Trials@uspto.gov
571-272-7822

Paper 34
Entered: May 21, 2015

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

BUTAMAX ADVANCED BIOFUELS LLC,
Petitioner,

v.

GEVO, INC.,
Patent Owner.

Case IPR2014-00142
Patent 8,193,402 B2

Before SHERIDAN K. SNEDDEN, CHRISTOPHER L. CRUMBLEY, and GEORGIANNA W. BRADEN, *Administrative Patent Judges*.

SNEDDEN, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
35 U.S.C. § 318 and 37 C.F.R. § 42.73

I. INTRODUCTION

Butamax Advanced Biofuels LLC ("Petitioner") filed a Petition to institute an *inter partes* review of claims 1–23 of U.S. Patent No. 8,193,402 B2 ("the '402 patent") pursuant to 35 U.S.C. §§ 311–319. Paper 1 ("Pet."). Gevo, Inc. ("Patent Owner") did not file a preliminary response to the Petition. On May 22, 2014, we instituted trial for challenged claims 1–17 and 19–23 on the following grounds of unpatentability asserted by Petitioner:

Challenged Claim[s]	Basis	Reference[s]
1–10, 12, 15–17, 19–20, 22–23	§ 102(e)	D'Amore[1]
1–10, 12, 15–17, 19–20, 22–23	§ 103(a)	D'Amore and ASTM D4814[2]
11	§ 103(a)	D'Amore, Wilke,[3] and ASTM D4814
13	§ 103(a)	D'Amore and ASTM D975[4]
14	§ 103(a)	D'Amore and ASTM D1655[5]
21	§ 103(a)	D'Amore and D910[6]

Decision to Institute (Paper 13, "Dec.").

After institution of trial, the Patent Owner filed a Patent Owner Response

[1] D'Amore, US 2008/0132741 A1, published June 5, 2008. Ex. 1003.

[2] ASTM Standard D4814, "Standard Specification for Automotive Spark-Ignition Engine Fuel," ASTM International, West Conshohocken, PA, Sept. 2007, available at http://www.astm.org ("ASTM D4814"). Ex. 1014.

[3] Wilke, US 4,359,533, issued Nov. 16, 1982. Ex. 1006.

[4] ASTM Standard D975, "Standard Specification for Diesel Fuel Oils," ASTM International, West Conshohocken, PA, Aug. 2007, available at http://www.astm.org ("ASTM D975"). Ex. 1015.

[5] ASTM Standard D1655, "Standard Specification for Aviation Turbine Fuels," ASTM International, West Conshohocken, PA, July 2007, available at http://www.astm.org ("ASTM D1655"). Ex. 1017.

[6] ASTM Standard D910, "Standard Specification for Aviation Gasolines," ASTM International, West Conshohocken, PA, Aug. 2007, available at http://www.astm.org ("ASTM D910"). Ex. 1016.

(Paper 20, "PO Resp."), to which Petitioner filed a Reply (Paper 22, "Reply").

Petitioner relies upon the Declarations of Dr. Joseph T. Joseph (Exs. 1030 and 1040) in support of its Petition.

Oral argument was conducted on January 14, 2015. A transcript is entered as Paper 33 ("Tr.").

We have jurisdiction under 35 U.S.C. § 6(c). In this Final Written Decision, issued pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73, we determine Petitioner has shown by a preponderance of the evidence that claims 1–17 and 19–23 of the '402 patent are unpatentable.

A. Related Proceedings

Petitioner informs us of no related litigations. Pet. 2. Concurrent with the present *inter partes* review, Petitioner also requested review of, and the Board instituted trial on, the following claims in patents in the same family as the '402 patent: claims 1–21 of U.S. Patent No. 8,378,160, Case IPR2014-00143 (PTAB May 22, 2014) (Paper 9); claims 1–14 and 16–19 of U.S. Patent No. 8,487,149, Case IPR2014-00144 (PTAB May 22, 2014) (Paper 9); and claims 1–21 of US Patent No. 8,546,627, Case IPR2014-00250 (PTAB May 22, 2014) (Paper 8). Additionally, Petitioner requested review of, and the Board instituted trial on, claims 1–15 of unrelated U.S. Patent No. 8,373,012 in IPR2014-00402 (PTAB August 8, 2014) (Paper 11).

B. The '402 patent (Ex. 1001)

Transportation fuels are defined as mixtures of typically aliphatic and (optionally) aromatic hydrocarbons that meet a collection of physical properties and requirements, as defined in standards such as ASTM D4814 (gasoline), ASTM D975 (diesel fuel), ASTM D910 (aviation gasoline), and ASTM D1655 (jet fuel). Ex. 1001, 12:15–17:25. Gasoline, for example, is defined not by its composition,

but by its ability to function in a spark ignition engine according to properties defined by ASTM D4814. *Id.* at 11:36–43. Such properties include vapor pressure, energy density, octane number, water solubility, thermal oxidation stability, gum content, and drivability. *Id.* at 15:27–45. The properties of gasoline can be adjusted by modifying the amounts and types of organic molecules that make up the gasoline. *Id.* For example, the octane number of a gasoline mixture can be raised by adding high octane components. *Id.*

The ’402 patent, titled “Renewable Compositions,” describes methods for making renewable hydrocarbons. *Id.* at 3:62–4:59. The methods involve preparing a feedstock from a biomass to serve as a carbon source. *Id.* at 6:47–7:13. The feedstock is fermented with microorganisms to form C_2–C_6 alcohols. *Id.* at 3:65–67. The alcohols are dehydrated to form C_2–C_6 olefins (alkenes). *Id.* at 4:1–3. The olefins are reacted with an oligomerization catalyst to form more highly alkylated aromatic hydrocarbons, for example, C_6–C_{24} unsaturated oligomers. *Id.* at 4:5–8 and 9:62–10:9. The dehydration step and oligomerization step may be carried out separately or combined into a single process. *Id.* at 20:35–41. The olefins are then reduced to heat-stable saturated hydrocarbons in a hydrogenation reaction. *Id.* at 23:53–59. The ’402 patent discloses that the compositions produced according to the methods of the patent meet the fuel-defining ASTM International specifications. *Id.* at 18: 26–38.

C. Illustrative Claim

Claim 1 is the only independent claim of the ’402 patent, and is reproduced below:

1. A process for preparing renewable hydrocarbons comprising:
   (a) treating biomass to form a feedstock;
   (b) fermenting the feedstock with one or more species of microorganism, thereby forming one or more C_2–C_6 alcohols;

> (c) dehydrating at least a portion of the one or more C_2–C_6 alcohols obtained in step (b), thereby forming a product comprising one or more C_2–C_6 olefins;
>
> (d) isolating the one or more C_2–C_6 olefins;
>
> (e) oligomerizing at least a portion of the one or more C_2–C_6 olefins isolated in step (d), thereby forming a product comprising one or more C_6-C_{24} unsaturated oligomers; and
>
> (f) hydrogenating at least a portion of the product of step (e) in the presence of hydrogen, thereby forming a product comprising one or more C_6–C_{24} saturated alkanes;
>
> whereby the product of step (f) itself meets the requirements of at least one of ASTM D4814, ASTM D975, ASTM D910, or ASTM D1655, or a blend of at least 10% of the product of step (f) with a mixture of hydrocarbons meets the requirements of at least one of ASTM D4814, ASTM D975, ASTM D910 or ASTM D1655.

