifically, Nelson performed experiments in Example 5 (paragraphs [0082]-[0085]) and 7 (paragraphs [0089]-[0092]), and provides the data in FIG. 14 and FIG. 15.

4. In Example 5, Nelson treated Norit DARCO® FGD with gaseous HBr, and tested its use by injecting the HBr-treated sorbent into a simulated coal-fired flue-gas stream in a pilot-scale test system. Nelson's FIG. 14 shows data for one activated carbon sample treated with HBr. The activated carbon had 10 wt% HBr, and at a sorbent injection rate of about 3.7 lb/MMacf gave a mercury removal of about 82%. As reported in paragraph [0082] of Nelson, duct-injection runs were performed with a simulated coal-fired flue-gas

stream on a 50-acfm pilot-scale test system. As described, the mercury mass transfer to fluidized sorbent and adsorption kinetics in this system were similar to that in a full-scale utility application. The fully-instrumented duct-injection test system that was used included a propane burner unit to generate the hot flue gas; a humidification drum to add an appropriate degree of moisture to the gas; an elemental mercury spiking subsystem with elemental mercury permeation tubes; a flue gas spiking subsystem with mass flow controllers for SO_2, NO_x, and HCl; a small sorbent feeder and fluidizing injection subsystem to lessen sorbent pulsing; 10 meters of insulated, 10-cm-diameter ducting circling the ceiling; thermocouples; an electrostatic filter with an effective specific collection area (SCA) of about 500 ft^2/Kacf; a back-up fabric filter; a safety filter; an orifice plate to measure flow; and a variable-speed I.D. fan. The gas temperature at injection was about 175 °C and at the electrostatic precipitator (ESP) was about 145 °C and the spiked flue gas concentrations were about 24 μg/Nm^3 Hg(0), 1400 ppm SO_2 , 600 ppm NO_x, and 5 ppm HCl, typical values for coal-fired power plants.

5. In Example 7, Nelson treated Norit DARCO® FGD with gaseous HBr, and tested its use in a coal-fired power plant by injecting the treated sorbent into the flue gas prior to the electrostatic precipitator (ESP). Nelson's FIG. 15 shows data for two activated carbon samples treated with HBr. The two activated carbon samples contained 9 wt% HBr. The data in FIG. 15 for the two HBr-treated sorbents show that at a sorbent injection rate of about 2.2 lb/MMacf, 45% of the mercury was removed, and at a sobent injection rate of about 4.2 lb/MMacf, 62% of the mercury was removed. As reported in paragraphs [0089]-[0091] of Nelson, a large-scale duct-injection trial was performed at the 18-MW scale, with about 60,000 acfm of flue gas at 160 °C (320 °F). The plant had stoker-fed boilers, burned a high-sulfur bituminous coal, and had just a cold-side ESP for emission control. Baseline sampling according to the Ontario Hydro Method indicated no intrinsic mercury removal of mercury across the ESP. Without sorbent injection, the plant emitted about 10 μg/Nm^3 of mercury from the stack, with 80 to 90% of this in oxidized forms. In these trials, the mercury was measured using a speciating PS Analytical Sir Galahad continuous mercury monitor. Inlet mercury values were obtained

by sampling upstream of the sorbent injection point and outlet mercury was measured at the stack. The sorbents were injected into ductwork through a lance to mix with the flue gases about 40 feet from the entrance to the ESP. The flue gas contained about 1000 ppm of SO_2, 20 ppm of SO_3, 250 ppm of NO_x, and 25 ppm of HCl. The ESP had an SCA of 370 ft^2/Kacfm.

6. Nelson's Examples 5 and 7 do not describe the use of a scrubber. Example 7 of Nelson uses only a cold-side ESP for emission control, with injection of the activated carbon upstream of the ESP. Example 5 of Nelson describes an ESP that occurs after the point of injection and that has a temperature of 145 °C (293 °F) at the inlet, also corresponding to a cold-side ESP. Similarly, in the pilot-scale setup described at item 8 of Declaration B no scrubber was used, and activated carbon was injected upstream of the ESP. These similarities between Nelson's Example 5 and 7 and the pilot-scale setup described at item 8 of Declaration B allow for good comparison with the Nelson data.

7. Nelson's Example 5 describes a flue gas HCl concentration of 5 ppm, which is similar to the flue gas HCl concentration in the pilot-scale setup described at item 8 of Declaration B, allowing for good comparison between Nelson's Example 5 and the pilot-scale setup described at item 8 of Declaration B. However, Nelson's Example 7 describes a flue gas HCl concentration of 25 ppm. The higher HCl concentration in Nelson's Example 7 flue gas allows for easier mercury removal, due to HCl acting as a promotor of the activated carbon, as compared to the pilot-scale setup described at item 8 of Declaration B.

8. The mercury concentration of the flue gas from the pilot-scale setup described at item 8 of Declaration B was in the range of 6-10 $\mu g/m^3$, as compared to Nelson's Example 5 data for which the mercury concentration of the flue gas is about 24 $\mu g/m^3$. The higher mercury concentration in Nelson's Example 5 allows for easier mercury removal as the mercury concentration at the point of activated carbon injection is much higher. To illustrate this, to remove 70% of the mercury from Nelson's Example 5 setup,

the mercury concentration leaving the ESP after the mercury is captured by the treated activated carbon would be: 24 - (24*70/100) = 7.2 $\mu g/m^3$. To remove 70% of the mercury from the pilot-scale setup described at item 8 of Declaration B, the mercury concentration leaving the ESP after the mercury is captured by the activated carbon would be: 8 - (8*70/100) = 2.4 $\mu g/m^3$. When mercury concentration is lower, the probability of activated carbon sorbent particles contacting mercury in the flue gas is lower, and the overall number of encounters between activated carbon particles and mercury atoms or compounds per time is lower; therefore, the activated carbon sorbent particles must be more adsorptive (e.g., reactive) toward mercury in order to remove mercury at low concentrations as compared to the same activated carbon sorbent placed in a higher concentration of mercury. As the calculation shows, it is more difficult to remove the same percentage of mercury from the flue gas starting with a lower concentration of 8 $\mu g/m^3$ than starting at a higher concentration of 24 $\mu g/m^3$.

9. As explained at item 6, Nelson's experimental setup in Examples 5 and 7 and the experimental setup described at item 8 of Declaration B inject activated carbon sorbent into a flue gas upstream of an ESP and use no scrubber, making the procedures comparable. However, as explained at item 7, the higher HCl concentration in Nelson's Example 7 flue gas allows for easier mercury removal, due to HCl acting as a promotor of the activated carbon, as compared to the pilot-scale setup described at item 8 of Declaration B. Further, as explained at item 8, the higher mercury concentration in Nelson's Example 5 makes it easier for Nelson's sorbents to remove the same overall percentage of mercury from the flue gas, as compared to the pilot-scale setup described at item 8 of Declaration B. Therefore, if Nelson's Example 5 and 7 HCl and mercury concentrations were changed to match those of the pilot-scale setup described at item 8 of Declaration B, Nelson's sorbents would remove a lower percentage of mercury than found in Nelson's Examples 5 and 7.

10. I further declare that all statements made herein of my own knowledge are true, and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by a fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application and/or any patent issued thereon.

Dated: March 20, 2019 By: / John Pavlish /

John Pavlish

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s): Edwin S. Olson et al. Examiner: AMBER ROSE ORLANDO
Application No.: 15/978,760 Group Art Unit: 1776
Filed: May 14, 2018 Docket No.: 4820.007US4
Confirmation No.: 6432
Title: SORBENTS FOR THE OXIDATION AND REMOVAL OF MERCURY

DECLARATION UNDER 37 C.F.R. § 1.132

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

DECLARATION C

We, John Pavlish and Nicholas Lentz, declare and say as follows:

1. I, John Pavlish, have been the Chief Technology Officer and Senior Vice President of Midwest Energy Emissions Corporation since November 16, 2014. Prior to this, I served as an Executive Consultant Advisor to Midwest Energy Emissions Corporation. Prior to joining Midwest Energy Emissions Corporation, I was a Senior Research Advisor and the Director of the Center for Air Toxic Metals Program at the Energy & Environmental Research Center in Grand Forks, North Dakota. I have over 25 years of mercury-related experience and am regarded as an international expert on the topic of mercury. My primary areas of interest and expertise include research, technical consultation and development of mercury control technologies, in particular, for coal combustion and gasification systems. I am an inventor of a number of patented mercury control technologies and have years of experience in development and testing of these technologies for commercial applications. Over the last 15 years, I have spent much time evaluating the efficacy of a number of different mercury control technologies/approaches and their cost competitiveness in the commercial market. I also have years of power plant experience and have worked for an engineering/consulting company, Black & Veatch, where I served as Unit Leader/System Engineer. I am a professional engineer, a member of the American Society of Mechanical Engineers, and a member of the Air & Waste Management Association (A&WMA). I serve on numerous professional and

technical committees and am a U.S. Representative on the Mercury Emissions from Coal International Experts Working Group on Reducing Emissions from Coal and a member of the United Nations Environment Programme Global Mercury Partnership, Reduction of Mercury Releases from Coal Combustion. I have published over 200 papers, articles, and reports on various mercury-related topics and issues.

2. I, Dr. Nicholas Lentz, Field Technical Manager for Midwest Energy Emissions Corporation, have more than 10 years of experience conducting mercury research and tests, both in the lab and in the field with over 30 full-scale mercury test programs and also numerous bench- and pilot-test projects. I am also an expert in the identification and development of new analytical methods for the advancement of elemental and small molecule analysis in a wide range of matrices including coal and coal by-products, CO_2 capture solutions, oil and gas fuels; analysis for combustion flue gas, syngas, fuel oil, and biowaste. Prior to my current position, I was an Associate Director for Energy Technology Applications in the Institute for Energy Studies at the University of North Dakota. I also previously was a Center for Air Toxic Metals (CATM) Program Area Manager and Research Scientist at the Energy & Environmental Research Center where I was responsible for managing a portfolio of measurement-based research projects in the Analytical Measurement Area of CATM as well as experimental design and analysis related control technologies to remove mercury, trace metals, and halogens from combustion and gasification systems. I have a B.S. in Chemistry from Bemidji State University and Ph.D. in Analytical Chemistry from Iowa State University. I have authored and co-authored numerous publications.

3. All websites referenced in this document were accessed 3/15/2019.

4. Merriam-Webster dictionary defines "bromine" as "a nonmetallic halogen element that is isolated as a deep red corrosive toxic volatile liquid of disagreeable odor. See, https://www.merriam-webster.com/dictionary/bromine. Wikipedia defines "bromine" as "...a chemical element with symbol Br and atomic number 35. It is the

third-lightest halogen, and is a fuming red-brown liquid at room temperature that evaporates readily to form a similarly coloured gas." See, https://en.wikipedia.org/wiki/Bromine. Dictionary.com defines "bromine" as "an element that is a dark-reddish, fuming, toxic liquid and a member of the halogen family: obtained from natural brines and ocean water, and used chiefly in the manufacture of gasoline antiknock compounds, pharmaceuticals, and dyes. Symbol: Br; atomic weight: 79.909; atomic number: 35 ...." See, https://www.dictionary.com/browse/bromine.

5. Merriam-Webster dictionary defines "chlorine" as "a halogen element that is isolated as a heavy greenish-yellow diatomic gas of pungent odor and is used especially as a bleach, oxidizing agent, and disinfectant in water purification." See, https://www.merriam-webster.com/dictionary/chlorine. Wikipedia defines "chlorine" as "...a chemical element with symbol Cl and atomic number 17. The second-lightest of the halogens, it appears between fluorine and bromine in the periodic table and its properties are mostly intermediate between them. Chlorine is a yellow-green gas at room temperature." See, https://en.wikipedia.org/wiki/Chlorine. Dictionary.com defines "chlorine" as "a halogen element, a heavy, greenish-yellow, incombustible, water-soluble, poisonous gas that is highly irritating to the respiratory organs, obtained chiefly by electrolysis of sodium chloride brine: used for water purification, in the making of bleaching powder, and in the manufacture both of chemicals that do not contain chlorine, as ethylene glycol, and of those that do. Symbol: Cl; atomic weight: 35.453; atomic number: 17." See, https://www.dictionary.com/browse/chlorine.

6. Encyclopedia Britannica online states that "[a]t room temperature and atmospheric pressure the halogen elements in their free states exist as diatomic molecules." https://www.britannica.com/science/halogen-element. The Chemistry LibreTexts Library states that "[h]alogens form diatomic molecules (of the form X_2, where X denotes a halogen atom) in their elemental states. The bonds in these diatomic molecules are non-polar covalent single bonds" See, https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Supplemental_Modules_(I

nOrganic_Chemistry)/Descriptive_Chemistry/Elements_Organized_by_Block/2_p-Block_Elements/Group_17%3A_The_Halogens/0Group_17%3A_Physical_Properties_of_the_Halogens/Group_17%3A_General_Properties_of_Halogens. ThoughtCo.com states that "[h]alogens range from solid (I_2) to liquid (Br_2) to gaseous (F_2 and Cl_2) at room temperature. As pure elements, they form diatomic molecules with atoms joined by nonpolar covalent bonds." See, https://www.thoughtco.com/halogen-elements-and-properties-606650.

7. Sigma-Aldrich gives the properties of elemental bromine, Br_2 as including a molecular weight of 159.81 g/mol, a boiling point of 58.8 °C, and a melting point of -7.2 °C. See, https://www.sigmaaldrich.com/catalog/product/sigald/207888?lang=en&region=US.

8. Sigma-Aldrich gives the properties of Cl_2 as including a molecular weight of 70.91 g/mol, a boiling point of -34 °C, and a melting point of -101 °C. See, https://www.sigmaaldrich.com/catalog/product/aldrich/295132?lang=en&region=US

9. Merriam-Webster dictionary defines "bromide" as "1: a binary compound of bromine with another element or a radical including some (such as potassium bromide) used as sedatives." See, https://www.merriam-webster.com/dictionary/bromide. Wikipedia defines "bromide" as " ..a chemical compound containing a bromide ion or ligand. This is a bromine atom with an ionic charge of -1 (Br^-); for example, in caesium bromide, caesium cations (Cs^+) are electrically attracted to bromide anions (Br^-) to form the electrically neutral ionic compound CsBr. The term "bromide" can also refer to a bromine atom with an oxidation number of -1 in covalent compounds such as sulfur dibromide (SBr_2).." See, https://en.wikipedia.org/wiki/Bromide. Dictionary.com defines "bromide" as "1. A salt of hydrobromic acid consisting of two elements, one of which is bromine, as sodium bromide, NaBr; 2. A compound containing bromine, as methyl bromide." See, https://www.dictionary.com/browse/bromide.

10. Merriam-Webster dictionary defines "chloride" as "1: a compound of chlorine with another element or group especially:a salt or ester of hydrochloric acid; 2: a monovalent anion consisting of one atom of chlorine." See, https://www.merriam-webster.com/dictionary/chloride. Wikipedia defines "chloride" as "...a compound of chlorine with a salt or ester of hydrochloric acid" and as "...the anion (negatively charged ion) Cl^-." See, https://en.wikipedia.org/wiki/Chloride_(disambiguation) and https://en.wikipedia.org/wiki/Chloride. Dictionary.com defines "chloride" as "1. A salt of hydrochloric acid consisting of two elements, one of which is chlorine, as sodium chloride, NaCl; 2. A compound containing chlorine, as methyl chloride, CH_3Cl." See, https://www.dictionary.com/browse/chloride.

11. Wikipedia defines "hydrogen halides" as "... diatomic inorganic compounds with the formula HX where X is one of the halogens: fluorine, chlorine, bromine, iodine, or astatine. ... Hydrogen halides are gases that dissolve in water to give acids which are commonly known as hydrohalic acids. The direct reaction of hydrogen with fluorine and chlorine gives hydrogen fluoride and hydrogen chloride, respectively. Industrially these gases are, however, produced by treatment of halide salts with sulfuric acid. Hydrogen bromide arises when hydrogen and bromine are combined at high temperatures in the presence of a platinum catalyst. The least stable hydrogen halide, HI, is produced less directly, by the reaction of iodine with hydrogen sulfide or with hydrazine." See, https://en.wikipedia.org/wiki/Hydrogen_halide.

12. Merriam-Webster defines "hydrogen bromide" "a colorless irritating gas HBr that fumes in moist air and yields hydrobromic acid when dissolved in water." See, https://www.merriam-webster.com/dictionary/hydrogen%20bromide. Dictionary.com defines "hydrogen bromide" as "a colorless gas, HBr, having a pungent odor: the anhydride of hydrobromic acid." See, https://www.dictionary.com/browse/hydrogen-bromide. Wikipedia defines "hydrogen bromide" as "...the diatomic molecule with the formula HBr. It is a colorless compound and a hydrogen halide. Hydrobromic acid is a solution of HBr in water. Both the anhydrous and aqueous solutions of HBr are common

reagents in the preparation of bromide compounds. ...Hydrogen bromide (along with hydrobromic acid) is produced by combining hydrogen and bromine at temperatures between 200 and 400 °C. The reaction is typically catalyzed by platinum or asbestos."

