

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

PEROXYCHEM LLC,
Petitioner,

v.

INNOVATIVE ENVIRONMENTAL TECHNOLOGIES, INC.,
Patent Owner.

Case IPR2016-00241
Patent 7,531,709 B2

Before ZHENYU YANG, CHRISTOPHER M. KAISER, and
JEFFREY W. ABRAHAM, *Administrative Patent Judges*.

KAISER, *Administrative Patent Judge*.

DECISION
Institution of *Inter Partes* Review
37 C.F.R. § 42.108

INTRODUCTION

A. Background

PeroxyChem LLC (“Petitioner”) filed a Petition (Paper 1, “Pet.”) requesting *inter partes* review of claims 1–16 of U.S. Patent No. 7,531,709 B2 (Ex. 1001, “the ’709 patent”). Innovative Environmental Technologies, Inc. (“Patent Owner”) filed a Preliminary Response. Paper 8 (“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). The standard for instituting an *inter partes* review is set forth in 35 U.S.C. § 314(a), which provides that an *inter partes* review may not be instituted unless “there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition.”

After considering the Petition and the Preliminary Response, we determine that Petitioner has demonstrated that there is a reasonable likelihood that it would prevail with respect to at least one of the claims challenged in the Petition. Accordingly, we institute *inter partes* review.

B. Related Matters

The parties note that the ’709 patent is the subject of *Innovative Environmental Technologies, et al. v. PeroxyChem LLC, Scott Steffel, and Bruce Lerner*, Case No. 2:15-cv-03145-JP (E.D. Pa.), and *PeroxyChem, LLC v. Innovative Environmental Technologies, Inc. et al.*, Case No. 2:14-cv-06446-JP (E.D. Pa.). Pet. 6–7; Paper 4, 2.

C. The Asserted Grounds of Unpatentability

Petitioner contends that claims 1–16 of the '709 patent are unpatentable based on the following grounds (Pet. 23–59):¹

Statutory Ground	Basis	Challenged Claim(s)
§ 102	Hitchens ²	1, 7, 9, and 14
§ 102	Vance ³	1, 3, 7, 9, and 14–16
§ 102	Alvarez ⁴	1, 3, 7, and 14
§ 103	Rice ⁵ and Cantrell ⁶	1–3, 5, 7, 11, 12, and 14–16
§ 103	Vance and Schuring ⁷	4, 10, and 13
§ 103	Hitchens and Grasso ⁸	8
§ 103	Hitchens and Odom ⁹	6

¹ Petitioner also relies on a declaration from Dr. John A. Bergendahl. Ex. 1011 (“the Bergendahl Declaration” or “Bergendahl Decl.”).

² Hitchens et al., U.S. Patent No. 6,265,205 B1, issued July 24, 2001 (Ex. 1003, “Hitchens”).

³ Vance et al., US 2002/0151602 A1, published Oct. 17, 2002 (Ex. 1010, “Vance”).

⁴ Alvarez et al., WO 98/49106, published Nov. 5, 1998 (Ex. 1004, “Alvarez”).

⁵ Rice et al., U.S. Patent No. 6,001,252, issued Dec. 14, 1999 (Ex. 1006, “Rice”).

⁶ Cantrell et al., U.S. Patent No. 5,857,810, issued Jan. 12, 1999 (Ex. 1026, “Cantrell”).

⁷ Schuring et al., U.S. Patent No. 5,032,042, issued July 16, 1991 (Ex. 1024, “Schuring”).

⁸ DOMENIC GRASSO, HAZARDOUS WASTE SITE REMEDIATION SOURCE CONTROL § J (Bioremediation) (1993) (Ex. 1014, “Grasso”).

⁹ Odom, U.S. Patent No. 5,587,317, issued Dec. 24, 1996 (Ex. 1025, “Odom”).

D. The '709 Patent

The '709 patent “relates to the combined and synergistic utilization of chemicals in conjunction with the biomineralization processes of subsurface soil and groundwater pollutants.” Ex. 1001, 1:15–19. Specifically, the invention “achieves accelerated dechlorination of soil and water contaminated with chlorinated solvents by stimulating anaerobic microorganisms and thus increasing the rate of biological mineralization of the solvents.” *Id.* at 2:11–14. The '709 patent describes accomplishing this result

by a treatment process consisting of a colloidal suspension of metal powder, organic hydrogen donor such as glucose, sucrose, alcohols, propionates, lactates, acetates, chitin, polylactate esters, glycerol tripolylactate, xylitol pentapoly lactate, and sorbitol hexapoly lactate, chemical oxygen scavengers in solution with essential nutrients, and vitamin stimulants such as B2 and B12 delivered via interconnected pneumatic pumps and pressurized vessels driven by compressed gases N or CO₂ so as not to oxygenate an environment targeted for anaerobic processes.

Id. at 2:14–24. In a particular embodiment, the '709 patent describes establishing “delivery pathways and voids” using high-pressure gas, then injecting “sodium sulfite and nutrients” before injecting zero valent metal and an organic hydrogen source. *Id.* at 2:48–3:26.

E. Illustrative Claim

Of the challenged claims in the '709 patent, claim 1 is independent and illustrative. It recites:

1. A method for accelerated anaerobic dechlorination of subsoil matter, comprising the steps of:
 - supplying a mixture including a zero valent metal into soil pathways to biologically react with the dissolved chlorinated solvents in the groundwater; and
 - supplying an organic hydrogen donor into the soil pathways to produce dechlorinating conditions such that indigenous anaerobic bacteria biodegrade residual concentrations of chlorinated solvents.

Ex. 1001, 6:28–36.

ANALYSIS

A. Claim Construction

In an *inter partes* review, we construe claim terms in an unexpired patent according to their broadest reasonable construction in light of the specification of the patent in which they appear. 37 C.F.R. § 42.100(b); *see In re Cuozzo Speed Techs., LLC*, 793 F.3d 1268, 1275–79 (Fed. Cir. 2015), *cert. granted sub nom. Cuozzo Speed Techs. LLC v. Lee*, 136 S. Ct. 890 (mem.) (2016).¹⁰ Claim terms also are given their ordinary and customary meaning, as would be understood by one of ordinary skill in the art in the context of the entire disclosure. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007).

1. “Organic Hydrogen Donor”

Petitioner argues that “organic hydrogen donor” should be interpreted to mean “a biodegradable organic compound capable of producing hydrogen through microbiological activity.” Pet. 13–14 (emphasis removed). Patent

¹⁰ We note that neither Petitioner nor Patent Owner has proposed that any different claim-construction standard be used in this proceeding. Pet. 12; Prelim. Resp. 8–9.

Owner argues that this term should mean “[a]n organic compound delivered in sufficient quantity such that it will under subsurface conditions ferment providing a slow release of hydrogen in sufficient quantity to meet the hydrogen needs of the anaerobic bacteria so that the anaerobic bacteria can biodegrade the residual concentrations of chlorinated solvents.” Prelim. Resp. 12–13. The evidence currently of record does not support either of these proposed constructions as the broadest reasonable interpretation of “organic hydrogen donor.”

The evidence provided by Petitioner does not limit the organic hydrogen donor to biodegradable compounds. The Specification of the ’709 patent describes biodegradation of chlorinated solvents that exist in the subsurface environment, not of the organic hydrogen donor. Ex. 1001, 4:28–36. Similarly, Petitioner has not directed us to evidence currently of record showing that the organic hydrogen donor is limited to compounds that produce hydrogen through microbiological activity, nor has Patent Owner directed us to evidence that the organic hydrogen donor must produce hydrogen through fermentation. As for Patent Owner’s argument that the organic hydrogen donor must produce hydrogen slowly, we note that this is a feature of only “one embodiment” of the invention of the ’709 patent. *Id.* at 2:48, 3:20–23. Limitations cannot be imported from the Specification into the claims:

Though understanding the claim language may be aided by explanations contained in the written description, it is important not to import into a claim limitations that are not part of the claim. For example, a particular embodiment appearing in the written description may not be read into a claim when the claim language is broader than the embodiment.