Id. at 62:11–33.

II. ANALYSIS

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); *see also In re Cuozzo Speed Techs., LLC,* 778 F.3d 1271, 1279–83 (Fed. Cir. 2015) ("Congress implicitly adopted the broadest reasonable interpretation standard in enacting the AIA," and "the standard was properly adopted by PTO regulation."). Under that standard, and absent any special definitions, we give claim terms 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).

We interpret the following claim terms of the challenged claims as part of our analysis.

1. *"whereby the product of step (f) itself meets the requirements of at least one of ASTM D4814 . . . ."*

Challenged claims 1–12, 15–17, 19–20, and 22–23 require products produced by the claimed method to meet requirements of certain standards developed by ASTM International, such as ASTM D4814, which is the standard specification for gasoline. Ex. 1014. Petitioner contends that the Patentee of the '402 patent acted as his own lexicographer by expressly disavowing ASTM D4814's distillation curve as a requirement for gasoline produced by the claimed process. Pet. 12–14. Petitioner directs our attention to the following portion of the '402 patent:

> The distillation curve of a gasoline mixture is measured using ASTM method D86, and the specification is calibrated by how the typical hydrocarbon mixtures that comprise gasoline behave in an engine. When a substantial amount of the hydrocarbon component in a gasoline mixture is replaced with a different type of organic compound, i.e. an alcohol such as n-butanol or isobutanol, the distillation curve will differ from what is specified in ASTM D4814, even though the blend has similar, if not identical, engine performance compared to unblended gasoline. For this reason, *the distillation curve specification is not used to describe the gasoline compositions of the present invention*.

Ex. 1001, 15:62–16:6 (emphasis added).

Patent Owner does not address claim construction or Petitioner's contention regarding the '402 patent disavowing ASTM D4814's distillation curve as a requirement for gasoline produced by the claimed process.

We agree with Petitioner that the above disclosure in the '402 patent amounts to an express disavowal of ASTM D4814's distillation curve as a requirement for products produced according to the method of challenged claims 1–12, 15–17, 19–20, and 22–23.

B. Principles of Law

To prevail in its challenges to the patentability of the claims, a petitioner must establish facts supporting its challenges by a preponderance of the evidence. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d). A claim is unpatentable under 35 U.S.C. § 102 if a prior art reference discloses every limitation of the claimed invention, either explicitly or inherently. *Glaxo Inc. v. Novopharm Ltd.*, 52 F.3d 1043, 1047 (Fed. Cir.1995); *see MEHL/Biophile Int'l Corp. v. Milgraum*, 192 F.3d 1362, 1365 (Fed. Cir. 1999) (holding that "[t]o anticipate, a single reference must teach every limitation of the claimed invention," and any limitation not taught explicitly must be taught inherently and would be so understood by a person experienced in the field); *In re Baxter Travenol Labs*., 952 F.2d 388, 390 (Fed. Cir. 1991) (the dispositive question is "whether one skilled in the art would reasonably understand or infer" that a reference teaches or discloses all of the elements of the claimed invention).

The principle of inherency, in the law of anticipation, requires that any information missing from the reference would nonetheless be known to be present in the subject matter of the reference, when viewed by persons experienced in the field of the invention. We note, however, that "anticipation by inherent disclosure is appropriate only when the reference discloses prior art that must *necessarily* include the unstated limitation, [or the reference] cannot inherently anticipate the claims." *Transclean Corp. v. Bridgewood Servs., Inc.*, 290 F.3d 1364, 1373 (Fed. Cir. 2002) (internal citation omitted); *see Hitzeman v. Rutter*, 243 F.3d 1345, 1355 (Fed. Cir. 2001) ("consistent with the law of inherent anticipation, an inherent property must necessarily be present in the invention described by the count, and it must be so recognized by persons of ordinary skill in the art") (citations omitted); *In re Robertson*, 169 F.3d 743, 745 (Fed. Cir. 1999) (that a feature in the prior art

reference "could" operate as claimed does not establish inherency). Thus, when a claim limitation is not set forth explicitly in a reference, evidence "must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill." *Continental Can Co.*, 948 F.2d 1264, 1268–69 (Fed. Cir. 1991) (citations omitted). It is not sufficient if a material element or limitation is "merely probably or possibly present" in the prior art. *Trintec Indus., Inc. v. Top-U.S.A. Corp.*, 295 F.3d 1292, 1295 (Fed. Cir. 2002) (citations omitted); s*ee W.L. Gore & Assocs., Inc. v. Garlock, Inc.*, 721 F.2d 1540, 1554 (Fed. Cir. 1983) (anticipation "cannot be predicated on mere conjecture respecting the characteristics of products that might result from the practice of processes disclosed in references") (citation omitted); *In re Oelrich*, 666 F.2d 578, 581 (CCPA 1981) (to anticipate, the asserted inherent function must be present in the prior art).

A claim is unpatentable under 35 U.S.C. § 103(a) 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. *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) objective evidence of nonobviousness, i.e., secondary considerations. *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

We analyze the instituted grounds of unpatentability in accordance with the above-stated principles.

C. Level of Ordinary Skill in the Art

In determining whether an invention would have been obvious at the time, it was made; we consider the level of ordinary skill in the pertinent art at the time of the invention. *Graham v. John Deere*, 383 U.S. at 17. "The importance of resolving the level of ordinary skill in the art lies in the necessity of maintaining objectivity in the obviousness inquiry." *Ryko Mfg. Co. v. Nu-Star, Inc.*, 950 F.2d 714, 718 (Fed. Cir. 1991).

Petitioner contends that a person of ordinary skill in the art at the time of the '402 patent would have a Ph.D. in Chemistry, Chemical Engineering, or a similar related discipline and would have experience in organic chemistry and/or fuel chemistry, as well as transportation fuel production. Pet. 4 (citing Ex. 1030 ¶ 16). Petitioner argues, in the alternative, that a person of ordinary skill in the art would have a Bachelor's degree in Chemistry, Chemical Engineering, or a similar related discipline and substantial experience in an industry involving organic chemistry and/or fuel chemistry, as well as transportation fuel production. *Id.* Patent Owner states that one of ordinary skill in the art at the time of the '402 patent would have a Ph.D. in Chemistry, Chemical Engineering, or a similar related discipline and would have experience in fuel chemistry. Tr. 42:21–43:12.

Based on our review of the '402 patent and the types of problems and solutions described in the '402 patent and cited prior art, we conclude a person of ordinary skill in the art at the time of the '402 patent would have a Ph.D. in Chemistry, Chemical Engineering, or a similar related discipline and some experience in an industry involving organic chemistry and/or fuel chemistry. Based on the stated qualifications of Joseph T. Joseph, Ph.D. (Ex. 1030 ¶¶ 9–14) and his Curriculum Vitae (Ex. 1035), Petitioner's declarant meets the requirements of this definition. We further note that the applied prior art reflects the appropriate

level of skill at the time of the claimed invention. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001).

