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Paper No. 10
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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

HUBEI GRAND LIFE SCIENCE AND TECHNOLOGY CO., LTD,
Petitioner,

v.

VITAWORKS IP, LLC,
Patent Owner.

Case IPR2018-01767
Patent 9,428,451 B2

Before ERICA A. FRANKLIN, JENNIFER MEYER CHAGNON, and TIMOTHY G. MAJORS, *Administrative Patent Judges*.

FRANKLIN, *Administrative Patent Judge*.

DECISION
Institution of *Inter Partes* Review
35 U.S.C. § 314

I. INTRODUCTION

Hubei Grand Life Science and Technology Co., Ltd. ("Petitioner"),[1] filed a Petition to institute *inter partes* review of claims 1–8 of U.S. Patent No. 9,428,451 B2 (Ex. 1001, "the '451 patent"). Paper 2 ("Pet."). Vitaworks IP, LLC ("Patent Owner") filed a Preliminary Response to the Petition. Paper 6 ("Prelim. Resp.").

We have authority to determine whether to institute an *inter partes* review. 35 U.S.C. § 314(b); 37 C.F.R. § 42.4(a). Upon considering the Petition, we determine that Petitioner has shown a reasonable likelihood that it would prevail in showing the unpatentability of at least one challenged claim. Accordingly, we institute an *inter partes* review of all challenged claims based upon all grounds raised in the Petition.

A. Related Proceedings

Petitioner states that it is a named defendant in *Vitaworks IP, LLC v. Hubei Grand Life Science and Technology Co., Ltd. et al.*, No. 2:17-cv-12358-CCC-MF (D.N.J. filed Dec. 1, 2017), a litigation in which the '451 patent is asserted. Pet. 3. According to Petitioner, however, Vitaworks IP, LLC, has not served a complaint in that proceeding on Petitioner. *Id.* at 3–4. Petitioner also identifies two other pending litigations related to the '451 patent. *Id.* at 4. Patent Owner identifies the same three proceedings. Paper 4, 1.

[1] Petitioner identifies a number of entities as the real parties-in-interest in this proceeding. Pet. 3. We do not repeat that listing here.

As for related matters before the Board, Petitioner identifies two pending petitions for *inter partes* review, which were filed concurrently with the present Petition. Pet. 4. Those petitions challenge U.S. Patent No. 9,428,450 B2 ("the '450 patent") (IPR2018-01766) and U.S. Patent No. 9,573,890 B2 ("the '890 patent") (IPR2018-01768).[2] *Id.*

B. The '451 Patent

The '451 patent describes "a cyclic process for the production of taurine from alkali isethionate and from alkali vinyl sulfonate in a high overall yield . . . by continuously converting the byproducts of the ammonolysis reaction, alkali ditaurinate and alkali tritaurinate, to alkali taurinate." Ex. 1001, 1:12–17. Taurine, 2-aminoethanesulfonic acid, "is one of the amino sulfonic acids found in the tissues of many animals," and exhibits "such pharmacological effects as detoxification effect, fatigue-relieving effect and nourishing and tonifying effect." *Id.* at 1:22–27. Thus, "taurine finds wide applications as an essential ingredient for human and animal nutrition." *Id.* at 1:27–28.

The '451 patent describes an existing method of producing taurine known as the "ethylene oxide process," *id.* at 1:31–37, which we may refer to as the "EO process." In this process, ethylene oxide is first reacted with sodium bisulfite to produce sodium isethionate, which is then subjected to an ammonolysis reaction to yield sodium taurinate. *Id.* at 1:34–35. The ammonolysis reaction may be catalyzed with, e.g., sodium sulfate, sodium sulfite, or sodium carbonate. *Id.* at 1:61–63. The resulting sodium taurinate

[2] The '451 patent issued on a continuation-in-part (CIP) application to the application that issued as the '450 patent; the '890 patent issued on a CIP application of the application that issued as the '451 patent.

is then neutralized with an acid (e.g., hydrochloric acid, and preferably sulfuric acid), to produce taurine. *Id.* at 1:35–37.

According to the '451 patent, this EO process is "well established and widely practiced in commercial production." *Id.* at 1:38–39. Nevertheless, the '451 patent explains, "overall yield is not very high," and "the process generates a large amount of waste stream that is increasingly difficult to dispose of." *Id.* at 1:39–42. The Specification explains that byproducts of the EO process include, among other compounds, alkali ditaurinate and alkali tritaurinate. Specifically, the '451 patent states, "[f]rom these prior arts, it is therefore concluded that the ammonolysis of sodium isethionate invariably yields a mixture of sodium taurinate, sodium ditaurinate, and sodium tritaurinate." *Id.* at 2:15–18.

