

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CELANESE INTERNATIONAL CORPORATION,
Petitioner,

v.

DAICEL CORPORATION,
Patent Owner.

Case IPR2017-00165
Patent 9,073,843 B2

Before SHERIDAN K. SNEDDEN, ZHENYU YANG, and
TINA E. HULSE, *Administrative Patent Judges*.

SNEDDEN, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
35 U.S.C. § 318(a); 37 C.F.R. § 42.73

I. INTRODUCTION

This is a Final Written Decision in an *inter partes* review challenging the patentability of claims 1–13 of U.S. Patent No. 9,073,843 B2 (Ex. 1001, “the ’843 patent”). We have jurisdiction under 35 U.S.C. § 6. We conclude for the reasons that follow that Petitioner has shown by a preponderance of the evidence that claims 1–13 of the ’843 patent are unpatentable.

A. Procedural History

Celanese International Corporation (“Petitioner”) filed a Petition to institute an *inter partes* review of claims 1–13 (Paper 1, “Pet.”) of the ’843 patent. Daicel Corporation (“Patent Owner”) filed a Patent Owner Preliminary response. Paper 6. Based on these submissions, we instituted trial on the following grounds of unpatentability asserted by Petitioner:

Ground	Reference[s]	Basis	Challenged Claims
1	Patt ¹	§ 102	1–4, 6–10, 12
2 ²	Patt	§ 103	5
3	Patt and Gambale ³	§ 103	11, 13

¹ Jeremy J. Patt, U.S. Patent Publication No. 2009/0270650 A1, published Oct. 29, 2009 (Ex. 1003, “Patt”).

² Because we determine that claims 11 and 13 would have been obvious in view of the combination of Patt and Gambale, we do not reach Petitioner’s alternative ground that claims 11 and 13 would have been obvious over Patt alone.

³ Dean Gambale, “*Choosing Specialty Metals for Corrosion-Sensitive Equipment*,” AMER. INST. CHEM. ENG’G, 62–66 (2010) (Ex. 1004, “Gambale”).

Decision to Institute (Paper 7, “Dec.”). Patent Owner filed a Request for Rehearing asking that we reconsider our decision to institute *inter partes* review on the ground that challenged claims 1–4, 6–10, and 12 are anticipated by Patt (Paper 10). Petitioner filed a Response to Patent Owner’s Request for Rehearing (Paper 15). Based on these submissions, we denied Patent Owner’s Request for Rehearing (Paper 19).

After institution of trial, Patent Owner filed a Patent Owner Response (Paper 22, “PO Resp.”), to which Petitioner filed a Reply (Paper 32, “Reply”). Pursuant to our authorization (Paper 35), Patent Owner filed a Sur-Reply to Petitioner’s Reply to Patent Owner’s Response (Paper 36, “Sur-Reply”).

Petitioner relies on the Declarations of Dr. Ronnie Michael Hanes (Ex. 1002; Ex. 1059).

Patent Owner relies on the Declarations of Dr. Vijay S. Bhise, Eng. Sc.D. (Ex. 2001; Ex. 2028), David Hendrix, P.E. (Ex. 2003), and David A. Rockstraw, Ph.D., P.E. (Ex. 2029).

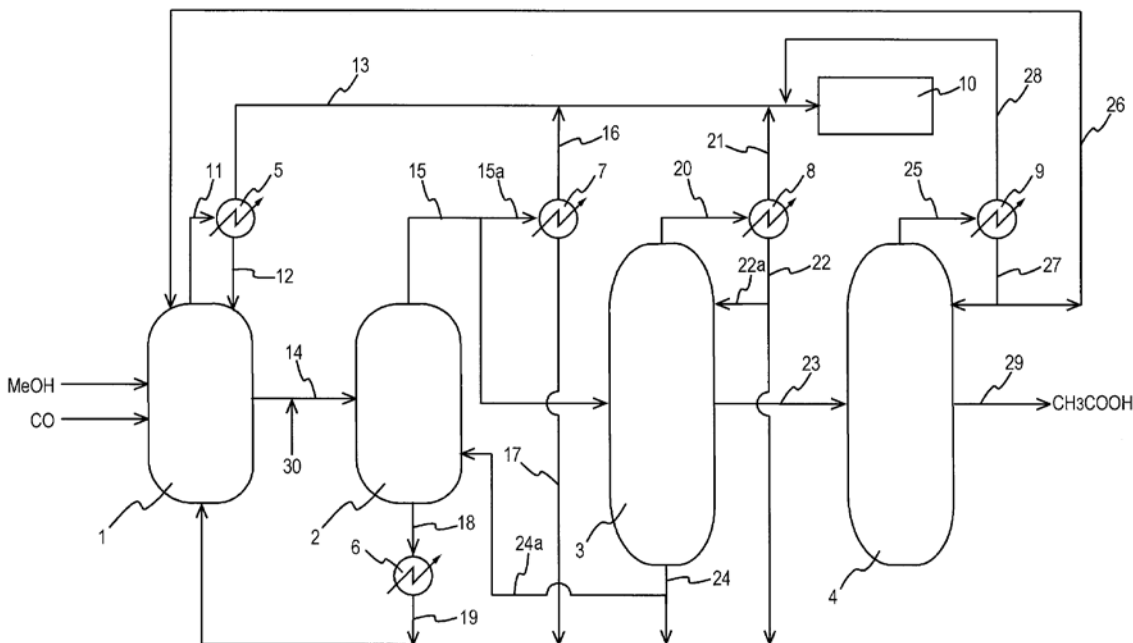
Petitioner filed a motion to exclude certain of Patent Owner’s evidence. Paper 41. Patent Owner filed an opposition (Paper 43), and Petitioner filed a reply (Paper 44).

Oral argument was conducted on January 23, 2018. A transcript is entered as Paper 49 (“Tr.”).

B. The ’843 patent (Ex. 1001)

The ’843 patent “relates to a process for producing acetic acid while efficiently inhibiting an increase in concentration of hydrogen iodide in a flash evaporator (flasher) for distilling a reaction mixture from a reactor.” Ex. 1001, 1:5–8. Figure 1, shown below, provides a diagram of an

embodiment for a continuous production process of acetic acid disclosed in the '843 patent. *Id.* at 5:27–31.



The process comprises a reactor **1**, for carbonylation reaction of methanol, and a flasher (flash evaporator) **2**, for separating a liquid reaction mixture, which is introduced from the reactor **1** through a feed line **14**. The liquid reaction mixture is separated into a volatile component (acetic acid stream or lower boiling point fraction) and a low-volatile component (higher boiling point fraction). The volatile component contains acetic acid, methyl acetate, and methyl iodide, and a liquid catalyst mixture. The low-volatile component contains the catalyst component (e.g., a rhodium catalyst and lithium iodide). *Id.* at 5:36–64.