D. Alleged Anticipation of Claims 1–10, 12, 15–17, 19–20, 22, and 23 by D'Amore

Petitioner contends D'Amore anticipates, under 35 U.S.C. § 102(e), claims 1–10, 12, 15–17, 19–20, 22, and 23 of the '402 patent. Pet. 19–42. For the following reasons, we determine Petitioner has not shown by a preponderance of the evidence that claims 1–10, 12, 15–17, 19–20, 22, and 23 are unpatentable under 35 U.S.C. § 102(e).

1. Overview of D'Amore

D'Amore describes an invention useful for the production of intermediate compounds used in transportation fuels such as gasoline. Ex. 1002 ¶ 20. Specifically, D'Amore discloses producing isobutanol (a C_2–C_6 alcohol) by culturing microorganisms in the presence of carbohydrates. Ex. 1003 ¶¶ 23, 56. D'Amore specifically teaches converting isobutanol into butene (a C_2–C_6 olefin) in the presence of a catalyst (*id.* ¶ 56, Fig. 1) and converting dimerized butene into isooctene (*id.* ¶¶ 64, 76). Recovered isooctene can be reacted with a hydrogenation catalyst to produce isooctane. *Id.* ¶¶ 57, 64, 76. D'Amore discloses that isooctane produced by the disclosed processes is useful as an additive to transportation fuels, such as gasoline. *Id.* at Abstract and ¶¶ 20, 64, 76.

2. Analysis

a. D'Amore Qualifies as 102(e) Prior Art

D'Amore was filed on June 13, 2007, published on June 5, 2008, and claims priority to U.S. Provisional Application No. 60/814,137 ("the '137 application"), filed on June 16, 2006. *See* Ex. 1004. The disclosure in the '137 application (Ex. 1004) is the same disclosure found in D'Amore (Ex. 1003). Ex. 1030 ¶ 46.

Thus, we conclude that D'Amore qualifies as prior art to the claims of the '402 patent under 35 U.S.C. § 102(e) as of the '137 application's filing date of June 16, 2006.

b. Independent Claim 1

Petitioner contends D'Amore, as summarized in the overview above, discloses each limitation of independent claim 1 of the '402 patent, except that D'Amore does not disclose explicitly that its products (e.g., isooctane) meet the requirements of at least one of ASTM D4814, ASTM D975, ASTM D910, or ASTM D1655, as recited in claim 1. Pet. 17–25. Petitioner contends, however, that the isooctane of D'Amore necessarily meets the requirements of, for example, ASTM D4814, without blending. *Id.* at 24–25; *see* Tr. 9:1–10:3. According to Petitioner, the product of D'Amore's process could contain up to 30% contamination with isobutene and the mixture would still meet the standards in ASTM D4814. Tr. 9:1–18; Ex. 1040 ¶¶ 17–18.

Petitioner relies on two Declarations from Dr. Joseph to support its position. *See* Exs. 1030, 1040. Dr. Joseph testifies that isooctane, a product of D'Amore's disclosed processes, meets the following criteria set forth in ASTM D4814: (i) the maximum vapor pressure of ASTM D4814 Table 1 (Ex. 1030 ¶¶ 50–51); (ii) the lead content maximum, copper strip corrosion maximum, silver strip corrosion maximum, solvent-washed gum content maximum, sulfur % mass maximum, oxidation stability minimum, and water tolerance of ASTM D4814 (*id*. ¶¶ 53–56); (iii) the vapor/liquid maximum ratio of ASTM D4814 Table 3 (*id*. ¶¶ 57–60); (iv) the "Workmanship" requirements of ASTM D4814 (*id*. ¶ 61); and (v) the antiknock requirements of ASTM D4814 (*id*. ¶ 62). Dr. Joseph also testifies that D'Amore's process necessarily would result in the production of isooctane free of lower molecular weight hydrocarbons, such as isobutene, and the recovered

isooctane would meet the requirements of ASTM D4814 on its own. Ex. 1040 ¶¶ 11–12. Dr. Joseph opines that a person of skill in the art would not be concerned by the presence of "contaminating" isobutene and that the isooctane produced by D'Amore's process still necessarily would meet the requirements of ASTM D4814 on its own or when blended, even if contaminating amounts isobutene were present. *Id.* ¶ 14.

Patent Owner disagrees with Petitioner's characterization of D'Amore and argues that D'Amore does not disclose, directly or inherently, a process for producing (1) "renewable hydrocarbons" which meet the requirements of at least one of ASTM D975, ASTM D910, or ASTM D1655, or (2) a blend of at least 10% of the product renewable hydrocarbons produced by the claimed process which meet the requirements of at least one of ASTM D975, ASTM D910, or ASTM D1655. PO Resp. 4–7. Additionally, Patent Owner argues that the isooctane produced by D'Amore may not be of sufficient purity to meet the standards of ASTM D4814, in particular. *Id.* at 5. According to Patent Owner,

> the process of *D'Amore* ***may*** just as readily produce isooctene having sufficiently high, *e.g.*, isobutene or other low molecular weight alkene content, whereby after hydrogenation the isooctane produced contains enough lower molecular weight hydrocarbons such that it fails to meet, *e.g.*, (i) the maximum vapor pressure standard of ASTM D4814 Table 1. For example, a fuel meeting the requirements of ASTM D4814 (distillation class AA) can have a maximum vapor pressure of 54 kPa. Isobutane has a vapor pressure of 760 mm Hg (101.325 kPa) at –11.7ºC. Thus, even the presence of a small amount of, *e.g.*, isobutane in the isooctane allegedly provided by the process of *D'Amore* could result in a product that itself fails to meet the requirements of, *e.g.*, ASTM D4814 . . . .

Id. at 5–6 (citing Ex. 1003, 74–76; Ex. 1004, Table 1). Patent Owner concludes that D'Amore's failure necessarily and inevitably to produce a product that meets claim 1 prohibits a finding that D'Amore inherently anticipates claim 1. *Id*. at 6–7.

We are unpersuaded by Petitioner's argument that isooctane produced by the process disclosed in D'Amore necessarily and inherently meets the specifications in ASTM D4814 as required in the "whereby" clause of claim 1. Pet. 24; Ex. 1001, 59:52–57. Although we credit the testimony of Dr. Joseph regarding the characteristics of pure isooctane and the impact of certain impurities on whether isooctane would meet the criteria set forth in ASTM D4814, we find insufficient support for Dr. Joseph's statement that "D'Amore's process would necessarily result in the production of isooctane free of lower molecular weight hydrocarbons, such as isobutane." Ex. 1040 ¶ 11. Dr. Joseph's testimony appears to be directed to the characteristics of pure isooctane (Tr. 7:16–20), however, D'Amore does not disclose the purity level of the isooctane produced by its process. Ex. 1003 ¶ 76. Despite the testimony provided by Dr. Joseph, we have insufficient information to determine how much isooctene is converted in D'Amore to isooctane. Ex. 1030 ¶¶ 42–47; Ex. 1040 ¶¶ 10–11. Furthermore, we have insufficient evidence to determine (1) what low molecular weight hydrocarbons may result from D'Amore's process or (2) the level of other low molecular weight hydrocarbons that may be present. The missing crucial link in Petitioner's analysis is the difference between pure isooctane as discussed by Dr. Joseph and the products possibly produced in D'Amore. Thus, we conclude that Petitioner has not carried its burden to show that D'Amore's product is pure isooctane, that the only possible contaminant is isobutene, that the isobutene is less than 30%, or that D'Amore's product has the exact properties as discussed by Dr. Joseph.