13. Merriam-Webster defines "hydrogen chloride" as "a colorless pungent poisonous gas HCl that fumes in moist air and yields hydrochloric acid when dissolved in water." See, https://www.merriam-webster.com/dictionary/hydrogen%20chloride. Dictionary.com "hydrogen chloride" "a colorless gas, HCl, having a pungent odor: the anhydride of hydrochloric acid." Wikipedia defines "hydrogen chloride" as "[t]he compound hydrogen chloride has the chemical formula HCl and as such is a hydrogen halide. At room temperature, it is a colorless gas, which forms white fumes of hydrochloric acid upon contact with atmospheric water vapor. Hydrogen chloride gas and hydrochloric acid are important in technology and industry. Hydrochloric acid, the aqueous solution of hydrogen chloride, is also commonly given the formula HCl. ...pure chlorine gas can be combined with hydrogen to produce hydrogen chloride in the presence of UV light: $Cl_2(g) + H_2(g) \rightarrow 2\ HCl(g)$."

14. Sigma-Aldrich gives the properties of HBr as including a molecular weight of 80.91 g/mol, a boiling point of -67 °C, and a melting point of -87 °C. See, https://www.sigmaaldrich.com/catalog/product/aldrich/295418?lang=en&region=US.

15. Sigma-Aldrich gives the properties of HCl as including a molecular weight of 36.46 g/mol, a boiling point of -85 °C, and melting point of -114 °C. See, https://www.sigmaaldrich.com/catalog/product/aldrich/295426?lang=en&region=US.

16. Wikipedia defines the "octet rule" as "... a chemical rule of thumb that reflects observation that atoms of main-group elements tend to combine in such a way that each atom has eight electrons in its valence shell, giving it the same electron configuration as a noble gas. The rule is especially applicable to carbon, nitrogen, oxygen, and the

halogens, but also to metals such as sodium or magnesium." See, https://en.wikipedia.org/wiki/Octet_rule.

17. As shown by items 3-16 herein, hydrogen halides are diatomic molecules including a halogen atom and a hydrogen atom; in contrast, elemental halogens are diatomic molecules including two of the same halogen atom. HBr and HCl each include a hydrogen atom and one halogen atom, while Br_2 and Cl_2 each include two halogen atoms. Hydrogen halides have different properties than elemental halogens and are therefore different compounds. HBr has a molecular weight of 80.91 g/mol, while Br_2 has a molecular weight of 159.81 g/mol; HBr has a boiling point of -67 °C, while Br_2 has a boiling point of 58.8 °C; HBr has a melting point of -87 °C, while Br_2 has a melting point of -7.2 °C. HCl has a molecular weight of 36.46 g/mol, while Cl_2 has a molecular weight of 70.91 g/mol; HCl has a boiling point of -85 °C, while Cl_2 has a boiling point of 70.91 g/mol; HCl has a melting point of -114 °C, while Cl_2 has a melting point of -101 °C. Hydrogen halides are not part of and cannot be extracted or isolated from elemental halides; rather, only via a chemical reaction that results in a chemical and structural change can hydrogen halides be formed from elemental halides. Hydrogen bromide is produced by reacting hydrogen and Br_2 at about 200-400 °C, a reaction that is typically catalyzed by platinum or asbestos. Hydrogen chloride is produced by reacting hydrogen and chlorine with one another. Therefore, elemental halogens are not hydrogen halides, and do not include hydrogen halides—Br_2 is not HBr and does not include HBr, and Cl_2 is not HCl and does not include HCl.

18. As shown by items 3-16 herein, chlorine has an atomic number of 17, meaning it has 17 protons and 17 electrons, giving it an electron configuration of $1s^2 2s^2 2p^6 3s^2 3p^5$, having 7 electrons in its outer shell. Bromine has an atomic number of 35, meaning it has 35 protons and 35 electrons, giving it an electron configuration of $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^5$, also having 7 electrons in its outer shell. According to the octet rule, a halogen atom desires to fill its outer shell with 8 electrons total by gaining one electron. A halide ion is a halogen atom that has accepted an electron from an

electron doner, in the case of chloride giving it 18 total electrons to give a total charge of -1, and in the case of bromide giving it 36 total electrons to give a total charge of -1. Halogen atoms do not donate electrons to other atoms, because this would result in a halogen atom losing an electron to have 6 electrons in its outer shell, an unstable configuration according to the octet rule. In the case of an elemental halogen, which exists as a diatomic molecule, instead of donating electrons to one another, each halogen atom shares one of its electrons in the outer shell with the other halogen atom via overlapping electron orbitals in a covalent bond, allowing each halogen atom to have a filled octet while the diatomic molecule remains neutrally charged. Therefore, a halogen atom does not donate electrons to another halogen atom to form a halide, and a diatomic halogen molecule never includes a halide; Br_2 is not and does not include Br^-, and Cl_2 is not and does not include Cl^-.

19. As described in the paper "Effect of HBr formation on mercury oxidation via $CaBr_2$ addition to coal during combustion", Y. Yang et al., RSC Adv., 2016, 6, 59009-59015 ("Yang"), in a bench-scale simulated coal-fired power plant, $CaBr_2$ was added in various concentrations to three different types of coal that were combusted and the concentration of HBr and Br_2 in the released combustion gases were analyzed by quantitative gas analysis mass spectrometry. See, Yang at Sections 2.1-2.2. Section 3.4 states at page 59012 bridging to page 59013 that "[t]he results confirmed the generation of HBr in coal-fired flue gas due to the $CaBr_2$ additive in coal, but Br_2 was not detected." Near the end of Section 3.4 at page 59013 Yang states that "[t]he HBr concentration in flue gas increased with increasing amounts of $CaBr_2$ additive..." At the top of the right column on page 59013, Yang proposes the following formula for the generation of HBr from $CaBr_2$: $CaBr_2 + H_2O \rightarrow CaO + HBr$, stating at page 59013 from the left column bridging to the right column that the water is generated by hydrogen-containing organisms in coal during combustion via $C_nH_mOH + O_2 \rightarrow H_2O + CO_2$.

20. As described in the paper "Mercury control evaluation of calcium bromide injection into a PRB-fired furnace with an SCR", M. Berry, Proceedings of the Air

Quality VI Conference, Arlington, VA, 2007 ("Berry"), a $CaBr_2$ was injected at various concentrations into the furnace of a full-scale coal-fired power plant and the concentration of HBr in the released combustion gases were analyzed at the ESP inlet and at the ESP outlet. Berry found that HBr content increased with increasing calcium bromide injection. See, Berry at page 5, top two paragraphs and Figure 3.

21. As described in the book "Coal Combustion Products (CCPs) Characteristics, Utilization, and Beneficiation", T. Robl et al., Woodhead Publishing, 2017, ("Robl"), at page 91, last full paragraph and last partial paragraph:

> As described previously, eastern coals with a higher chlorine content produce mostly oxidized mercury in their flue gases, while western coals, such as PRB coals, that have a low chlorine content tend to produce mostly elemental mercury. ...
>
> Halogen salts such as calcium chloride ($CaCl_2$), calcium bromide ($CaBr_2$), or potassium iodide (KI) can be added to the coal as a means of supplementing the coal chlorine content. Salts added with the coal or injected into the furnace decompose at furnace temperatures to form vapor-phase acids (HCl, hydrogen bromide (HBr), or hydrogen iodide (HI)) in the flue gas.

22. Typical temperatures in a coal-combustion furnace range from 2,400-4,200 °F, with internal flame temperatures reaching 4,000-4,200 °F or higher. Table 1 lists select halide salt boiling points. Coal-combustion furnace temperatures are higher than the boiling points of halide salts such as NaBr and $CaBr_2$. Thus, the conditions and environment inside the furnace/boiler are adequate for boiling of halide salts (whether in a solid state, in a liquid solution, or as part of the coal) to form gaseous molecules.

Table 1. Common Halide Salt Boiling Points.[1]

Compound	Boiling point, °F
NaBr	2,534
NaCl	2,669
NaI	2,379
$CaCl_2$	3,516
$CaBr_2$	3,299
CaI	2,●12
NH_4Br	745
NH_4Cl	640
NH_4I	761

23 The FactSage program (see, http://www.factsage.com/) is one of the largest fully integrated database computing systems for chemical thermodynamics calculations. The FactSage program is a series of information, database, calculation, and manipulation modules that access databases containing properties of materials. The FactSage program can calculate the conditions for multiphase, multicomponent equilibria, with a wide variety of tabular and graphical output modes, under a large range of constraints. Equilibrium calculations performed by the FactSage program can be used to determine equilibrium molecular decomposition states as a function of temperature. These thermodynamic models can be used to predict the chemical species that will be present to react with other molecules present in the flue gas at the same time, such as radicals, ionic compounds, elemental forms of chemical elements, and the like. FactSage was used to calculate equilibrium concentrations of materials present for a 1●● g solid NaBr sample in a coal-combustion furnace as a function of temperature, shown in Figure 1. Figure 1 clearly shows the rapid emergence of gaseous NaBr molecules once the NaBr boiling point of 2,53● °F is reached. At temperatures of around 3,●●● °F, nearly all the solid NaBr has been converted to gas phase NaBr molecules. As the gas phase NaBr molecules are brought to temperatures beyond 3,●●● °F, dissociation into gaseous sodium atoms and bromine atoms occurs.

[1] Lide, D.R., 1995, CRC handbook of chemistry and physics: a ready-reference book of chemical and physical data, CRC press.

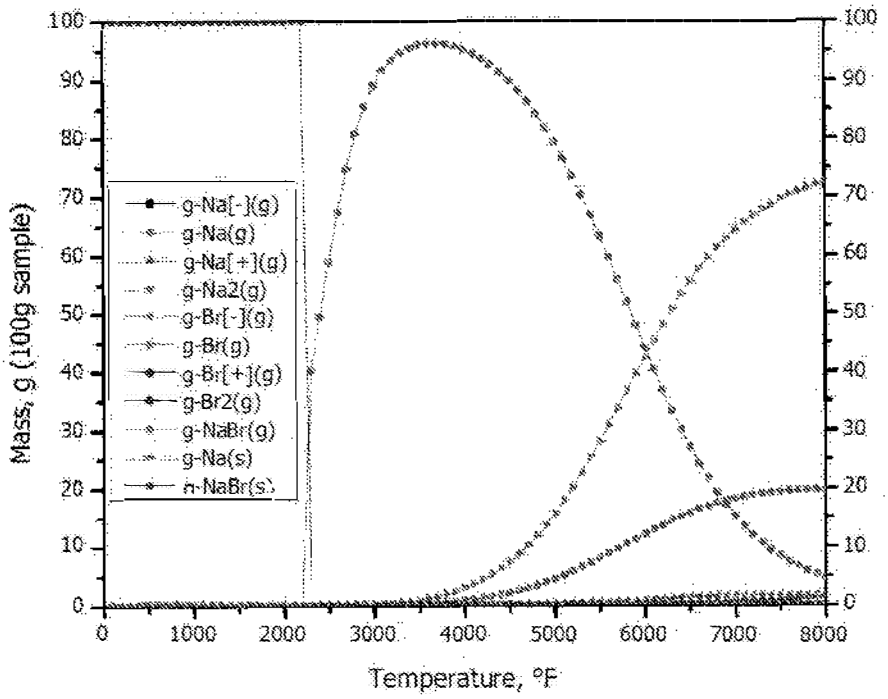


Figure 1. NaBr FactSage equilibrium calculation.

24. Not shown in Figure 1, the gaseous NaBr reacts with water molecules in the flue gas to form HBr, via $NaBr + H_2O \rightarrow NaOH + HBr$, see, Yang and discussion thereof at item 19 herein. The HBr is then available to react with Hg^0 released by the coal and with activated carbon sorbent that has been introduced further downstream into the flue gas.

25. The effect of chlorides in coal on flue gas HCl content has been studied much more than the effect of bromides on coal on flue gas HBr content, due in part to federal HCl emission regulations. Chlorides, like bromides, also exhibit a similar transformation to hydrogen chloride in coal combustion flue gas, see, Robl and discussion thereof at item 21 herein. Hydrogen chloride, as an acid gas, is one of the emission categories that the EPA regulates through the Mercury Air Toxics Standards (MATS)[2]. The MATS includes specific HCl limits that power plants must comply with by performing quarterly EPA

[2] https://www.epa.gov/mats

Method 26(A)[3] stack sampling to verify compliance. Inorganic and organically bound chlorides in the coal are volatilized and decomposed in the furnace and form HCl in the flue gas.

26. As shown in the report "Pilot- and full-scale demonstration of advanced mercury control technologies for lignite-fired power plants", S. Benson et al., Energy & Environmental Research Center, Final report, U.S. Department of Energy, National Energy Technology Laboratory, February 2005 ("Benson 1"), at figure 31 on page 37, addition of NaCl to lignite coal in a pilot-scale coal combustion system caused an increased HCl concentration in the flue gas. The HCl concentration in the flue gas increased with increased amounts of NaCl on the coal. Benson 1 shows at figure 36 on page 41 that addition of $CaCl_2$ to the coal caused increased HCl concentration in the flue gas. The HCl concentration in the flue gas increased with increasing amounts of $CaCl_2$ on the coal. Figures 31 and 36 of Benson 1 are reproduced below.

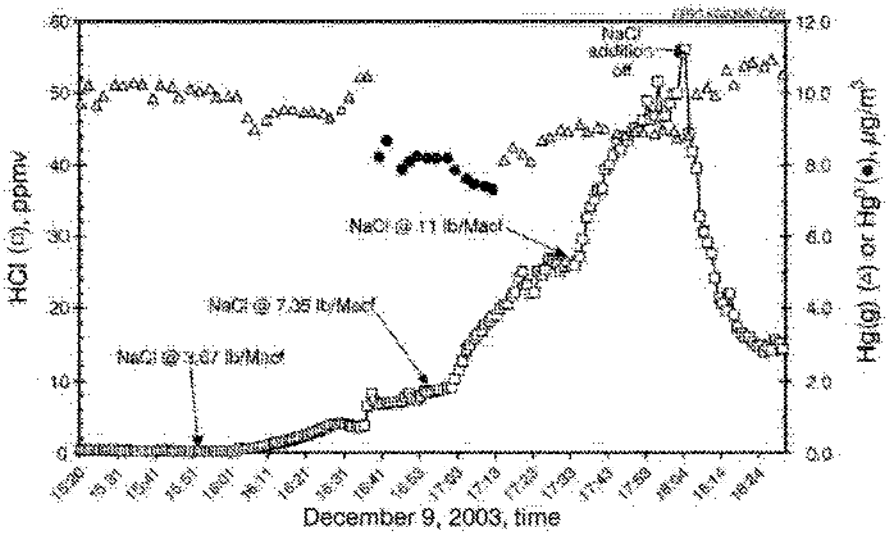


Figure 31. Temporal variations in SDA inlet HCl and FF outlet Hg(g) and Hg^0 concentrations as NaCl was added to the Center lignite coal.

[3] https://www.epa.gov/emc/method-26a-hydrogen-halide-and-halogen-isokinetic-method

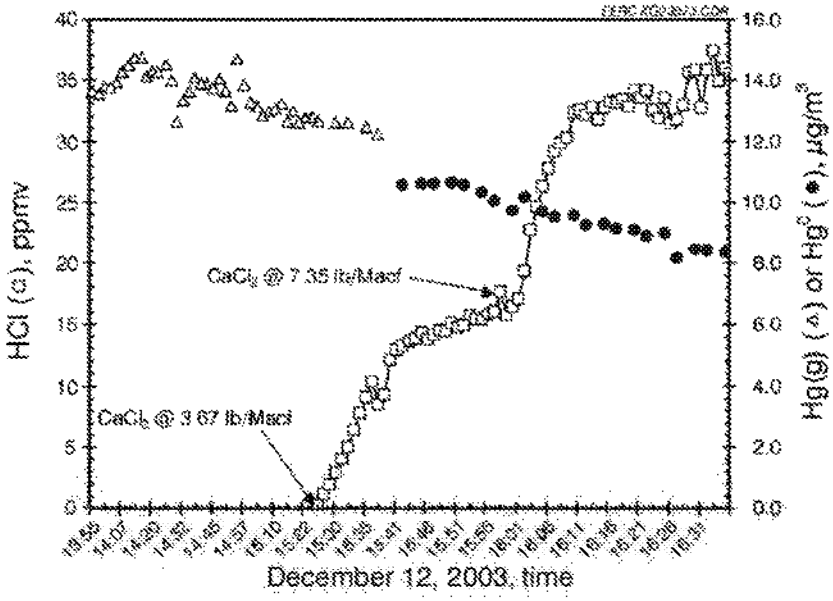


Figure 36. Temporal variations in SDA inlet HCl and FF outlet Hg(g) and Hg^0 concentrations during $CaCl_2$ additions to the Center lignite coal.

27. As shown in the report "JV Task 73—Mercury control technologies for electric utilities burning subbituminous coals", S. Benson et al., Energy and Environmental Research Center, Draft final report, June 2005 ("Benson 2"), at figure 11-11 at page 48, addition of $CaCl_2$ to subbituminous coal in a pilot-scale coal combustion system caused an increased HCl concentration in the flue gas. The HCl concentration in the flue gas increased with increased amounts of $CaCl_2$ on the coal. Figure 11-11 of Benson 2 is reproduced below.