The volatile component (acetic acid stream) is introduced into the first distillation column (splitter column) **3** through a feed line **15** as an overhead from a column top. The first distillation column (splitter column) **3** separates a lower boiling point component (containing methyl iodide, methyl acetate, and

acetaldehyde) out of the volatile component from a higher boiling point fraction (containing, e.g., water and propionic acid). The lower boiling point component is introduced to a second distillation column **4** through a feed line **23** by side cut, which the lower boiling point component is further separated from a higher boiling point fraction. *Id.*

C. Illustrative Claims

Petitioner challenges claims 1–13 of the '843 patent. Independent claims 1 and 12 are illustrative of the challenged claims and are reproduced below:

1. A process for producing acetic acid, which comprises
 - a reaction step for continuously allowing methanol to react with carbon monoxide in the presence of a catalyst system comprising a metal catalyst, an ionic iodide, and methyl iodide in a carbonylation reactor,
 - a flash evaporation step for continuously feeding a flasher with a reaction mixture from the reactor and evaporating a volatile component at least containing product acetic acid, methyl acetate, and methyl iodide by flash evaporation to separate the volatile component and a liquid catalyst mixture at least containing the metal catalyst and the ionic iodide,
 - a recycling step for recycling the liquid catalyst mixture to the reactor, and
 - an acetic acid collection step comprising distilling and separating the volatile component into a lower boiling point fraction as a first overhead, a side stream containing acetic acid, and a higher boiling point fraction and distilling and separating the side stream into a lower boiling point component as a second overhead, and an acetic acid stream as a side or bottom stream for separating a stream containing acetic acid from the volatile component to collect acetic acid,
 - wherein the metal catalyst comprises a rhodium catalyst, and
 - in the flash evaporation step, the flash evaporation is conducted at a temperature of about 100 to 260° C. under an absolute pressure of about 0.03 to 1 MPa while maintaining the

concentration of methyl acetate of about 0.6 to 15% by weight and the concentration of water of about 0.8 to 8% by weight in the liquid catalyst mixture.

12. A method for inhibiting production of hydrogen iodide or increased concentration of hydrogen iodide in a flasher in a production process of acetic acid, the production process comprising

a reaction step for continuously allowing methanol to react with carbon monoxide in the presence of a catalyst system comprising a metal catalyst, an ionic iodide, and methyl iodide in a carbonylation reactor,

a flash evaporation step for continuously feeding a flasher with a reaction mixture from the reactor and evaporating a volatile component at least containing product acetic acid, methyl acetate, and methyl iodide by flash evaporation to separate the volatile component and a liquid catalyst mixture at least containing the metal catalyst and the ionic iodide,

a recycling step for recycling the liquid catalyst mixture to the reactor, and

an acetic acid collection step comprising distilling and separating the volatile component into a lower boiling point fraction as a first overhead, a side stream containing acetic acid, and a higher boiling point fraction and distilling and separating the side stream into a lower boiling point component as a second overhead, and an acetic acid stream as a side or bottom stream for separating a stream containing acetic acid from the volatile component to collect acetic acid, wherein the metal catalyst comprises a rhodium catalyst, and

in the flash evaporation step, the flash evaporation is conducted at a temperature of about 100 to 260° C. under an absolute pressure of about 0.03 to 1 MPa while maintaining the concentration of methyl acetate of about 0.6 to 15% by weight and the concentration of water of about 0.8 to 8% by weight in the liquid catalyst mixture.

Claims 2–11 depend from claim 1, either directly or indirectly.

Claim 13 depends directly from claim 12.

II. DISCUSSION

A. Claim Interpretation

We interpret claims using the “broadest reasonable construction in light of the specification of the patent in which [they] appear[.]” 37 C.F.R. § 42.100(b); *Cuozzo Speed Techs. LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016). Under the broadest reasonable construction standard, claim terms are generally given their “ordinary and customary meaning,” as would be understood by one of ordinary skill in the art at the time of the invention. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007) (quoting *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312 (Fed. Cir. 2005)). We note that only those claim terms that are in controversy need to be construed, and “only to the extent necessary to resolve the controversy.” *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co. Ltd.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)).

Based on our review of the record, we provide the following discussion with regard to the interpretation of certain claim elements. We determine that no other claim terms require an express interpretation to resolve the issues presented by the Petitioner’s patentability challenges.

1. Preambles of claims 1 and 12

If the body of the claim sets out the complete invention, and the preamble is not necessary to give “life, meaning, and vitality” to the claim, “then the preamble is of no significance to claim construction because it cannot be said to constitute or explain a claim limitation.” *Pitney Bowes, Inc. v. Hewlett-Packard Co.*, 182 F.3d 1298, 1305 (Fed. Cir. 1999). The preamble of claim 1 recites “a process for producing acetic acid” and the

preamble of claim 12 recites “[a] method for inhibiting production of hydrogen iodide or increased concentration of hydrogen iodide in a flasher in a production process of acetic acid.”

For the reasons set forth on pages 12–13 of the Petition, which we adopt, we agree with Petitioner that the preambles of claims 1 and 12 are non-limiting. Briefly, the preambles are non-limiting because they merely state a purpose or intended use, fail to define or suggest any additional structural or process limitations, and no element of claim 1 or 12 draws its antecedent basis from the preamble. Pet. 12–13. Patent Owner does not specifically dispute Petitioner’s contentions. See PO Resp. 9–11. Patent Owner does, however, argue that claim 1 should be interpreted as limited to an “actual process” for producing acetic acid and not a computer-simulated process. *Id.* at 9. We address Patent Owner’s argument in Section II.C.1.b, below.

2. “nickel-based alloy”

Claims 11 and 13 contain the phrase “wherein the material of the flasher comprises a nickel-based alloy.” Ex. 1001, 26:10–49. Patent Owner contends that the claimed nickel-based alloy would be on the inside of the flasher because “hydrogen iodide production in the flasher can be reduced so as to avoid corrosive effects of hydrogen iodide in the flasher.” PO Resp. 10–11 (citing Ex 1001, 3:20–37, 4:66–5:11, 13:56–14:11; Ex. 2028 ¶¶ 55–56). Petitioner does not dispute Patent Owner’s contentions.

We agree with Patent Owner that a person of ordinary skill in the art would understand that, in order to function for its intended purpose of inhibiting corrosion, the nickel-based alloy would be on the inside of the

flasher “where a material is being reacted or processed.” Ex. 2028 ¶¶ 55–56; *see also* Ex. 1001, 4:54–57, 13:56–14:11.