Superguide Corp. v. DirecTV Enterprises, Inc., 358 F.3d 870, 875 (Fed. Cir. 2004). In addition, we see no need to construe “organic hydrogen donor” as including Patent Owner’s proposed “sufficient quantity to meet the hydrogen needs of the anaerobic bacteria so that the anaerobic bacteria can biodegrade the residual concentrations of chlorinated solvents” language. This is a separate limitation of the only independent claim of the ’709 patent, so it would be present in all the claims regardless of its inclusion in or exclusion from the definition of “organic hydrogen donor.” Ex. 1001, 6:29–37.

Because nearly any organic compound could be made to generate hydrogen under some reaction conditions, we find that the proper interpretation of the term must include the reaction conditions under which hydrogen is generated. The claims of the ’709 patent require “anaerobic dechlorination of subsoil matter.” *Id.* at 6:29–30. Accordingly, the “organic hydrogen donor” must produce hydrogen under anaerobic conditions in the subsoil environment. Therefore, on this record, and for purposes of this decision, we interpret “organic hydrogen donor” as “an organic compound capable of producing hydrogen through reactions in a subsoil anaerobic environment.”

2. “Soil Pathways”

Patent Owner proposes that “soil pathways” be construed as meaning “[m]ore permeable zones within a soil through which liquids may pass.” Prelim. Resp. 9–10. Petitioner does not propose a construction for this term. Pet. 12–14. We do not adopt Patent Owner’s construction of this term. First, the “[m]ore permeable” language proposed by Patent Owner raises the unanswered question of what the soil pathways are more permeable than; it is therefore unhelpful as a definition of a term. Second, the evidence Patent

Owner cites describes “delivery pathways” rather than “soil pathways.” Ex. 1001, 3:62–64. The “soil pathways” recited in the claims of the ’709 patent are not the pathways through which the recited zero-valent metal and organic hydrogen donor reach the site where they react with the chlorinated solvents present in the environment. Instead, they are the destination for the injected zero-valent metal and organic hydrogen donor. *Id.* at 6:29–37. The destination is important because it must lie within the area contaminated by (or likely to be contaminated by) the chlorinated solvents in order for the reaction between the zero-valent metal, the organic hydrogen donor, and the chlorinated solvents to occur. *Id.* Accordingly, on this record, and for purposes of this decision, we interpret “soil pathways” as “the paths or courses through the soil where the chlorinated solvents are, have been, or are reasonably likely to reach.”

3. “Residual Concentrations of Chlorinated Solvents”

Patent Owner argues that “residual concentrations of chlorinated solvents” should be construed as “[c]hlorinated solvents remaining after the rapid reduction of higher concentrations by the mixture including a zero-valent metal.” Prelim. Resp. 10. Petitioner does not propose a construction for this term. Pet. 12–14. We do not adopt Patent Owner’s construction of this term. This construction suggests that the organic hydrogen donor, which produces conditions that “biodegrade residual concentrations of chlorinated solvents,” Ex. 1001, 6:34–37, must be supplied into the soil pathways after the zero-valent metal has been supplied and has had time to dechlorinate the majority of the chlorinated solvents. We do not interpret the claims of the ’709 patent as limited to separate, sequential applications of the zero-valent metal and the organic hydrogen donor. The

claims do not include language of temporal limitation, as might be accomplished by describing one limitation as “first” and another as “second.” *Id.* Moreover, Patent Owner agrees that the claims are not so limited, admitting that “the claims do not preclude the mixture including zero valent metal and the electron donor from being supplied together as one solution.” Prelim. Resp. 52. We conclude that “residual concentrations of chlorinated solvents” does not require express claim construction for purposes of this decision.

B. Asserted Anticipation by Hitchens

Petitioner argues that claims 1, 7, 9, and 14 are anticipated by Hitchens.

1. Hitchens

Hitchens discloses “a novel method for bioremediation of soil and ground water based on supplying hydrogen (H₂) to naturally occurring anaerobic bacteria in the soil or ground water . . . to perform . . . the dehalogenation of chlorinated organic compounds.” Ex. 1003, at [57]. It discloses supplying “formate, glucose, [or] lactate . . . [to] dechlorinate chlorocarbons.” *Id.* at 2:32–44. It also discloses “abiotic reductive dehalogenation” by supplying zero-valent iron, which also causes the production of hydrogen and stimulates “the growth of methanogenic bacteria,” which “enzymatically dechlorinat[e] additional contaminants.” *Id.* at 3:39–60. Hitchens discloses that “vitamin B₁₂” can assist in bacterial dechlorination. *Id.* at 2:63–67. In accordance with these disclosures, Hitchens claims a “method for enhancing the rate of biodegradation of chlorinated organic compounds” that includes delivering into the contaminated environment “at least one organic electron donor,” which can

be “glucose, methanol, ethanol, [or] toluene,” dispersing “corroding metal particles” in the soil, and “delivering nutrients into the soil.” *Id.* at 17:8–18:13.

2. *Analysis of Anticipation by Hitchens*

Petitioner argues that Hitchens discloses all the limitations of each of claims 1, 7, 9, and 14 of the ’709 patent. Pet. 23–30. Patent Owner argues that Hitchens fails to disclose several limitations of these claims. Prelim. Resp. 15–24. Specifically, Patent Owner argues that Hitchens fails to disclose the combined use (as opposed to the separate, individual uses) of zero-valent metal and an organic hydrogen donor. *Id.* at 22–24. In addition, Patent Owner argues that Hitchens fails to disclose the injection of the zero-valent metal and organic hydrogen donor into the soil pathways (as opposed to using those substances to create a reactive barrier). *Id.* at 22, 24.

Anticipation of a claim under 35 U.S.C. § 102 occurs when each claimed element and the claimed arrangement or combination of those elements is disclosed, inherently or expressly, by a single prior art reference. *Therasense, Inc. v. Becton, Dickinson & Co.*, 593 F.3d 1325, 1332 (Fed. Cir. 2010). Anticipation requires “no difference between the claimed invention and the reference disclosure, *as viewed by a person of ordinary skill* in the field of the invention.” *Scripps Clinic & Research Found, v. Genentech Inc.*, 927 F.2d 1565, 1576 (Fed. Cir. 1991) (emphasis added). As discussed above, Hitchens discloses a dechlorination method in which organic compounds such as glucose, metal particles, and nutrients are delivered into contaminated soil. Ex. 1003, 17:8–18:13. The Specification of Hitchens describes using metal particles that include zero-valent iron and using nutrients that include vitamin B₁₂. *Id.* at 2:63–67, 3:39–60. On the present

record, we conclude that Petitioner has made a sufficient showing that Hitchens discloses the recited limitations of “supplying a mixture including a zero valent metal” and “supplying an organic hydrogen donor.”