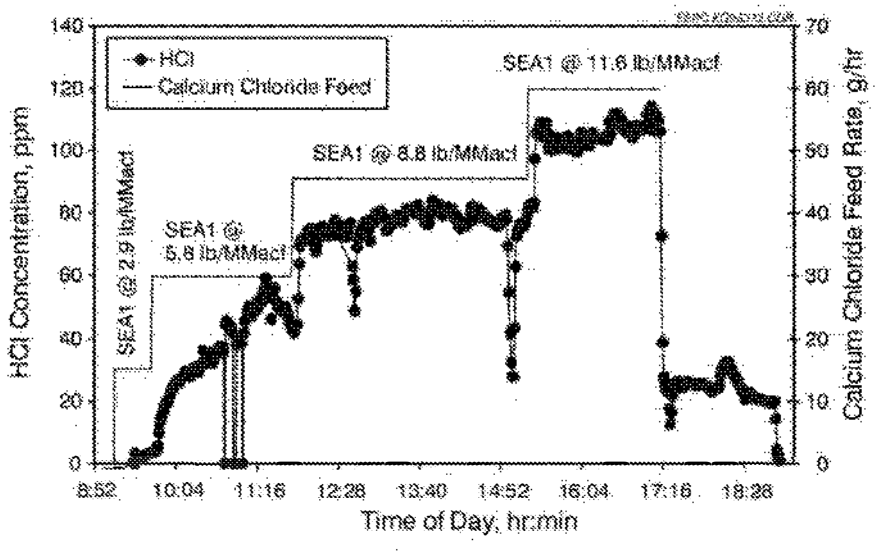


Figure 11-11. Temporal variations in ESP outlet HCl concentrations and SEA1 ($CaCl_2$) addition rates.

28. As shown by items 19-27 herein, in a coal-fired power plant, placing halide salts on the coal or in the combustion chamber results in formation of gaseous halide salt in the flue gas and formation of the respective hydrogen halide in the flue gas. Placing bromide salts such as NaBr or $CaBr_2$ on the coal or in the combustion chamber results in formation of gaseous NaBr or $CaBr_2$ in the flue gas, as well as formation of HBr in the flue gas. Likewise, placing chloride salts such as NaCl or $CaCl_2$ on coal or in the combustion chamber results in formation gasoues NaCl or $CaCl_2$ in the flue gas, as well as the formation of HCl in the flue gas.

29. Wikipedia defines "salt" as "...an ionic compound that can be formed by the neutralization reaction of an acid and a base. Salts are composed of related numbers of cations (positively charged ions) and anions (negative ions) so that the product is electrically neutral (without a net charge). These component ions can be inorganic, such as chloride (Cl^-), or organic, such as acetate ($CH_3CO_2^{-1}$); and can be monatomic, such as

fluoride (F^-), or polyatomic, such as sulfate (SO_4^{-2})." See, https://en.wikipedia.org/wiki/Salt_(chemistry).

30. Dictionary.com defines "bromide" as "Wikipedia defines "NaBr" as "a salt of hydrobromic acid consisting of two elements, one of which is bromine, as sodium bromide, NaBr." See, https://www.dictionary.com/browse/bromide.

31. Dictionary.com defines "salt" as "a Wikipedia defines "NaCl" as "a crystalline compound, sodium chloride, NaCl, occurring as a mineral, a constituent of seawater, etc., and used for seasoning food, as a preservative, etc." See, https://www.dictionary.com/browse/salt?s=t.

32. Sigma-Aldrich has an online products page entitled "Sodium Salts" that includes sodium bromide and sodium chloride. See, https://www.sigmaaldrich.com/materials-science/material-science-products.html?TablePage=19295381.

33. As shown by items 29-32 herein, NaBr is a salt that includes Na^+ ions and Br^- ions. NaCl is a salt that includes Na^+ ions and Cl^- ions. $CaBr_2$ is a salt that includes Ca^+ ions and Br^- ions. $CaCl_2$ is a salt that includes Ca^+ ions and Cl^- ions.

34. We further declare that all statements made herein of my own knowledge are true, and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by a fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application and/or any patent issued thereon.

Dated: March 20, 2019 By: / John Pavlish /

John Pavlish

Dated: March 15, 2019 By: / Nicholas Lentz /

Nicholas Lentz

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s): Edwin S. Olson et al. Examiner: AMBER ROSE ORLANDO
Application No.: 15/978,760 Group Art Unit: 1776
Filed: May 14, 2018 Docket No.: 4820.007US4
Confirmation No.: 6432
Title: SORBENTS FOR THE OXIDATION AND REMOVAL OF MERCURY

DECLARATION UNDER 37 C.F.R. § 1.132

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

DECLARATION B

I, John Pavlish, declare and say as follows:

1. I have been the Chief Technology Officer and Senior Vice President of Midwest Energy Emissions Corporation since November 16, 2014. Prior to this, I served as an Executive Consultant Advisor to Midwest Energy Emissions Corporation. Prior to joining Midwest Energy Emissions Corporation, I was a Senior Research Advisor and the Director of the Center for Air Toxic Metals Program at the Energy & Environmental Research Center in Grand Forks, North Dakota. I have over 25 years of mercury-related experience and am regarded as an international expert on the topic of mercury. My primary areas of interest and expertise include research, technical consultation and development of mercury control technologies, in particular, for coal combustion and gasification systems. I am an inventor of a number of patented mercury control technologies and have years of experience in development and testing of these technologies for commercial applications. Over the last 15 years, I have spent much time evaluating the efficacy of a number of different mercury control technologies/approaches and their cost competitiveness in the commercial market. I also have years of power plant experience and have worked for an engineering/consulting company, Black & Veatch, where I served as Unit Leader/System Engineer. I am a professional engineer, a member of the American Society of Mechanical Engineers, and a member of the Air & Waste Management Association (A&WMA). I serve on numerous professional and

technical committees and am a U.S. Representative on the Mercury Emissions from Coal International Experts Working Group on Reducing Emissions from Coal and a member of the United Nations Environment Programme Global Mercury Partnership, Reduction of Mercury Releases from Coal Combustion. I have published over 200 papers, articles, and reports on various mercury-related topics and issues.

2. U.S. patent publication no. 2004/0003716 ("Nelson") describes treatment of activated carbon outside the flue gas with hydrogen bromide (HBr), and describes testing to measure the percent mercury removal when the treated activated carbon was injected into either simulated or actual flue gas at various injection rates. Specifically, Nelson performed experiments in Example 5 (paragraphs [0082]-[0085]) and 7 (paragraphs [0089]-[0092]), and provides the data in FIG. 14 and FIG. 15.

3. In Example 5, Nelson treated Norit DARCO® FGD with gaseous HBr, and tested its use by injecting the HBr-treated sorbent into a simulated coal-fired flue-gas stream in a pilot-scale test system. Nelson's FIG. 14 shows data for one activated carbon sample treated with HBr. The activated carbon had 10 wt% HBr, and at a sorbent injection rate of about 3.7 lb/MMacf gave a mercury removal of about 82%.

4. In Example 7, Nelson treated Norit DARCO® FGD with gaseous HBr, and tested its use in a coal-fired power plant by injecting the treated sorbent into the flue gas prior to the electrostatic precipitator (ESP). Nelson's FIG. 15 shows data for two activated carbon samples treated with HBr. The two activated carbon samples contained 9 wt% HBr. The data in FIG. 15 for the two HBr-treated sorbents show that at a sorbent injection rate of about 2.2 lb/MMacf, 45% of the mercury was removed, and at a sobent injection rate of about 4.2 lb/MMacf, 62% of the mercury was removed.

5. The percent mercury removal, and the percent mercury removal per 1 wt% HBr additive on the sorbent, versus the sorbent injection rate for Nelson's HBr-treated activated carbon formed in Nelson's Examples 5 and 7 is given in the table below. The

percent mercury removal per 1 wt% HBr was calculated as the percent mercury removal divided by the HBr wt% on the sorbent. The units "lb/MMacf" are pounds of sorbent per 1 million actual cubic feet of flue gas.

Sample	Additive	Sorbent Description	Sorbent Injection Rate (lb/MMacf)	HBr wt% on Sorbent	%Hg Removal	%Hg Removal per 1 wt% HBr on Sorbent
N1	HBr outside flue gas	Norit DARCO® FGD	3.7	10	82	8.2
N2	HBr outside flue gas	Norit DARCO® FGD	2.2	9	45	5.0
N3	HBr outside flue gas	Norit DARCO® FGD	4.2	9	62	6.8

6. A bromine-treated activated carbon was prepared by exposing activated carbon (Norit DARCO® Hg, an activated carbon that a Norit Americas technical representative told me was rebranded for mercury control applications and was previously referred to as Norit DARCO® FGD) to gaseous bromine. A cement mixer was used to expose the activated carbon to the bromine gas. Tumbling vanes produced a dispersion of the activated carbon within the barrel. A cover was fit over the opening to keep the activated carbon dispersion inside the barrel. In the center of the lid, a small hole was drilled, and a tube extended to the center of the barrel. The tube was attached to a source of bromine vapor (Br_2) in dry nitrogen via a swivel so that the tube in the barrel would rotate and the tube to the source would be stationary. A charge of 1 to 5 kg of the activated carbon was weighed and transferred to the barrel. The weight of bromine transferred to the barrel was equal to 5 weight % of the amount of activated carbon.

7. An HCl-treated activated carbon was prepared by exposing activated carbon (Norit DARCO® Hg) to gaseous HCl. The carbon was weighed and added to a flask which was attached to a rotary apparatus. A hard-plastic tube was inserted into the

condenser end of the apparatus for introduction of the HCl/nitrogen gas mix. This extended to the center of the flask. HCl from a cylinder was run through a flow meter and mixed with a low flow of nitrogen in a T-tube attached to the inlet tube. The flow rate was set to provide 5 wt % HCl over 15 minutes exposure. The flask was slowly rotated in the apparatus at room temperature so that the carbon turned over but did not exit the flask. After the exposure period, the HCl flow was stopped and the HCl-treated activated carbon was removed.

8. A pilot-scale 550,000-Btu/hr pulverized coal (pc)-fired test unit was used to combust subbituminous coal and test mercury control using various sorbents. The coal combustion flue gas exiting the pilot unit was cooled down to a nominal temperature of 149°C (300°F) and then was introduced into a single wire tubular ESP unit. Activated carbon sorbents were fed with a K-Tron dual-screw feeder upstream of the ESP. The feeder was calibrated prior to the start of each carbon injection test. No scrubber was used. Before Hg control testing began, a baseline condition was established with the pilot-scale unit, and flue gas mercury content was measured before each test as about 6-10 $\mu g/m^3$. The flue gas HCl concentration, with no additives on the coal, as calculated by the chlorine measured in the coal, was 2-5 ppm. Percent mercury removal was then measured for the activated carbon alone (untreated), the activated carbon treated with Br_2 outside the flue gas described herein at item 6 as per the Nelson procedure, and with sodium bromide (NaBr) or sodium chloride (NaCl) added to coal prior to introduction to the furnace with injection of untreated activated carbon into the flue gas.

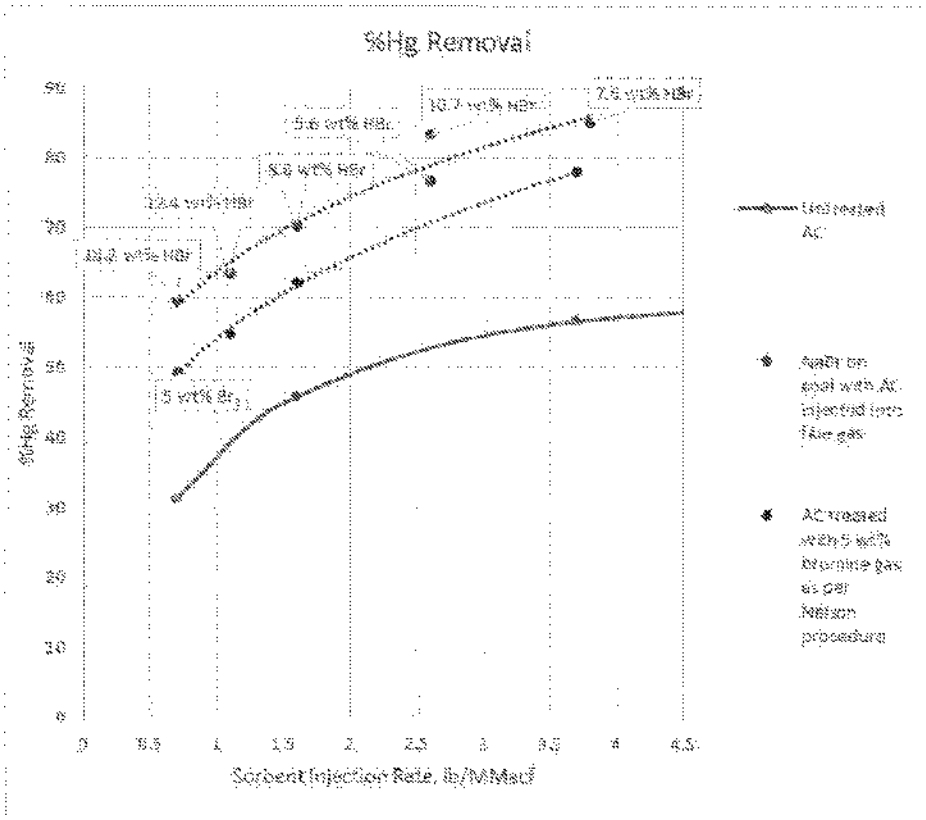
9. The results of the pilot-scale test with untreated activated carbon and with the activated carbon treated with Br_2 outside the flue gas described herein at item 6 are given in the table below.

Sample	Additive	Sorbent Description	Sorbent Injection Rate (lb/MMacf)	Br_2 wt% on Sorbent	%Hg Removal
1	None	Norit DARCO® Hg	0.7	0	31.4
2	None	Norit DARCO® Hg	1.6	0	45.9
3	None	Norit DARCO® Hg	3.7	0	56.6
4	None	Norit DARCO® Hg	9.2	0	61.2
5	None	Norit DARCO® Hg	25.7	0	62.5
6	Br_2 outside flue gas	Norit DARCO® Hg	0.7	5	49.5
7	Br_2 outside flue gas	Norit DARCO® Hg	1.1	5	54.9
8	Br_2 outside flue gas	Norit DARCO® Hg	1.6	5	62.2
9	Br_2 outside flue gas	Norit DARCO® Hg	3.7	5	78.1

10. The results from the pilot-scale test with sorbent enhancement additives (SEAs) NaBr or NaCl added to coal along with injection of untreated activated carbon into the flue gas, and with the activated carbon treated with HCl outside the flue gas described at item 7, are given in the table below. The bromide (Br^-) or chloride (Cl^-) injection rate was calculated as the SEA injection rate times the fraction of the additive (based on molecular weight) that is Br^- or Cl^-; for Br^-, $Br^-/NaBr = 79.904/(79.904+22.9898) = 0.7766$; for Cl^-, $Cl^-/NaCl = 35.453/(35.453+22.9898) = 0.6066$. The HBr or hydrogen chloride (HCl) equivalent injection rate was calculated as the Br^- or Cl^- injection rate times the molecular weight ratio of HBr/Br^- or of HCl/Cl^-; for HBr/Br^-, this is $(1.00794+79.904)/79.904 = 1.013$; for HCl/Cl^-, this is $(1.00794+35.453)/35.453 = 1.028$. The equivalent HBr or HCl wt% on sorbent was calculated as the HBr or HCl injection rate divided by the sum of the sorbent injection rate and the HBr or HCl injection rate (e.g., 100% of the HBr or HCl was assumed to react with the sorbent). The percent mercury removal per 1 wt% HBr or HCl was calculated as the percent mercury removal divided by the HBr wt% or HCl wt% on sorbent.