By neutralizing with an acid, as noted above, the sodium taurinate can be converted to taurine and filtered out. Ex. 1001, 2:30–32 (describing a known technique wherein "[c]rude taurine is easily obtained [following neutralization of sodium taurinate in acid] by filtration from a crystalline suspension of taurine after cooling"). The remaining waste supernatant, also known as the "mother liquor," still includes taurine, sodium sulfate, along with byproducts of the reaction, i.e., sodium ditaurinate, sodium tritaurinate, and sodium isethionate. *Id.* at 2:32–34, 58–67.

According to the '451 patent, an object of the invention is to provide a cyclic process for the production of taurine, wherein the above-mentioned byproducts—particularly sodium ditaurinate and/or sodium tritaurinate—can be recycled and subjected to further ammonolysis to increase the production of sodium taurinate and, hence, taurine. *Id.* at 2:38–67. The Specification discloses that "[t]he mother liquor, consisting of sodium taurinate, sodium ditaurinate, sodium tritaurinate, and sodium isethionate, is recycled to the

ammonolysis reaction to produce sodium taurinate." *Id.* at 2:64–67. The Specification states, "[w]hen sodium ditaurinate and sodium tritaurinate are reacted with aqueous ammonia under ammonolysis reaction conditions, a mixture of similar compositions of sodium taurinate, ditaurinate, and tritaurinate is formed in an equilibrium state. This novel finding renders the cyclic process possible." Ex. 1001, 2:50–55; *see also id.* at 4:6–9 ("[T]he inevitable byproducts of the ammonolysis step, i.e., sodium ditaurinate and sodium tritaurinate, can be continuously converted to sodium taurinate in each successive cycle.").[3]

C. Illustrative Claim

Petitioner challenges claims 1–8. Claim 1, the only independent claim, is illustrative and reads as follows:

> 1. A cyclic process for the production of taurine from alkali isethionate, comprising:
>
> (a) adding an excess of ammonia to a solution of alkali isethionate and subjecting the solution to ammonolysis reaction in the presence of one or more catalysts to yield a mixture of alkali taurinate, alkali ditaurinate, alkali tritaurinate, and unreacted alkali isethionate;
>
> (b) recovering the excess ammonia from (a) and neutralizing the solution with sulfuric acid to obtain a crystalline suspension of taurine in a solution of alkali sulfate, alkali ditaurinate, alkali tritaurinate, and alkali isethionate;
>
> (c) separating taurine from (b) to provide a mother liquor
>
> (d) adjusting the pH of the mother liquor to basic to

[3] Although the '451 patent discloses a cyclic or continuous process, the patent states that the "invention can be carried out discontinuously, semi-continuously, and continuously." Ex. 1001, 6:7–9. The patent further indicates that its examples are not intended to be limiting. *Id.* at 6:13–14.

convert taurine present in the mother liquor to alkali taurinate and prevent the crystallization of taurine, and removing alkali sulfate from the mother liquor by performing evaporative crystallization and cooling crystallization through solid-liquid separation;

(e) returning the mother liquor of (d) to (a) for further ammonolysis of alkali ditaurinate, alkali tritaurinate, and unreacted alkali isethionate.

Ex. 1001, 8:15–36.

D. The Asserted Grounds of Unpatentability

Petitioner challenges the patentability of claims 1–8 of the '451 patent on the following grounds:

Claims	Basis	References
1–8	§ 103(a)	Liu,[4] Bondareva,[5] DD 023[6]
1–8	§ 103(a)	Chen,[7] Bondareva, DD 023
1–8	§ 103(a)	Wu,[8] Chen, Bondareva, DD 023

[4] Liu Fuming, *Process Design of Taurine Ammonolysis*, 5:8 CHINA CHEMICAL TRADE 120 (2013) (Ex. 1017), English Translation (Ex. 1018) ("Liu").
[5] O.M. Bondareva et al., *Synthesis of Taurine*, 42 J. PHARM. CHEM. 142 (2008) (Ex. 1025) ("Bondareva").
[6] Bach, et al., DD 219 023 A3, published Feb. 20, 1985 (Exhibit 1009), English Translation (Ex. 1010) ("DD 023").
[7] Yong Chen, US 2014/0121405, published May 1, 2014 (Ex. 1021) ("Chen").
[8] Wu Jiang et al., *Optimization on Ammonolysis in Manufacturing Method of Taurine*, 19:1 JOURNAL OF HUBEI POLYTECHNIC UNIVERSITY 23–26 (2004) (Ex. 1014), English Translation (Ex. 1015) ("Wu").

Petitioner also relies on the Declaration of Mark A. Lipton, Ph.D. (Ex. 1003), among other evidence. Patent Owner relies upon the Declaration of Robert E. Maleczka, Jr., Ph.D. (Ex. 2001).