The claims of the '709 patent require more than just supplying zero-valent metal and an organic hydrogen donor. They require supplying these substances “into the soil pathways.” Ex. 1001, 6:29–37. Petitioner relies, Pet. 27, on Figure 7 of Hitchens, reproduced below, to disclose delivery into the soil pathways:

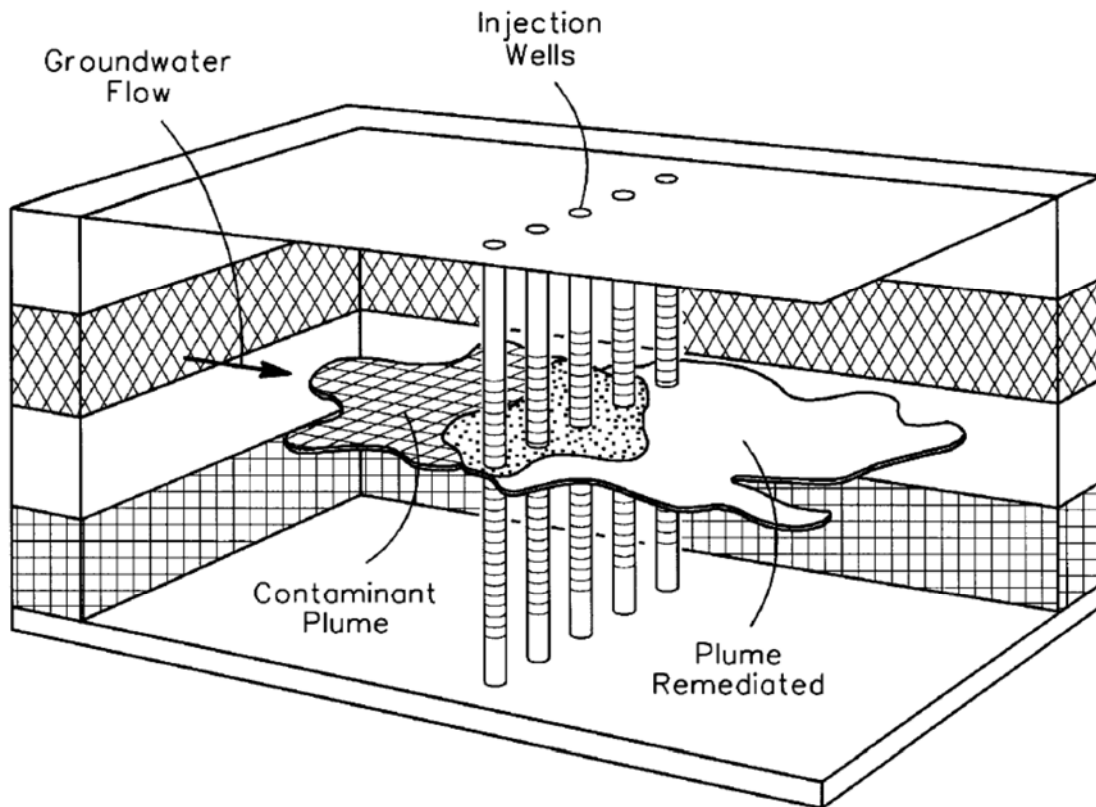


FIG. 7

Figure 7 of Hitchens depicts “a passive ‘anaerobic barrier,’” Ex. 1003, 11:1–2, which consists of injection wells configured to inject treatment chemicals into the soil downstream of the source of a contaminant, in a location the contaminant plume is likely to reach, so that the contaminant

plume is remediated as it is carried by the groundwater flow past the injection wells. Patent Owner notes that Figure 7 discloses only the placement of zero-valent metal and an organic hydrogen donor “to form a barrier . . . so the contaminant will eventually flow through it,” which Patent Owner argues is “[c]learly” not a way of supplying zero-valent metal and an organic hydrogen donor into soil pathways. Prelim. Resp. 22. As discussed above, on the present record, we construe “soil pathways” as “the paths or courses through the soil where the chlorinated solvents are, have been, or are reasonably likely to reach.” Under this construction, we find that Figure 7 of Hitchens discloses delivering its zero-valent metal and organic hydrogen donor into soil pathways, because it discloses delivering those substances to an area the chlorinated solvents are reasonably likely to reach.

With respect to claim 7, the evidence currently of record sufficiently supports the inclusion of nutrients such as vitamin B₁₂ in the mixture injected into soil pathways. Pet. 29 (citing Ex. 1003, 16:33–34); *see* Ex. 1003, 2:63–67, 18:12–13. With respect to claim 9, the evidence currently of record sufficiently supports the organic hydrogen donor being lactate or a sugar. *Id.* at 30 (citing Ex. 1003, 2:32–44). With respect to claim 14, the evidence currently of record sufficiently supports the zero-valent metal being iron. *Id.* at 29 (citing Ex. 1003, 3:39–56).

Based on the evidence currently of record, as well as on the arguments in the Petition and Preliminary Response, we conclude that Petitioner has shown sufficiently that it is reasonably likely to prevail in showing that Hitchens anticipates claims 1, 7, 9, and 14 of the ’709 patent. Accordingly, we institute *inter partes* review on this ground.

C. Asserted Anticipation by Vance

Petitioner argues that claims 1, 3, 7, 9, and 14–16 of the '709 patent are anticipated by Vance.

1. Vance

Vance discloses “a method of using elemental metal to reductively dehalogenate halogenated hydrocarbons.” Ex. 1010, at [57]. This method is disclosed as including “the in-situ treatment of chlorinated solvents . . . [using] zero valence state elemental metals to reductively dehalogenate halogenated hydrocarbons.” *Id.* ¶ 2. “Elemental metal” is equated expressly with zero-valent metal. *Id.* ¶ 112. Vance discloses mixing zero-valent iron with corn syrup and injecting the mixture through a well. *Id.* at Fig. 5. In accordance with these disclosures, Vance claims a “method of injecting nanoscale metal particles into soil” in which “a colloid suspension having metal particles in the presence of a carbohydrate” is injected into soil through a well, and in which the metal can be iron and the carbohydrate can be corn syrup. *Id.* at Claims 11–15. Vance also claims adding nitrogen gas to the elemental-metal-and-carbohydrate mixture. *Id.* at Claims 16, 20.

2. Analysis of Anticipation by Vance

Petitioner argues that Vance discloses all the limitations of each of claims 1, 3, 7, 9, and 14–16 of the '709 patent. Pet. 30–37. Patent Owner argues that Vance fails to disclose the recited organic hydrogen donor. Prelim. Resp. 26–28. With respect to claim 7, Patent Owner also argues that Vance fails to disclose the inclusion of nutrients in the injected mixture. *Id.* at 28–29.

a. Claim 1

The evidence currently of record sufficiently supports Vance disclosing the injection of zero-valent metal into soil pathways through a well. Pet. 32–33 (citing Ex. 1010 ¶¶ 2, 112, Fig. 5, Claims 11–13).

Although there is no evidence currently of record that Vance recognizes the dechlorination benefit of doing so, the current record sufficiently supports Vance disclosing injecting an organic hydrogen donor into soil pathways. Vance discloses injecting corn syrup through a well. *Id.* at 33–34 (citing Ex. 1010, Fig. 5, Claims 11, 15). Corn syrup contains sugars. Ex. 1011 ¶ 86. The '709 patent describes sugars as examples of organic hydrogen donors. Ex. 1001, 4:29–32 (“[a]n organic hydrogen donor such as . . . sugars, glucose, etc.”).

Based on the evidence currently of record, as well as on the arguments in the Petition and Preliminary Response, we conclude that Petitioner has shown sufficiently that it is reasonably likely to prevail in showing that Vance anticipates claim 1 of the '709 patent.

b. Claim 3

Claim 3 requires injection “by placing an injection rod into the soil and then injecting [the zero-valent metal and organic hydrogen donor] under pressure through an injection rod.” Ex. 1001, 6:41–44. Vance discloses injecting its mixture of substances using a pump through an injector placed in the soil. Pet. 35–36 (citing Ex. 1010 ¶ 104, Fig. 4). Based on the evidence currently of record, as well as on the arguments in the Petition and Preliminary Response, we conclude that Petitioner has shown sufficiently that it is reasonably likely to prevail in showing that Vance anticipates claim 3 of the '709 patent.

c. Claim 7

Claim 7 requires that the injected mixture include nutrients. Ex. 1001, 6:53–54. Petitioner argues that Vance’s disclosure of including nitrogen gas in the injected mixture is disclosure of including a nutrient, because the ’709 patent describes nitrogen as a nutrient. Pet. 36–37. Although Petitioner is correct that the ’709 patent describes nitrogen as a nutrient, Ex. 1001, 2:64–65, we are not persuaded that the nitrogen gas of Vance is a nutrient. The ’709 patent describes the form of nitrogen delivered as a nutrient as “organic ammonia.” *Id.* at 3:5. Further, another of Petitioner’s prior-art references, Grasso, teaches that nitrogen typically is supplied “as ammonium or nitrate ions.” Ex. 1014, 34.¹¹ Accordingly, the reference to “nitrogen” in the ’709 patent does not necessarily refer to nitrogen gas. In the absence of additional evidence suggesting that a person of ordinary skill in the art would have understood nitrogen gas to be a nutrient, we cannot conclude that Petitioner has shown a reasonable likelihood of prevailing on the issue of whether Vance anticipates claim 7.