Sample	Additive	Additive injection rate (lb/MMacf)	Sorbent description	Sorbent injection rate (lb/MMacf)	Br or Cl injection rate (lb/MMacf)	HBr or HCl equivalent injection rate (lb/MMacf)	Equivalent HBr or HCl wt% on sorbent	%Hg removal	%Hg removal per 1 wt% HCl or HBr on sorbent	Milligrams HBr or HCl/MMacf per 1% Hg Removal
13	NaBr on coal	0.2	Norit DARCO® Hg	0.7	0.16	0.16	18.2	59.8	3.3	1211
14	NaBr on coal	0.2	Norit DARCO® Hg	1.1	0.16	0.16	12.4	63.6	5.1	1139
15	NaBr on coal	0.2	Norit DARCO® Hg	1.6	0.16	0.16	8.8	70.4	18.0	1029
16	NaBr on coal	0.2	Norit DARCO® Hg	2.6	0.16	0.16	5.6	76.7	13.6	944
17	NaBr on coal	0.4	Norit DARCO® Hg	2.6	0.31	0.31	10.7	83.3	7.8	1739
18	NaBr on coal	0.4	Norit DARCO® Hg	3.8	0.31	0.31	7.6	85.1	11.3	1702
19	NaCl on coal	2.4	Norit DARCO® Hg	0.7	1.46	1.50	67.5	60.6	0.9	11202
20	NaCl on coal	3.4	Norit DARCO® Hg	0.7	2.06	2.12	74.7	61.2	0.8	15714
21	NaCl on coal	4.9	Norit DARCO® Hg	0.7	2.97	3.06	80.9	57.8	0.7	23979
22	NaCl on coal	4.9	Norit DARCO® Hg	1.1	2.97	3.06	73.0	67.4	0.9	20564
23	NaCl on coal	4.9	Norit DARCO® Hg	1.6	2.97	3.06	65.0	69.6	1.1	19914
24	NaCl on coal	6.9	Norit DARCO® Hg	1.6	4.19	4.30	72.3	71.2	1.0	27412
25	HCl outside flue gas	0	Norit DARCO® Hg	0.7	0.04	0.04	5.0	27.9	5.6	569
26	HCl outside flue gas	0	Norit DARCO® Hg	1.6	0.08	0.08	5.0	34.2	6.8	1061
27	HCl outside flue gas	0	Norit DARCO® Hg	2.6	0.13	0.13	5.0	35.1	7.0	1680
28	HCl outside flue gas	0	Norit DARCO® Hg	4.9	0.24	0.25	5.0	40.3	8.1	2757
29	HCl outside flue gas	0	Norit DARCO® Hg	7.7	0.37	0.39	5.0	43.9	8.8	3978
30	HCl outside flue gas	0	Norit DARCO® Hg	15.5	0.75	0.78	5.0	52.9	10.6	6645

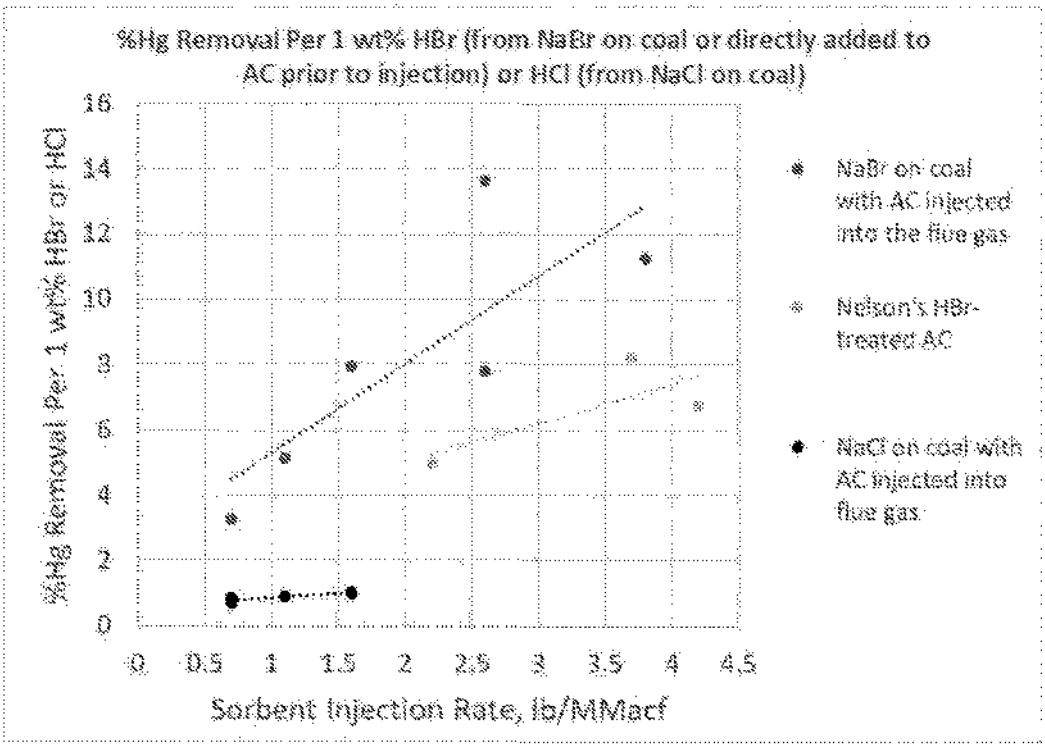
11. The following plot shows the percent mercury removal versus the sorbent injection rate for the activated carbon alone (untreated), the activated carbon treated with Br_2 outside the flue gas described herein at item 6 as per the Nelson procedure, and for NaBr added to coal prior to introduction to the furnace with injection of untreated activated carbon into the flue gas. All of the data in the following plot is taken from the data in the tables at item 9 and 10, which was produced using the same pilot-scale setup described at item 8.

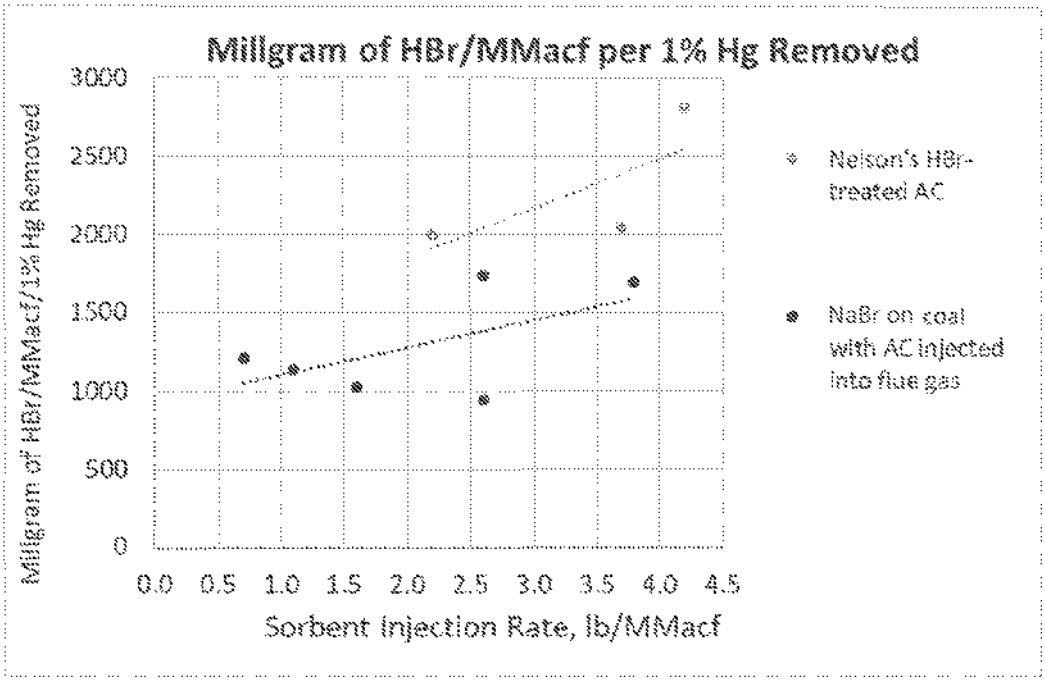


12. The data in the plot above show that the NaBr added to coal prior to introduction to the furnace with injection of untreated activated carbon into the flue gas (in-flight promotion with Br^-) provided a higher percent of mercury removal at all tested sorbent

injection rates as compared to the activated carbon alone (untreated) and compared to the activated carbon treated with Br_2 outside the flue gas described herein at item 6 as per the Nelson procedure. With NaBr added to the coal and activated carbon injected into the flue gas, there was a significant reduction in the amount of sorbent required to acheive similar mercury removal compared to the activated carbon treated with Br_2 outside the flue gas. For example, to acheive 70% mercury removal, 2.5 lb/MMacf of Br_2-treated carbon was required, as compared to 1.6 lb/MMacf with NaBr added to the coal and activated carbon injected into the flue gas; an additional (2.5-1.6/1.6)*100% or 56% treated sorbent was required to achieve the same leval of mercury removal.

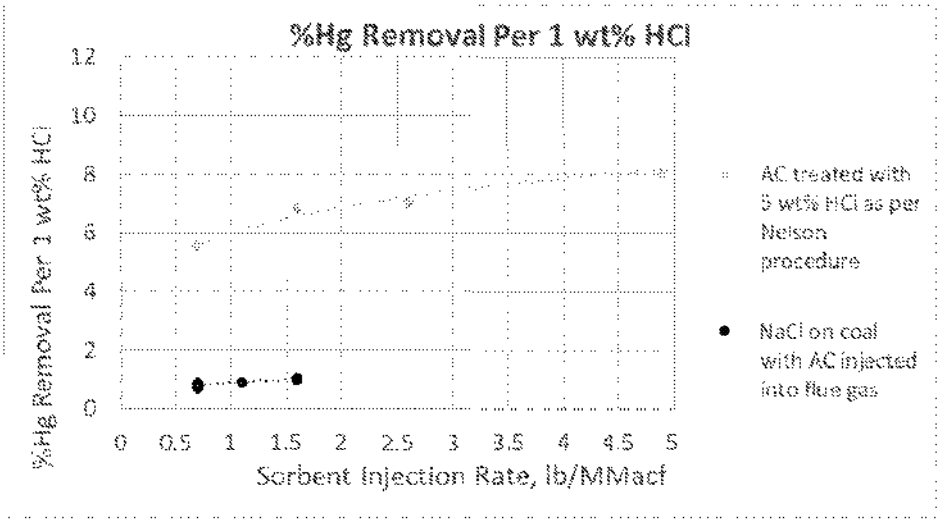
13. The following first plot shows the percent mercury removal per 1 wt% HBr or HCl versus the sorbent injection rate with NaBr or NaCl added to coal prior to introduction to the furnace with injection of untreated activated carbon into the flue gas, and for Nelson's activated carbon treated with HBr outside the flue gas. The following second plot shows the milligrams of HBr/MMacf per 1% mercury removal versus the sorbent injection rate with NaBr added to coal prior to introduction to the furnace with injection of untreated activated carbon into the flue gas, and for Nelson's activated carbon treated with HBr outside the flue gas; NaCl added to coal prior to introduction to the furnace with injection of untreated activated carbon into the flue gas was omitted from this plot because the values for the milligrams of HCl/MMacf per 1% mercury removal were so high (about 10,000 to 30,000). The data sets in the following first and second plots "NaBr on coal with AC injected into the flue gas" and "NaCl on coal with AC injected into flue gas" are taken from the data in table at item 10, which was produced using the same pilot-scale setup described at item 8. The data set in the following first and second plots "Nelson's HBr-treated AC" is taken from the table at item 5, which is from Nelson's experimental setup.

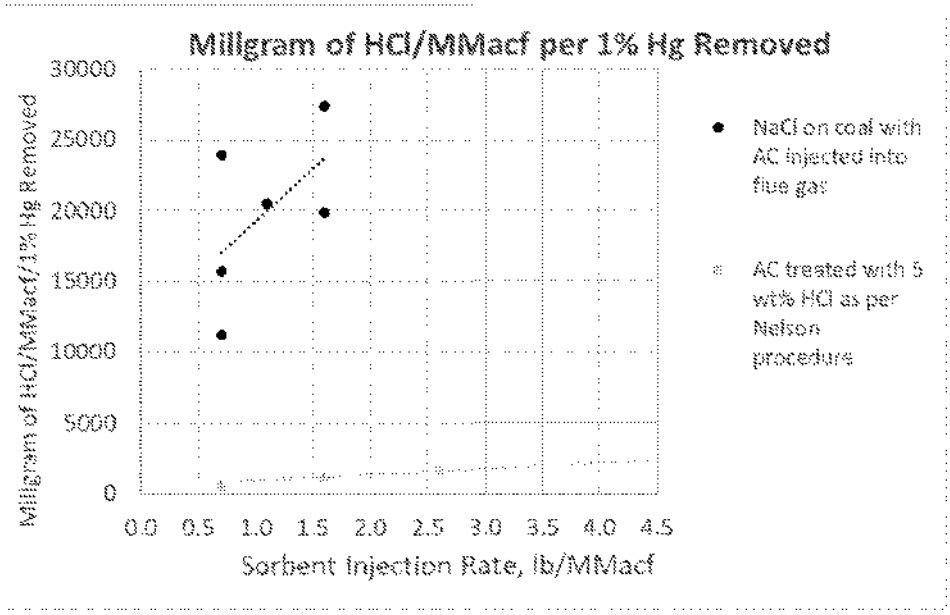

%Hg Removal Per 1 wt% HBr (from NaBr on coal or directly added to AC prior to injection) or HCl (from NaCl on coal)
%Hg Removal Per 1 wt% HBr or HCl
0
2
4
6
8
10
12
14
16
0 0.5 1 1.5 2 2.5 3 3.5 4 4.5
Sorbent Injection Rate, lb/MMacf
NaBr on coal with AC injected into the flue gas
Nelson's HBr-treated AC
NaCl on coal with AC injected into flue gas


Millgram of HBr/MMacf per 1% Hg Removed
Millgram of HBr/MMacf/1% Hg Removed
0
500
1000
1500
2000
2500
3000
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5
Sorbent Injection Rate, lb/MMacf
Nelson's HBr-treated AC
NaBr on coal with AC injected into flue gas

14. The data in the first plot above show that the NaBr added to coal prior to introduction to the furnace with injection of untreated activated carbon into the flue gas provided a significantly higher (about 2x) percent mercury removal per 1 wt% HBr at all tested sorbent injection rates as compared to Nelson's activated carbon treated with HBr outside the flue gas. Further, the data show that NaBr added to coal prior to introduction to the furnace with injection of untreated activated carbon into the flue gas provided a significantly higher (about 6-8x) percent mercruy removal per 1 wt% HBr or HCl at all tested sorbent injection rates compared to the NaCl added to coal prior to introduction to the furnace with injection of untreated activated carbon into the flue gas. The data in the second plot above shows that NaBr added to coal prior to introduction to the furnace with injection of untreated activated carbon into the flue gas provided a significantly lower milligrams of HBr/MMacf per 1% mercury removal at all tested sorbent injection rates as compared to Nelson's activated carbon treated with HBr outside the flue gas, indicating more efficient (approximately 2x) use of HBr for mercury removal during in-flight promotion of activated carbon than treatment of activated carbon outside the flue gas.

15. The following first plot shows the percent mercury removal per 1 wt% HCl versus the sorbent injection rate for NaCl added to coal prior to introduction to the furnace with injection of untreated activated carbon into the flue gas, and for the activated carbon treated with HCl outside the flue gas described herein at item 7 as per the Nelson procedure. The following second plot shows the milligrams of HCl/MMacf per 1% mercury removal versus the sorbent injection rate with NaCl added to coal prior to introduction to the furnace with injection of untreated activated carbon into the flue gas, and for the activated carbon treated with HCl outside the flue gas described herein at item 7 as per the Nelson procedure. The data sets in the following first and second plots are taken from the data in table at item 10, which was produced using the same pilot-scale setup described at item 8.





16. The data in the first plot above show that activated carbon treated with HCl outside the flue gas as per the Nelson procedure provided a much higher percent of mercury removal per 1 wt% HCl at all tested sorbent injection rates as compared to NaCl

added to coal prior to introduction to the furnace with injection of untreated activated carbon into the flue gas. The data in the second plot above show that the milligrams of HCl/MMacf per 1% mercury removal versus the sorbent injection rate with NaCl added to coal prior to introduction to the furnace with injection of untreated activated carbon into the flue gas was significantly higher as compared to the activated carbon treated with HCl outside the flue gas described herein at item 7 as per the Nelson procedure, indicating more efficient use of HCl for mercury removal by treatment of activated carbon outside the flue gas than by promotion in-flight.

17. I further declare that all statements made herein of my own knowledge are true, and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by a fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application and/or any patent issued thereon.

Dated: March 20, 2019 By: /John Pavlish/

John Pavlish

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s): Edwin S. Olson et al. Examiner: AMBER ROSE ORLANDO
Application No.: 15/978,760 Group Art Unit: 1776
Filed: May 14, 2018 Docket No.: 4820.007US4
Confirmation No.: 6432
Title: SORBENTS FOR THE OXIDATION AND REMOVAL OF MERCURY

DECLARATION UNDER 37 C.F.R. § 1.132

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

DECLARATION A

I, John Pavlish, declare and say as follows:

1. I have been the Chief Technology Officer and Senior Vice President of Midwest Energy Emissions Corporation since November 16, 2014. Prior to this, I served as an Executive Consultant Advisor to Midwest Energy Emissions Corporation. Prior to joining Midwest Energy Emissions Corporation, I was a Senior Research Advisor and the Director of the Center for Air Toxic Metals Program at the Energy & Environmental Research Center in Grand Forks, North Dakota. I have over 25 years of mercury-related experience and am regarded as an international expert on the topic of mercury. My primary areas of interest and expertise include research, technical consultation and development of mercury control technologies, in particular, for coal combustion and gasification systems. I am an inventor of a number of patented mercury control technologies and have years of experience in development and testing of these technologies for commercial applications. Over the last 15 years, I have spent much time evaluating the efficacy of a number of different mercury control technologies/approaches and their cost competitiveness in the commercial market. I also have years of power plant experience and have worked for an engineering/consulting company, Black & Veatch, where I served as Unit Leader/System Engineer. I am a professional engineer, a member of the American Society of Mechanical Engineers, and a member of the Air & Waste Management Association (A&WMA). I serve on numerous professional and

technical committees and am a U.S. Representative on the Mercury Emissions from Coal International Experts Working Group on Reducing Emissions from Coal and a member of the United Nations Environment Programme Global Mercury Partnership, Reduction of Mercury Releases from Coal Combustion. I have published over 200 papers, articles, and reports on various mercury-related topics and issues.

2. Herein, when I refer to the invention I am referring to a method of separating mercury from a mercury-containing gas as described in independent claim 2 of U.S. patent application serial no. 15/978,760. All websites referenced in this document were accessed March 20, 2019.

The EPA Calls For New Mercury Removal Technology in the 1990s

3. The background story for this technology begins with the Clean Air Act Amendments of 1990. That law required the U.S. Environmental Protection Agency (EPA) to study the impact of various air pollutants, including mercury.[1] To assist in the research, in 1992, the EPA established a National Center for Excellence at the Energy & Environmental Research Center (EERC) referred to as the Center for Air Toxic Metals (CATM). It is through the EERC that my fellow co-inventors and I would eventually discover the invention claimed in U.S. patent application serial no. 15/978,760. Our research focused heavily on developing new methods for detecting, measuring, and ultimately, removing mercury from coal-fired power plant exhaust gas.