3. “continuous”

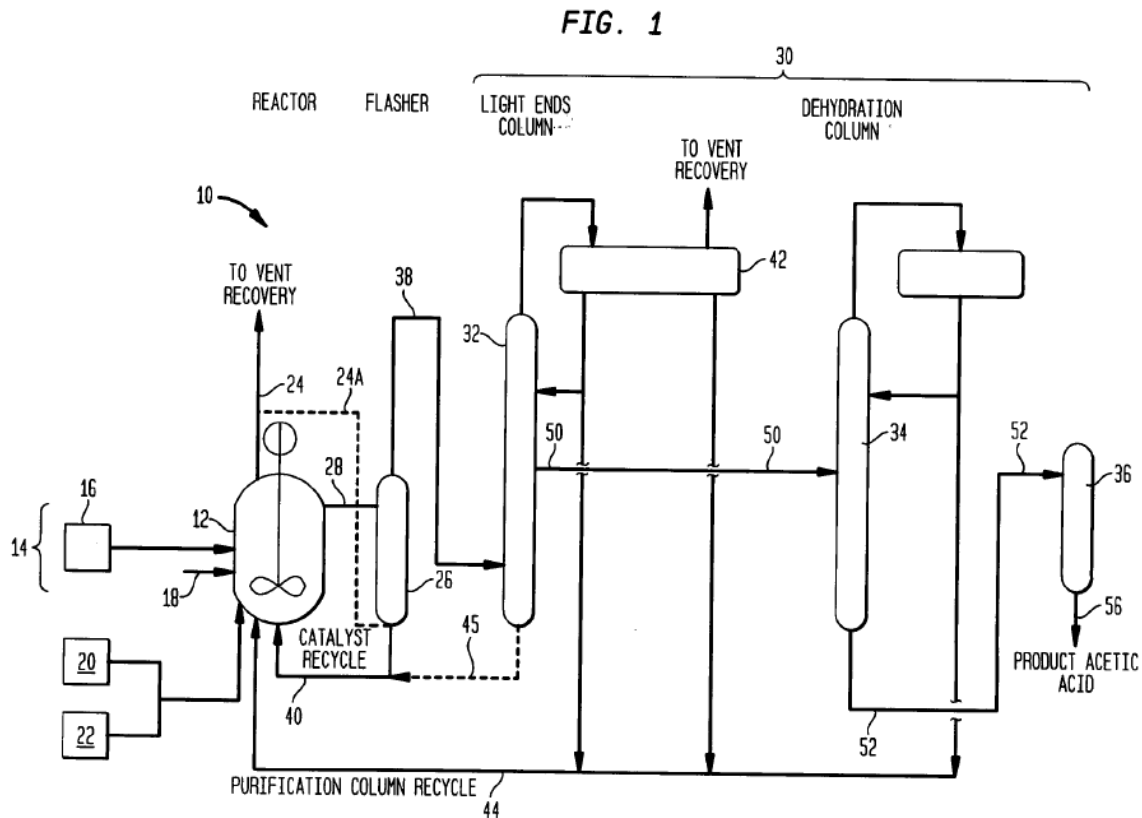
Despite Patent Owner’s discussion regarding the recitation of the term “continuous” in claim 1, we determine express construction of this term is unnecessary. PO Resp. 9–10. Patent Owner does not rely on this element to distinguish the claims from the prior art, except to argue that Patt does not enable a continuous feed to the flasher. *See id.* at 30–31; *cf.* Pet. 26 (citing Ex. 1003 ¶ 39 (“From the reactor, a stream of the reaction mixture is continuously fed via conduit **28** to flasher **26**.”)). In this regard, Patent Owner merely highlights the recitations of the term “continuous” in the challenged claims, but does not offer any construction for the term. We agree, and Petitioner does not dispute, that because “the reactor and flasher are both expressly identified in the claims as being continuous, the liquid catalyst recycle must also be continuous.” PO Resp. 10 (citing Ex. 2028 ¶ 58).

B. Prior Art

Petitioner relies upon the following prior art in support of its challenges.

1. *Patt*

Patt relates to carbonylating methanol to form acetic acid. Ex. 1003 ¶ 5. Figure 1 of Patt, reproduced below, provides a schematic diagram illustrating the Patt process.



The schematic diagram of Figure 1 shows the Patt process uses a reactor 12, a flasher 26, a recycle line 44, and a distillation/purification section 30. *Id.* ¶¶ 35–39. Patt provides the following description of Figure 1:

In FIG. 1 there is shown a carbonylation system **10** including a reactor **12** provided with a feed system **14** including a methanol surge tank **16** and carbon monoxide feed line **18**. A catalyst reservoir system includes a methyl iodide storage vessel **20** as well as a catalyst storage tank **22**. Reactor **12** is provided with a vent **24** and an optional vent **24a**. Reactor **12** is coupled to a flash vessel **26** by way of a conduit **28** and optionally by way of vent **24a**. The flasher, in turn, is coupled to a purification section **30**

. . . .

Carbon monoxide and methanol are introduced continuously into reactor **12** with adequate mixing at a high carbon monoxide partial pressure. . . .

From the reactor, a stream of the reaction mixture is continuously fed via conduit **28** to flasher **26**. Through the flasher the product acetic acid and the majority of the light ends (methyl iodide, methyl acetate, and water) are separated from the reactor catalyst solution, and the crude process stream **38** is forwarded with dissolved gases to the distillation or purification section **30** in single stage flash. The catalyst solution is recycled to the reactor via conduit **40**. In accordance with the invention, the flasher is heated

Id.

“The carbonylation reaction proceeds as methanol and carbon monoxide are continuously fed to the reactor.” *Id.* ¶ 29. The reaction step forms a crude acetic acid product, which is a mixture of acetic acid, methanol and/or methyl acetate, and other components such as a soluble rhodium catalyst, carbon monoxide, methyl iodide, and water. *Id.* ¶¶ 29–33; Ex. 1002 ¶ 30.

The reaction liquid is flash evaporated to form a vapor fraction (i.e., a volatile component) and a liquid fraction (i.e., non-volatile component or the liquid catalyst mixture). Ex. 1003 ¶¶ 34, 40; Ex. 1002 ¶ 31. Patt states that “by way of heating a flash vessel to maintain an elevated flash vapor temperature,” “the relative content of acetic acid in the crude product stream is increased, de-bottlenecking purification.” Ex. 1003 ¶ 1. The vapor fraction comprises acetic acid, water, methyl acetate, and methyl iodide, whereas the liquid fraction comprises the catalyst as well as water, acetic acid, methyl acetate, methyl iodide, and an ionic iodide. *Id.* ¶ 39; Ex. 1002 ¶ 31. The liquid fraction is recycled to the reactor. Ex. 1003 ¶ 39; Ex. 1002

¶ 32. Acetic acid product is collected from the vapor fraction in a purification section. Ex. 1003 ¶ 40; Ex. 1002 ¶ 37.

Patt discloses the results from a semi-empirical simulator that “was used to study the effect of flash temperature while holding constant the mass flow of [methyl acetate] in the vapor stream.” Ex. 1003 ¶ 49. Tables 1–7 of Patt show compositions of both the vapor and liquid fractions exiting the flasher for each of the examples. *Id.* ¶ 50. Comparative Example A and Examples 1–3 show that the liquid fraction exiting the flasher comprises water in a concentration of between 0.8 to 8% by weight and methyl acetate in a concentration of 0.6 to 15% by weight. *Id.* (Tables 1–4).