Accordingly, we find that Petitioner has not shown by a preponderance of the evidence that claim 1 is anticipated under 35 U.S.C. § 102(e) by D'Amore.

c. Dependent Claims

Claims 2–10, 12, 15–17, 19–20, 22, 23 depend from claim 1, and Petitioner contends that D'Amore discloses embodiments that teach aspects of each dependent claim. Pet. 25–38; Ex. 1030 ¶¶ 67–87. Patent Owner does not provide separate contentions regarding additional limitations recited in the dependent claims. After careful consideration of the language recited in claims 2–10, 12, 15–17, 19–20, 22, and 23, and the testimony of Dr. Joseph, we are unpersuaded that D'Amore anticipates these dependent claims for the same reasons discussed with respect to claim 1.

Accordingly, we find that Petitioner has not shown by a preponderance of the evidence that claims 2–10, 12, 15–17, 19–20, 22, and 23 are anticipated under 35 U.S.C. § 102(e) by D'Amore.

E. Obviousness of Claims 1–10, 12, 15–17, 19–20, 22, and 23 over the Combination of D'Amore and ASTM D4814

Petitioner argues that the combination of D'Amore, as summarized in the overview in Section II.D.1 above, and ASTM D4814 renders each of claims 1–10, 12, 15–17, 19–20, 22, and 23 obvious. Pet. 39–48. For reasons that follow, we determine Petitioner has shown by a preponderance of the evidence that claims 1–10, 12, 15–17, 19–20, 22, and 23 are unpatentable under 35 U.S.C. § 103(a).

1. Overview of ASTM D4814

ASTM D4814 describes standard specifications for automotive spark-ignition engine fuel (i.e., automotive fuel or gasoline). Ex. 1014 ¶ 1.3. Such specifications include the materials and manufacture of automotive fuel, how the

automotive fuel is tested, and the required performance characteristics of such fuel. *Id.*

2. Analysis

a. Independent Claim 1

Petitioner contends D'Amore, as summarized in the overview above, discloses each limitation of claim 1 of the '402 patent, except that D'Amore does not disclose explicitly that its products (e.g., isooctane) meet the requirements of at least one of ASTM D4814, ASTM D975, ASTM D910, or ASTM D1655, as recited in claim 1. Pet. 17–25. Petitioner further contends that a person of ordinary skill in the art would have had reason to reach the invention recited in claim 1 based on the combined teachings of D'Amore and ASTM D4814 (Ex. 1014), which discloses the standards for automotive fuel (i.e., gasoline) within the fuel industry. *Id.* at 45–47. According to Petitioner, although D'Amore does not disclose explicitly renewable isooctane meeting the standards set forth in ASTM D4184, a person of ordinary skill in the art would have had reason to review and meet the ASTM specifications when preparing automotive fuel, because the ASTM standards are used by governmental agencies to regulate the transportation fuel industry. Pet. 47 (citing Ex. 1030 ¶¶ 100–107). Petitioner reasons that a person of ordinary skill in the art would have had reason to modify the products of D'Amore to meet the ASTM D4814 specification in order to have a commercially useful fuel. *Id.*

Petitioner asserts that producing a renewable isooctane that meets the specifications of ASTM D4184 using D'Amore's process would have been obvious to a person of ordinary skill in the art and would have required no more than routine optimization. *Id.* at 46 (citing Ex. 1030 ¶¶ 100–107). Petitioner supports this assertion with the first Declaration of Dr. Joseph, who testifies that

the transportation fuel additives discussed in D'Amore are regulated by the Environmental Protection Agency ("EPA") and/or Federal Aviation Administration ("FAA"), which have incorporated ASTM standards into their regulations governing approval of transportation fuel. Ex. 1030 ¶¶ 48–49. Dr. Joseph further testifies that a person of ordinary skill in the art would understand that in order to be approved for commercial use as a transportation fuel, a hydrocarbon product would have to meet the ASTM standards. *Id.* ¶ 48. Dr. Joseph reasons that any alternative mechanism for bringing the product to market for the fuel industry would require "going through the lengthy, burdensome, and expensive testing process," and such process would render the fuel commercially unviable. *Id.* Dr. Joseph specifically states a person of skill in the art "reading D'Amore's disclosure of methods of making renewable isooctanes for use as a transportation fuel, including gasoline, would have had a reason to ensure that isooctane met the ASTM D4814 industry standard" because "meeting the requirements of ASTM D4814 is one step in the process of obtaining EPA approval to sell a gasoline." *Id*. ¶ 96. Moreover, Dr. Joseph testifies that isooctane, a product of D'Amore's disclosed processes, would meet the standards set forth in ASTM D4814. *Id.* ¶¶ 48–66.

Patent Owner contests Petitioner's position, arguing that ASTM D4814 merely provides a set of metrics to determine whether or not a given composition meets the limitations of the subject ASTM standard. PO Resp. 7–11. Patent Owner contends ASTM D4814 does not provide any disclosure or guidance regarding a ***process*** to make a fuel that meets the requirements of ASTM D4814. *Id*. at 9. According to Patent Owner, a person of skill in the art would need a reference detailing the process steps between D'Amore and ASTM D4814 in order to create a product that would comply with the specification in ASTM D4814,

because such information is not evidently and indisputably within the common knowledge of those skilled in the art. *Id*. at 9–10; Tr. 39:1–40:18. Patent Owner argues that the Declaration of Dr. Joseph (Ex. 1030) cannot support a finding of obviousness based on D'Amore and ASTM D4814, because: (1) the testimony is conclusory; (2) claim rejections must be based on prior art; and (3) rather than merely relying on the opinion of Dr. Joseph, a reference should be provided to establish that modifying the process of D'Amore as proposed was obvious. PO Resp. 9–10.

We find that D'Amore discloses each of required steps (a)–(f) of claim 1. First, D'Amore discloses steps (a) and (b) by treating an aqueous stream of biomass-derived carbohydrates that are fermented with microorganisms to create a fermentation broth that produces isobutanol ($C_4H_{10}O$, an alcohol). Ex. 1003 ¶¶ 56, 57. Second, D'Amore discloses step (c) by separating the isobutanol-rich phase dehydrating isobutanol (*id.* ¶¶ 3, 21) and using an acid catalyst to convert the dry isobutanol into isolated butene (C_4H_8, an alkene olefin) (*id*. ¶¶ 56–57). Lastly, D'Amore discloses steps (e) and (f) by oligomerizing butene into isooctene (C_8H_{16}, an unsaturated oligomer) (*id*. ¶¶ 64, 74) and hydrogenating the isooctene to form isooctane (C_8H_{18}, an saturated alkane)(*id*. ¶ 76). Therefore, we find that D'Amore discloses the required steps (a)–(f).