4. In 1997 and 1998, the EPA issued two reports to Congress: *Mercury Study Report to Congress* (issued December 1997)[2] and *Study of Hazardous Air Pollutant Emissions*

[1] Website: https://www.epa.gov/clean-air-act-overview/1990-clean-air-act-amendment-summary-title-iii
[2] United States Environmental Protection Agency, "Mercury Study Report to Congress, Volume I: Executive Summary", EPA-452/R-97-003, December 1997, https://www.epa.gov/mercury/mercury-study-report-congress

from Electric Utility Steam (issued February 1998)[3]. As an outcome of these studies, the EPA found a pressing need for regulation of mercury pollution from power plants.[4] Unfortunately, it also found that no existing technologies were up to the task of significantly reducing the mercury pollution from those plants.[5]

5. With that said, the EPA did provide some indications as to promising areas for future research. For example, similar to cited reference U.S. patent no. 5,435,980 ("Felsvang"), the EPA noted a connection between the chlorine content in coal and potential ways to remove mercury.[6] It also identified activated carbon injection as a potential control technology for mercury removal.[7] Nonetheless, it acknowledged that much more research was needed:

> Research continues on the chemistry and interactions of flue gas, fly ash, and mercury species. This fundamental research is needed at various flue gas conditions encountered across the utility industry in order to develop low cost mercury strategies for full-scale utility operation. Thus, while AC injection shows promise as a mercury control technology, more data and research are needed to understand the factors that affect mercury removal.[8]

6. In the wake of these reports, various governmental and industry organizations injected millions of dollars into basic scientific research and experimental studies in the

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[3] United States Environmental Protection Agency, "Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units -- Final Report to Congress", United States Office of Air Quality EPA-453/R-98-004a, Environmental Protection Planning and Standards, February 1998, https://www.epa.gov/mats/study-hazardous-air-pollutant-emissions-electric-utility-steam-generating-units-final-report

[4] On March 15, 2005, the EPA issued the Clean Air Mercury Rule to significantly reduce mercury emissions from coal-fired power plants, with a goal of reducing utility emissions of mercury from 48 tons/year to 15 tons/year, a reduction of nearly 70 percent. See, https://en.wikipedia.org/wiki/Mercury_regulation_in_the_United_States.

[5] Footnote 3 reference at ES-19, "Regarding potential methods for reducing mercury emissions, the EPA has not identified any demonstrated add-on control technologies currently in use in the U.S. that effectively remove mercury from utility emissions."

[6] Footnote 3 reference at section 13, pages 37-38.

[7] Footnote 3 reference at section 13, pages 40-41.

[8] Footnote 3 reference at section 13, page 43, second full paragraph.

search for new mercury removal technologies.[9] Because increased regulation of mercury emissions was expected to require significant upgrades to the country's fleet of coal-fired plants, much of the research focused on retrofit technologies that could be adopted at relatively low cost, including sorbent injection systems[10].

The EPA Espouses the Conventional Wisdom in Favor of Pre-Treated Sorbents, Not In-Flight Sorbent Enhancement in the Flue Gas

7. In 2002, the EPA surveyed the state of research in this field and produced a follow-up report.[11] It noted that the complex chemistry of the coal combustion process was still not fully understood, but that progress had been made. It described how coals with higher halogen content (specifically, chlorine) were better able to oxidize mercury and promote its capture.[12] However, it also noted that this oxidation reaction could be inhibited by other chemicals present during combustion in the boiler.[13] The EPA also described promising experiments being performed with halogen-treated sorbents.[14]

8. Notably, the EPA did not recommend in-flight sorbent enhancement in the flue gas by spraying additives on coal or injecting halogens into the boiler. Rather, it described research into methods for *pre-treating* sorbents with various additives, including chlorine, and then injecting those pre-treated sorbents downstream from the

[9] T. D. Brown, D. N. Smith, R. A. Hargis Jr., W. J. O'Dowd, 1999, Mercury Measurement and Its Control: What We Know, Have Learned, and Need to Further Investigate, Journal of the Air & Waste Management Association, 49:6, 1-97, DOI: 10.1080/10473289.1999.10463841
[10] Footnote 9 reference at page 80, first column.
[11] J. D. Kilgroe, C. B. Sedman, R. K. Srivastava, J. V. Ryan, C. W. Lee, S. A. Thorneloe, Control of Mercury Emissions from Coal-Fired Electric Utility Boilers: Interim Report, U.S. Environmental Protection Agency, Office of Research and Development, EPA-600/R-01-109, December 2001
[12] Footnote 11 reference at section 6, page 7, first full paragraph.
[13] Footnote 11 reference at section 5, page 7, second full paragraph "It is speculated that SO_2 and water vapor may inhibit gas-phase oxidation of Hg^0 by scavenging the chlorinating agent."
[14] Footnote 11 reference at ES-8, second-to-last full paragraph, "Impregnation of carbons with sulfur, iodine, or chlorine can increase the reactivity and capacity of sorbents."

boiler.[15] This approach ensured that, e.g., chlorinating agents could react with the sorbent material without being "scavenged" by other chemicals present in the boiler. This approach also ensured that the sorbent additive would have plenty of time to react with the sorbent—the EPA explained that, for many plants, injected sorbents would have only a few seconds to find and react with mercury present in the flue gas, with high and costly carbon-to-Hg ratios needed to achieve adequate mercury removal.[16] This is consistent with the general understanding in the industry that sorbent additives such as halogens or halides should be mixed with sorbents *before* coming in contact with mercury-containing flue gas.

Sidney Nelson Touts Brominated Sorbent, Not In-Flight Sorbent Enhancement in the Flue Gas

9. The same year the EPA published its follow-up report,[17] on April 24, 2002, Sidney Nelson filed the provisional application for the cited reference U.S. patent publication no. 2004/0003716 ("Nelson"), U.S. provisional application no. 60/377,790 ("Nelson provisional"). His application reported experiments that he had conducted using sorbents pre-treated with Br_2 and HBr. His application demonstrated that those pre-treated sorbents could outperform some commercially available sorbents, explaining exposing the activated carbon to concentrated forms of Br_2 or HBr outside the flue gas allows a relatively large quantity of the concentrated Br_2 or HBr to react with the activated carbon.[18]

[15] Footnote 11 reference at section 5, paragraph bridging pages 33-34.
[16] Footnote 11 reference at 5-33, "Activated carbon duct injection seems to be the most promising Hg control technology for coal-fired electric utility boilers equipped with ESPs. In this technology, the injected activated carbon removes Hg only while contacting the flue gas during very limited sorbent/gas contact time (<3 seconds)." Note that this section of the report refers to the reaction between pre-treated chlorinated sorbent and mercury as occurring "in-flight." To be clear, this portion of the report describes only the use of a pre-treated sorbent, not the claimed invention.
[17] Footnote 11 reference.
[18] Nelson at paragraph [0043], "…it appears that in exposing PAC to concentrated bromine gas, a relatively large quantity of the bromine reacts with the carbon, forming surface compounds on the large surface-area of the carbon."

10. Consistent with EPA teachings, Nelson did not recommend or teach adding chemicals to the flue gas or in-flight mixing of Br_2 and HBr with sorbents. Quite the contrary, he recommended that the bromine be contacted with the sorbent outside the presence of boiler gases "...for a sufficient time..." to ensure that enough bromine reacted with the sorbent.[19] Treatment times for HBr- and Br_2-treatment of activated carbon described by Nelson were on the order of several minutes (1.5-100 minutes)[20]; in contrast, only a few seconds are available for in-flight sorbent enhancement in the flue gas (e.g., generally less than 10 seconds)[16]. He also identified an even further reason to avoid in-flight sorbent enhancement in the flue gas: he noted that bromine compounds are "...quite corrosive."[21] As a result, he recommended mixing bromine and sorbent in equipment "...preferably lined with corrosion-resistant material..."[21] such as Teflon[22]—an approach that is not possible when bromine is added to coal or injected upstream from or into the boiler.

11. Despite the development of brominated sorbents and other advancements in the field, by 2003, the EPA recognized that there was still no "single best technology that can be broadly applied" for mercury capture.[23]

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[19] Nelson at paragraphs [0023], [0028], and claim 1.
[20] Nelson at page 8, paragraph [0087] and the table at the top of the second column. For HBr-treated activated carbon, the adsorption rate was 1 gram of HBr absorbed per 1 kg of activated carbon per minute, or 0.1 wt% HBr absorbed per minute, meaning that to reach the 9 wt% HBr reported in the table required about 90 minutes. Note that Figure 14 reports results for 10 wt% HBr, and Figure 15 reports results for 9 wt% HBr. For Br_2-treated activated carbon, the adsorption rate was 10 grams of Br_2 absorbed per 1 kg of activated carbon per minute, or 1 wt% Br_2 absorbed per minute, meaning that to reach the 15 wt% Br_2 reported in the table required about 15 minutes. Note that Figures 14 and 15 report results for 1.5 wt%, 5 wt%, and 15 wt% Br_2, according to the table requiring about 1.5 to 15 minutes to form.
[21] Nelson at paragraph [0044].
[22] Nelson provisional at page 4, last paragraph.
[23] J. H. Pavlish, E. A. Sondreal, M. D. Mann, E. S. Olson, K. C. Galbreath, D. L. Laudal, S. A. Benson, "Status Review of Mercury Control Options for Coal-Fired Power Plants", Fuel Processing Technology 82 (2003) 89–165, at page 89, first paragraph.

The EPA Continues to Teach Away from In-Flight Sorbent Enhancement in the Flue Gas

12. In 2005, the EPA issued another follow-on report.[24] In this report, the EPA again noted the connection between chlorine content in coal and mercury capture.[25] It also recognized the advantages of brominated carbon sorbents.[26] The report also notes that halogen-containing sorbent enhancement additives have been added to coal along with injection of activated carbon sorbents into the flue gas to remove mercury.[27] However, despite being aware of these facts—facts that the examiner has relied on to demonstrate obviousness of the claims at issue—in the final summary the EPA does not recommend, or even mention, in-flight sorbent enhancement in the flue gas.[28] Although the EPA's "key observations" for retrofitting the country's coal plant fleet mention the use of fuel additives and the injection of activated carbon into the flue gas, the use of these technologies together is not mentioned, and in-flight enhancement of the sorbent in the flue gas is not mentioned; rather, injection of pre-treated halogenated activated carbon is emphasized.[29]

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[24] U.S. Environmental Protection Agency, "Control of Mercury Emissions from Coal Fired Electric Utility Boilers: An Update", Air Pollution Prevention and Control Division, National Risk Management Research Laboratory, Office of Research and Development, February 18, 2005

[25] Footnote 24 reference at page 25, third-to-last bullet point. See also, page 10, second paragraph, with regard to chloride salts on coal, noting that "Long term effects, such as corrosion, plugging, impacts on combustion equipment could not be assessed during the short-term parametric tests. Therefore, the use of coal additives offer some promise at improving mercury capture; however, they may have other impacts that need to be evaluated."

[26] Footnote 24 reference at pages 18-21.

[27] Footnote 24 reference at page 22, second paragraph. See also, page 24, second-to-last full paragraph, "Additives used to enhance PAC performance or other sorbents that may be used, however, might cause adverse effects on plant components. The potential for such impacts would have to be evaluated through long-term field testing conducted over time periods of several months or more."

[28] Footnote 24 reference at pages 30-32.

[29] Footnote 24 reference at pages 31-32, items 6 and 9, discussing injection of activated carbon and halogenated activated carbon, are the only items to highlight specific mercury removal levels, and fail to mention halogenated fuel additives or in-flight sorbent enhancement in the flue gas.

13. The EPA's failure to recommend the use of halogenated fuel additives in combination with injection of activated carbon into the flue gas to cause in-flight enhancement of the sorbent in the flue gas is particularly striking because my coinventors and I had already begun publishing results from initial testing of in-flight sorbent enhancement in the flue gas. The EPA acknowledged those results in their report, noting that 63% mercury removal was achieved, and specifically found that this approach is different from merely using pre-treated sorbent.[27] Nonetheless, despite having this initial data as a roadmap to arrive at the claimed invention, the EPA continued to espouse the conventional view in favor of pre-treated sorbents.

The Department of Energy Funds Research into In-Flight Sorbent Enhancement in the Flue Gas

14. Despite the EPA's optimism for injection of pre-treated halogenated carbon sorbents into the flue gas in the early 2000s, various research groups were pursuing alternative technologies during this time period. The EERC was one of those groups. After extensive research into methods for detecting and measuring mercury species, and some research into various sorbents, my co-inventors and I theorized that in-flight sorbent enhancement in the flue gas could provide an improvement over pre-treated sorbent.

15. The EERC obtained funding to test this theory in 2003 from the U.S. Department of Energy's National Energy Technology Laboratory (DOE/NETL) under the Office of Fossil Energy's Innovations for Existing Plants (IEP) Program.[30] The goal of Phases I and II of the program was development of Hg control technologies that could achieve 50 to 70% Hg capture at costs 25 to 50% less than the baseline 1999 estimate.[31] Our initial pilot-scale tests suggested that our approach could achieve mercury removal efficiencies

[30] T.J. Feeley III, J. Murphy, J. Hoffmann, S. A. Renninger, A Review of DOE/NETL's Mercury Control Technology R&D Program for Coal-Fired Power Plants, April 2003.
[31] Footnote 30 reference, page 3, second paragraph.

ranging from 50-90%. As a result, the EERC successfully obtained several multi-million-dollar awards under the program.[32]

In-Flight Sorbent Enhancement in the Flue Gas Is Finally Recognized as a Critical Advancement

16. It is estimated that over $60 million dollars was spent by the EERC on the research, development, testing, and demonstration of mercury removal from flue gas.[33] In 2008, DOE published a document highlighting the successful development and demonstration of the technology.[34] Some of the key advantages of the technology are highlighted as follows[34, 35]:

- Improves mercury oxidation and enhances activated carbon reactivity, which can improve capture in downstream equipment.
- Allows use of more abundantly available supplies of activated carbon (treated activated carbons have limited supply).
- Improves mercury capture while using far less activated carbon.
- Improves mercury capture efficiencies in some instances to greater than 90% (standard ACs can be limited to around 60%).
- Allows for performance and cost optimization of SEA and activated carbon at each site.
- Minimizes ESP particulate and opacity problems by using lower amounts of activated carbon.
- Minimizes fabric filter particulate emissions and pressure drop while allowing the unit to operate at maximum load by using lower amounts of activated carbon.

[32] Footnote 30 reference, page 2, second paragraph; page 5 at Table 1; page 6 at Table 2; page 7 at Table 3; page 9, first full paragraph; page 13, last paragraph; page 17, last full paragraph; paragraph bridging pages 17-18; page 18, first full paragraph; and page 19, last partial paragraph.
[33] https://www.midwestemissions.com/
[34] U.S. Department of Energy, Office of Fossil Energy, National Energy Technology Laboratory, Cooperative Research and Development, "Successes: Sorbent Enhancement Additive Technology for Mercury Control", 2008
[35] A. P. Jones, J. W. Hoffmann, D. N. Smith, T. J. Feeley, J. T. Murphy, "DOE/NETL's Phase II Mercury Control Technology Field Testing Program: Preliminary Economic Analysis of Activated Carbon Injection," Environ. Sci. Technol., 2007, 41 (4), pp 1365–1371. DOI: 10.1021/es061734o, January 17, 2007.

In-Flight Sorbent Enhancement in the Flue Gas Experiences Commercial Success and Is Copied by Sidney Nelson and Other Competitors

17. One of the most straightforward indications of the success of the invention comes from chemical giant Albemarle, one of the largest suppliers of bromine worldwide. In 2008, Albemarle acquired Sidney Nelson's brominated sorbent company Sorbent Technologies Corp. and the Nelson patent.[36] Albermarle continued to market and sell brominated carbon sorbents. Nonetheless, today, even Albemarle now sells chemicals and systems for in-flight sorbent enhancement in the flue gas.[37]

18. In fact, even Mr. Nelson himself ultimately accepted the benefits of in-flight sorbent enhancement in the flue gas. In a post-Albemarle acquisition presentation entitled "How China Can Leapfrog the World in Mercury Emission Reduction", he noted that pre-treated sorbents were accepted in the U.S., but he recommended that Chinese operators should instead use in-flight sorbent enhancement in the flue gas.[38] As his basis for proposing that new approach he did not cite his own research or some commonly understood reference or theory from the 1990s or early 2000s. Rather, he relied on data collected by myself and my colleagues at the EERC and published in 2006.[39]

19. Despite the initial success of pre-treated sorbents, in-flight sorbent enhancement in the flue gas has more recently experienced important growth in the U.S. EPA data indicates that in-flight sorbent enhancement in the flue gas is currently used by more than

[36] See, U.S. assignment database for U.S. patent no. 6,953,494, assigned to Sorbent Technologies Corporation on 9/18/2006, and assigned to Albemarle Corporation on 9/30/2010. See also, http://www.chemeurope.com/en/news/85387/albemarle-corporation-acquires-sorbent-technologies-corporation.html.
[37] https://www.albemarle.com/businesses/bromine-specialties/bromine-&-derivatives/mercury-control, at the "ADDITIVES" tab.
[38] https://www.dri.edu/images/stories/editors/leapfrog/techprog/IId_3_NelsonJr.pdf at slide 24.
[39] Footnote 38 reference at slide 20.

one-third of all plants in the U.S.,[40] and it has been recognized as one of the key technologies enabling cost effective mercury removal from coal plant exhaust.

20. I further declare that all statements made herein of my own knowledge are true, and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by a fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application and/or any patent issued thereon.