2. *Gambale*

Gambale “focuses on corrosion-sensitive equipment typically found in processing plants and the specialty-metal material options and techniques that should be considered when stainless steel and fluorinated polymers are insufficient.” Ex. 1004, 1. “For corrosion-related applications, the term specialty metal generally refers to titanium, nickel alloys, zirconium, and tantalum.” *Id.* With regard to selection of nickel-based alloys, Gambale states that “[n]ickel alloys are often selected when steels do not offer adequate corrosion resistance” and “are applicable in a wide range of acids, salt solutions, and caustic environments, and are suitable in the chemical . . . industr[y].” Ex. 1004, 3–4.

C. Anticipation of Claims 1–4, 6–10, and 12 by Patt

1. Whether Patt discloses all elements of the challenged claims as arranged in the claim

a. Summary of the Parties’ Contentions

In support of its assertion that Patt anticipates claims 1–4, 6–10, and 12, Petitioner provides a detailed discussion and claim chart explaining how

each claim limitation is disclosed in Patt. Pet. 20–47. For example, regarding claim 1, Petitioner contends that Patt discloses the reaction step (Ex. 1003 ¶¶ 2, 5, 29, 25, 26, 35; Ex. 1002 ¶¶ 29–30), the flash evaporation step (Ex. 1003 ¶¶ 5, 39, 47, 49, 50 (Tables 1–7), 51; Ex. 1002 ¶ 31), the recycling step (Ex. 1003 ¶ 39, Figures 1 and 3; Ex. 1002 ¶¶ 31–32), and the acetic acid collection step (Ex. 1003 ¶¶ 1, 35, 40, 41; Ex. 1002 ¶¶ 37–38). Pet. 23–32. Petitioner contends Patt discloses a rhodium catalyst. *Id.* at 32 (citing Ex. 1003 ¶ 22). Regarding the recited ranges for temperature, pressure, water concentration, and methyl acetate concentration, Petitioner relies on the data produced by a “semi-empirical simulator . . . used to study the effect of flash temperature” disclosed in Tables 1 to 4 of Patt. *Id.* at 33–36 (citing Ex. 1003 ¶¶ 49–50, Tables 1–4).

Petitioner further contends that

[t]he Examples described in Patt do not specifically list the concentrations of rhodium or other trace components in the catalyst recycle stream[, because] [t]he ‘*catalyst* recycle stream’ . . . contains catalyst and other components in such small amounts (parts per million) that their presence does not significantly affect amounts of the remaining components shown in the liquid stream.

Id. at 36 n.5 (citing Ex. 1002 ¶¶ 41–42).

Patent Owner contends that Patt does not describe the elements of the invention “arranged as in the claim.” PO Resp. 11–13 (quoting *Sanofi-Synthelabo v. Apotex, Inc.*, 550 F.3d 1075, 1083 (Fed. Cir. 2008)). First, Patent Owner contends that the challenged claims are directed to “an actual process for producing acetic acid; not a computer simulated process.” *Id.* at 9. Patent Owner further contends that “Petitioner relies on Patt for the disclosure of computer simulated data” and that “the [person of ordinary

skill in the art] would deem such data to be a hypothetical disclosure or invitation to experiment without actually teaching an invention of an actual acetic acid process.” *Id.* at 12 (citing Ex. 2028 ¶ 114).

Second, Patent Owner contends that “Patt does not state what catalyst was used to generate the flasher input stream that was inputted into the semi-empirical simulator to generate the data reported in Tables 1–4.” *Id.* at 12–13. Patent Owner notes that “both Drs. Bhise and Rockstraw state that the catalyst was likely rhodium or a combination of rhodium and iridium,” but contends that “[t]hese two catalysts are not equivalent, and even if one of these catalysts would produce the results reported in the Tables . . . , both catalysts would not produce such results.” *Id.* at 13 (citing Ex. 2028 ¶ 71; Ex. 2029 ¶ 118).

In its Reply, Petitioner contends that Patt describes each and every element recited in claims 1–4, 6–10, and 12 and that “the process for producing acetic acid described in Patt is arranged in the same way as claimed in the ’843 Patent.” Reply 2. Specifically, Petitioner notes the following:

After describing the conventional steps of producing acetic acid (*see, e.g.*, Ex. 1003, ¶¶[0029]–[0041]; Ex. 1002, ¶¶29–32, 37–38), Patt analyzes the flash evaporation step in more detail through the use of semi-empirical simulations concerning the flasher. (Ex. 1003, ¶[0049]; Ex. 1002, ¶33.) These semi-empirical simulations are not examples unrelated to the descriptions of the process in Patt; instead, the semi-empirical simulations analyze a unit operation well-known to a [person of ordinary skill in the art] and investigate concentrations of the streams exiting the flasher at different temperatures.

A [person of ordinary skill in the art] knew the flash evaporation step utilizes a flasher to effect a physical separation of certain components fed into the flasher. (*See, e.g.*, Ex. 1050,

577:3–578:4.) The data described in the Patt examples utilize an inlet stream composition that reflects the composition of a real-world stream that was well-known to a [person of ordinary skill in the art]. (See *infra* Section II.C.3.) As acknowledged by Daicel’s witnesses, using a representative feed stream in simulations would be expected by a [person of ordinary skill in the art]. (See, e.g., Ex. 1039, 121:12–122:6; Ex. 1050, 699:4–12.)

Id. at 3.

b. Analysis

The Court of Appeals for the Federal Circuit summarized the analytical framework for determining whether prior art anticipates a claim as follows:

A patent is invalid if “the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.” 35 U.S.C. § 102(b) (2006). A prior art reference can only anticipate a claim if it discloses all the claimed limitations “arranged or combined in the same way as in the claim.” *Wm. Wrigley Jr. Co. v. Cadbury Adams USA LLC*, 683 F.3d 1356, 1361 (Fed. Cir. 2012) (quoting *Net MoneyIN, Inc. v. VeriSign, Inc.*, 545 F.3d 1359, 1370 (Fed. Cir. 2008)). However, a reference can anticipate a claim even if it “d[oes] not expressly spell out” all the limitations arranged or combined as in the claim, if a person of skill in the art, reading the reference, would “at once envisage” the claimed arrangement or combination. *In re Petering*, 49 CCPA 993, 301 F.2d 676, 681 (1962).

Kennametal, Inc. v. Ingersoll Cutting Tool Co., 780 F.3d 1376, 1381 (Fed. Cir. 2015) (alteration in original) (footnote omitted).