II. ANALYSIS

A. Claim Construction

In an *inter partes* review, we interpret claim terms in an unexpired patent based on the broadest reasonable construction in light of the specification of the patent in which they appear. 37 C.F.R. § 42.100(b) (2018); *Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2142 (2016) (affirming applicability of the broadest reasonable construction standard in *inter partes* review proceedings).[9] 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); *TriVascular, Inc. v. Samuels*, 812 F.3d 1056, 1062 (Fed. Cir. 2016) ("Under a broadest reasonable interpretation, words of the claim must be given their plain meaning, unless such meaning is inconsistent with the specification and prosecution history.").

Any special definitions for claim terms must be set forth with reasonable clarity, deliberateness, and precision. *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994).

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[9] The Final Rule changing the claim construction standard in IPR proceedings does not apply here, as the Petition was filed before the rule's effective date, November 13, 2018. *See* Changes to the Claim Construction Standard for Interpreting Claims in Trial Proceedings Before the Patent Trial and Appeal Board, 83 Fed. Reg. 51,340, 51,340, 51,344 (Oct. 11, 2018). Nevertheless, we do not perceive on this record that the construction would be different if the standard in the above-noted Final Rule were applied.

In the Petition and the Patent Owner's Preliminary Response, neither party contends that any claim terms require express construction. Pet. 10; Prelim. Resp. 9. We agree. *See Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (only terms that are in controversy need to be construed, and only to the extent necessary to resolve the controversy); *see also Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (applying *Vivid Techs.* in the context of an *inter partes* review).

After Patent Owner's Preliminary Response was filed, however, an issue arose related to whether the claims require a "second" or "subsequent" ammonolysis step.[10] *See* Paper 8, 5–6; Paper 9, 1–3. We address that issue here.

According to Petitioner, the question whether the claims require a "second" ammonolysis step is "not an issue of claim construction," but instead goes to Patent Owner's attempt to distinguish the cited prior art. Paper 8, 5–6. In particular, Petitioner contends Patent Owner is urging that the claims require a "second" ammonolysis step because Patent Owner argues that the prior art discloses a first ammonolysis reaction, but does not describe "precise conditions" for a second ammonolysis reaction. *Id.* at 6. In any event, Petitioner contends "[t]he claims themselves" confirm that a second ammonolysis step is not required. *Id.* at 5 (citing, e.g., dependent

[10] The Board held a conference call with counsel for the parties, and the Board authorized further pre-institution briefing on two issues: (i) whether statements of Patent Owner in other proceedings were inconsistent with positions taken in the Preliminary Response; and (ii) whether the claims require a second ammonolysis step. Paper 8 (Petitioner's Reply); Paper 9 (Patent Owner's Sur-Reply).

claim 2 of the '450 patent, IPR2018-01766, Ex. 1001, and dependent claim 2 of the '890 patent, IPR2018-01768, Ex. 1001).

Patent Owner responds that "[t]he claims at issue in all three patents ['450 patent, '451 patent, and '890 patent] require a 'second' or subsequent ammonolysis reaction." Paper 9, 1. According to Patent Owner, a "first" ammonolysis is one conducted first in time and without any "alkali di- and/or tritaurinate, (collectively 'ditaurinate')." *Id.* Patent Owner contends that "[i]n all the challenged claims ditaurinate is present in the reaction mixture before ammonolysis [and] therefore they all read on a second ammonolysis." *Id.*

We determine, for purposes of this Decision, that the process recited in independent claim 1 of the '451 patent includes an ammonolysis reaction in step (a), followed by another ammonolysis reaction, which occurs as a result of step (e), i.e., "returning the mother liquor of (d) to (a) for further ammonolysis of alkali ditaurinate, alkali tritaurinate, and unreacted alkali isethionate." Ex. 1001, 8:17–21, 34–36. In other words, unlike in the '450 patent and '890 patent, claim 1 of the '451 patent includes a step that expressly requires "returning," i.e., cycling, the mother liquor to the same ammonolysis step recited in step (a). Insofar as that cycling step leads to a later, subsequent, or second ammonolysis step, we agree with Patent Owner. However, that "second" ammonolysis proceeds in the same manner as the "first," because it follows the same recited reaction process recited in step (a). Thus, we disagree with Patent Owner that the first and second ammonolysis involve different *reaction* steps.

B. Level of Ordinary Skill in the Art

The level of skill in the art is a factual determination that provides a primary guarantee of objectivity in an obviousness analysis. *Al-Site Corp. v.*

VSI Int'l Inc., 174 F.3d 1308, 1324 (Fed. Cir. 1999) (citing *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966); *Ryko Mfg. Co. v. Nu-Star, Inc.*, 950 F.2d 714, 718 (Fed. Cir. 1991)).