Claim 1 further recites "whereby the product of step (f) itself meets the requirements of at least one of ASTM D4814, ASTM D975, ASTM D910, or ASTM D1655, or a blend of at least 10% of the product of step (f) with a mixture of hydrocarbons meets the requirements of at least one of ASTM D4814, ASTM D975, ASTM D910 or ASTM D1655." Despite Patent Owner's contentions, we are persuaded by Petitioner's arguments and find that a person of ordinary skill in the art could have combined the teachings of D'Amore and ASTM D4814 to reach

the invention recited in the whereby clause of claim 1, and would have had reason to do so.

As discussed above, the level of skill in the art is that of a person with a doctoral degree in chemistry or related discipline (*see supra*, Section II.C.), and it is easier to establish obviousness under a higher level of ordinary skill in the art. *Kinetic Concepts, Inc. v. Smith & Nephew, Inc.*, 688 F.3d 1342, 1366 (Fed. Cir. 2012); *see also Innovention Toys, LLC v. MGA Entm't, Inc.*, 637 F.3d 1314, 1323–24 (Fed. Cir. 2011) (finding that a less sophisticated level of skill generally favors a determination of nonobviousness, while a higher level of skill favors the reverse). Given this high level of skill in the art, we credit the testimony of Dr. Joseph that a person of ordinary skill in the art would have had reason to modify the isooctanes of D'Amore to meet the ASTM D4814 specification (Ex. 1030 ¶¶ 90–99), and that such modifications could have been accomplished using routine optimization techniques that were common in the art (*id*. ¶ 98). Dr. Joseph cites to multiple publications providing several examples of well-known properties of isooctane and techniques to produce a mixture of saturated alkanes and aromatic hydrocarbons that meets ASTM D4814. *Id*. ¶¶ 17–19, 44–45, 91–98. Thus, we are persuaded that a Ph.D. chemist would have knowledge of routine techniques as discussed by Dr. Joseph and would have had a reasonable expectation that such techniques would be successful. *See, e.g.*, *Randall Mfg. v. Rea*, 733 F.3d 1355, 1363 (Fed. Cir. 2013) (recognizing that combining familiar elements with known functions, according to known methods, and yielding predictable results likely is obvious).

We are unpersuaded by Patent Owner's contention that "[p]etitioner attempts to circumvent the requirement that claims rejections be based on prior art by relying on Dr. Joseph's opinions." PO Resp. 10. Rather, we conclude that Petitioner relies on the testimony of Dr. Joseph to indicate the knowledge of one of

ordinary skill in the art in order to demonstrate that the teachings of D'Amore, in view of the teachings ASTM D4814, as understood by one of ordinary skill in the art, would have rendered the challenged claims obvious at the time of the invention. *See* Ex. 1030 ¶¶ 17–19, 44–45, 91–98.

We also are unpersuaded by Patent Owner's contentions that:

> [i]f the presently claimed process were indeed obvious, and the knowledge in the art was so readily known and available to one skilled in the art, Petitioner would not rely on the opinions of Dr. Joseph, but rather, would simply provide a reference to establish that modifying the process of D 'Amore as proposed was obvious

(PO Resp.10), because the Supreme Court has cautioned against the overemphasis on publications and the explicit contents of issued patents during an obviousness analysis. *KSR*, 550 U.S. at 415–16. In *KSR*, the Supreme Court criticized a rigid approach to determining obviousness based on the disclosures of individual prior art references, with little recourse to the knowledge, creativity, and common sense that an ordinarily skilled artisan would have brought to bear when considering combinations or modifications. *Id.* at 415–22. Thus, we conclude that a person with a doctoral degree in chemistry would not need a reference detailing the process steps between D'Amore and ASTM D4814 in order to create a product that would comply with the specification in ASTM D4814.

Accordingly, we find Dr. Joseph's testimony persuasive and hold that Petitioner has shown by a preponderance of the evidence that claim 1 is unpatentable under 35 U.S.C. § 103(a) for obviousness in view of the disclosures of D'Amore and ASTM D4814.

b. Dependent Claims

Claims 2–10, 12, 15–17, 19–20, 22, and 23 depend from claim 1, and Petitioner contends that D'Amore and ASTM D4814 teach or suggest each

dependent claim. Pet. 17–25, 39–45. Patent Owner does not provide separate contentions regarding additional limitations recited in the dependent claims. PO Resp. 11.

After careful consideration of the language recited in claims 2–10, 12, 15–17, 19–20, 22, and 23, we are satisfied D'Amore in view of ASTM D4814 teaches or suggests the elements recited in the dependent claims. *See e.g.*, Ex. 1003 ¶¶ 56, 75, 76 (disclosing dehydrating, oligomerizing, and hydrogenating in the presence of a catalyst, as recited in claim 2); ¶ 79 (disclosing two steps of claim 2 being carried out in the same reaction zone, as recited in claim 4); ¶¶ 21, 50, 75 (disclosing dehydrating and oligomerizing, and hydrogenating in the presence of an acidic catalyst, as recited in claims 5–7); ¶ 77 (disclosing list of hydrogenation, as recited in claim 9); ¶ 74 (disclosing C_1–C_6 alcohol isobutanol converted to isooctane to be used as a biofuel precursor, as recited in claim 16); ¶ 64 (disclosing C_2–C_6 alcohol isobutanol is converted to butene, which is oligomerized to isooctane and used as a biofuel precursor, as recited in claim 18); and ¶¶ 49, 91 (disclosing dehydration "reaction can be carried out in liquid or vapor phase . . . ," with a vapor phase being a gas phase as recited in claim 22).

Accordingly, we find that Petitioner has shown by a preponderance of the evidence that claims 2–10, 12, 15–17, 19–20, 22, and 23 are unpatentable under 35 U.S.C. § 102(e) because they would have been obvious in view of D'Amore and ASTM D4814.

F. Obviousness of Claim 11 over the Combination of D'Amore, Wilke, and ASTM D4814

1. Overview of Wilke

Wilke discloses a process for producing and recovering alcohols using a combination of vacuum fermentation and vacuum distillation. Ex. 1006, Abstract.

Wilke further discloses the fermentative production of alcohols below atmospheric pressure, such that a vapor of aqueous alcohol is removed. *Id.* at 5:12–17 and 7:67–8:1. Wilke specifically discloses that "[t]he pressure of the fermentation can be subatmospheric on the order of about 50 to 500 mm Hg." *Id.* at 5:12–17. Wilke also teaches that removing alcohol during the fermentative process by fermenting at reduced pressure would benefit the microorganisms by relieving any alcohol toxicity. *Id.* at 3:25–28.

2. Analysis

Petitioner contends that claim 11 would have been obvious over the combination of D'Amore, ASTM D4814, and Wilke. Pet. 49–53. Claim 11 provides as follows:

> 11. The process of claim 10, wherein said removing comprises carrying out said fermenting in step (b) below atmospheric pressure, whereby aqueous C_2–C_6 alcohol vapor is removed.