For the reasons set forth on pages 23–46 of the Petition and pages 2–3 of Petitioner’s Reply, which we adopt, we agree that Patt discloses all of the limitations of the challenged claims. Patt describes the conventional steps of

producing acetic acid (Ex. 1003 ¶¶ 29–41, Figure 1; Ex. 1002 ¶¶ 29–32, 37–38) and analyzes changes in temperature on the flash evaporation step using semi-empirical simulations (Ex. 1003 ¶ 49; Ex. 1002 ¶ 33). The semi-empirical simulations relate to the processes described in Patt and anticipate the claimed ranges for temperature, pressure, methyl acetate concentration, and water concentration in the flash evaporation step. Pet. 33; Ex. 1003 ¶¶ 39, 47, 49, Tables 1–4. Though it is true that there is no evidence in Patt of “actual performance” of the disclosed acetic acid production processes, this is not required to establish anticipation. *Novo Nordisk Pharm., Inc. v. Bio-Tech. Gen. Corp.*, 424 F.3d 1347, 1355 (Fed. Cir. 2005) (“anticipation does not require actual performance of suggestions in a disclosure” (quoting *Bristol-Myers Squibb Co. v. Ben Venue Labs., Inc.*, 246 F.3d 1368, 1379 (Fed. Cir. 2001))); *see also Schering Corp. v. Geneva Pharm.*, 339 F.3d 1373, 1380 (Fed. Cir. 2003) (“Anticipation does not require the actual creation or reduction to practice of the prior art subject matter . . .”).

Regarding the limitation requiring the use of a rhodium catalyst, there is no dispute between the parties that Patt expressly discloses “rhodium and/or iridium” as a metal catalyst to be used in Patt’s processes. Ex. 1003 ¶ 22. The dispute between the parties concerns which catalyst was used in the semi-empirical simulations. The Examples described in Patt do not specifically name the type of metal catalyst used in the liquid catalyst mixture. Each of the parties’ respective declarants, however, testify that the catalyst used in the Examples described in Patt was either rhodium or a combination of rhodium and iridium. *See* Ex. 2028 ¶ 71 (Dr. Bhise); Ex. 2029 ¶ 118 (Dr. Rockstraw); Ex. 1059 ¶ 14 (Dr. Hanes) (“A [person of ordinary skill in the art] would know that a catalyst including rhodium was

used.”). We also credit the testimony of Dr. Hanes explaining that a catalyst would have been necessarily present and at low amounts such that it “would not change appreciably the amounts of the major components shown in Tables 1–4.” Ex. 1002 ¶ 35. Accordingly, we find that the evidence of record shows that the catalyst was necessarily either rhodium or a combination of rhodium and iridium, either of which satisfies the claim requirement that “the metal catalyst comprises a rhodium catalyst.” We, therefore, conclude that Patt discloses the metal catalyst element arranged as in the challenged claims.

In view of the above, we conclude that Petitioner has established by a preponderance of the evidence that Patt anticipates claims 1–4, 6–10, and 12 of the ’843 patent.

2. *Whether Patt is a non-enabling reference*

a. *Summary of Patent Owner’s Contentions*

Patent Owner sets forth a series of arguments alleging that Patt fails to enable “(1) producing the flasher inlet stream described in paragraph [0049] and (2) conducting the flashing step on the flasher inlet stream to produce the relevant data reported in Tables 1–4, together with the use of the claimed (but not fully described) catalyst.” PO Resp. 46; *see also id.* at 13–46. In particular, Patent Owner contends that considerable experimentation would be needed to “recreate the data points reported in Tables 1–4” and that “[a]ctual tests are required to confirm the accuracy of the data in Tables 1–4 of Patt.” PO Resp. 24, 33. Patent Owner further examines “undue experimentation” under the *Wands* factors, which include (1) the quantity of experimentation; (2) the amount of direction or guidance present; (3) the presence or absence of working examples; (4) the nature of the invention;

(5) the state of the prior art; (6) the relative skill of those in the art; (7) the predictability or unpredictability of the art; and (8) the breadth of the claims. *In re Wands*, 858 F.2d 731, 737 (Fed. Cir. 1988); PO Resp. 32–46.

To support its position that undue experimentation would be required to practice the “semi-empirical” invention described in Patt, Patent Owner relies on its declarant, Dr. Bhise, to support its contention that “it would be an extremely difficult task (perhaps impossible task) for a [person of ordinary skill in the art] to create a complete process for making acetic acid, from a reaction step to a collection step, that embodies and recreates the flashing step described in Patt including the examples in Tables 1–4.” PO Resp. 15 (citing Ex. 2028 ¶¶ 115, 154); *see also* Ex. 2028 ¶¶ 60–64, 83–111. Patent Owner further relies on the testimony of Dr. Rockstraw who testifies that the simulation disclosed in Patt is likely flawed and does not accurately predict actual experimental results. PO Resp. 43; Ex. 2029 ¶¶ 79–83.

Dr. Rockstraw summarizes his analysis as follows:

Since Patt runs a computer simulation (i) without regressing experimental results into the property model parameters, (ii) with only five components when many other components are expected, (iii) without accounting for vapor phase dimerization of the acetic acid, (iv) without accounting for entrainment of LiI with the vapor phase, and (v) without accounting for the continued reactions in the flash drum, a person skilled in simulation of chemical engineering processes would expect, based on the state of the art in December 2010, that the data tabulated in Tables 1-7 will not accurately predict actual experimental results and is therefore unreliable.

Ex. 2029 ¶ 83.

Patent Owner contends that “Patt presents almost no guidance or direction except for the components, temperature, and pressure of the flasher inlet stream.” PO Resp. 35. Patent Owner contends that the continuous inlet

stream is an essential starting material for the flashing step and that “it would be impossible or it would require undue experimentation for a [person of ordinary skill in the art] to actually create inlet streams that are continuously fed to the flasher in Patt that have the compositions described in Patt.” *Id.* at 36–37 (citing Ex. 2028 ¶ 118).

Patent Owner contends that Patt only provides an example using a semi-empirical simulator and thus there is a “complete absence of any working examples to any part of the process disclosed in Patt.” *Id.* at 40 (citing Ex. 2029 ¶ 119). More specifically, Patent Owner contends as follows:

[A] semi-empirical simulator would not produce reliable results, and experimental data is necessary to test the results. *Id.* The flasher inlet stream described in paragraph [0049] of Patt is not representative of an actual flasher inlet stream because of a failure to account for inevitable impurities that are known to affect at least the flashing step of the acetic acid production process. Ex. 2028, ¶¶80-82; Ex. 2029, ¶ 119. The absence of actual working examples in Patt contributes significantly to the amount of experimentation that would be necessary to reproduce the data reported in Patt. Ex. 2028, ¶¶ 118-119; Ex. 2029 ¶¶ 118-119.

Id.

Patent Owner contends that acetic acid production processes involve a number of variables, the adjustment of which may create wide-ranging results. *Id.* at 41–42 (citing Ex. 2028 ¶¶ 120–123; Ex. 2029 ¶ 23). Patent Owner further contends that “computer simulation of acetic acid production in at least the reaction and flashing stages involves a large number of variables, which makes computer simulation of the process unpredictable and unreliable.” *Id.* at 42 (citing Ex. 2028 ¶¶ 85–88, 120).