Petitioner describes a person having ordinary skill in the art as follows:

> [A] POSA at the time of the alleged invention . . . would have an advanced degree, such as a Master's or Ph.D., in the field of organic chemistry or a closely related field. (Ex. 1003, ¶ 17). A POSA would also have at least five years of experience with organic synthesis of nitrogen-containing compounds, and would understand basic chemistry principles and organic synthesis techniques. (*Id.*)

Pet. 10. Patent Owner agrees. Prelim. Resp. 10; Ex. 2001 ¶¶ 21–22.

At this stage in the proceeding, we find that the parties' agreed-upon description of the level of ordinary skill in the art is sufficiently supported by the current record. Moreover, we 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). Thus, for purposes of this Decision, we adopt the parties' agreed-upon description of a person of ordinary skill in the art.

C. Obviousness over Liu in view of Bondareva and DD 023

Petitioner asserts that claims 1–8 would have been obvious over Liu, in view of Bondareva and DD 023. Pet. 20–39. Patent Owner disagrees. Prelim. Resp. 26–37.

1. Liu

Liu relates to ammonolysis and a method for the large-scale production of taurine, a product Liu describes as having "been applied extensively in the pharmaceutical and food industries." Ex. 1018, 6. Liu further "explains the process of producing taurine using the ethylene oxide

method [i.e., the EO process], the theoretical analysis of ammonolysis, [and] the applications of the mother liquor in production." *Id.*

Liu describes a reaction between ethylene oxide and sodium bisulfite solution under alkaline conditions (30% sodium hydroxide) that produces 2-sodium isethionate. Ex. 1018, 6. That product then undergoes an initial ammonolysis reaction at high temperature and pressure (18–19.5 MPa, 265–270°C) to generate 2-sodium aminoethanesulfonate (i.e., sodium taurinate). *Id.* Liu further teaches that a neutralization of sodium taurinate in sulfuric acid generates sodium sulfate and taurine. *Id.* After the neutralization reaction, the crude taurine and sodium sulfate are removed and the mother liquor remains. *Id.* According to Liu, "[c]omponent analysis of the mother liquor indicates that it contains many components," including, *inter alia*, remaining taurine, 2-sodium isethionate, sodium sulfate, and sodium ditaurinate. *Id.* Liu explains that this mother liquor, if released, "becomes highly concentrated contaminated emissions, damaging and polluting the environment." *Id.*

To address that concern, Liu describes an "Application of Mother Liquor Recycle in Production." Ex. 1018, 6 (emphasis omitted). Liu teaches that "[t]he 2-sodium isethionate that does not participate in ammonolysis follows the production system into the next process." *Id.* According to Liu, "[e]xcluding a small amount that undergoes a secondary reaction, the majority exists in the mother liquor in the form of 2-sodium isethionate," and "[t]he mother liquor can undergo the corresponding processing and purification to participate again in ammonolysis in the form of sodium isethionate." *Id.* Moreover, Liu discloses, "sodium ditaurinate is also generated during the ammonolysis process." *Id.* According to Liu, "[t]his sodium ditaurinate also exists in the mother liquor system," and "[i]f

this sodium ditaurinate is fed again into ammonolysis, the proportion of 2-sodium isethionate in the reaction product can be increased, increasing generation yield." *Id.*

Liu further teaches that "[a]mmonolysis process reaction yield can be increased from 70%-80% to 85%-95%." Ex. 1018, 6. And, Liu discloses, the "equipment operations are stable, reducing the discharge of waste liquids and overall production costs." *Id.*

2. Bondareva

Bondareva describes methods of synthesizing taurine. Ex. 1025, 5. In particular, Bondareva describes a method of isolating taurine from the mixture of reaction products. *Id.* Bondareva explains that the main components of the product mixture is taurine and sodium sulfate. *Id.* at 5–6. Bondareva demonstrates that the solubilities of those components are "similar and that their separation is difficult with both of them in the solution." *Id.* at 6. Bondareva describes developing conditions for isolating taurine, involving reacting taurine with ammonia to form ammonium sulfate, which has "increased solubility in aqueous ammonia, in contrast with sodium sulfate, which has no affinity for this solvent." *Id.* Before the start of isolation, the mixture was dehydrated "by distilling water or using anhydrous Na_2SO_4 that can convert upon cooling into the crystalline hydrate $Na_2SO_4 \cdot 10H_2O$." *Id.* Then, taurine was isolated from the ammonia solution by removing gaseous ammonia from it by heating, resulting in "an aqueous solution of taurine containing a small amount of sodium sulfate impurity." *Id.*

3. DD 023

DD 023 discloses a method for producing "sodium taurine by converting sodium isethionate with ammonia in the presence of neutral and strong alkaline electrolytes." Ex. 1010, 1. DD 023 explains that the reaction involves "the formation of undesired byproducts, i.e. ditaurine and tritaurine," and describes a method for limiting their contents. *Id.*

4. Analysis

A patent claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). "An obviousness determination requires finding both 'that a skilled artisan would have been motivated to combine the teachings of the prior art references to achieve the claimed invention, and that the skilled artisan would have had a reasonable expectation of success in doing so.'" *CRFD Research, Inc. v. Matal*, 876 F.3d 1330, 1340 (Fed. Cir. 2017) (quoting *Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1367–1368 (Fed. Cir. 2016)). "The reasonable expectation of success requirement refers to the likelihood of success in combining references to meet the limitations of the claimed invention." *Intelligent Bio-Sys., Inc.*, 821 F.3d at 1367.