Petitioner refers to D'Amore's disclosure of a method for producing isooctane for use as an additive to transportation fuels. *Id.* ASTM D4814 is relied upon for defining standard specifications for automotive park-ignition engine fuel (i.e., gasoline) within the fuel industry. *Id.* (citing Ex. 1014). Such specifications include the materials and manufacture of gasoline, how the gasoline is tested, and the required performance characteristics of such fuel. Ex. 1014.

Petitioner contends that performing fermentation below atmospheric pressure was known in the art and determining the pressure at which to perform fermentation would have been a design choice. Pet. 51–52 (citing Ex. 1030 ¶ 126). Petitioner further contends that "fermenting at below atmospheric pressure would have been a matter of common sense and routine optimization based on the knowledge of techniques that would have yielded nothing more than predictable results." *Id.* at 52.

Patent Owner states that Wilke does not cure the deficiencies of the combination of D'Amore and ASTM D4814. PO Resp. 23–24. Yet, in its Response, Patent Owner does not present argument or evidence attempting to distinguish any other features of claim 11 over the prior art.

Our Scheduling Order in this case cautioned Patent Owner that "any arguments for patentability not raised in the [Patent Owner Response] will be deemed waived." Paper 14, 3. The Board's Trial Practice Guide, furthermore, states that the Patent Owner Response "should identify all the involved claims that are believed to be patentable and state the basis for that belief." Office Patent Trial Practice Guide, 77 Fed. Reg. 48,756, 48,766 (Aug. 14, 2012). Furthermore, as the Board has stated, our governing statute and Rules "clearly place some onus on the patent owner, once trial is instituted, to address the material facts raised by the petition as jeopardizing patentability of the challenged claims." *Johnson Health Tech Co. Ltd. v. Icon Health & Fitness, Inc.*, Case IPR2013-00463, slip op. at 12 (PTAB Jan. 29, 2015) (Paper 41). We do not consider any argument not presented in Patent Owner's Response.

In our Decision to Institute, we concluded that Petitioner had made a threshold showing that the combination of taught all the limitations of claim 11, sufficient for us to conclude that there was a reasonable likelihood that Petitioner would prevail in showing that the challenged claims were obvious over the combination of D'Amore, ASTM D4814, and Wilke. Dec. 14–15. The record contains the same arguments and evidence regarding the merits of this ground as it did at the time of our Decision to Institute. We must now determine whether the preponderance of the evidence of record supports a finding that the combination of D'Amore, ASTM D4814, and Wilke renders claim 11 obvious. 35 U.S.C. § 316(e).

As discussed above, we are persuaded by Petitioner's arguments and the supporting testimony of Dr. Joseph. Specifically, as discussed above, we are persuaded that D'Amore teaches each of required steps (a)–(f), the wherein clauses, and the whereby clause of claim 1. *See supra*, Section II.D.2.b. Claim 11 depends directly from claim 1. Based upon review of the evidence of record summarized above, Petitioner has set forth sufficiently how each element of claim 11 of the '402 patent is taught or suggested by D'Amore, ASTM D4814, and Wilke. Furthermore, Petitioner has presented articulated reasoning with rational underpinning to support the combination of D'Amore, ASTM D4814, and Wilke. *See KSR Int'l Co.*, 550 U.S. at 418.

Accordingly, we determine that Petitioner has shown by a preponderance of the evidence that claim 11 is unpatentable under 35 U.S.C. § 103(a) for obviousness in view of the disclosures of D'Amore, Wilke, and ASTM D4814.

G. Obviousness of Claim 13 over the Combination of D'Amore and ASTM D975

Petitioner argues that the combination of D'Amore and ASTM D975 renders claim 13 obvious. Pet. 45–47. In view of the overview of D'Amore provided above (*see supra*, Section II.D.1) and for reasons that follow, we determine Petitioner has shown by a preponderance of the evidence that claim 13 is unpatentable under 35 U.S.C. § 103(a).

1. Overview of ASTM D975

ASTM D975 describes standard specifications for diesel fuel oils (i.e., diesel fuel). Ex. 1015. Such specifications include the materials and manufacture of diesel fuel, how the diesel fuel is tested, and the required performance characteristics of such fuel. *Id.*

2. Analysis

Claim 13 provides as follows:

> 13. A process of preparing a renewable diesel fuel comprising the method of claim 1, whereby the product of step (f) itself meets the requirements of ASTM D975, or a blend of at least 10% of the product of step (f) with a mixture of hydrocarbons meets the requirements of ASTM D975.

Petitioner contends that a person of ordinary skill in the art would have had reason to reach the invention recited in claim 10 based on the combined teachings of D'Amore, which discloses a method for producing isooctane used in transportation fuels such as diesel fuel (Ex. 1003 ¶ 20), and ASTM D975, which discloses the standards for diesel fuel within the fuel industry (Ex. 1015). Pet. 45–47. According to Petitioner, although D'Amore does not disclose explicitly renewable isooctane meeting the standards set forth in ASTM D975, a person of ordinary skill in the art would have had reason to review and meet the ASTM specifications when preparing diesel fuel, because the ASTM standards are used by governmental agencies to regulate the transportation fuel industry. *Id.* at 45–46 (citing Ex. 1030 ¶¶100–107). Petitioner reasons that a person of ordinary skill in the art would have had reason to modify the products of D'Amore to meet the ASTM D975 specification in order to have a commercially useful diesel fuel. Pet. 46–47; Ex. 1030 ¶ 102.

Petitioner further contends that producing a renewable isooctane that meets the specifications of ASTM D975 using D'Amore's process would have been obvious to a person of ordinary skill in the art and would have required no more than routine optimization. *Id.* at 46–47 (citing Ex. 1030 ¶ 104). Petitioner's position is supported by the testimony of Dr. Joseph, who states a person of skill in the art would have been able to modify D'Amore's process to produce saturated

alkanes that meet the ASTM D975 industry standard. Ex. 1030 ¶¶ 102. Dr. Joseph explains that "[f]or example, isooctaness kinematic viscosity is below that required in ASTM D975[, but a person of ordinary skill in the art] would have readily been able to modify D'Amore's process to increase the kinematic viscosity of the product by running the oligomerization step further to produce not only dimers, but also trimers and tetramers in order to ASTM D975's requirements." *Id.* ¶ 103. Dr. Joseph further testifies that "[s]imilarly, D975 requires a certain cetane number for diesel fuel[, and a person of ordinary skill in the art] would have known that a fuel with a high octane number has a low cetane number (and vice versa)." *Id.* ¶ 104 (citing Ex. 1015, Table 1; Ex. 1021, 8). Dr. Joseph concludes that a person of ordinary skill in the art would have the knowledge and skill to optimize the processes disclosed in D'Amore to meet the parameters of ASTM D975. *Id.* ¶ 106.