Patent Owner further contends that “the failure of Patt to identify the specific catalyst used to generate the data further contributes to the experimentation that would be required to reproduce the data in Tables 1–4 of Patt.” *Id.* at 32.

b. Summary of Petitioner’s Contentions

Petitioner contends that “Patt must enable the *claimed methods* of the ’843 Patent, not the exact composition of the flasher inlet stream described in Patt.” Reply 8. Petitioner further responds as follows:

Daicel repeatedly fails to focus on the *claimed methods* in its arguments. (*See, e.g.*, [PO Resp.], 28, 33.) For example, Daicel states that Patt “must enable operation of a flasher to produce the relevant data points in Table[s] 1–4” or considerable experimentation would be needed to “recreate the data points reported in Tables 1-4.” ([PO Resp.], 14, 33.) These are just two examples of the incorrect framing of the relevant question. . .

. . . The relevant question is whether a [person of ordinary skill in the art] credited with general knowledge in the field can make the claimed methods of the ’843 Patent in view of Patt. Notably, the claimed methods include conventional steps for producing acetic acid and wide-ranging amounts of certain components in particular streams. (Ex. 1059, ¶¶ 9, 21.) These are the methods that must be enabled by Patt.

Id. at 9–10. In this regard, Petitioner contends that “Patt describes an acetic acid process and a detailed analysis of flasher operation commensurate with the scope of the claimed methods.” *Id.* at 19 (citing Ex. 1059 ¶ 21). That is, a person of ordinary skill in the art could make the claimed methods of the ’843 patent in view of Patt. *Id.* at 10.

Petitioner contends that Patt provides sufficient guidance to a person of ordinary skill in the art in the form of “a diagram for a full continuous carbonylation reaction (Fig. 1), a system with a heat exchanger between the

reactor and flasher (Fig. 2), a flow chart of operation of the system (Fig. 3), and accompanying descriptions.” *Id.* at 16 (citing Ex. 1003 ¶¶ 2, 35–48). Petitioner further contends that the systems described by Patt are similar to those described in the ’843 patent. *Id.* at 12–13; Ex. 1059 ¶¶ 8–10.

Petitioner contends that acetic acid production is a mature technology and that the industry developed refined property models and parameters for simulating low water carbonylation processes. Reply 15–16 (citing Ex. 1039, 158:19–21; Ex. 1050, 700:18–20); Ex. 1039, 159:12–161:4, 162:14–22; Ex. 1059 ¶ 15 (“Simulations were regularly used by a [person of ordinary skill in the art] to investigate different operating conditions and parameters.”). That is, “[u]sing computer simulations to study the refinements was routine.” Reply 17 (citing Ex. 1059 ¶ 18); Ex. 2028 ¶ 33; Ex. 2029 ¶ 17; *see also* Ex. 1002 ¶ 34.

Addressing the predictability of the art, Petitioner contends as follows:

Although the chemistry of acetic acid production is complex, a [person of ordinary skill in the art] would have understood this complexity and the factors, such as physical property data, that influence the system. (Ex. 1059, ¶20.) This understanding allowed for sophisticated computer modeling, which was routinely used to predict the effects of modifications. (Ex. 1059, ¶20; *see also* Ex. 2028, ¶33; Ex. 2029, ¶17; Ex. 1039, 158:10-166:9.) Thus, although the art includes some unpredictability, much is known by and available to reduce unpredictability and allow a POSITA to practice the claimed methods without undue experimentation. (Ex. 1059, ¶20.)

Id. at 18–19 (footnote omitted).

Petitioner contends that “[a] [person of ordinary skill in the art] would understand Patt’s use of the term ‘semi-empirical simulator,’ (Ex. 1003, ¶[0049],) to refer to a simulation that is, at least in part, **based on actual experimental data.**” *Id.* at 11 (citing Ex. 2038, 181:12–182:4; Ex. 1039,

116:3–22). More specifically, “a [person of ordinary skill in the art] would expect that the semi-empirical simulations were modeled on an **actual** inlet stream and would expect the adiabatic operation shown in Table 1 of Patt shows actual values for the inlet and bottom stream (liquid) for the flasher at standard operation (i.e., without heating the flasher).” *Id.* at 17 (citing Ex. 1059 ¶¶ 13, 17).

Furthermore, Petitioner contends that the composition of the inlet stream entering the flasher as described in Patt is consistent with conventional streams known to a person of ordinary skill in the art. *Id.* at 12 (citing Ex. 1059 ¶ 12).

c. Analysis

To anticipate a claimed method, the reference must enable one of skill in the art to make and use the claimed invention. *Bristol-Myers Squibb Co. v. Ben Venue Labs., Inc.*, 246 F.3d 1368, 1374 (Fed. Cir. 2001); *In re Gleave*, 560 F.3d 1331, 1335 (Fed. Cir. 2009). The Court of Appeals for the Federal Circuit summarized the analytical framework for determining whether an anticipatory prior art reference discloses the subject matter of a claim in an enabling manner as follows:

In order to anticipate, a prior art disclosure must also be enabling, such that one of ordinary skill in the art could practice the invention without undue experimentation. [*SmithKline Beecham Corp. v. Apotex Corp.*, 403 F.3d 1331, 1342 (Fed. Cir. 2005)]. The standard for enablement of a prior art reference for purposes of anticipation under section 102 differs from the enablement standard under 35 U.S.C. § 112. *Rasmusson v. SmithKline Beecham Corp.*, 413 F.3d 1318, 1325 (Fed. Cir. 2005) (citation omitted). While section 112 “provides that the specification must enable one skilled in the art to ‘use’ the invention,” *id.* (quoting *In re Hafner*, 56 C.C.P.A. 1424, 410 F.2d 1403, 1405 (1969)), “section 102 makes no such requirement as

to an anticipatory disclosure,” *id.* Significantly, we have stated that “anticipation does not require actual performance of suggestions in a disclosure. Rather, anticipation only requires that those suggestions be enabled to one of skill in the art.” *Bristol-Myers Squibb Co. v. Ben Venue Labs., Inc.*, 246 F.3d 1368, 1379 (Fed. Cir. 2001) (citing *In re Donohue*, 766 F.2d 531, 533 (Fed. Cir. 1985) (“It is not, however, necessary that an invention disclosed in a publication shall have actually been made in order to satisfy the enablement requirement.”)).

Novo Nordisk Pharm., 424 F.3d at 1355.

Having considered the parties’ positions and evidence of record, summarized above, we conclude that Patt enables a person of ordinary skill in the art make and use the subject matter of the challenged claims. We agree with Petitioner that, under the proper standard, Patt must enable the claimed invention, not, as Patent Owner contends, enable a person of ordinary skill in the art “to reproduce the prior art without undue experimentation.” PO Resp. 13. In this regard, both the ’843 patent and Patt disclose conventional steps of producing acetic acid, which have been known in a mature industry for many years. Pet. 22, 24; Reply 16; Ex. 1003 ¶¶ 2, 29, 35–48, Figure 1; Ex. 1002 ¶¶ 29–32, 37–38; Ex. 2028 ¶ 36; Ex. 1039, 158:19–21; Ex. 1050, 700:18–20.