Petitioner asserts that a combination of Liu and Bondareva discloses every limitation of claim 1. Pet. 21. Generally, Petitioner asserts that Liu discloses a process of producing taurine from sodium isethionate, involving reacting sodium isethionate with ammonia, under alkaline conditions, to

produce sodium taurinate, and then neutralizing the sodium taurinate to form taurine. *Id.* at 22 (citing Ex. 1018, 6; Ex. 1003 ¶¶ 65, 77). Petitioner asserts also that Liu teaches that the mother liquor that remains after separating crude taurine and sodium sulfate may "'participate again in ammonolysis.'" *Id*. (quoting Ex. 1018, 6). According to Petitioner and its declarant, Dr. Lipton, that teaching by Liu would have informed a person of ordinary skill in the art that "the ammonolysis reaction can be a cyclic reaction," and thus a person of ordinary skill would have understood Liu as disclosing a cyclic process of producing taurine from sodium isethionate. *Id.* (citing Ex. 1003 ¶ 70).

Specifically, Petitioner asserts that Liu teaches step (a) of claim 1 by disclosing an ammonolysis reaction of sodium isethionate that takes place after an "Addition Reaction" between ethylene oxide and sodium bisulfite to produce the sodium isethionate. Pet. 23 (citing Ex. 1018, 6; Ex. 1003 ¶¶ 66–67). Petitioner asserts that because Liu describes the "Addition Reaction" taking place in 30% sodium hydroxide, a person of ordinary skill in the art would have understood that the sodium hydroxide is part of the reaction environment and will remain in the reaction system during the ammonolysis reaction that followed the "Addition Reaction." *Id.* (citing Ex. 1003 ¶ 69). According to Petitioner, that sodium hydroxide would function as a catalyst during the ammonolysis of sodium isethionate. *Id.*

Further, Petitioner asserts that it would have been obvious for a person of ordinary skill in the art to use excess ammonia in the ammonolysis reaction, as it "favors the formation of taurinate, the primary amine." *Id*. at 23–24 (citing Ex. 1003 ¶ 42). Petitioner asserts that Liu discloses that, after ammonolysis, the reaction mixture includes sodium taurinate, unreacted sodium isethionate, and sodium ditaurinate. *Id.* at 24 (citing Ex. 1018, 6;

Ex. 1003 ¶ 68). Petitioner refers to DD 023 for its teaching that confirms that the mother liquor resulting from the ammonolysis of sodium isethionate contains sodium taurinate, sodium ditaurinate, and sodium tritaurinate. *Id.* (citing Ex. 1010, Abstract).

Regarding step (b), Petitioner asserts that Liu discloses that excess ammonia is recovered through the "'ammonia absorption system,'" after the ammonolysis reaction. Pet. 25 (citing Ex. 1018, 6). Petitioner asserts also that Liu discloses that "after the ammonolysis reaction, a neutralization occurs to generate taurine, and a POSA would have understood that crystalline taurine inevitably forms in this neutralization reaction." *Id.* (citing Ex. 1003 ¶ 68). Additionally, Petitioner asserts that Liu discloses that the mother liquor remains after crystallized taurine and sodium sulfate are removed, and a person of skill in the art would have understood that mother liquor contains alkali sulfate, alkali ditaurinate, alkali tritaurinate, and alkali isethionate, as recited in claim 1 because the claim 1 is directed to the same reaction as disclosed in Liu. *Id.* (citing Ex. 1003 ¶ 77).

Petitioner asserts that Liu's separation of the crude taurine and sodium sulfate after the neutralization reaction meets step (c), as a mother liquor remains after that separation. *Id.* at 26 (citing Ex. 1018, 6; Ex. 1003 ¶ 68).

Regarding step (d), Petitioner asserts that Liu discloses separating the sodium sulfate, in addition to taurine, from the mother liquor, but does not specifically disclose doing so by adjusting the pH of the mother liquor, as required by claim 1. Pet. 26–27. Petitioner asserts, however, that "pH adjustment is one of the small handful of techniques available for solid-liquid separation," and Bondareva discloses such use of pH adjustment to separate sodium sulfate in a process of taurine synthesis that produces sodium sulfate as a byproduct. *Id.* at 27 (citing Ex. 1025, 5–6; Ex. 1003

¶¶ 72, 78). In particular, Petitioner asserts that Bondareva recognizes that because taurine is an acid, it forms sulfonates with bases, including ammonia, and has increased solubility in a basic solution such as aqueous ammonia, compared to sodium sulfate. *Id.* (citing Ex. 1025, 6). That difference in solubility allows sodium sulfate to be removed through crystallization. *Id.* at 28 (citing Ex. 1025, 6).