Dated: March 20, 2019 By: / John Pavlish /

John Pavlish

[40] EPA Air Markets Program Data: https://ampd.epa.gov/ampd/. From this webpage, the "Query" tab was clicked. For programs and data sets, the program "mercury and air toxics standards (MATS)" and the data set "facility attributes" were selected, and then "next step" was clicked. For time frame, "select a range" was selected from 2019 to 2019, and then "next step" was clicked. For criteria, nothing was selected, and then "next step" was clicked. For variables, only the variables "owner", "fuel type (primary)", and "mercury controls" were selected, and then "next step" was clicked. The CSV file was downloaded, and then the "facility" file was opened as an Excel spreadsheet. The data was sorted to include only coal plants, column G, which totaled 606. Column H was then sorted to include only additives to enhance PAC; the total number was 70. Column H was then sorted to include only the units that had actually filled out what mercury control technology they are using, which totaled 228. Assuming that the 228 units are a random sampling of the 606 total, that number statistically represents all of the units and the distribution of different mercury control approaches. Thus, if 70 units are using coal additives with PAC and 228 units are representative of the 606, about 1/3 (e.g., 70/228 = 0.31) of the units are using coal additives with PAC.

CERTIFICATION AND REQUEST FOR PRIORITIZED EXAMINATION UNDER 37 CFR 1.102(e)

(Page 1 of 1)

First Named Inventor:	Edwin S. Olson	Nonprovisional Application Number (if known):	15/978,760
Title of Invention:	SORBENTS FOR THE OXIDATION AND REMOVAL OF MERCURY	Docket No.:	4820.007US4

APPLICANT HEREBY CERTIFIES THE FOLLOWING AND REQUESTS PRIORITIZED EXAMINATION FOR THE ABOVE-IDENTIFIED APPLICATION.

1. The processing fee set forth in 37 CFR 1.17(i)(1) and the prioritized examination fee set forth in 37 CFR 1.17(c) have been filed with the request. The publication fee requirement is met because that fee, set forth in 37 CFR 1.18(d), is currently $0. The basic filing fee, search fee, and examination fee are filed with the request or have been already been paid. I understand that any required excess claims fees or application size fee must be paid for the application.

2. I understand that the application may not contain, or be amended to contain, more than four independent claims, more than thirty total claims, or any multiple dependent claims, and that any request for an extension of time will cause an outstanding Track I request to be dismissed.

3. **Request for Continued Examination – Prioritized Examination under § 1.102(e)(2)**

   i. A request for continued examination has been filed with, or prior to, this form.
   ii. If the application is a utility application, this certification and request is being filed via EFS-Web.
   iii. The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a), or is a national stage entry under 35 U.S.C 371.
   iv. This certification and request is being filed prior to the mailing of a first Office action responsive to the request for continued examination.
   v. No prior request for continued examination has been granted prioritized examination status under 37 CFR 1.102(e)(2).

Signature /Nicholas P. Lanzatella/	Date March 20, 2019
Name (Print/Typed) Nicholas P. Lanzatella	Practitioner Registration Number: 63,803

Note: *This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. Submit multiple forms if more than one signature is required, see below*.*

*Total of 1 forms are submitted.

Attorney Docket No. 4820.007US4

Amended PTO/AIA/96 (08-12)
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STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: Midwest Energy Emissions Corp

Application No./Patent No.: 15/978,760 Filed/Issue Date: May 14, 2018

Titled: SORBENTS FOR THE OXIDATION AND REMOVAL OF MERCURY

Midwest Energy Emissions Corp a Corporation
(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☒ The assignee of the entire right, title, and interest.

2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):

   ☐ The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

   ☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3 ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are.

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (e.g., bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. ☒ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel 042921, Frame 0770-0787, or for which a copy thereof is attached.

B. ☐ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: _____ To: _____

   The document was recorded in the United States Patent and Trademark Office at

   Reel _____, Frame _____, or for which a copy thereof is attached.

2. From: _____ To: _____

   The document was recorded in the United States Patent and Trademark Office at

   Reel _____, Frame _____, or for which a copy thereof is attached.

This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Attorney Docket No. 4820.007US4

Amended PTO/AIA/96 (08-12)
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STATEMENT UNDER 37 CFR 3.73(c)

3. From: _____ To: _____

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6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☒ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Nicholas P. Lanzatella/ March 20, 2019

Signature Date

Nicholas P. Lanzatella USPTO Reg. No. 63,803

Printed or Typed Name Title or Registration Number

CONFIRMATORY ASSIGNMENT

THIS CONFIRMATORY ASSIGNMENT is made by Michael J. Holmes residing at 2424 S 38th St, Grand Forks, ND ("Assignor"), to Energy and Environmental Research Center Foundation, a North Dakota nonprofit corporation having a business address of 15 N. 23rd Street, Stop 9018, Grand Forks, North Dakota, 58202-9018 ("Assignee") and is effective as of the date this Confirmatory Assignment is executed by Assignor.

WHEREAS, Assignor has invented the inventions disclosed in the patents and patent applications listed in Exhibit A attached (collectively, and including all such inventions and all patents and patent applications for such inventions that have now been, or may in the future be, filed and/or granted for such inventions, including without limitation those patents and patent applications listed in Exhibit A, "Inventions") and, for good and valuable consideration, has agreed to assign, and has assigned, all of Assignor's right, title and interest in and to the Inventions to Assignee; and

WHEREAS, Assignor desires to confirm and assure the assignment, sale and transfer to Assignee of any and all right, title, and interest Assignor has in the Inventions; and

WHEREAS, this Confirmatory Assignment confirms that all Inventions listed in Exhibit A belong exclusively to Assignee and that Assignor has assigned, sold and transferred to Assignee, and hereby further assigns, sells and transfers to Assignee, without any requirement of further consideration, the entire right, title and interest in and to the Inventions, in the United States and its territorial possessions, and in all foreign countries, including without limitation all rights to claim priority in and to any and all improvements which are disclosed in the Inventions, and that upon the request of the Assignee, Assignor will take such further actions, including without limitation execution and delivery of instruments of conveyance, as may be appropriate to give full and proper effect to such assignment.

NOW THEREFORE, in consideration of the foregoing premises, the sum of Ten Dollars ($10.00) and other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, Assignor hereby assigns, sells and transfers to Assignee Assignor's entire right, title and interest in and to the Inventions, in the United States and its territorial possessions, and in all foreign countries, including without limitation: (1) all rights to claim priority in and to the Inventions and/or any and all improvements which are disclosed in the Inventions; (2) all rights with respect to the Inventions, including all United States patents and/or other

governmental grants and/or issuances that may be granted with respect to the Inventions and/or from any direct and/or indirect divisionals, continuations, continuations-in-part and/or other patent applications claiming priority rights from the Inventions; (3) all reissues, reexaminations, extensions and/or registrations of the foregoing; (4) all non-United States patents, patent applications and/or counterparts relating to the foregoing, including without limitation certificates of invention, utility models, industrial design protection, design patent protection and other governmental grants and/or issuances, and including the right to file United States and/or foreign applications directly in the name of Assignee, its successors and assigns; (5) all causes of action and/or remedies related to the foregoing (including without limitation, the right to sue for past, present and/or future infringement, misappropriation and/or violation of rights related to any of the foregoing and the right to collect royalties and/or other payments under or on account of any of the foregoing); and, (6) any and all other rights and/or interests arising out of, in connection with and/or in relation to the foregoing.

Assignor hereby covenants that no assignment, sale, agreement or encumbrance has been or will be made or entered into which would conflict with this Confirmatory Assignment.

Assignor agrees now, and at any time and from time to time in the future, upon request of Assignee, Assignee's successors, legal representatives and/or assigns, and at Assignee's expense, to take, execute, acknowledge, and deliver all such further acts and deeds, assignments, instruments of transfer or conveyance, registrations for assignments, powers of attorney, declarations and/or assurances as may be required for the assigning, selling, transferring, assuring and confirming to Assignee, and Assignee's successors and assigns, and/or for aiding and assisting in collecting and reducing to possession, the rights assigned, sold and transferred under this Confirmatory Assignment, to participate in proceedings regarding such rights (including without limitation, any litigation and/or patent office proceedings) and/or to or perfect and/or defend title to such rights.

Assignor requests the respective patent office or governmental agency in each jurisdiction to issue any and all patents, certificates of invention, utility models and/or other governmental grants and/or issuances that may be granted upon the rights assigned, sold and transferred under this Confirmatory Assignment in the name of the Assignee, as the assignee to the entire interest therein.

The terms and conditions of this Confirmatory Assignment will inure to the benefit of Assignee, and Assignee's successors, legal representatives and assigns, and will be binding upon Assignor, and Assignor's successors, legal representatives and assigns.

By: _____
(Michael J. Holmes/*Signature MUST be attested*)

ATTESTATION

ATTESTATION OF SIGNATURE PURSUANT TO 28 U.S.C. 1746

The undersigned witnessed the signature of Michael J. Holmes to the above Confirmatory Assignment and makes the following statements:

1. I am over the age of 18 and competent to testify as to the facts in this Attestation block if called upon to do so.

2. Michael J. Holmes is personally known to me (or proved to me on the basis of satisfactory evidence) and appeared before me on August 22, 2014 to execute the above Confirmatory Assignment.

3. Michael J. Holmes subscribed to the above Confirmatory Assignment.

I declare under penalty of perjury under the laws of the United States of America that the statements made in the three (3) numbered paragraphs immediately above are true and correct.

EXECUTED on August 22, 2014 (date)

_____
Print Name: James R Duzan

Exhibit A

1. U.S. Patent No. 7,435,286, issued October 14, 2008, titled "Sorbents for the Oxidation and Removal of Mercury"

2. U.S. Patent No. 7,615,101, issued November 10, 2009, titled "High Energy Dissociation for Mercury Control Systems"

3. U.S. Patent No. 7,628,969, issued December 8, 2009, titled "Multifunctional Abatement of Air Pollutants in Flue Gas"

4. U.S. Patent No. 8,168,147, issued May 1, 2012, titled "Sorbents for the Oxidation and Removal of Mercury"

5. U.S. Patent No. 8,173,566, issued May 8, 2012, titled "Process for Regenerating a Spent Sorbent"

6. U.S. Patent No. 8,312,822, issued November 20, 2012, titled "Mercury Control Using Moderate-Temperature Dissociation of Halogen Compounds"

7. U.S. Patent No. 8,440,585, issued May 14, 2013, titled "Process for Regenerating a Spent Sorbent"

8. U.S. Patent No. 8,512,655, issued August 20, 2013, titled "Sorbents for the Oxidation and Removal of Mercury"

9. U.S. Patent No. 8,652,235, issued February 18, 2014, titled "Sorbents for the Oxidation and Removal of Mercury"

10. U.S. Patent No. 8,807,056, issued August 19, 2014, titled "Mercury Control Using Moderate-Temperature Dissociation of Halogen Compounds"

11. U.S. Patent Application Serial No. 13/544,971, filed on July 9, 2012, titled "Mercury Control Using Moderate-Temperature Dissociation of Halogen Compounds"

12. U.S. Patent Application Serial No. 13/966,768, filed on August 14, 2013, titled "Sorbents for the Oxidation and Removal of Mercury"

13. U.S. Patent Application Serial No. 14/102,896, filed on December 11, 2013, titled "Sorbents for the Oxidation and Removal of Mercury"

14. U.S. Patent Application Serial No. 14/318,270, filed on June 27, 2014, titled "Sorbents for the Oxidation and Removal of Mercury"

15. U.S. Patent Application Serial No. 14/446,992, filed on July 30, 2014, titled "Mercury Control Using Moderate-Temperature Dissociation of Halogen Compounds"

16. U.S. Provisional Patent Application Serial No. 60/605,640, filed on August 30, 2004, titled "Sorbents for the Oxidation and Removal of Mercury"

17. U.S. Provisional Patent Application Serial No. 60/464,868, filed on April 23, 2003, titled "Process for Regenerating a Spent Sorbent"

18. U.S. Provisional Patent Application Serial No. 60/947,543, filed on July 2,2007, titled "Mercury Control Using Moderate-Temperature Dissociation of Halogen Compounds"

CONFIRMATORY ASSIGNMENT

THIS CONFIRMATORY ASSIGNMENT is made by John H. Pavlish residing at 4220 4 2nd St S#2, East Grand Fork, MN ("Assignor"), to Energy and Environmental Research Center Foundation, a North Dakota nonprofit corporation having a business address of 15 N. 23rd Street, Stop 9018, Grand Forks, North Dakota, 58202-9018 ("Assignee") and is effective as of the date this Confirmatory Assignment is executed by Assignor.

WHEREAS, Assignor has invented the inventions disclosed in the patents and patent applications listed in Exhibit A attached (collectively, and including all such inventions and all patents and patent applications for such inventions that have now been, or may in the future be, filed and/or granted for such inventions, including without limitation those patents and patent applications listed in Exhibit A, "Inventions") and, for good and valuable consideration, has agreed to assign, and has assigned, all of Assignor's right, title and interest in and to the Inventions to Assignee; and

WHEREAS, Assignor desires to confirm and assure the assignment, sale and transfer to Assignee of any and all right, title, and interest Assignor has in the Inventions; and

WHEREAS, this Confirmatory Assignment confirms that all Inventions listed in Exhibit A belong exclusively to Assignee and that Assignor has assigned, sold and transferred to Assignee, and hereby further assigns, sells and transfers to Assignee, without any requirement of further consideration, the entire right, title and interest in and to the Inventions, in the United States and its territorial possessions, and in all foreign countries, including without limitation all rights to claim priority in and to any and all improvements which are disclosed in the Inventions, and that upon the request of the Assignee, Assignor will take such further actions, including without limitation execution and delivery of instruments of conveyance, as may be appropriate to give full and proper effect to such assignment.

NOW THEREFORE, in consideration of the foregoing premises, the sum of Ten Dollars ($10.00) and other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, Assignor hereby assigns, sells and transfers to Assignee Assignor's entire right, title and interest in and to the Inventions, in the United States and its territorial possessions, and in all foreign countries, including without limitation: (1) all rights to claim priority in and to the Inventions and/or any and all improvements which are disclosed in the Inventions; (2) all rights with respect to the Inventions, including all United States patents and/or other

governmental grants and/or issuances that may be granted with respect to the Inventions and/or from any direct and/or indirect divisionals, continuations, continuations-in-part and/or other patent applications claiming priority rights from the Inventions; (3) all reissues, reexaminations, extensions and/or registrations of the foregoing; (4) all non-United States patents, patent applications and/or counterparts relating to the foregoing, including without limitation certificates of invention, utility models, industrial design protection, design patent protection and other governmental grants and/or issuances, and including the right to file United States and/or foreign applications directly in the name of Assignee, its successors and assigns; (5) all causes of action and/or remedies related to the foregoing (including without limitation, the right to sue for past, present and/or future infringement, misappropriation and/or violation of rights related to any of the foregoing and the right to collect royalties and/or other payments under or on account of any of the foregoing); and, (6) any and all other rights and/or interests arising out of, in connection with and/or in relation to the foregoing.

Assignor hereby covenants that no assignment, sale, agreement or encumbrance has been or will be made or entered into which would conflict with this Confirmatory Assignment.

Assignor agrees now, and at any time and from time to time in the future, upon request of Assignee, Assignee's successors, legal representatives and/or assigns, and at Assignee's expense, to take, execute, acknowledge, and deliver all such further acts and deeds, assignments, instruments of transfer or conveyance, registrations for assignments, powers of attorney, declarations and/or assurances as may be required for the assigning, selling, transferring, assuring and confirming to Assignee, and Assignee's successors and assigns, and/or for aiding and assisting in collecting and reducing to possession, the rights assigned, sold and transferred under this Confirmatory Assignment, to participate in proceedings regarding such rights (including without limitation, any litigation and/or patent office proceedings) and/or to or perfect and/or defend title to such rights.

Assignor requests the respective patent office or governmental agency in each jurisdiction to issue any and all patents, certificates of invention, utility models and/or other governmental grants and/or issuances that may be granted upon the rights assigned, sold and transferred under this Confirmatory Assignment to the name of the Assignee, as the assignee to the entire interest therein.

The terms and conditions of this Confirmatory Assignment will inure to the benefit of Assignee, and Assignee's successors, legal representatives and assigns, and will be binding upon Assignor, and Assignor's successors, legal representatives and assigns.

By: _____
(John H. Pavlish, *Signature MUST be attested*)

ATTESTATION

ATTESTATION OF SIGNATURE PURSUANT TO 28 U.S.C. 1746

The undersigned witnessed the signature of John H. Pavlish to the above Confirmatory Assignment and makes the following statements:

1. I am over the age of 18 and competent to testify as to the facts in this Attestation block if called upon to do so.

2. John H. Pavlish is personally known to me (or proved to me on the basis of satisfactory evidence) and appeared before me on August 25, 2014 to execute the above Confirmatory Assignment.

3. John H. Pavlish subscribed to the above Confirmatory Assignment.

I declare under penalty of perjury under the laws of the United States of America that the statements made in the three (3) numbered paragraphs immediately above are true and correct.