In relevant part, the claims of the ’843 patent require the flash evaporation step to maintain the variables of temperature, pressure, methyl acetate concentration, and water concentration within the certain ranges. Ex. 1001, 3:38–4:17; Ex. 2028 ¶¶ 73–74. Patt, “[a]fter describing the overall process, . . . focuses on the flash evaporation step in more detail through the use of semi-empirical simulations concerning the flasher,” where a person of ordinary skill in the art would have known “that the semi-empirical simulations were based, at least in part, on actual data” and based on a

conventional liquid catalyst stream. Ex. 1059 ¶ 12; Ex. 1002 ¶¶ 29–33, 37–38; Ex. 1039, 121:12–19 (Dr. Rockstraw acknowledging that, if tasked with determining the effect of temperature on the flasher, he “would want to start with a representative feed stream that represents what [he] would be doing in the field”); Ex. 1050, 700:13–17; *see also* Ex. 1003 ¶¶ 49–50 (Tables 1–7) (disclosing the concentrations of the major components of the catalyst recycle stream). Relevant to the ranges recited in the claims of the ’843 patent, Patt discloses a refinement to conventional steps of producing acetic acid by studying the effects of temperature on the flasher step. Ex. 1003 ¶ 4; Ex. 1002 ¶ 33; Ex. 1059 ¶ 18. The ranges of temperature, pressure, methyl acetate concentration, and water concentration used or produced by the semi-empirical simulations fall within the ranges recited in the challenged claims.

We find that the use of semi-empirical simulations by Patt enables the subject matter of the challenged claims. First, we note that, to be an enabling prior art reference, Patt need not disclose an actual acetic acid production process. *In re Donohue*, 766 F.2d at 533. Second, to qualify as an enabling prior art reference, Patt does not need to teach how to reproduce the data set forth in the Tables 1–7, i.e., the results of the semi-empirical process described in Patt, with 100% accuracy. Rather, Patt “must sufficiently describe the claimed invention to have placed the public in possession of it.” *Id.* In this regard, the evidence of record indicates that the industry matured to the point where reliance on computer simulation was commonplace and routine. Ex. 1059 ¶ 18; Ex. 1002 ¶ 34 (citing Ex. 1014, 40 (“Process simulation is the main conceptual tool, both for analysis and synthesis purposes [and that] the traditional art-of-engineering is replaced by

accurate computer simulation. Modern steady-state and dynamic simulation techniques make possible the investigation of complex processes close to the real situation.”)); Ex. 2001 ¶¶ 56–59; Ex. 2028 ¶¶ 90, 101; Ex. 2029 ¶¶ 9, 22–33. Thus, Patt uses an industry accepted means to indicate what results one might expect by use of the disclosed processes. The disclosed simulation is sufficient to be anticipating, and sufficient to enable a method falling within the scope of the challenge claims. That is, one skilled in the art would have known how to refine conventional acetic acid production processes to make and use the methods disclosed in Patt, and would not have had to engage in undue experimentation to gain possession of a method falling within the scope of the challenged claims.

In view of the above, we conclude that Patt sufficiently describes its disclosed acetic acid production processes so as to have placed the public in possession of subject matter encompassed by the challenged claims.

D. Obviousness of Claim 5 over Patt

Petitioner asserts that claim 5 is rendered obvious in view of Patt. Pet. 47–56. Claim 5 provides as follows:

5. A process according to claim 1, wherein the ionic iodide comprises an alkali metal iodide, and the concentration of the metal catalyst in the liquid catalyst mixture is not less than 300 ppm on the basis of weight.

Ex. 1001, 25:31–34.

In support of its assertion that Patt renders claim 5 obvious, Petitioner provides a detailed discussion and claim chart explaining how each claim limitation is disclosed in Patt. Pet. 47–56. Petitioner contends that “Patt identifies lithium iodide, an alkali metal iodide, as a promoter in the acetic acid production process.” *Id.* at 49.

With regard to the claim limitation that the metal catalyst concentration in the liquid catalyst mixture is not less than 300 ppm on the basis of weight, Petitioner notes that claim 10 of Patt discloses a carbonylation process “wherein the rhodium metal catalyst is present in the reaction mixture at a concentration of from about 300 ppm to about 5,000 ppm by weight of the reaction mixture.” *Id.* Petitioner further contends as follows:

Patt is silent with regard to the concentration of metal catalyst in the liquid catalyst mixture. However, Patt discloses that the metal catalyst (rhodium) is present *in the reaction mixture* at a concentration of about 300 ppm to 5,000 ppm by weight. Ex. 1003, Claim 10; Ex. 1002, ¶ 47. Although Patt does not specifically provide the concentration of the metal catalyst in the catalyst recycle stream (referred to in the ’843 patent as the “liquid catalyst mixture”), a concentration of the metal catalyst in the catalyst recycle stream of not less than 300 ppm on the basis of weight would have been obvious to one of ordinary skill in the art based on Patt in view of general knowledge in the art. Ex. 1002, ¶ 48–50.

Id. at 50 (footnote omitted). Petitioner further contends that catalyst loss in a low water carbonylation system is minimal and that the liquid catalyst mixture that exits the flasher includes substantially all of the catalyst that enters the flasher. *Id.* at 51 (citing Ex. 1002 ¶¶ 48, 50, 52; Ex. 1012, 14:1–15 (Table IV); Ex. 1013, 017, 020).

Petitioner further relies on the testimony of its declarant, Dr. Hanes, to support its position that a person of ordinary skill in the art would have been able to calculate the relative concentration of the metal catalyst in the resultant liquid catalyst mixture based on the disclosed amount of metal catalyst present in the reaction mixture (about 300 ppm and about 5,000 ppm) with the aid of computer modeling that “was common in the industry

and was widely accepted as accurate.” *Id.* at 53 (citing Ex. 1014, 40; Ex. 1002 ¶¶ 49–50).

Patent Owner disagrees, and rebuts with the following:

Although claims 9 and 10 of Patt do identify the catalyst as being rhodium or iridium and suggest a concentration in the 300–5,000 ppm range, a [person of ordinary skill in the art] would not take this disclosure as being particularly informative of the concentration actually used to generate the data in the Tables. *See* Ex. 2028, ¶¶ 83–109, 126–132; Ex. 2029, ¶ 118.

PO Resp. 51. Patent Owner further argues as follows:

Tables 1–7 of Patt show that increasing the flash temperature from adiabatic (297°F) to isothermal (387°F) results in lower amounts of water and methyl acetate, which are undesirable “non-product” components. Ex. 1003, [0048]. Thus, when optimizing the process of Patt, one of ordinary skill in the art would look to Tables 6 and 7 of Patt (which produce optimum results). Ex. 2028, ¶ 136. However, Tables 6 and 7 of Patt provide values of methyl acetate and water below what is recited in claim 5 (due to its dependency from claim 1). Ex. 2028, ¶ 136. Thus, any optimization of Patt would result in a process that falls outside of the claimed invention as recited in claim 5.