d. Claim 9

Claim 9 requires that the organic hydrogen donor be “from the group consisting of lactate, proprionate, chitin, butyrate, acetate, sugars, glycerol tripoly lactate, xylitol pentapoly lactate, and sorbitol hexapoly lactate.” Ex. 1001, 6:57–60. One of the options in claim 9 is “sugars,” and there is evidence of record that Vance’s corn syrup contains sugars. Pet. 37; Ex. 1011 ¶ 86. Based on the evidence currently of record, as well as on the

¹¹ In citations to Grasso, we refer to the page numbers of Exhibit 1014, inserted at the lower right of each page, rather than to the page numbers of the reference itself, which appear at the upper right of each page.

arguments in the Petition and Preliminary Response, we conclude that Petitioner has shown sufficiently that it is reasonably likely to prevail in showing that Vance anticipates claim 9 of the '709 patent.

e. Claim 14

Claim 14 requires that the zero-valent metal be iron. Ex. 1001, 8:1. Vance discloses and claims iron as a zero-valent metal to be injected into the soil. Pet. 34 (citing Ex. 1010, Claim 2). Based on the evidence currently of record, as well as on the arguments in the Petition and Preliminary Response, we conclude that Petitioner has shown sufficiently that it is reasonably likely to prevail in showing that Vance anticipates claim 14 of the '709 patent.

f. Claim 15

Claim 15 requires that the zero-valent metal be “in a colloidal suspension.” Ex. 1001, 8:2–3. Vance discloses “making a colloid suspension having metal particles.” Pet. 37 (citing Ex. 1010 ¶¶ 118–120). Based on the evidence currently of record, as well as on the arguments in the Petition and Preliminary Response, we conclude that Petitioner has shown sufficiently that it is reasonably likely to prevail in showing that Vance anticipates claim 15 of the '709 patent.

g. Claim 16

Claim 16 requires the inclusion of a reducing agent in the injected mixture. Ex. 1001, 8:4–5. There is evidence of record that Vance's corn syrup is a reducing agent. Pet. 37 (citing Ex. 1011 ¶ 94). Based on the evidence currently of record, as well as on the arguments in the Petition and Preliminary Response, we conclude that Petitioner has shown sufficiently

that it is reasonably likely to prevail in showing that Vance anticipates claim 16 of the '709 patent.

Petitioner has shown sufficiently that it is reasonably likely to prevail in showing that Vance anticipates claims 1, 3, 9, and 14–16 of the '709 patent. Accordingly, we institute *inter partes* review of these claims on this ground. We do not institute *inter partes* review of claim 7 on this ground.

D. Asserted Anticipation by Alvarez

Petitioner argues that claims 1, 3, 7, and 14 are anticipated by Alvarez.

1. Alvarez

Alvarez discloses “methods . . . for bioremediation of mixed waste aquifers, based on a synergistic combination of reductive treatment using zero-valent iron and anaerobic biotransformations.” Ex. 1004, at [57]. In particular, Alvarez discloses reductive dechlorination of polychlorinated organic compounds. *Id.* at 4:19–24. This is disclosed as carried out “by pure and mixed methanogenic . . . and non-methanogenic, anaerobic cultures.” *Id.* at 6:12–17. Alvarez discloses maintaining the anaerobic conditions necessary to support these bacteria by corrosion of zero-valent iron. *Id.* at 6:27–7:2. In addition, Alvarez discloses combining these biotransformations with “abiotic processes.” *Id.* at 9:17–18. In addition to disclosing supplying zero-valent iron, Alvarez discloses supplying “one or more nutrients, vitamins, minerals, or substrates for utilization by the microbial colony.” *Id.* at 11:29–30. Among the “substrates” that Alvarez discloses are methanol and acetate. *Id.* at 26:6–7. Alvarez discloses supplying the zero-valent iron and substrates through injection wells. *Id.* at 16:16–23.

2. Analysis of Anticipation by Alvarez

Petitioner argues that Alvarez discloses all the limitations of each of claims 1, 3, 7, and 14 of the '709 patent. Pet. 37–44. Patent Owner argues that Alvarez fails to disclose the organic hydrogen donor recited in the claims of the '709 patent. Prelim. Resp. 36–41.

With respect to claim 1, the evidence of record shows sufficiently that Alvarez discloses injecting substances into soil pathways for purposes of dechlorinating chlorinated organic compounds, and that Alvarez discloses that the injected substances include zero-valent metal. Pet. 39–41; Ex. 1004, 4:19–24, 6:27–7:2, 16:16–23. Claim 1 also requires supplying an organic hydrogen donor into soil pathways. Ex. 1001, 6:29–37. Petitioner argues that Alvarez discloses this limitation by disclosing the supply of “substrates,” Pet. 41–42; see Ex. 1004, 11:29–30, and by disclosing that the “substrates” can include either methanol or acetate, Pet. 42; see Ex. 1004, 26:6–7, both of which are described as organic hydrogen donors by the '709 patent, Ex. 1001, 2:16–19. Patent Owner argues that this disclosure is insufficient because Alvarez describes methanol and acetate as prior-art alternatives to supplying hydrogen to the microorganisms that dechlorinate organic solvents, and because Alvarez describes using zero-valent iron to produce this hydrogen in situ. Prelim. Resp. 36–41.

We are persuaded, based on the evidence currently of record, that the disclosure of Alvarez is sufficient to show a reasonable likelihood that Alvarez anticipates claim 1 of the '709 patent. Although Patent Owner is correct that Alvarez describes producing hydrogen abiotically using zero-valent iron and describes hydrogen as an alternative to methanol and acetate, Ex. 1004, 24:10–18, it also discloses supplying several optional

components along with the zero-valent iron. *Id.* at 11:27–31. These optional components include “substrates.” *Id.* at 11:29–30. Alvarez describes “substrates” as including “methanol and acetate.” *Id.* at 26:6–7. The ’709 patent lists both “alcohols” and “acetates” as examples of organic hydrogen donors. Ex. 1001, 2:16–17.

With respect to claim 3, Alvarez discloses the use of injection wells, Pet. 43; *see* Ex. 1004, 16:16–23, and there is evidence of record to support injection wells being understood as including injection rods, Pet. 43 (citing Ex. 1011 ¶ 101). With respect to claim 7, Alvarez discloses supplying nutrients in addition to the zero-valent iron and the substrates. Pet. 44; *see* Ex. 1004, 11:29–30. With respect to claim 14, Alvarez discloses supplying zero-valent iron as the zero-valent metal. Pet. 43; *see* Ex. 1004, 10:18.

Based on the evidence currently of record, as well as on the arguments in the Petition and Preliminary Response, we conclude that Petitioner has shown sufficiently that it is reasonably likely to prevail in showing that Alvarez anticipates claims 1, 3, 7, and 14 of the ’709 patent. Accordingly, we institute *inter partes* review on this ground.

E. Asserted Obviousness over Rice and Cantrell

Petitioner argues that claims 1–3, 5, 7, 11, 12, and 14–16 are unpatentable under 35 U.S.C. § 103(a) as obvious over the combination of Rice and Cantrell.

1. Rice

Rice discloses “[a] method for in situ anaerobic dehalogenation of a halogenated organic compound in a groundwater plume.” Ex. 1006, at [57]. This method involves injection of substances into the ground. *Id.* at 3:35–40. These substances are disclosed as including sodium sulfite as an oxygen

scavenger, *id.* at 3:47–57, as well as an organic electron donor, *id.* at 4:9–10, which can be lactate or acetate, *id.* at 6:34–36. Rice also discloses that nutrients can be included in the injected mixture to support the anaerobic microorganisms that carry out the dehalogenation. *Id.* at 4:29–43.