Patent Owner contests Petitioner's position, contending that claim 1 is not rendered obvious merely by providing D'Amore's methods and a set of metrics to determine whether or not a given composition meets the limitations of a subject ASTM standard. PO Resp. 11–15. Patent Owner also proffers the same arguments as presented against the combination of D'Amore and ASTM D4814. *Id.*

We are persuaded by Petitioner's arguments and the supporting testimony of Dr. Joseph. Despite Patent Owner's contentions, we are persuaded by Petitioner's arguments and find that a person of ordinary skill in the art could have combined the teachings of D'Amore and ASTM D975 to reach the invention recited in dependent claim 10, and would have had reason to do so. As discussed above, the level of skill in the art is that of a person with a doctoral degree in chemistry or related discipline (*see supra*, Section II.C.). Given this high level of skill in the art, we credit the testimony of Dr. Joseph that a person of ordinary skill in the art would have had reason to modify the isooctanes of D'Amore to meet the ASTM

D975 specification (Ex. 1030 ¶¶ 100–107), and that such modifications could have been accomplished using routine optimization techniques that were common in the art (*id*. ¶ 106). Dr. Joseph cites to multiple publications providing several examples of well-known properties of isooctane and techniques to produce a mixture of saturated alkanes and aromatic hydrocarbons that meet ASTM D975. *Id*. ¶¶ 103–104 (citing Exs. 1019, 1021, 1029, 1037, 1038). Thus, we find that a Ph.D. chemist would have knowledge of routine techniques as discussed by Dr. Joseph and would have had a reasonable expectation that such techniques would be successful. *See, e.g.*, *Randall Mfg.*, 733 F.3d at 1363.

As discussed in detail above (*see supra*, Section II.D.3.b), we are unpersuaded by Patent Owner's contentions regarding Dr. Joseph's testimony. PO Resp. 12–14. Rather, we conclude that Petitioner relies on the testimony of Dr. Joseph to indicate the knowledge of one of ordinary skill in the art in order to demonstrate that the teachings of D'Amore, in view of the teachings ASTM D975, as understood by one of ordinary skill in the art, would have rendered the challenged claims obvious at the time of the invention. *See* Ex. 1030 ¶¶ 100–107 (citing Exs. 1019, 1021, 1029, 1037, 1038).

Accordingly, we find Dr. Joseph's testimony persuasive and hold that Petitioner has shown by a preponderance of the evidence that claim 13 is unpatentable under 35 U.S.C. § 103(a) for obviousness in view of the disclosures of D'Amore and ASTM D975.

H. Obviousness of Claim 14 over the Combination of D'Amore and ASTM D1655

Petitioner contends that claim 14 would have been obvious over the combination of D'Amore and ASTM D1655. Pet. 50–52. Claim 14 provides as follows:

> 14. A process of preparing a renewable jet fuel comprising the method of claim 1, whereby the product of step (f) itself meets the requirements of ASTM D1655, or a blend of at least 10% of the product of step (f) with a mixture of hydrocarbons meets the requirements of ASTM D1655.

As in previous grounds, Petitioner refers to D'Amore's disclosure of a method for producing isooctane for use as an additive to transportation fuels such as jet fuel. *Id.* (citing Ex. 1003 ¶ 20). ASTM D1655 describes standard specifications for aviation turbine fuels. Ex. 1017. Such specifications include the materials and manufacture of aviation turbine fuels, how the fuels are tested, and the performance characteristics of such fuel. *Id.*

Petitioner contends that a person of ordinary skill in the art would have had reason to reach the invention recited in claim 14 based on the combined teachings of D'Amore and ASTM D1655. Pet. 47–49. According to Petitioner, although D'Amore does not disclose explicitly renewable isooctane meeting the standards set forth in ASTM D1655, a person of ordinary skill in the art would have had reason to review and meet the ASTM specifications when preparing jet fuel, because the ASTM standards are used by governmental agencies, such as the FAA, to regulate the jet fuel industry. Pet. 48–49 (citing Ex. 1030 ¶¶ 108–113). Petitioner reasons that a person of ordinary skill in the art would have had reason to modify the products of D'Amore to meet the ASTM D1655 specification in order to have an approvable and sellable jet fuel. *Id.* (citing Ex. 1030 ¶¶ 110–113).

Petitioner further contends that producing a renewable isooctane that meets the specifications of ASTM D1655 using D'Amore's process would have been obvious to a person of ordinary skill in the art and would have required no more than routine optimization. *Id.* (citing Ex. 1030 ¶¶ 111–113). Petitioner's position is supported by the testimony of Dr. Joseph, who states a person of skill in the art

would have been able to modify D'Amore's process to produce alkanes that meet the ASTM D1655 industry standard. Ex. 1030 ¶ 109. Dr. Joseph explains that "[f]or example [a person of ordinary skill in the art] would have known that if the specific properties of a reaction product, such as its density, would fail to meet ASTM D1655's requirements, then continuing oligomerization to increase the chain length of the reaction product would increase those properties." *Id.* ¶ 110 (footnote omitted). Dr. Joseph concludes that a person of ordinary skill in the art would have the knowledge and skill to optimize the processes disclosed in D'Amore to meet the parameters of ASTM D1655. *Id.* ¶ 112.

Patent Owner contests Petitioner's position, contending that ASTM D1655 merely provides a set of metrics to determine whether or not a given composition meets the limitations of the subject ASTM standard, and proffering the same arguments as present regarding the combination of D'Amore and ASTM D4814. PO Resp. 15–19.

We are persuaded by Petitioner's arguments and the supporting testimony of Dr. Joseph. Specifically, as discussed above, we are persuaded that D'Amore teaches each of required steps (a)–(f), the wherein clauses, and the whereby clause of claim 1. *See supra*, Section II.D.2.b. Claim 14 depends directly from claim 1. Despite Patent Owner's contentions, we are persuaded by Petitioner's arguments and find that a person of ordinary skill in the art could have combined the teachings of D'Amore and ASTM D1655 to reach the invention recited in dependent claim 14, and would have had reason to do so. As discussed above, the level of skill in the art is that of a person with a doctoral degree in chemistry or related discipline (*see supra*, Section II.C.), and it is easier to establish obviousness under a higher level of ordinary skill in the art. *Kinetic Concepts, Inc. v. Smith & Nephew, Inc.*, 688 F.3d 1342, 1366 (Fed. Cir. 2012); *see also Innovention Toys,*

LLC v. MGA Entm't, Inc., 637 F.3d 1314, 1323–24 (Fed. Cir. 2011) (finding that a less sophisticated level of skill generally favors a determination of nonobviousness, while a higher level of skill favors the reverse). Given this high level of skill in the art, we credit the testimony of Dr. Joseph that a person of ordinary skill in the art would have had reason to modify the isooctanes of D'Amore to meet the ASTM D1655 specification (Ex. 1030 ¶¶ 108–113), and that such modifications could have been accomplished using routine optimization techniques that were common in the art (*id*. ¶ 112). Dr. Joseph cites to multiple publications providing several examples of well-known properties of isooctane and techniques to produce a mixture of saturated alkanes and aromatic hydrocarbons that meet ASTM D1655. *Id*. ¶¶ 110 (citing Exs. 1017, 1019, 1023). Thus, we find that a Ph.D. chemist would have knowledge of routine techniques as discussed by Dr. Joseph and would have had a reasonable expectation that such techniques would be successful. *See, e.g.*, *Randall Mfg.*, 733 F.3d at 1363.