EXECUTED on August 25, 2014 (date)

James R Duzan
Print Name: James R Duzan

Exhibit A

1. U.S. Patent No. 7,435,286, issued October 14, 2008, titled "Sorbents for the Oxidation and Removal of Mercury"

2. U.S. Patent No. 7,615,101, issued November 10, 2009, titled "High Energy Dissociation for Mercury Control Systems"

3. U.S. Patent No. 7,628,969, issued December 8, 2009, titled "Multifunctional Abatement of Air Pollutants in Flue Gas"

4. U.S. Patent No. 8,168,147, issued May 1, 2012, titled "Sorbents for the Oxidation and Removal of Mercury"

5. U.S. Patent No. 8,173,566, issued May 8, 2012, titled "Process for Regenerating a Spent Sorbent"

6. U.S. Patent No. 8,312,822, issued November 20, 2012, titled "Mercury Control Using Moderate-Temperature Dissociation of Halogen Compounds"

7. U.S. Patent No. 8,440,585, issued May 14, 2013, titled "Process for Regenerating a Spent Sorbent"

8. U.S. Patent No. 8,512,655, issued August 20, 2013, titled "Sorbents for the Oxidation and Removal of Mercury"

9. U.S. Patent No. 8,652,235, issued February 18, 2014, titled "Sorbents for the Oxidation and Removal of Mercury"

10. U.S. Patent No. 8,807,056, issued August 19, 2014, titled "Mercury Control Using Moderate-Temperature Dissociation of Halogen Compounds"

11. U.S. Patent Application Serial No. 13/453,274, filed on April 23, 2012, titled "Carbon Nanocomposite Sorbent and Methods of Using the Same for Separation of One or More Materials from a Gas Stream"

12. U.S. Patent Application Serial No. 13/544,971, filed on July 9, 2012, titled "Mercury Control Using Moderate-Temperature Dissociation of Halogen Compounds"

13. U.S. Patent Application Serial No. 13/966,768, filed on August 14, 2013, titled "Sorbents for the Oxidation and Removal of Mercury"

14. U.S. Patent Application Serial No. 14/102,896, filed on December 11, 2013, titled "Sorbents for the Oxidation and Removal of Mercury"

15. U.S. Patent Application Serial No. 14/318,270, filed on June 27, 2014, titled "Sorbents for the Oxidation and Removal of Mercury"

16. U.S. Patent Application Serial No. 14/195,360, filed on March 6, 2013, titled "Activated Carbon Sorbent Including Nitrogen and Methods of Using the Same"

17. U.S. Patent Application Serial No. 14/446,992, filed on July 30, 2014, titled "Mercury Control Using Moderate-Temperature Dissociation of Halogen Compounds"

18. U.S. Provisional Patent Application Serial No. 60/605,640, filed on August 30, 2004, titled "Sorbents for the Oxidation and Removal of Mercury"

19. U.S. Provisional Patent Application Serial No. 60/464,868, filed on April 23, 2003, titled "Process for Regenerating a Spent Sorbent"

20. U.S. Provisional Patent Application Serial No. 60/947,543, filed on July 2,2007, titled "Mercury Control Using Moderate-Temperature Dissociation of Halogen Compounds"

21. U.S. Provisional Patent Application Serial No. 61/773,549, filed on March 6, 2013, titled "Activated Carbon Sorbent Including Nitrogen and Methods of Using the Same".

CONFIRMATORY ASSIGNMENT

THIS CONFIRMATORY ASSIGNMENT is made by Edwin S. Olson residing at 2234 Valk Walk Dr, Grand Forks, ND 58201 ("Assignor"), to Energy and Environmental Research Center Foundation, a North Dakota nonprofit corporation having a business address of 15 N. 23rd Street, Stop 9018, Grand Forks, North Dakota, 58202-9018 ("Assignee") and is effective as of the date this Confirmatory Assignment is executed by Assignor.

WHEREAS, Assignor has invented the inventions disclosed in the patents and patent applications listed in Exhibit A attached (collectively, and including all such inventions and all patents and patent applications for such inventions that have now been, or may in the future be, filed and/or granted for such inventions, including without limitation those patents and patent applications listed in Exhibit A, "Inventions") and, for good and valuable consideration, has agreed to assign, and has assigned, all of Assignor's right, title and interest in and to the Inventions to Assignee; and

WHEREAS, Assignor desires to confirm and assure the assignment, sale and transfer to Assignee of any and all right, title, and interest Assignor has in the Inventions; and

WHEREAS, this Confirmatory Assignment confirms that all Inventions listed in Exhibit A belong exclusively to Assignee and that Assignor has assigned, sold and transferred to Assignee, and hereby further assigns, sells and transfers to Assignee, without any requirement of further consideration, the entire right, title and interest in and to the Inventions, in the United States and its territorial possessions, and in all foreign countries, including without limitation all rights to claim priority in and to any and all improvements which are disclosed in the Inventions, and that upon the request of the Assignee, Assignor will take such further actions, including without limitation execution and delivery of instruments of conveyance, as may be appropriate to give full and proper effect to such assignment.

NOW THEREFORE, in consideration of the foregoing premises, the sum of Ten Dollars ($10.00) and other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, Assignor hereby assigns, sells and transfers to Assignee Assignor's entire right, title and interest in and to the Inventions, in the United States and its territorial possessions, and in all foreign countries, including without limitation: (1) all rights to claim priority in and to the Inventions and/or any and all improvements which are disclosed in the Inventions; (2) all rights with respect to the Inventions, including all United States patents and/or other

governmental grants and/or issuances that may be granted with respect to the Inventions and/or from any direct and/or indirect divisionals, continuations, continuations-in-part and/or other patent applications claiming priority rights from the inventions; (3) all reissues, reexaminations, extensions and/or registrations of the foregoing; (4) all non-United States patents, patent applications and/or counterparts relating to the foregoing, including without limitation certificates of invention, utility models, industrial design protection, design patent protection and other governmental grants and/or issuances, and including the right to file United States and/or foreign applications directly in the name of Assignee, its successors and assigns; (5) all causes of action and/or remedies related to the foregoing (including without limitation, the right to sue for past, present and/or future infringement, misappropriation and/or violation of rights related to any of the foregoing and the right to collect royalties and/or other payments under or on account of any of the foregoing); and, (6) any and all other rights and/or interests arising out of, in connection with and/or in relation to the foregoing.

Assignor hereby covenants that no assignment, sale, agreement or encumbrance has been or will be made or entered into which would conflict with this Confirmatory Assignment.

Assignor agrees now, and at any time and from time to time in the future, upon request of Assignee, Assignee's successors, legal representatives and/or assigns, and at Assignee's expense, to take, execute, acknowledge, and deliver all such further acts and deeds, assignments, instruments of transfer or conveyance, registrations for assignments, powers of attorney, declarations and/or assurances as may be required for the assigning, selling, transferring, assuring and confirming to Assignee, and Assignee's successors and assigns, and/or for aiding and assisting in collecting and reducing to possession, the rights assigned, sold and transferred under this Confirmatory Assignment, to participate in proceedings regarding such rights (including without limitation, any litigation and/or patent office proceedings) and/or to or perfect and/or defend title to such rights.

Assignor requests the respective patent office or governmental agency in each jurisdiction to issue any and all patents, certificates of invention, utility models and/or other governmental grants and/or issuances that may be granted upon the rights assigned, sold and transferred under this Confirmatory Assignment in the name of the Assignee, as the assignee to the entire interest therein.

The terms and conditions of this Confirmatory Assignment will inure to the benefit of Assignee, and Assignee's successors, legal representatives and assigns, and will be binding upon Assignor, and Assignor's successors, legal representatives and assigns.

By: _____
(Edwin S. Olson, *Signature MUST be attested*)

ATTESTATION

ATTESTATION OF SIGNATURE PURSUANT TO 28 U.S.C. 1746

The undersigned witnessed the signature of Edwin S. Olson to the above Confirmatory Assignment and makes the following statements:

1. I am over the age of 18 and competent to testify as to the facts in this Attestation block if called upon to do so.

2. Edwin S. Olson is personally known to me (or proved to me on the basis of satisfactory evidence) and appeared before me on August 25, 2014 to execute the above Confirmatory Assignment.

3. Edwin S. Olson subscribed to the above Confirmatory Assignment.

I declare under penalty of perjury under the laws of the United States of America that the statements made in the three (3) numbered paragraphs immediately above are true and correct.

EXECUTED on August 25, 2014 (date)

_____
Print Name: _____

iii.

Exhibit A

1. U.S. Patent No. 7,435,286, issued October 14, 2008, titled "Sorbents for the Oxidation and Removal of Mercury"

2. U.S. Patent No. 7,615,101, issued November 10, 2009, titled "High Energy Dissociation for Mercury Control Systems"

3. U.S. Patent No. 7,628,960, issued December 8, 2009, titled "Multifunctional Abatement of Air Pollutants in Flue Gas"

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6. U.S. Patent No. 8,312,822, issued November 20, 2012, titled "Mercury Control Using Moderate-Temperature Dissociation of Halogen Compounds"

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8. U.S. Patent No. 8,512,655, issued August 20, 2013, titled "Sorbents for the Oxidation and Removal of Mercury"

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11. U.S. Patent Application Serial No. 13/453,274, filed on April 23, 2012, titled "Carbon Nanocomposite Sorbent and Methods of Using the Same for Separation of One or More Materials from a Gas Stream"

12. U.S. Patent Application Serial No. 13/544,971, filed on July 9, 2012, titled "Mercury Control Using Moderate-Temperature Dissociation of Halogen Compounds"

13. U.S. Patent Application Serial No. 13/966,768, filed on August 14, 2013, titled "Sorbents for the Oxidation and Removal of Mercury"

14. U.S. Patent Application Serial No. 14/102,896, filed on December 11, 2013, titled "Sorbents for the Oxidation and Removal of Mercury"

15. U.S. Patent Application Serial No. 14/318,270, filed on June 27, 2014, titled "Sorbents for the Oxidation and Removal of Mercury"

16. U.S. Patent Application Serial No. 14/195,360, filed on March 6, 2013, titled "Activated Carbon Sorbent Including Nitrogen and Methods of Using the Same"

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18. U.S. Provisional Patent Application Serial No. 60/605,640, filed on August 30, 2004, titled "Sorbents for the Oxidation and Removal of Mercury"

19. U.S. Provisional Patent Application Serial No. 60/464,868, filed on April 23, 2003, titled "Process for Regenerating a Spent Sorbent"

20. U.S. Provisional Patent Application Serial No. 60/947,543, filed on July 2,2007, titled "Mercury Control Using Moderate-Temperature Dissociation of Halogen Compounds"

21. U.S. Provisional Patent Application Serial No. 61/773,549, filed on March 6, 2013, titled "Activated Carbon Sorbent Including Nitrogen and Methods of Using the Same"

REQUEST FOR CONTINUED EXAMINATION (RCE) TRANSMITTAL		
	Application Number	15/978,760
	Filing Date	May 14, 2018
	First Named Inventor	Edwin S. Olson
	Confirmation Number	6432
	Group Art Unit	1776
	Examiner Name	Amber Orlando
	Attorney Docket Number	4820.007US4
	Customer No.	21186

This is a Request for Continued Examination (RCE) under 37 C.F.R § 1.114 of the above-identified application entitled
SORBENTS FOR THE OXIDATION AND REMOVAL OF MERCURY

1. Submission required under 37 C.F.R. § 1.114:

   X Amendment and Response Under 37 C.F.R § 1.116 (89 pages) is enclosed.

   X Information Disclosure Statement (2 pages), Form 1449 (2 pages), and copies of cited documents (18).

   X DECLARATION UNDER 37 C.F.R. § 1.132 (A) (11 pgs), (B) (12 pgs), (C) (16 pgs), and (D) (6 pgs)

   X Power of Attorney (1 pg), Statement Under 37 CFR 3.73(c) (2 pgs), and Copy of Assignment (15 pgs)

   X Certification and Request for Prioritized Examination Under 37 CFR 1.102(e) (1 pg)

2. Fees

   X Authorization to charge deposit account 19-0743 in the amount of $1300.00 to pay the RCE filing fee required under 37 C.F.R. § 1.17(e).

   X Authorization to charge deposit account 19-0743 in the amount of $1460.00 to cover the fee for additional claims.

The fee for additional claims has been calculated as follows:

CLAIMS AS AMENDED						
	Claims Remaining After Amendment		**Highest Number Previously Paid For**	**Present Extra**	Rate	**Fee**
TOTAL CLAIMS	30	-	20	10	x 100.00 =	1000.00
INDEPENDENT CLAIMS	4	-	3	1	x 460.00 =	460.00
[] MULTIPLE DEPENDENT CLAIMS PRESENTED						0.00
TOTAL						1460.00

The Commissioner is hereby authorized to charge any additional fees or credit overpayment to Deposit Account No. 19-0743.

SCHWEGMAN LUNDBERG & WOESSNER, P.A.

By: /Nicholas P. Lanzatella/
Nicholas P. Lanzatella
Reg. No. 63,803

Electronic Patent Application Fee Transmittal

Application Number:	15978760
Filing Date:	14-May-2018
Title of Invention:	SORBENTS FOR THE OXIDATION AND REMOVAL OF MERCURY
First Named Inventor/Applicant Name:	Edwin S. Olson
Filer:	Janal M. Kalis/Megan Reed
Attorney Docket Number:	4820.007US4

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
CLAIMS IN EXCESS OF 20	1202	10	100	1000
INDEPENDENT CLAIMS IN EXCESS OF 3	1201	1	460	460
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
RCE- 1ST REQUEST	1801	1	1300	1300
		Total in USD ($)		**2760**

Electronic Acknowledgement Receipt	
EFS ID:	35481043
Application Number:	15978760
International Application Number:	
Confirmation Number:	6432
Title of Invention:	SORBENTS FOR THE OXIDATION AND REMOVAL OF MERCURY
First Named Inventor/Applicant Name:	Edwin S. Olson
Customer Number:	21186
Filer:	Janal M. Kalis/Megan Reed
Filer Authorized By:	Janal M. Kalis
Attorney Docket Number:	4820.007US4
Receipt Date:	20-MAR-2019
Filing Date:	14-MAY-2018
Time Stamp:	15:40:40
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$2760
RAM confirmation Number	032119INTEFSW00002288190743
Deposit Account	190743
Authorized User	Megan Reed
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.16 (National application filing, search, and examination fees) 37 CFR 1.17 (Patent application and reexamination processing fees)	

37 CFR 1.19 (Document supply fees)

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		_SIGNED_4820_007US4_RCE_Resp.pdf	14682568 11ac7700e05bc44d9dd6f4058a21284d5832e991	yes	158

Multipart Description/PDF files in .zip description

Document Description	Start	End
TrackOne Request	158	158
Assignee showing of ownership per 37 CFR 3.73	141	157
Power of Attorney	140	140
Affidavit-traversing rejectns or objectns rule 132	134	139
Affidavit-traversing rejectns or objectns rule 132	118	133
Affidavit-traversing rejectns or objectns rule 132	106	117
Affidavit-traversing rejectns or objectns rule 132	95	105
Information Disclosure Statement (IDS) Form (SB08)	93	94
Transmittal Letter	91	92
Applicant Arguments/Remarks Made in an Amendment	10	90
Claims	3	9
Amendment Submitted/Entered with Filing of CPA/RCE	2	2
Request for Continued Examination (RCE)	1	1

Warnings:

Information:

2	Non Patent Literature	0001_2_npl_15382114_aarn_31219_f.pdf	203950 062a02384d07adf943ba14294c4c4d22e6bef18b	no	24
Warnings:					
Information:					
3	Non Patent Literature	0002_2_npl_4820003us2_foar_03012019_f.pdf	438392 afc489830dbea877f6c29afb6924f4c47c7ee55	no	10
Warnings:					
Information:					
4	Non Patent Literature	0003_2_npl_benson_mercury_trol_tech_2005_f.pdf	2551334 8fd9045757afdc97878698cb938177b2ac17fb7f	no	97
Warnings:					
Information:					
5	Non Patent Literature	0004_2_npl_benson_subbituminous_coals_2005_f.pdf	4821773 64b13531f14c3b4e11c0d8ff7a3d8ec1cbe0d25b	no	165
Warnings:					
The page size in the PDF is too large. The pages should be 8.5 x 11 or A4. If this PDF is submitted, the pages will be resized upon entry into the Image File Wrapper and may affect subsequent processing					
Information:					
6	Non Patent Literature	0005_2_npl_berry_mercury_trol_2007_f.pdf	195610 cb8e6dd2fcaab471b30aa5a6bb23926a2f1f8651	no	9
Warnings:					
Information:					
7	Non Patent Literature	0006_2_npl_brown_mercury_measurement_2011_f.pdf	1949189 53723bc2e3203fb4a0573e45cfaa3829c4f20411	no	98
Warnings:					
Information:					
8	Non Patent Literature	0007_2_npl_coalcombustionproducts_elsevier_2017_f.pdf	9826297 b34c1108bbaecea0b7d7e9344c24ad4aa1e4def4	no	565
Warnings:					
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Image File Wrapper and may affect subsequent processing					
Information:					
9	Non Patent Literature	0008_2_npl_doe_seas_for_mercury_trol_2008_f.pdf	178022 3f355a9fd9e5166e7097a55d92962f84530897da	no	4
Warnings:					
Information:					
10	Non Patent Literature	0009_2_npl_epa_mercury_emissions_update_2005_f.pdf	599904 ad34bde3c7430bc3f8d071849d0efcf1436fd987	no	59
Warnings:					
Information:					
11	Non Patent Literature	0010_2_npl_feeley_doe_netl_mercury_2003_f.pdf	476773 32ce83fec8112183656d82a66ba543ae4b00ae06	no	32
Warnings:					
Information:					
12	Non Patent Literature	0011_2_npl_french_epa_utility_report_1998_f.pdf	4362131 80537cdcc83bb3ea70b44cccd5e61aeca4bad774	no	502
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13	Non Patent Literature	0012_2_npl_ghorishi_inflight_2001_f.pdf	189025 5a3eefbb9e780b9a0e8aa985e5b573520de6561c	no	14
Warnings:					
Information:					
14	Non Patent Literature	0013_2_npl_jones_doe_netl_phase2_hg_2007_f.pdf	220901 98972a16be0e1a0de1e30154f383df6d01e63693	no	7
Warnings:					
Information:					
15	Non Patent Literature	0014_2_npl_keating_epa_mercury_study_1997_f.pdf	943771 c5491a9f37b1746e0b4fb68dca646e60e28728f4	no	95