2. *Cantrell*

Cantrell discloses the formation of a “chemical barrier . . . by injecting a suspension of solid particles or colloids into the subsurface.” Ex. 1026, 2:10–11. This is done by “injecting the optimized stable colloid suspension at a sufficiently high flow rate to move the colloids through the subsurface sediment.” *Id.* at 2:15–17. Cantrell teaches that the particular solid particles or colloids injected are chosen based “on the targeted contaminant, the remediation objective, and site conditions.” *Id.* at 5:17–19. It also teaches that “[z]ero-valent iron . . . has the capability to dehalogenate several halogenated-hydrocarbon compounds.” *Id.* at 5:32–35.

3. *Analysis of Obviousness over Rice and Cantrell*

Petitioner argues that the combination of Rice and Cantrell teaches or suggests all the limitations of claims 1–3, 5, 7, 11, 12, and 14–16 of the ’709 patent and that a person of ordinary skill in the art would have found it obvious to combine the teachings of Rice and Cantrell. Pet. 44–53. Patent Owner argues that Petitioner has not shown a reason to combine Rice and Cantrell, that the combination of Rice and Cantrell does not teach or suggest the claimed supplying of zero-valent metal into soil pathways, and that the combination of Rice and Cantrell does not teach or suggest supplying an organic hydrogen donor separately from supplying the zero-valent metal. Prelim. Resp. 43–52. With respect to claim 11, Patent Owner argues that the combination of Rice and Cantrell does not teach or suggest the recited

colloidal suspension of zero-valent iron in a sodium sulfite solution. *Id.* at 52–53. With respect to claim 16, Patent Owner argues that the combination of Rice and Cantrell does not teach or suggest the recited inclusion of a reducing agent. *Id.* at 53.

a. Claim 1

Petitioner relies on the combination of Rice and Cantrell to show that the claims of the '709 patent are obvious. Petitioner argues that a person of ordinary skill in the art would have combined Rice and Cantrell for several reasons:

1) the addition of zero valent iron to Rice's solution provides an additional (abiotic) mechanism to reductively dechlorinate chlorinated solvents; 2) the zero valent iron acts as an oxygen scavenger to maintain favorable anaerobic conditions for biological dechlorination; 3) in an anaerobic environment the corrosion of zero valent iron results in the generation of hydrogen which is also favorable to indigenous anaerobic bacteria; and 4) the addition of the zero valent iron to Rice's solution reduces the amount of pyruvate, lactate, formate, propionate and acetate that needs to be provided as the zero valent iron also serves as an electron donor.

Pet. 48. Petitioner also argues that a person of ordinary skill in the art reasonably would have expected these results to be achieved by combining the teachings of Rice and Cantrell:

Given the well-known use of zero valent iron and the well-known use of organic electron donors individually for the dechlorination of chlorinated solvents in the soil, as well as the known symbiotic characteristics of the two methods to one another, a POSA would have been confident in the success of combining the teachings of Rice and Cantrell as described above.

Id. (citing Ex. 1011 ¶ 112). Patent Owner argues that Petitioner has not demonstrated sufficiently either that a person of ordinary skill in the art

would have had reason to combine the teachings of Rice and Cantrell or that a person of ordinary skill in the art would have had a reasonable expectation of success in doing so. Prelim. Resp. 43–49.

To succeed, Petitioner’s obviousness argument must be supported by “some articulated reasoning with some rational underpinning” to combine the elements taught or suggested by the prior art in the manner required in the claim at issue. *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007). However, “the analysis need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ.” *Id.* Obviousness does not require absolute predictability, only a reasonable expectation that the beneficial result will be achieved. *In re Merck & Co.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986).

On the present record, and for purposes of the present decision, Petitioner has shown sufficiently both a reason to combine and a reasonable expectation of success in doing so. Patent Owner’s arguments to the contrary are not persuasive. First, although Patent Owner argues that Petitioner has not “provided any finding that there was some teaching, suggestion, or motivation . . . to combine reference teachings,” Prelim. Resp. 44, there is no requirement for Petitioner to do so. While the requirement for a teaching, suggestion, or motivation (the TSM test) to combine known elements in order to show that the combination would have been obvious may be “a helpful insight,” it cannot be used as a rigid and mandatory formula. *KSR*, 550 U.S. at 418–19. Second, although Patent Owner argues that Petitioner and Dr. Bergendahl have not fully explained why a person of ordinary skill in the art would have wanted to achieve the benefits that

Petitioner identifies in the combination of the teachings of Rice and Cantrell, Prelim. Resp. 45–47, we cannot say that the evidence currently of record fails to provide “some articulated reasoning with some rational underpinning” to combine the elements taught or suggested by the prior art in the manner required in the claim at issue. *KSR*, 550 U.S. at 418.

Third, although Patent Owner argues that Dr. Bergendahl’s testimony that there would have been a reasonable expectation of success in combining Rice and Cantrell is conclusory, Prelim. Resp. 47–48, there is evidence in the record to support that testimony. As discussed above, Hitchens, a prior-art reference, recognizes that there are benefits to be gained from combining both an abiotic reductive dechlorination based on zero-valent iron with a parallel biological enzymatic dechlorination stimulated by hydrogen. Ex. 1003, 3:39–60. Accordingly, we cannot classify as entirely conclusory Dr. Bergendahl’s testimony that it was known that dechlorination using zero-valent iron and dechlorination using hydrogen had symbiotic characteristics.

Given that Petitioner has shown sufficiently a reason to combine Rice and Cantrell, we proceed to determine whether Petitioner has shown sufficiently that Rice and Cantrell teach or suggest the limitations of claim 1. Petitioner argues that Cantrell teaches or suggests injecting zero-valent metal into soil pathways. Pet. 46–47. Clearly, Petitioner is correct that Cantrell teaches injecting zero-valent metal. Ex. 1026, 5:55–60. The only question is whether Cantrell teaches or suggests that the zero-valent metal should be injected into soil pathways, which Patent Owner argues it does not. Prelim. Resp. 51. As discussed above, we construe “soil pathways” to include locations that the chlorinated solvents are reasonably likely to reach.

Cantrell teaches forming “a chemical barrier . . . in the flow path of a contaminant plume.” Ex. 1026, 1:12–27 (explaining what a chemical barrier is); see Pet. 46 (citing Ex. 1026, 2:11–19, for the formation of a chemical barrier). Accordingly, the evidence currently of record sufficiently shows that the combination of Rice and Cantrell teaches or suggests the limitation requiring supplying a zero-valent metal into soil pathways.

Petitioner argues that Rice teaches or suggests supplying an organic hydrogen donor into soil pathways. Pet. 47–48. Rice does teach supplying an organic electron donor, Pet. 47 (citing Ex. 1006, 4:9–10), which can be lactate or acetate, *id.* (citing Ex. 1006, 6:34–36), both of which are identified as organic hydrogen donors in the ’709 patent, Ex. 1001, 2:16–17. Patent Owner argues that claim 1 of the ’709 patent requires the organic hydrogen donor and the mixture containing the zero-valent metal to be supplied separately (even if they are supplied at the same time), that Cantrell does not teach a mixture containing its zero-valent metal, that Petitioner’s proposed combination must be a mixture containing both Cantrell’s zero-valent metal and Rice’s organic hydrogen donor, and that this does not satisfy both limitations of claim 1. Prelim. Resp. 52. Patent Owner’s argument is not persuasive on the current record. Patent Owner does not explain why the claims of the ’709 patent require the zero-valent metal mixture and the organic hydrogen donor to be supplied separately. Without further development of this argument and evidence to support it, we cannot say that claim 1 requires anything more than the supply of both a zero-valent metal mixture and an organic hydrogen donor into soil pathways. On the present record, Petitioner has shown sufficiently that both these limitations are taught or suggested by the combination of Rice and Cantrell, so Petitioner is

reasonably likely to succeed in showing that claim 1 is obvious over this combination of references.