Regarding step (e), Petitioner asserts that Liu discloses that the mother liquor, including, e.g., the sodium ditaurinate, can participate in the ammonolysis reaction again. Pet. 29 (citing Ex. 1003 ¶¶ 67–68).

According to Petitioner, a person of ordinary skill in the art would have been motivated to combine Liu, Bondareva, and DD 023 because each reference is directed to a process for synthesizing taurine. Pet. 29. In particular, Petitioner asserts that a person of skill in the art would have had a reason to substitute Liu's technique for separating taurine and sodium sulfate with the technique taught in Bondareva because the skilled artisan "would have appreciated the Bondareva's separation technique would have been especially advantageous for use in [Liu's] process because ammonolysis has to proceed in a basic environment, and the separation technique disclosed in Bondareva would have already made the mother liquor basic before ammonolysis – thereby improving [Liu's] process by streamlining it." *Id.* at 30 (citing Ex. 1018, 6; Ex. 1003 ¶ 81; Ex. 1008 ¶ 127).

Petitioner asserts that a person of skill in the art would have had a reasonable expectation of success in combining Liu, Bondareva, and DD 023 because DD 023 discloses all of the products formed in the ammonolysis of Liu, and Bondareva suggests that the sodium sulfate byproduct in Liu's process can be easily separated. Pet. 31. Moreover, Petitioner asserts that a "POSA would appreciate that there is no risk that

Bondareva's technique would interfere with the cyclic synthesis disclosed in Liu" because Bondareva's technique does not require any reagents not used in Liu's process. *Id.* (citing Ex. 1003 ¶ 82). For those reasons, Petitioner asserts that "[a] POSA would have fully expected to successfully improve the process of [Liu] by combining it with [] the separation technique taught in Bondareva." *Id.*

Based upon our review and consideration of the current record, we determine that Petitioner has established a reasonable likelihood of successfully demonstrating that claim 1 is unpatentable over the combination of Liu, Bondareva, and DD 023. In particular, the information presented at this stage of the proceeding supports Petitioner's assertions that a person of ordinary skill in the art would have been motivated to combine the teachings of Liu and Bondareva to provide an efficient process of synthesizing taurine, with a reasonable expectation of successfully doing so.

In reaching those determinations, we considered Patent Owner's arguments and found them deficient at this stage as explained in the following discussion.

Patent Owner's arguments are centered, in large part, on a contention that the combined prior art does not teach or suggest the second or subsequent ammonolysis reaction required by claim 1. To begin, Patent Owner asserts that it is unreasonable for Petitioner to rely on Liu as describing a second ammonolysis step because Liu's disclosure of recycling of a mother liquor from a prior first ammonolysis step is not enabled as Liu does not describe the procedure or reaction conditions used for a second ammonolysis step. Prelim. Resp. 27. However, the disclosures in prior art publications, e.g., Liu, are presumed to be enabled for the ordinarily skilled person absent persuasive evidence to the contrary, which Patent Owner does

not provide on this record. *See Impax Labs., Inc. v. Aventis Pharms., Inc.*, 545 F.3d 1312, 1316 (Fed. Cir. 2008) (patentee may overcome the presumption of enablement by establishing with persuasive evidence that the prior art does not enable the claimed invention).

According to Patent Owner, the reaction chemistry of a second ammonolysis step is fundamentally different from the first because there are no di- and tritaurinates present during a first ammonolysis. Prelim. Resp. 27. Patent Owner asserts that Liu "offers no reason to assume that what it did for its first ammonolysis would be appropriate for a second ammonolysis given the added components." *Id.* Patent Owner, however, premises that argument upon an unestablished assertion, that there is a fundamental difference in the second ammonolysis. As Petitioner responds, the challenged claims do not recite any fundamental differences between the first and second ammonolysis steps. *See* Paper 8, 6. Rather, in those claims, as in Liu, the same ammononlysis step is employed, albeit with additional components in solution the second time. Insofar as Patent Owner asserts that those additional components require adjusting the ammonolysis step, the challenged claims are silent in that regard.

Patent Owner asserts further that the second and subsequent ammonolysis in Liu cannot be assumed to occur at the same conditions as the first ammonolysis because Liu "misses the step of converting the acidic mother liquor (after neutralization using sulfuric acid) to basic as required in the claimed cyclic process." Prelim. Resp. 31. This argument, however, does not account for the evidence that the skilled artisan, in order to render a reaction environment suitable for subsequent ammonolysis of sodium ditaurinate (something Liu discloses can be done to improve yield), would know that a basic environment must be used and take steps to make it so,

such as adding alkali hydroxides. Ex. 1003 ¶ 81 ("[A]n ammonolysis reaction must proceed in a basic environment because ammonia is a moderate base.").