Id. at 52–53.

Having considered the parties’ positions and evidence of record, summarized above, we conclude that Patt teaches the elements of claim 5. As discussed above, a person of ordinary skill in the art would have understood that the catalyst in the Examples of Patt necessarily included rhodium. *See supra* Section II.C.1. With regard to the concentration of the catalyst, claims 9 and 10 of Patt suggest a concentration of catalyst in the 300–5,000 ppm range. Ex. 1003, 6. Furthermore, the evidence of record supports Petitioner’s contention that “[t]he specific disclosure of LiI, as described in the Examples of Patt, the range of rhodium concentrations in

the reaction mixture, and a routine calculation of the amount of rhodium in the liquid recycle stream are sufficient to render the method of claim 5 obvious.” Reply 21; Ex. 1002 ¶¶ 48–51. Here, we credit the testimony of Dr. Hanes and supporting evidence that the catalyst from Patt’s reaction mixture would have been largely conserved and recycled to the reactor from the flasher resulting in negligible losses. Thus, “[i]f the concentration of rhodium in the reaction mixture is 300 to 5,000 ppm, as disclosed in Patt, it would have been obvious to a person of skill in the art, based on general knowledge known in the art, that the concentration of rhodium in the liquid catalyst mixture would be not less than 300 ppm, as recited in claim 5.” Ex. 1002 ¶ 48.

We further agree with Petitioner that Patt is prior art for all it teaches and that the obviousness analysis does not require a person of ordinary skill in the art to limit its focus to Tables 6 and 7 of Patt. Reply 21 (citing *Beckman Instruments v. LKB Produkter AB*, 892 F.2d 1547, 1551 (Fed. Cir. 1989)).

Accordingly, in view of the above, we determine that Petitioner has demonstrated, by a preponderance of the evidence, that the subject matter of claim 5 of the ’843 patent would have been obvious over Patt.

E. Obviousness of Claims 11 and 13 over the Combination of Patt and Gambale

Petitioner asserts that claims 11 and 13 are rendered obvious over the combination of Patt and Gambale. Pet. 56–59. In support of this assertion, Petitioner provides a detailed discussion and claim chart explaining how each claim limitation is disclosed by the combination of Patt and Gambale. *Id.* In particular, Petitioner contends that “Patt discloses that, given the corrosive nature of acetic acid production, different metallurgy may be

required for different parts of the process stream.” Pet. 57 (citing Ex. 1003 ¶ 37; Ex. 1002 ¶ 55).

With reference to Gambale, Petitioner contends that Gambale discloses replacing stainless steel with nickel-based alloys in acidic chemical processing environments. *Id.* at 58; Ex. 1004, 64–65 (“Nickel alloys are often selected when steels do not offer adequate corrosion resistance.”); Ex. 1002 ¶ 56. Petitioner provides the following rationale for combining the teachings of Patt and Gambale:

Given the suggestion of Patt to use different metallurgy in the more corrosive environments of the acetic acid production system and to use stainless steel in less corrosive environments, one of skill in the art would have looked to the relevant art to identify a practical, corrosion-resistant material for the flasher. Gambale discloses replacing stainless steel with nickel-based alloys in acidic chemical processing environments. Ex. 1004, p. 62; Ex. 1002, ¶ 56. Thus, one of skill in the art would have combined the method of Patt with the teachings of Gambale to arrive at a flasher made of a nickel-based alloy. Ex. 1002, ¶ 58. As described above, flashers made of nickel-based alloys were in commercial use [] in acetic acid production well before the priority date of the ‘843 patent. Ex. 1002, ¶ 53.

Pet. 58–59.

Patent Owner responds as follows:

Corrosion experiments are not present in Patt but are present in the ‘843 Patent. Ex. 2028, ¶¶ 48, 142; Ex. 1001, 22:62–23:22. The significant cost advantage of using a nickel-based alloy instead of a more expensive zirconium is discussed by Dr. Bhise. Ex 2028, ¶¶ 48, 139, and 143. It could not be predicted from Patt that a nickel-based alloy could be effectively employed in the flasher in the process claimed in the ‘843 Patent. *Id.* The acceptable results reported in the corrosion tests in the ‘843

patent could not have been predicted and represent a valuable technical contribution to the art.

Even if Patt is combined with Gambale, the deficiencies of Patt are not remedied. Ex. 2028, ¶¶ 139-140. Gambale is an overview article that describes various advantages and disadvantages of specialty metals for corrosion-sensitive equipment (Ex. 1004, title). . . .

. . . .

. . . [A] [person of ordinary skill in the art] could not predict the corrosion data reported in the '843 Patent and could not feel confident using a nickel-based alloy in a flasher operating under the conditions described by Patt. Ex. 2028, ¶ 149. It is submitted that only by use of impermissible hindsight can the invention of claims 11 and 13 be reached.

PO Resp. 55–58 (citing Ex. 2028 ¶¶ 48, 139–140, 143–145, 148; Ex. 2029 ¶¶ 145, 149).

Having considered the parties' positions and evidence of record, summarized above, we find that the evidence of record shows that the problem of corrosion was well known to a person of ordinary skill in the art (Ex. 1002 ¶ 58), that Patt expressly suggests the use of different metallurgy for different chemical environments (Ex. 1003 ¶ 37; Ex. 1002 ¶ 58), and that the choice of a nickel-based alloy in the flasher of Patt would have been obvious to a person of ordinary skill in the art in view of Gambale's teaching that nickel alloys offer adequate corrosion resistance in acidic chemical processing environments (Ex. 1004, 64–65; Ex. 1002 ¶¶ 55–58). Here, we credit the testimony of Dr. Hanes that flashers made of nickel-based alloys were in commercial use in acetic acid production well before the priority date of the '843 patent. Ex. 1002 ¶ 53 (citing Ex. 1008).

Accordingly, in view of the above, we determine that Petitioner has demonstrated, by a preponderance of the evidence, that the subject matter of

claim 11 and 13 of the '843 patent would have been obvious over the combination of Patt and Gambale.

III. SAS INSTITUTE INC. v. IANCU

The Supreme Court issued its decision on April 24, 2018, in *SAS Institute Inc. v. Iancu* concerning final written decisions issued by the Board addressing all claims a petitioner challenged in a petition. *SAS Institute Inc. v. Iancu*, No. 16-969, 2018 WL 1914661 (April 24, 2018). To the extent either party believes that the Court's decision in *SAS Institute* requires additional consideration in this proceeding, the party may file a rehearing request pursuant to 37 C.F.R. § 42.71(d).

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that claims 1–13 of the '843 patent are held unpatentable; and

FURTHER ORDERED that this is a Final Written Decision; therefore, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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