b. Claim 2

Claim 2 of the '709 patent requires the inclusion of a reducing agent among the substances that are supplied into the soil pathways. Ex. 1001, 6:38–40. Rice teaches the use of sodium sulfite as a reducing agent in the solution that is to be injected into the soil pathways. Pet. 50 (citing Ex. 1006, 3:47–57). On the present record, Petitioner has shown sufficiently that it is reasonably likely to succeed in showing that claim 2 is obvious over the combination of Rice and Cantrell.

c. Claim 3

Claim 3 requires injection “by placing an injection rod into the soil and then injecting [the zero-valent metal and organic hydrogen donor] under pressure through an injection rod.” Ex. 1001, 6:41–44. Rice teaches injecting its solution into the soil pathways under pressure using a well. Pet. 51 (citing Ex. 1006, 3:35–46). Dr. Bergendahl testifies that a person of ordinary skill in the art would have understood that this required the use of an injection pipe, line, or tube placed in the ground. *Id.* (citing Ex. 1011 ¶ 114). On the present record, Petitioner has shown sufficiently that it is reasonably likely to succeed in showing that claim 3 is obvious over the combination of Rice and Cantrell.

d. Claim 5

Claim 5 requires the inclusion of sodium sulfite as a reducing agent in the mixture to be supplied to the soil pathways. Ex. 1001, 6:49–50. As discussed above, Rice teaches the use of sodium sulfite as a reducing agent in the solution that is to be injected into the soil pathways. Pet. 50 (citing

Ex. 1006, 3:47–57). On the present record, Petitioner has shown sufficiently that it is reasonably likely to succeed in showing that claim 5 is obvious over the combination of Rice and Cantrell.

e. Claim 7

Claim 7 requires that the injected mixture include nutrients. Ex. 1001, 6:53–54. Rice teaches that nutrients can be included in the injected mixture to support the anaerobic microorganisms that carry out the dehalogenation. Pet. 51–52 (citing Ex. 1006, 4:28–43). On the present record, Petitioner has shown sufficiently that it is reasonably likely to succeed in showing that claim 7 is obvious over the combination of Rice and Cantrell.

f. Claim 11

Claim 11 requires that the zero-valent metal mixture be “a colloidal suspension in a sodium sulfite solution.” Ex. 1001, 6:63–65. As discussed above, Rice teaches the use of sodium sulfite as a reducing agent in the solution that is to be injected into the soil pathways. Pet. 52–53 (citing Ex. 1006, 3:47–57). Cantrell teaches the use of colloidal zero-valent iron. *Id.* at 46 (citing Ex. 1026, 2:11–19, 5:17–35). On the present record, Petitioner has shown sufficiently that it would have been obvious to mix these components together for injection into soil pathways. Patent Owner’s argument that “[t]here is no disclosure in Cantrell related to including a reducing agent in the non-Newtonian suspension [of zero-valent iron]” and that “[t]here is also no disclosure in Rice that the deoxygenated aqueous electron donor solution includes iron,” Prelim. Resp. 53, does not persuade us otherwise. The proposed ground of unpatentability is based on the combination of the teachings of Rice and the teachings of Cantrell, not on the teachings of either reference individually. Further, there is no

requirement that either reference contain a teaching, suggestion, or motivation to combine it with the other reference. *KSR*, 550 U.S. at 418–19. Accordingly, on the present record, Petitioner has shown sufficiently that it is reasonably likely to succeed in showing that claim 11 is obvious over the combination of Rice and Cantrell.

g. Claim 12

Claim 12 requires that a sodium sulfite and nutrient solution be injected into the soil “after the step of injecting the organic hydrogen donor.” Ex. 1001, 6:66–7:3. Rice teaches injecting sodium sulfite and nutrients into the soil. Pet. 51 (citing Ex. 1006, 3:35–46); *id.* at 53 (citing Ex. 1006, 3:47–57, 4:28–43). In addition, Rice teaches “repeated applications of [its] method,” suggesting an injection of these substances subsequent to the initial injection of the combination of these substances and zero-valent iron that is taught or suggested by the combination of Rice and Cantrell. *Id.* (citing Ex. 1006, 4:54–60). On the present record, Petitioner has shown sufficiently that it is reasonably likely to succeed in showing that claim 12 is obvious over the combination of Rice and Cantrell.

h. Claim 14

Claim 14 requires that the zero-valent metal be iron. Ex. 1001, 8:1. Cantrell teaches the use of zero-valent iron. Pet. 44–45 (citing Ex. 1026, 5:17–35). On the present record, Petitioner has shown sufficiently that it is reasonably likely to succeed in showing that claim 14 is obvious over the combination of Rice and Cantrell.

i. Claim 15

Claim 15 requires that the zero-valent metal be “in a colloidal suspension.” Ex. 1001, 8:2–3. As discussed above, Cantrell teaches the use

of colloidal particles of zero-valent iron, Pet. 44–45 (citing Ex. 1026, 2:11–19), and the combination of Rice and Cantrell, on the present record, teaches or suggests the suspension of those colloidal particles in a solution. On the present record, Petitioner has shown sufficiently that it is reasonably likely to succeed in showing that claim 15 is obvious over the combination of Rice and Cantrell.

j. Claim 16

Claim 16 requires the inclusion of a reducing agent in the injected mixture. Ex. 1001, 8:4–5. Rice teaches the use of sodium sulfite as a reducing agent in the solution that is to be injected into the soil pathways. Pet. 52–53 (citing Ex. 1006, 3:47–57). On the present record, Petitioner has shown sufficiently that it is reasonably likely to succeed in showing that claim 16 is obvious over the combination of Rice and Cantrell. Patent Owner’s argument that “the non-Newtonian stable colloid suspension [of Cantrell] does not include a reducing agent, and there is no suggestion in Cantrell of including one” and that “[t]here is no disclosure that the deoxygenated aqueous electron donor solution of Rice includes a colloidal suspension,” Prelim. Resp. 53, does not persuade us otherwise. The proposed ground of unpatentability is based on the combination of the teachings of Rice and the teachings of Cantrell, not on the teachings of either reference individually. Further, there is no requirement that either reference contain a teaching, suggestion, or motivation to combine it with the other reference. *KSR*, 550 U.S. at 418–19.

Because Petitioner has shown a reasonable likelihood of prevailing on its assertion that each of claims 1–3, 5, 7, 9, and 14–16 is obvious over the

combination of Rice and Cantrell, we institute *inter partes* review of these claims on this ground.

F. Asserted Obviousness over Vance and Schuring

Petitioner argues that claims 4, 10, and 13 are unpatentable under 35 U.S.C. § 103(a) as obvious over the combination of Vance and Schuring.

1. Schuring

Schuring discloses “a method and apparatus for eliminating non-naturally occurring, subsurface, liquid toxic contaminants that introduces flow channels into the soil.” Ex. 1024, 5:29–32. It teaches “pneumatic fracturing” of the soil to “permit more rapid movement of liquid and vapor through the soil matrix.” *Id.* at 9:16–20. Schuring teaches using air as the pneumatic fracturing fluid. *Id.* at 8:66–9:1.

2. Analysis of Obviousness over Vance and Schuring

Petitioner argues that the combination of Vance and Schuring teaches or suggests all the limitations of claims 4, 10, and 13 of the ’709 patent and that a person of ordinary skill in the art would have found it obvious to combine the teachings of Vance and Schuring. Pet. 54–57. Patent Owner argues that Petitioner has not shown a reason to combine Vance and Schuring and that Petitioner has not shown that the combination of Vance and Schuring teaches or suggests the recited establishment of preferential delivery pathways. Prelim. Resp. 54–56.

Petitioner relies on the combination of Vance and Schuring to show that the claims of the ’709 patent are obvious. Petitioner argues that a person of ordinary skill in the art would have combined Vance and Schuring for several reasons:

1) as noted by Schuring, the modification would result in greater permeability which enhances the effectiveness of in situ treatment processes; 2) the modification results in better distribution of the materials within the treatment zone; 3) the modification would open up additional soil pathways within the treatment zone; 4) the modification would allow for an increased rate of delivery of the slurry of iron and corn syrup; 5) would result in a dispersal of the slurry within the subsurface over significant horizontal distances; and 6) the modification would reduce the number of injection wells required.