Moreover, Petitioner combines Liu with Bondareva's teaching to adjust the pH of the mother liquor to separate alkali taurinate and alkali sulfate. Based on the current record, we disagree with Patent Owner's assertion that a person of skill in the art would not have considered Bondareva's chemistry applicable to Liu's process or to Liu's reaction product because, Patent Owner contends, Bondareva's process differs in that it does not involve an ammonolysis reaction and does not produce di- and/or tritaurinate. Prelim. Resp. 31–32. As Petitioner explains, it is the chemistry regarding the relative solubilities of taurine and sodium sulfate that Bondareva lends. Pet. 27–28. Patent Owner has not explained how that chemistry would be inapplicable based upon the fact that Bondareva and Liu describe different processes prior to arriving at the need to separate taurine and sodium sulfate.

Additionally, Patent Owner asserts that Bondareva's teaching to use an ammonia solution because sodium sulfate has no affinity for it "would discourage a POSA from using a claimed alkali base such as an alkali hydroxide to adjust pH of the mother liquor." Prelim. Resp. 32; 2001 ¶¶ 102, 105. According to Dr. Maleczka, "use of ammonia to adjust pH in the '451 Patent is contrary to the teaching because catalyst is required." Ex. 2001 ¶ 105. It is apparent from Dr. Maleczka's opinion and Patent Owner's argument that they do not believe a skilled artisan would use an ammonia solution in step (d) and then a catalyst, such as alkali hydroxide upon recycling to step (a). At this stage in the proceeding, that assertion has not been fully developed so as to overcome Petitioner's showing that alkali

hydroxide would already (and/or separately) be a part of the reaction environment that the reaction products are recycled into for the second ammonolysis. *See* Pet. 23.

Patent Owner asserts that Liu's chemistry differs from what is claimed because the claims require a reaction mixture that includes isethionate prior to ammonolysis in a second ammonolysis step, but the experts "appear to actually agree that isethionate is consumed in the ammonolysis reaction to produce taurinate as well as ditaurinate and tritaurinate." Prelim. Resp. 29 (citing Ex. 2001 ¶¶ 51, 58, 59, 94; Ex. 1003 ¶ 48). We do not find such agreement in the cited paragraphs of the declarations of Drs. Maleczka and Lipton. At most, we find that Dr. Maleczka opines that Liu's process reduces the amount of isethionate in the reaction product. *See* Ex. 2001 ¶ 94. As Patent Owner acknowledges, that opinion contradicts Liu's disclosure that an increase in isethionate content in the reaction product is realized. Prelim. Resp. 29 (citing Ex. 1018, 6). Insofar as Dr. Maleczka's opinion differs from what the prior art says, we leave the issue for trial.

Patent Owner asserts that a person of ordinary skill in the art "would not be able to conclude that [Liu] discloses a reaction mixture comprised of di- and/or tritaurinate and isethionate as claimed." *Id.* at 29–30. As Petitioner has demonstrated, Liu discloses that the mother liquor contains unreacted sodium isethionate and sodium ditaurinate. *See* Pet. 24 (citing Ex. 1018, 6). Petitioner also relies upon DD 023 in the combination for its teaching that the mother liquor resulting from the ammonolysis of sodium isethionate also contains tritaurinate, a teaching that Patent Owner has not challenged. *See id.*; Prelim. Resp. 33 (acknowledging DD 023 teaching that mother liquor produced from a first ammonolysis reaction of a taurine synthesis process contains tritaurinate). Further, based on the current record,

Petitioner has explained persuasively that a person of skill in the art would have understood that Liu's mother liquor necessarily contains the same species recited in claim 1 because the same reaction is carried out in both. Pet. 25.

Patent Owner asserts that Liu also differs from the claimed invention by failing to disclose recovering excess ammonia and neutralizing the solution *after* the second ammonolysis step. Prelim. Resp. 29. Patent Owner, however, has not explained how the challenged claims require repeating any step beyond step (a), as set forth in step (e), i.e., reciting a "further ammonolysis" step only.

Patent Owner asserts that nothing in Liu teaches or suggest the use of excess ammonia in a second ammonolysis. Prelim. Resp. 30. However, based on the current record, Petitioner has demonstrated persuasively that a person of ordinary skill in the art would have understood that adding excess ammonia is a standard protocol for an ammonolysis reaction, and that doing so would favor Liu's formation of taurinate/taurine. Pet. 23–24 (citing Ex. 1003 ¶ 42).