As discussed in detail above (*see supra*, Section II.D.2.b), we are unpersuaded by Patent Owner's contentions regarding Dr. Joseph's testimony. PO Resp. 16–19. Rather, we conclude that Petitioner relies on the testimony of Dr. Joseph to indicate the knowledge of one of ordinary skill in the art in order to demonstrate that the teachings of D'Amore, in view of the teachings ASTM D1655, as understood by one of ordinary skill in the art, would have rendered the challenged claims obvious at the time of the invention. *See* Ex. 1030 ¶¶ 110 (citing Exs. 1017, 1019, 1023).

Accordingly, we find Dr. Joseph's testimony persuasive and hold that Petitioner has shown by a preponderance of the evidence that claim 14 is unpatentable under 35 U.S.C. § 103(a) for obviousness in view of the disclosures of D'Amore and ASTM D1655.

I. Obviousness of Claim 21 over the Combination of D'Amore and ASTM D910

Petitioner contends that claim 21 would have been obvious over the combination of D'Amore and ASTM D910. Pet. 49–51. Claim 21 provides as follows:

> 21. A process of preparing a renewable aviation gasoline comprising the method of claim 1, whereby the product of step (f) itself meets the requirements of ASTM D910, or a blend of at least 10% of the product of step (f) with a mixture of hydrocarbons meets the requirements of ASTM D910.

As in previous grounds, Petitioner refers to D'Amore's disclosure of a method for producing isooctane for use as an additive to transportation fuels such as gasoline and jet fuel. *Id.* (citing Ex. 1003 ¶ 20). ASTM D910 describes standard specifications for aviation gasolines. Ex. 1016. Such specifications include the materials and manufacture of aviation turbine fuels, how the fuels are tested, and the performance characteristics of such fuel. *Id.*

Petitioner contends that a person of ordinary skill in the art would have had reason to reach the invention recited in claim 12 based on the combined teachings of D'Amore and ASTM D910. Pet. 49–51. According to Petitioner, although D'Amore does not disclose explicitly renewable isooctane meeting the standards set forth in ASTM D910, a person of ordinary skill in the art would have had reason to review and meet the ASTM specifications when preparing aviation gasolines, because the ASTM standards are used by governmental agencies, such as the FAA, to regulate the aviation fuel industry. *Id.* (citing Ex. 1030 ¶¶ 114–119). Petitioner reasons that a person of ordinary skill in the art would have had reason to modify the products of D'Amore to meet the ASTM D910 specification in order to have an approvable and sellable jet fuel. *Id.*

Petitioner further contends that producing a renewable isooctane that meets the specifications of ASTM D910 using D'Amore's process would have been obvious to a person of ordinary skill in the art and would have required no more than routine optimization. *Id.* at 49–50 (citing Ex. 1030 ¶¶ 114–122). Petitioner's position is supported by the testimony of Dr. Joseph, who states a person of skill in the art would have been able to modify D'Amore's process to produce saturated alkanes that meet the ASTM D9 10 industry standard. Ex. 1030 ¶¶ 115–117. Dr. Joseph explains that, for example, a person of ordinary skill in the art "would have looked to isooctane's physical properties, such as vapor pressure, and compared those to the ASTM D910's requirements." *Id.* ¶ 116. Dr. Joseph then states that "[t]o increase the vapor pressure, a [person of ordinary skill in the art] could have optimized D'Amore's process by blending lighter weight alkanes, such as isobutanes to meet the vapor pressure requirement." *Id.* Dr. Joseph concludes that a person of ordinary skill in the art would have the knowledge and skill to optimize the processes disclosed in D'Amore to meet the parameters of ASTM D910. *Id.* ¶¶ 117–118.

Patent Owner contests Petitioner's position, contending that ASTM D910 merely provides a set of metrics to determine whether or not a given composition meets the limitations of the subject ASTM standard, and proffering the same arguments as presented regarding the combination of D'Amore and ASTM D4814. PO Resp. 20–23.

We are persuaded by Petitioner's arguments and the supporting testimony of Dr. Joseph. Specifically, as discussed above, we find that D'Amore teaches each of required steps (a)–(f), the wherein clauses, and the whereby clause of claim 1. *See supra*, Section II.D.2.b. Claim 21 depends directly from claim 1. Despite Patent Owner's contentions, we are persuaded by Petitioner's arguments and find

that a person of ordinary skill in the art could have combined the teachings of D'Amore and ASTM D910 to reach the invention recited in dependent claim 21, and would have had reason to do so. As discussed above, the level of skill in the art is that of a person with a doctoral degree in chemistry or related discipline (*see supra*, Section II.C.). Given this high level of skill in the art, we credit the testimony of Dr. Joseph that a person of ordinary skill in the art would have had reason to modify the isooctanes of D'Amore to meet the ASTM D910 specification (Ex. 1030 ¶¶ 114–118), and that such modifications could have been accomplished using routine optimization techniques that were common in the art (*id*. ¶ 117). Thus, we find that a Ph.D. chemist would have knowledge of routine techniques as discussed by Dr. Joseph and would have had a reasonable expectation that such techniques would be successful. *See, e.g.*, *Randall Mfg.*, 733 F.3d at 1363.

As discussed in detail above (*see supra*, Section II.D.2.b), we are unpersuaded by Patent Owner's contentions regarding Dr. Joseph's testimony. PO Resp. 22–23. Rather, we conclude that Petitioner relies on the testimony of Dr. Joseph to indicate the knowledge of one of ordinary skill in the art in order to demonstrate that the teachings of D'Amore, in view of the teachings ASTM D910, as understood by one of ordinary skill in the art, would have rendered the challenged claims obvious at the time of the invention. *See* Ex. 1030 ¶¶ 114–118 (citing Ex. 1019).

Accordingly, we find Dr. Joseph's testimony persuasive and hold that Petitioner has shown by a preponderance of the evidence that claim 21 is unpatentable under 35 U.S.C. § 103(a) for obviousness in view of the disclosures of D'Amore and ASTM D910.

III. CONCLUSION

We conclude Petitioner has shown the following by a preponderance of the evidence:

1. Unpatentability of claims 1–10, 12, 15–17, 19–20, 22, and 23 under 35 U.S.C. § 103(a) for obviousness over D'Amore and ASTM D4814;
2. Unpatentability of claim 11, under 35 U.S.C. § 103(a) for obviousness over D'Amore, Wilke, and ASTM D4814;
3. Unpatentability of claim 13, under 35 U.S.C. § 103(a) for obviousness over D'Amore and ASTM D975;
4. Unpatentability of claim 14 under 35 U.S.C. § 103(a) for obviousness over D'Amore and ASTM D1655; and
5. Unpatentability of claim 21 under 35 U.S.C. § 103(a) for obviousness over D'Amore and ASTM D910.

IV. ORDER

For the reasons given, it is

ORDERED that claims 1–17 and 19–23 of the '402 patent are unpatentable;

FURTHER ORDERED that because this is a Final Written Decision, 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.

PETITIONER:

Deborah A. Sterling
Peter A. Jackman
STERNE, KESSLER, GOLDSTEIN & FOX P.L.L.C.
dsterlin-PTAB@skgf.com
pjackman-PTAB@skgf.com

PATENT OWNER:

Thomas Blinka
William Brow
COOLEY LLP
tblinka@cooley.com
wbrow@cooley.com

Brett Lund
GEVO, INC
blund@gevo.com