Pet. 55. Patent Owner argues that Petitioner has not demonstrated sufficiently that a person of ordinary skill in the art would have had reason to combine the teachings of Vance and Schuring or that a person of ordinary skill in the art would have had a reasonable expectation of success in doing so. Prelim. Resp. 54–55.

On the present record, and for purposes of the present decision, Petitioner has shown sufficiently both a reason to combine and a reasonable expectation of success in doing so. Patent Owner’s arguments to the contrary are not persuasive. First, although Patent Owner argues that Petitioner has not “provided any finding that there was some teaching, suggestion, or motivation . . . to combine reference teachings,” Prelim. Resp. 55, there is no requirement for Petitioner to do so. While the requirement for a teaching, suggestion, or motivation (the TSM test) to combine known elements in order to show that the combination would have been obvious may be “a helpful insight,” it cannot be used as a rigid and mandatory formula. *KSR*, 550 U.S. at 418–19. Second, although Patent Owner argues that Petitioner has not fully explained why a person of ordinary skill in the art would have wanted to achieve the benefits that Petitioner identifies in the combination of the teachings of Vance and Schuring, Prelim. Resp. 55, we

cannot say that the evidence currently of record fails to provide “some articulated reasoning with some rational underpinning” to combine the elements taught or suggested by the prior art in the manner required in the claim at issue. *KSR*, 550 U.S. at 418.

Third, as argued by Petitioner, Pet. 55, Schuring itself expressly recognizes the benefits of incorporating its techniques into subsurface contaminant treatments. Ex. 1024, 5:29–30. On the present record, we cannot say that this is inadequate evidence to show sufficiently that a person of ordinary skill in the art would have had a reasonable expectation of success in combining the teachings of Vance and the teachings of Schuring.

Given that Petitioner has shown sufficiently a reason to combine Vance and Schuring, we proceed to determine whether Petitioner has shown sufficiently that Vance and Schuring teach or suggest the limitations of claims 4, 10, and 13. Claims 4, 10, and 13 each require a “preliminary step of injecting a gas under pressure . . . into [the] soil to establish preferential delivery pathways therein.” Ex. 1001, 6:45–48. Claim 10 requires that the pneumatic fracturing gas be either nitrogen or carbon dioxide. *Id.* at 6:61–62. Claim 13 additionally requires a “final step of gas injection to clear [the] injection rod and fluid conduit lines connected thereto.” *Id.* at 7:4–6.

Schuring teaches “a method and apparatus for eliminating non-naturally occurring, subsurface, liquid toxic contaminants that introduces flow channels into the soil” by “pneumatic fracturing” of the soil to “permit more rapid movement of liquid and vapor through the soil matrix.” Pet. 54–55 (citing Ex. 1024, 5: 32, 9:16–26). Patent Owner argues that the “flow channels” established in Schuring “would be in the vadose zone, so [they] clearly would not provide . . . preferential delivery

pathway[s].” Prelim. Resp. 56. Patent Owner does not direct us to any evidence currently of record to support this argument. Without such evidence, we cannot find that Schuring’s “flow channels” would be restricted to the vadose zone of the soil or that they would fail to provide any delivery pathways that would be followed preferentially over other routes through the soil. On the present record, Petitioner has shown sufficiently that it is reasonably likely to succeed in showing that claim 4 is obvious over the combination of Vance and Schuring.

With respect to claim 10, Schuring teaches using air as the fracturing fluid. Pet. 55 (citing Ex. 1024, 8:66–9:1). Given the importance in the invention of the ’709 patent of maintaining an anaerobic environment for the benefit of the microorganisms that dechlorinate the chlorinated organic compounds, the fact that Schuring’s air is composed mostly of nitrogen is not sufficient to demonstrate that the use of nitrogen or carbon dioxide as the fracturing fluid, required by claim 10, was known in the prior art. However, Vance teaches using nitrogen gas to inject its iron-corn syrup mixture. *Id.* at 55–56; see Ex. 1010, Claim 20. There is evidence of record that a person of ordinary skill in the art would have preferred Vance’s nitrogen to Schuring’s air as the fracturing fluid. Pet. 55–56 (citing Ex. 1011 ¶ 132). On the present record, Petitioner has shown sufficiently that it is reasonably likely to succeed in showing that claim 10 is obvious over the combination of Vance and Schuring.

With respect to claim 13, as Petitioner admits, neither Vance nor Schuring teaches or suggests purging the injection system after delivery of the remediation substances to the soil pathways. Pet. 56. There is evidence currently of record, however, that this step would have been obvious to a

person of ordinary skill in the art, both because cleaning equipment after use was well-known and because ensuring all the remediation compounds are delivered to the subsurface environment makes economic sense. *Id.* (citing Ex. 1011 ¶ 132). On the present record, Petitioner has shown sufficiently that it is reasonably likely to succeed in showing that claim 13 is obvious over the combination of Vance and Schuring.

Because Petitioner has shown a reasonable likelihood of prevailing on its assertion that each of claims 4, 10, and 13 is obvious over the combination of Vance and Schuring, we institute *inter partes* review of these claims on this ground.

G. Asserted Obviousness over Hitchens and Grasso

Petitioner argues that claim 8 is unpatentable under 35 U.S.C. § 103(a) as obvious over the combination of Hitchens and Grasso.

1. Grasso

Grasso teaches that “the application of nutrients . . . can enhance the rate and extent of biodegradation.” Ex. 1014, 34. It also teaches that these nutrients include nitrogen, typically applied “as ammonium or nitrate ions,” and phosphorus, typically added as “inorganic orthophosphate.” *Id.*

2. Analysis of Obviousness over Hitchens and Grasso

Petitioner argues that the combination of Hitchens and Grasso teaches or suggests all the limitations of claim 8 of the ’709 patent and that a person of ordinary skill in the art would have found it obvious to combine the teachings of Hitchens and Grasso. Pet. 57–58. Patent Owner argues that Petitioner has not shown a reason to combine Hitchens and Grasso and that Grasso does not remedy the deficiencies of Hitchens with respect to claim 1, from which claim 8 depends indirectly. Prelim. Resp. 57–58.

Petitioner relies on the combination of Hitchens and Grasso to show that claim 8 of the '709 patent is obvious. Petitioner argues that a person of ordinary skill in the art would have combined Hitchens and Grasso for several reasons:

- 1) the application of such nutrients can enhance the rate of and extent of biodegradation; and 2) nitrogen and phosphorus are the limiting factor in the subsurface environment and must be supplied to ensure biodegradation.

Pet. 57–58. Patent Owner argues that Petitioner has not demonstrated sufficiently that a person of ordinary skill in the art would have had reason to combine the teachings of Hitchens and Grasso or that a person of ordinary skill in the art would have had a reasonable expectation of success in doing so. Prelim. Resp. 57–58.

On the present record, and for purposes of the present decision, Petitioner has shown sufficiently both a reason to combine and a reasonable expectation of success in doing so. Patent Owner's arguments to the contrary are not persuasive. First, although Patent Owner argues that Petitioner has not "provided any finding that there was some teaching, suggestion, or motivation . . . to combine reference teachings," Prelim. Resp. 55, there is no requirement for Petitioner to do so. While the requirement for a teaching, suggestion, or motivation (the TSM test) to combine known elements in order to show that the combination would have been obvious may be "a helpful insight," it cannot be used as a rigid and mandatory formula. *KSR*, 550 U.S. at 418–19. Second, although Patent Owner argues that Petitioner has not fully explained why a person of ordinary skill in the art would have wanted to achieve the benefits that Petitioner identifies in the combination of the teachings of Hitchens and Grasso, Prelim. Resp. 55, we

cannot say that the evidence currently of record fails to provide “some articulated reasoning with some rational underpinning” to combine the elements taught or suggested by the prior art in the manner required in the claim at issue. *KSR*, 550 U.S. at 418.