Patent Owner asserts also that Liu does not mention the use of a catalyst when it suggests recycling the mother liquor for further ammonolysis. Prelim. Resp. 30. According to Patent Owner, the sodium hydroxide catalyst that Petitioner argues is part of the reaction environment and will remain during a second ammonolysis is (1) only taught as the condition used during the "Addition Reaction" to create sodium isethionate, and (2) the solution from that reaction is unlikely to remain basic after the neutralization reaction. *Id.* at 30 (citing Ex. 1018, 6; Ex. 2001 ¶¶ 94, 99, 100). It is unclear from Patent Owner's argument, or cited declaration testimony, why the same reaction environment created prior to Liu's first

ammonolysis reaction, i.e., the "Addition Reaction," would not again be done in preparation for a second ammonolysis, such that the sodium hydroxide present would again function as a catalyst in the reaction system. Nor does that argument or declaration testimony address Petitioner's assertion that the '451 patent admits that it was known in the art to add a catalyst, such as sodium hydroxide, in the ammonolysis of isethionate. *See* Pet. 22 (citing Ex. 1001, 1:58–2:8).

Thus, based on the information presented at this stage of the proceeding, we determine that Petitioner has shown sufficiently that there is a reasonable likelihood that it would prevail in showing the unpatentability of independent claim 1 as obvious over the combination of Liu, Bondareva, and DD 023.

We have also reviewed the evidence and arguments relating to the dependent claims and determine, at this stage in the proceeding, that Petitioner has demonstrated a reasonable likelihood that those claims are also rendered obvious by the combined references. For example, claim 2 requires mixing the mother liquor "with a new batch of alkali isethionate," Ex. 1001, 8:37–40, and claim 3 requires "adding alkali hydroxide during the ammonolysis" reaction involving the mother liquor, *id.* at 8:47. Patent Owner asserts that Liu does not teach either of those steps, and therefore does not teach the limitations in claims 4 and 8 either, which set forth requirements for the species of catalyst, e.g., sodium hydroxide, and the species of alkali metals, e.g. sodium. Ex. 1001, 8:48–50, 60–61; Prelim. Resp. 34–35. However, as discussed above, based on the current record, Petitioner has argued persuasively that a person of ordinary skill in the art would have understood Liu's teaching to recycle the mother liquor means to feed it back into its disclosed ammonolysis step, wherein newly formed

sodium isethionate and sodium hydroxide catalyst are present, via the preceding "Addition Reaction." *See* Ex. 1018, 6.

Dependent claims 5, 6, and 7 each recite an overall yield percentage greater than 85%, 90%, and 95%, respectively. Ex. 1001, 8:54–59. Liu teaches that the ammonolysis process reaction yield can be increased to "85–95%." Ex. 1018, 6. Patent Owner challenges that disclosure by asserting that Liu lacks specificity regarding "what its stated yields mean" and fails to provide "experimental support or analytical data." Prelim. Resp. 35–36. At this stage in the proceeding, those assertions are insufficient to overcome Petitioner's evidence, i.e., Liu's express disclosure, demonstrating a reasonable likelihood of successfully showing that those claims are unpatentable.

D. Obviousness over Wu and/or Chen in view of Bondareva and DD 023

In the remaining grounds, Petitioner asserts that claims 1–8 would also have been obvious over the combination of Chen, Bondareva, and DD 023, and over the combination of Wu, Chen, Bondareva, and DD 023. Pet. 39–71. Patent Owner disagrees. Prelim. Resp. 37–54. For those grounds, Petitioner asserts that Chen and Wu each disclose a cyclic process for producing taurine from alkali isethionate, as claimed, when combined with Bondareva and DD 023, in the same manner discussed for the combination of Liu with Bondareva and DD 023. We do not provide an analysis of those remaining grounds, as we have already determined that Petitioner has demonstrated a reasonable likelihood that it would prevail in showing the unpatentability of each of the challenged claims based upon a combination of similar teachings and over similar arguments raised by Patent Owner. In view of that determination, we institute an *inter partes*

review of all the challenged claims based upon all grounds raised in the Petition.

III. CONCLUSION

For the foregoing reasons, we conclude that the information presented in the Petition establishes a reasonable likelihood that Petitioner would prevail in showing that at least one of the challenged claims of the '451 patent is unpatentable.

At this stage of the proceeding, the Board has not made a final determination as to the construction of any claim term or the patentability of any challenged claim.

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that, pursuant to 35 U.S.C. § 314, an *inter partes* review of claims 1–8 of the '451 patent is instituted with respect to all grounds set forth in the Petition; and

FURTHER ORDERED that, pursuant to 35 U.S.C. § 314 and 37 C.F.R. § 42.4(b), *inter partes* review of the '451 patent shall commence on the entry date of this Order, and notice is hereby given of the institution of a trial.

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