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Information:					
16	Non Patent Literature	0015_2_npl_kilgroe_epa_mercury_interim_report_2002_f.pdf	6484898 715cdf5bec2158a4706dc2d2e60443032cc7b486	no	485
Warnings:					
The page size in the PDF is too large. The pages should be 8.5 x 11 or A4. If this PDF is submitted, the pages will be resized upon entry into the Image File Wrapper and may affect subsequent processing					
Information:					
17	Non Patent Literature	0016_2_npl_nelson_china_emissions_2010_f.pdf	2799675 ba38c17eb4872e259e17fbc0d350c7d37cbc5d3d	no	24
Warnings:					
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Information:					
18	Non Patent Literature	0017_2_npl_pavlish_status_review_2003_f.pdf	907898 c7ac20e3f232959db071704dee4190e24d51a3f7	no	77
Warnings:					
The page size in the PDF is too large. The pages should be 8.5 x 11 or A4. If this PDF is submitted, the pages will be resized upon entry into the Image File Wrapper and may affect subsequent processing					
Information:					
19	Non Patent Literature	0018_2_npl_yang_hbr_hg_oxidation_2016_f.pdf	625917 1fde62883774b0b62b472fef194f805bc7eace56	no	7
Warnings:					
Information:					
20	Fee Worksheet (SB06)	fee-info.pdf	33704 dadbd2c423ca5f335388ddbb32ef21e8d0f2a5fc	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	52491732		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Document code: WFEE

United States Patent and Trademark Office
Sales Receipt for Accounting Date: 03/22/2019

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01	FC : 1817	4,000.00	DA
02	FC : 1830	140.00	DA

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 15/978,760	Filing Date 05/14/2018	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

	(Column 1)	(Column 2)			
FOR	NUMBER FILED	NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $460 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	03/20/2019	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 30	Minus	** 20	= 10		x $100 =	1000
	Independent (37 CFR 1.16(h))	* 4	Minus	*** 3	= 1		x $460 =	460
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	1460

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/ANITA JOHNSON/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Modified form PTO/SB/08A(04-07) OMB 651-0031
US Patent & Trademark Office: U.S. DEPARTMENT OF COMMERCE
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Substitute for form 1449A/PTO **INFORMATION DISCLOSURE STATEMENT BY APPLICANT** (Use as many sheets as necessary)	*Complete if Known*	
	Application Number	15/978,760
	Filing Date	May 14, 2018
	First Named Inventor	Edwin S. Olson
	Group Art Unit	1776
	Examiner Name	Amber Orlando
Sheet 1 of 1	Attorney Docket No: 4820.007US4	

US PATENT DOCUMENTS

Examiner Initial *	USP Document Number	Publication Date	Name of Patentee or Applicant of cited Document
	US-20190009247A1	1/10/2019	Olson, Edwin S, et al.

FOREIGN PATENT DOCUMENTS

Examiner Initial *	Foreign Document Number	Publication Date	Name of Patentee or Applicant of cited Document	T 1

OTHER DOCUMENTS – NON PATENT LITERATURE DOCUMENTS

Examiner Initial *	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T 1
	"Application Serial No. 14/712,558, Amendment and Response filed 12-03-18 to Non Final Office Action mailed 10-19-18", 28 pgs	
	"Application Serial No. 14/712,558, Final Office Action mailed 01-11-19", 27 pgs	
	"Application Serial No. 15/382,114, Non Final Office Action mailed 12-12-18", 46 pgs	
	"Application Serial No. 15/589,359, Amendment and Response filed 01-17-19 to Non Final Office Action mailed 10-22-18", 14 pgs	
	"Application Serial No. 15/974,343, Amendment and Response filed 12-03-18 to Non Final Office Action mailed 10-29-18", 37 pgs	
	"Application Serial No. 15/974,343, Final Office Action mailed 01-14-19", 25 pgs	
	"Application Serial No. 15/997,091, Final Office Action mailed 01-11-19", 20 pgs	
	"Application Serial No. 15/997,091, Response filed 12-03-18 Non Final Office Action mailed 11-02-18", 40 pgs	

EXAMINER **DATE CONSIDERED**

* EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. 1 Applicant is to place a check mark here if English language Translation is attached

Electronic Patent Application Fee Transmittal

Application Number:	15978760
Filing Date:	14-May-2018
Title of Invention:	SORBENTS FOR THE OXIDATION AND REMOVAL OF MERCURY
First Named Inventor/Applicant Name:	Edwin S. Olson
Filer:	David L. Buck/ Jamie Johnson
Attorney Docket Number:	4820.007US4

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
SUBMISSION- INFORMATION DISCLOSURE STMT	1806	1	240	240
		Total in USD ($)		**240**

Electronic Acknowledgement Receipt	
EFS ID:	35258431
Application Number:	15978760
International Application Number:	
Confirmation Number:	6432
Title of Invention:	SORBENTS FOR THE OXIDATION AND REMOVAL OF MERCURY
First Named Inventor/Applicant Name:	Edwin S. Olson
Customer Number:	21186
Filer:	David L. Buck/Jamie Johnson
Filer Authorized By:	David L. Buck
Attorney Docket Number:	4820.007US4
Receipt Date:	26-FEB-2019
Filing Date:	14-MAY-2018
Time Stamp:	16:54:08
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$240
RAM confirmation Number	022719INTEFSW00004077190743
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		15978760_SIDS_02-26-2019.pdf	292660 9855231eefe4d9afb3f574e4e30615d038480d10	yes	8
	Multipart Description/PDF files in .zip description				
	Document Description		**Start**	**End**	
	Miscellaneous Incoming Letter		1	1	
	Miscellaneous Incoming Letter		2	2	
	Transmittal Letter		3	4	
	Information Disclosure Statement (IDS) Form (SB08)		5	5	
	Transmittal Letter		6	7	
	Information Disclosure Statement (IDS) Form (SB08)		8	8	
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Information:					
2	Non Patent Literature	0001_2_npl_4820001u10_foar_01112019_f.pdf	891808 6ba80c712a7452b16b3f246717479bd8f0a1d443	no	20
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4	Non Patent Literature	0003_2_npl_4820001us7_aarn_120318_f.pdf	645370 4b6d7a942ae0897c15729f380b130074cd567f03	no	28

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5	Non Patent Literature	0004_2_npl_4820001us7_foar_01112019_f.pdf	1277410 7245c7f23fe880d8b4bd15b074dade2ff580150a	no	27
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6	Non Patent Literature	0005_2_npl_4820001us9_foar_01142019_f.pdf	1164983 55992c8bd625dbd9c2066b62330af4b8c211bdef	no	25
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Information:					
7	Non Patent Literature	0006_2_npl_4820003ca1_oarmisc_02182019_f.pdf	557901 f71ed0936bba9662fc42eb40f897a980f3852d51	no	6
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Information:					
8	Non Patent Literature	0007_2_npl_4820003us2_aarn_011719_f.pdf	177621 7dce4a72bf514b7875612ee25989d8410c78a6cb	no	14
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Information:					
9	Non Patent Literature	0008_2_npl_4820004us1_oarn_12122018_f.pdf	1799080 16da58cb37ab75b961952e1f4865dfc0e4035c36	no	46
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Information:					
10	Non Patent Literature	0009_2_npl_4820_001us9_aarn_120318_f.pdf	950258 375f14e1c530af4613f51fb0f58350ddf8c2a6ef	no	37
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Information:					
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Warnings:					
Information:					

Total Files Size (in bytes):	8703492

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s): Edwin S. Olson et al.
Title: SORBENTS FOR THE OXIDATION AND REMOVAL OF MERCURY

Docket No.:	4820.007US4	Serial No.:	15/978,760
Filed:	May 14, 2018	Due Date:	N/A
Examiner:	Amber Orlando	Group Art Unit:	1776
Customer No.:	21186	Confirmation No.:	6432

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

We are transmitting herewith the following attached items (as indicated with an "X"):

X Communication Concerning Prior and Copending Applications (1 pg.)
X Supplemental Information Disclosure Statement **Pursuant to 37 C.F.R. § 1.97(d)(1) and 37 C.F.R. § 1.97(e)(1)** (2 pgs.), Form 1449 (1 pg.) Copies of Cited References (1).
X Authorization to charge Deposit Account 19-0743 in the amount of $240.00 to cover the fee for consideration of Information Disclosure Statement under 37 C.F.R. § 1.97(c).
X Supplemental Information Disclosure Statement **Pursuant to 37 C.F.R. § 1.97(d)(1) and 37 C.F.R. § 1.97(e)(2)** (2 pgs.), Form 1449 (1 pg.) Copies of Cited References (8).

If not provided for in a separate paper filed herewith, please consider this a PETITION FOR EXTENSION OF TIME for sufficient number of months to enter these papers and please charge any additional fees or credit overpayment to Deposit Account No. 19-0743. If applicable, any papers or fees supplied herewith are considered to be timely filed pursuant to 37 C.F.R. § 1.7(a), the response period falling on a Federal Holiday, Saturday or Sunday being extended to the next succeeding business day.

SCHWEGMAN LUNDBERG & WOESSNER, P.A.
Customer No.: 21186

By 
Nicholas P. Lanzatella
Reg. No. 63,803

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s):	Edwin S. Olson et al.	Examiner:	Amber Orlando
Serial No.:	15/978,760	Group Art Unit:	1776
Filed:	May 14, 2018	Docket:	4820.007US4
Customer No.:	21186	Confirmation No.:	6432
Title:	SORBENTS FOR THE OXIDATION AND REMOVAL OF MERCURY		

COMMUNICATION CONCERNING PRIOR OR COPENDING APPLICATION(S)

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Pursuant to the guidance of MPEP §§ 2001.06(b) and 2004(9), Applicant would like to bring the following additional application(s) to the Examiner's attention. The identification of these applications is not intended to suggest that the subject matter claimed in any listed application is, or has been, substantially similar to any claim or claims in the present application.

Serial No./ Patent No.	Filing Date	Attorney Docket	Title
16/130,670	September 13, 2018	4820.005US2	SORBENT COMPRISING CARBON AND NITROGEN AND METHODS OF USING THE SAME

Respectfully submitted,

SCHWEGMAN LUNDBERG & WOESSNER, P.A.
P.O. Box 2938
Minneapolis, MN 55402
(612) 349-9580

Date 02/26/2019 By /Nicholas P. Lanzatella/

Nicholas P. Lanzatella
Reg. No. 63,803

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s):	Edwin S. Olson et al.	Examiner:	Amber Orlando
Serial No.:	15/978,760	Group Art Unit:	1776
Filed:	May 14, 2018	Docket:	4820.007US4
Customer No.:	21186	Confirmation No.:	6432
Title:	SORBENTS FOR THE OXIDATION AND REMOVAL OF MERCURY		

SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT UNDER 37 C.F.R §1.97(e)(1)

MS Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

In compliance with the duty imposed by 37 C.F.R. § 1.56, and in accordance with 37 C.F.R. §§ 1.97 *et. seq.*, the enclosed materials are brought to the attention of the Examiner for consideration in connection with the above-identified patent application. Applicant respectfully requests that this Information Disclosure Statement be entered and the documents listed on the attached PTO 1449 Form be considered by the Examiner and made of record. Pursuant to the provisions of MPEP 609, Applicant requests that a copy of the PTO 1449 Form, initialed as being considered by the Examiner, be returned to the Applicant with the next official communication.

Pursuant to 37 C.F.R. § 1.97(d)(1) and 37 C.F.R. § 1.97(e)(1), Applicant states that each item of information contained in the Information Disclosure Statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the Information Disclosure Statement.

Pursuant to 37 C.F.R. § 1.97(d)(2), Applicant hereby authorizes the Commissioner to charge the fee of $240.00 as set forth in 37 C.F.R. § 1.17(p), to Deposit Account No. 19-0743. Please charge any additional fees or deficiencies, or credit any overpayment to Deposit Account No. 19-0743.

Pursuant to 37 C.F.R. § 1.98(a)(2), copies of cited U.S. Patents and Published Applications, and Non-Published Applications identifiable by USPTO Serial Number, are no longer required to be provided to the Office. Applicant acknowledges the requirement to submit copies of foreign patent documents and non-patent literature in accordance with 37 C.F.R §

1.98(a)(2).

The Examiner is invited to contact the undersigned at the telephone number indicated if there are any questions regarding this communication.

Respectfully submitted,

SCHWEGMAN LUNDBERG & WOESSNER, P.A.
P.O. Box 2938
Minneapolis, MN 55402
(612) 349-9580

Date 02/26/2019 By /Nicholas P. Lanzatella/
Nicholas P. Lanzatella
Reg. No. 63,803

NPL:jj

Modified form PTO/SB/08A(04-07) OMB 651-0031
US Patent & Trademark Office: U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995 no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Substitute for form 1449A/PTO **INFORMATION DISCLOSURE STATEMENT BY APPLICANT** (Use as many sheets as necessary)	*Complete if Known*	
	Application Number	15/978,760
	Filing Date	May 14, 2018
	First Named Inventor	Edwin S. Olson
	Group Art Unit	1776
	Examiner Name	Amber Orlando
Sheet 1 of 1	Attorney Docket No: 4820.007US4	

US PATENT DOCUMENTS			
Examiner Initial *	**USP Document Number**	**Publication Date**	**Name of Patentee or Applicant of cited Document**

FOREIGN PATENT DOCUMENTS				
Examiner Initial *	**Foreign Document Number**	**Publication Date**	**Name of Patentee or Applicant of cited Document**	**T 1**

OTHER DOCUMENTS – NON PATENT LITERATURE DOCUMENTS		
Examiner Initial *	**Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.**	**T 1**
	"Canadian Application Serial No. 2,904,039, Office Action mailed 02-18-19", 6 pgs	

EXAMINER **DATE CONSIDERED**

* EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. 1 Applicant is to place a check mark here if English language Translation is attached

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s):	Edwin S. Olson et al.	Examiner:	Amber Orlando
Serial No.:	15/978,760	Group Art Unit:	1776
Filed:	May 14, 2018	Docket:	4820.007US4
Customer No.:	21186	Confirmation No.:	6432
Title:	SORBENTS FOR THE OXIDATION AND REMOVAL OF MERCURY		

SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT UNDER 37 C.F.R §1.97(e)(2)

MS Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

In compliance with the duty imposed by 37 C.F.R. § 1.56, and in accordance with 37 C.F.R. §§ 1.97 *et. seq.*, the enclosed materials are brought to the attention of the Examiner for consideration in connection with the above-identified patent application. Applicant respectfully requests that this Information Disclosure Statement be entered and the documents listed on the attached PTO 1449 Form be considered by the Examiner and made of record. Pursuant to the provisions of MPEP 609, Applicant requests that a copy of the PTO 1449 Form, initialed as being considered by the Examiner, be returned to the Applicant with the next official communication.

Pursuant to 37 C.F.R. § 1.97(d)(1) and 37 C.F.R. § 1.97(e)(2), Applicant states that no item of information contained in the Supplemental Information Disclosure Statement was cited in any communication from a foreign patent office in a counterpart foreign application and that no item of information contained in the Supplemental Information Disclosure Statement was known to any individual designated in § 1.56(c) more than three months prior to the filing of the information disclosure statement.

Pursuant to 37 C.F.R. § 1.98(a)(2), copies of cited U.S. Patents and Published Applications, and Non-Published Applications identifiable by USPTO Serial Number, are no longer required to be provided to the Office. Applicant acknowledges the requirement to submit copies of foreign patent documents and non-patent literature in accordance with 37 C.F.R § 1.98(a)(2).

The Examiner is invited to contact the undersigned at the telephone number indicated if there are any questions regarding this communication.

Respectfully submitted,

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Date 02/26/2019 By /Nicholas P. Lanzatella/
Nicholas P. Lanzatella
NPL:jj Reg. No. 63,803

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/978,760	05/14/2018	Edwin S. Olson	4820.007US4	6432

21186 7590 12/26/2018

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EXAMINER
ORLANDO, AMBER ROSE

ART UNIT	PAPER NUMBER
1776	

NOTIFICATION DATE	DELIVERY MODE
12/26/2018	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

SLW@blackhillsip.com
uspto@slwip.com

PTOL-90A (Rev. 04/07)

Office Action Summary	**Application No.** 15/978,760	**Applicant(s)** Olson et al.	
	Examiner AMBER R ORLANDO	**Art Unit** 1776	**AIA Status** No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 12/03/2018.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☑ This action is **FINAL.** 2b) ☐ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 2-19 and 22 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) ____ is/are allowed.

7) ☑ Claim(s) 2-19 and 22 is/are rejected.

8) ☐ Claim(s) ____ is/are objected to.

9) ☐ Claim(s) ____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. ____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date ____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: ____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

The present application is being examined under the pre-AIA first to invent provisions.

Claim Rejections - 35 USC § 103

In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the statutory basis for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

The following is a quotation of pre-AIA 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under pre-AIA 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.

2. Ascertaining the differences between the prior art and the claims at issue.

3. Resolving the level of ordinary skill in the pertinent art.

4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under pre-AIA 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the