Third, Grasso itself expressly recognizes the benefits of incorporating its techniques into contaminant treatments. Ex. 1014, 34. On the present record, we cannot say that this is inadequate evidence to show sufficiently that a person of ordinary skill in the art would have had a reasonable expectation of success in combining the teachings of Hitchens and the teachings of Grasso.

Given that Petitioner has shown sufficiently a reason to combine Hitchens and Grasso, we proceed to determine whether Petitioner has shown sufficiently that Hitchens and Grasso teach or suggest the limitations of claim 8. Patent Owner argues that Hitchens fails to disclose all the limitations of claim 1, from which claim 8 depends indirectly, and that Grasso fails to remedy this deficiency. Prelim. Resp. 58. As discussed above, however, for purposes of this decision and on the present record, Petitioner has shown sufficiently that Hitchens discloses the limitations of claim 1. Claim 8 requires the inclusion of nutrients in the substances to be injected into the soil pathways, where those nutrients “are organic ammonia and ortho-phosphate.” Ex. 1001, 6:55–56. Grasso teaches the use of nutrients, including both organic nitrogen in the form of ammonium ions and phosphorus, typically added as “inorganic orthophosphate.” Pet. 57; see Ex. 1014, 34.

On the present record, Petitioner has shown sufficiently that it is reasonably likely to succeed in showing that claim 8 is obvious over the

combination of Hitchens and Grasso. Because Petitioner has shown a reasonable likelihood of prevailing on its assertion that claim 8 is obvious over the combination of Hitchens and Grasso, we institute *inter partes* review of this claim on this ground.

H. Asserted Obviousness over Hitchens and Odom

Petitioner argues that claim 6 is unpatentable under 35 U.S.C. § 103(a) as obvious over the combination of Hitchens and Odom.

1. Odom

Odom teaches the use of both riboflavin and tetrapyrroles such as cyanocobalamin in microbiological dechlorination. Ex. 1025, 15:65–16:14. The use of both substances “greatly accelerated” the process of dechlorination over the use of either substance alone or neither substance. *Id.* at 15:55–67. Cyanocobalamin is vitamin B₁₂. *Id.* at 16:1–2.

2. Analysis of Obviousness over Hitchens and Odom

Petitioner argues that the combination of Hitchens and Odom teaches or suggests all the limitations of claim 6 of the ’709 patent and that a person of ordinary skill in the art would have found it obvious to combine the teachings of Hitchens and Grasso. Pet. 58–59. Patent Owner argues that Petitioner has not shown a reason to combine Hitchens and Odom and that Odom does not remedy the deficiencies of Hitchens with respect to claim 1, from which claim 6 depends. Prelim. Resp. 59–60.

Petitioner relies on the combination of Hitchens and Odom to show that claim 6 of the ’709 patent is obvious. Petitioner argues that a person of ordinary skill in the art would have combined Hitchens and Odom “to increase the amount of dehalogenation/dechlorination by several fold as taught by Odom as well as increasing the rate of dehalogenation/

dechlorination.” Pet. 59. Patent Owner argues that Petitioner has not demonstrated sufficiently that a person of ordinary skill in the art would have had reason to combine the teachings of Hitchens and Grasso or that a person of ordinary skill in the art would have had a reasonable expectation of success in doing so. Prelim. Resp. 59.

On the present record, and for purposes of the present decision, Petitioner has shown sufficiently both a reason to combine and a reasonable expectation of success in doing so. Patent Owner’s arguments to the contrary are not persuasive. First, although Patent Owner argues that Petitioner has not “provided any finding that there was some teaching, suggestion, or motivation . . . to combine reference teachings,” Prelim. Resp. 55, there is no requirement for Petitioner to do so. While the requirement for a teaching, suggestion, or motivation (the TSM test) to combine known elements in order to show that the combination would have been obvious may be “a helpful insight,” it cannot be used as a rigid and mandatory formula. *KSR*, 550 U.S. at 418–19. Second, although Patent Owner argues that Petitioner has not fully explained why a person of ordinary skill in the art would have wanted to achieve the benefits that Petitioner identifies in the combination of the teachings of Hitchens and Odom, Prelim. Resp. 55, we cannot say that the evidence currently of record fails to provide “some articulated reasoning with some rational underpinning” to combine the elements taught or suggested by the prior art in the manner required in the claim at issue. *KSR*, 550 U.S. at 418.

Third, Odom itself expressly recognizes the benefits of incorporating its techniques into contaminant treatments. Pet. 59; *see* Ex. 1025, 15:65–16:14. On the present record, we cannot say that this is inadequate evidence

to show sufficiently that a person of ordinary skill in the art would have had a reasonable expectation of success in combining the teachings of Hitchens and the teachings of Odom.

Given that Petitioner has shown sufficiently a reason to combine Hitchens and Odom, we proceed to determine whether Petitioner has shown sufficiently that Hitchens and Odom teach or suggest the limitations of claim 6. Patent Owner argues that Hitchens fails to disclose all the limitations of claim 1, from which claim 6 depends, and that Odom fails to remedy this deficiency. Prelim. Resp. 59. As discussed above, however, for purposes of this decision and on the present record, Petitioner has shown sufficiently that Hitchens discloses the limitations of claim 1. Claim 6 requires the inclusion of “vitamins B2 and B12” in the substances to be supplied to the soil pathways. Ex. 1001, 6:51–52. Odom teaches the use of cyanocobalamin, which is vitamin B₁₂, in microbiological dechlorination. Pet. 58–59 (citing Ex. 1025, 15:30–16:15). Odom also teaches the use of riboflavin in microbiological dechlorination. *Id.* Riboflavin is identified in the ’709 patent as vitamin B₂. Ex. 1001, 3:24.

On the present record, Petitioner has shown sufficiently that it is reasonably likely to succeed in showing that claim 6 is obvious over the combination of Hitchens and Odom. Because Petitioner has shown a reasonable likelihood of prevailing on its assertion that claim 6 is obvious over the combination of Hitchens and Odom, we institute *inter partes* review of this claim on this ground.

CONCLUSION

Upon consideration of the Petition, the Preliminary Response, and the evidence before us, we determine that Petitioner has demonstrated a

reasonable likelihood that it would prevail in showing that the claims it challenges are unpatentable on the following grounds:

Claims 1, 7, 9, and 14 as anticipated by Hitchens;

Claims 1, 3, 9, and 14–16 as anticipated by Vance;

Claims 1, 3, 7, and 14 as anticipated by Alvarez;

Claims 1–3, 5, 7, 11, 12, and 14–16 as obvious over the combination of Rice and Cantrell;

Claims 4, 10, and 13 as obvious over the combination of Vance and Schuring;

Claim 8 as obvious over the combination of Hitchens and Grasso; and

Claim 6 as obvious over the combination of Hitchens and Odom.

Accordingly, we institute *inter partes* review of these claims on these grounds. We determine that Petitioner has not demonstrated a reasonable likelihood of prevailing on its assertion that claim 7 is anticipated by Vance, so we do not institute an *inter partes* review on this ground. The Board has not made a final determination on the patentability of any challenged claim.

ORDER

It is hereby

ORDERED that, pursuant to 35 U.S.C. § 314, an *inter partes* review is hereby instituted to determine whether:

Claims 1, 7, 9, and 14 are anticipated by Hitchens;

Claims 1, 3, 9, and 14–16 are anticipated by Vance;

Claims 1, 3, 7, and 14 are anticipated by Alvarez;

Claims 1–3, 5, 7, 11, 12, and 14–16 are obvious over the combination of Rice and Cantrell;

Claims 4, 10, and 13 are obvious over the combination of Vance and Schuring;

Claim 8 is obvious over the combination of Hitchens and Grasso; and

Claim 6 is obvious over the combination of Hitchens and Odom;

FURTHER ORDERED that no ground other than those specifically identified above is authorized for this *inter partes* review; and

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

IPR2016-00241
Patent 7,531,709 B2

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