

*Inter Partes* Review of U.S. Patent No. 7,531,709

IN THE 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

---

**PATENT OWNER'S PRELIMINARY RESPONSE TO PETITION  
UNDER 37 C.F.R. § 42.107**

## **TABLE OF CONTENTS**

I.	INTRODUCTION.....	1
A.	Summary of Patent.....	2
B.	Overview of Challenges and Asserted Prior Art.....	3
C.	Overview of Petition’s Description of the State of the Art.....	6
D.	A Person with Ordinary Skill in the Art.....	7
II.	CLAIM CONSTRUCTION.....	8
A.	Petitioner Fails to Construe Terms Material to the Claims.....	9
B.	Petitioner Misconstrues Terms Material to the Claims.....	12
III.	The Board Should Not Institute Review on Any of the Purported Anticipation Grounds 1-3 Under 35 U.S.C. § 102(b).....	15
A.	The Board Should Deny Institution on Ground 1 Because Petitioner Has Not Demonstrated that the Claims were Anticipated by Hitchens.....	15
1.	Overview of Hitchens.....	15
2.	Petitioner Provides a Misleading Overview of Hitchens.....	17
3.	Errors in the Petitioner’s Detailed Claim Analysis.....	21
a.	Supplying a mixture including zero valent metal element [1.1].....	21
b.	Supplying an organic hydrogen donor [1.2].....	23
4.	Petitioner Has Not Met Its Burden of Showing Anticipation by Hitchens under 35 U.S.C. § 102(b).....	24

B.	The Board Should Deny Institution on Ground 2 Because Petitioner Has Not Demonstrated that the Challenged Claims were Anticipated by Vance.....	24
1.	Overview of Vance.....	25
2.	Errors in the Petitioner’s Detailed Claim Analysis.....	26
a.	Supplying an organic hydrogen donor [1.2] .....	26
b.	Wherein the mixture further includes nutrients [7.0] ...	28
3.	Petitioner Has Not Met Its Burden of Showing Anticipation by Vance under 35 U.S.C. § 102(a), (e).....	29
C.	The Board Should Deny Institution on Ground 3 Because Petitioner Has Not Demonstrated that the Challenged Claims were Anticipated by Alvarez.....	29
1.	Overview of Alvarez.....	30
2.	Petitioner Provides a Misleading Overview of Alvarez.....	31
3.	Errors in the Petitioners Detailed Claim Analysis.....	35
a.	Supplying an organic hydrogen donor [1.2].....	36
4.	Petitioner Has Not Met Its Burden of Showing Anticipation by Alvarez under 35 U.S.C. § 102(b).....	41
IV.	The Board Should Not Institute Review on Any of the Purported Obviousness Grounds 4-7.....	41
A.	The Board Should Deny Institution on Ground 4 Because Petitioner Has Not Demonstrated that the Challenged Claims are Obvious in Light of Rice in view of Cantrell.....	41
1.	Overview of Rice and Cantrell.....	41
2.	Motivation to Combined Rice and Cantrell is Insufficient....	43

3.	Errors in the Petitioners Detailed Claim Analysis.....	50
a.	Supplying a mixture including zero valent iron [1.1]....	50
b.	Supplying an organic hydrogen donor [1.2].....	51
c.	Mixture including zero valent metal is a colloidal suspension in a sodium sulfite solution [11.0].....	52
d.	Colloidal suspension includes a reducing agent [16.0]..	53
4.	Petitioner Has Not Met Its Burden of Showing Obviousness in Light of Rice in view of Cantrell under 35 U.S.C. § 103....	53
B.	The Board Should Deny Institution on Ground 5 Because Petitioner Has Not Demonstrated that the Challenged Claims are Obvious in Light of Vance in view of Schuring.....	54
1.	Overview of Schuring.....	54
2.	Motivation to Combined Vance and Schuring is Insufficient..	54
3.	Errors in the Petitioners Detailed Claim Analysis.....	55
a.	Injecting gas under pressure ... to establish preferential delivery pathways [4.0].....	56
4.	Petitioner Has Not Met Its Burden of Showing Obviousness in Light of Vance in view of Schuring under 35 U.S.C. § 103.....	56
C.	The Board Should Deny Institution on Ground 6 Because Petitioner Has Not Demonstrated that the Challenged Claims are Obvious in Light of Hitchens in view of Grasso.....	57
1.	Motivation to Combined Hitchens and Grasso is Insufficient..	57
2.	Proposed Combination of Hitchens and Grasso Insufficient Teachings.....	58

3.	Petitioner Has Not Met Its Burden of Showing Obviousness in Light of Hitchens in view of Grasso under 35 U.S.C. § 103.....	58
D.	The Board Should Deny Institution on Ground 7 Because Petitioner Has Not Demonstrated that the Claims are Obvious in Light of Hitchens in view of Odom.....	58
1.	Motivation to Combined Hitchens and Odom is Insufficient..	59
2.	Proposed Combination of Hitchens and Odom Insufficient Teachings.....	59
3.	Petitioner Has Not Met Its Burden of Showing Obviousness in Light of Hitchens in view of Odom under 35 U.S.C. § 103....	59
V.	Redundant Grounds.....	60
VI.	Conclusion.....	60

## EXHIBIT LIST

IET 2003	“pathway,” Merriam-Webster Online Dictionary, 2015, <a href="http://www.merriam-webster.com">http://www.merriam-webster.com</a> (March 10, 2016).
IET 2004	“Newtonian fluid,” Chemistry Glossary, 2015, <a href="http://glossary.periodni.com/dictionary">http://glossary.periodni.com/dictionary</a> (March 10, 2016).

## **I. Introduction**

Pursuant to 37 C.F.R. § 42.107, the undersigned, on behalf of and acting in a representative capacity for the patent owner, Innovative Environmental Technologies, Inc. (“Patent Owner”), hereby submits this preliminary response to the Petition for *Inter Partes* Review (“Petition”) of claims 1-16 of U.S. Patent No. 7,531,709 (“‘709 Patent”), issued to Innovative Environmental Technologies, Inc. Patent Owner files this Preliminary Response timely pursuant to 35 U.S.C. § 313 and 37 C.F.R. § 42.107 within three months of the mailing date of the Notice of Filing Date Accorded to Petition, which was mailed on December 10, 2015.

Patent Owner submits that the Petition should be denied because it does not comply with all of the requirements of a proper *inter partes* review petition and does not support the institution of a *inter partes* review under 37 C.F.R. § 42.104 and 35 U.S.C. § 311 *et seq.* The Petition should be rejected for the reasons outlined below. First, the Petition fails to specify the proper construction of the challenged claims. Second, the Petition fails to establish how the referenced prior art discloses all elements of the challenged claims. Third, the Petition fails to demonstrate how the invention claimed in the ‘709 Patent is rendered obvious in light of the referenced prior art. Fourth and finally, the Petition fails to demonstrate a reasonable likelihood of prevailing as to the invalidity of the challenged claims.

For the foregoing reasons, as more fully described below, *inter partes* review as requested by the Petition should not be instituted.

**A. Summary of Patent**

The ‘709 Patent issued to Innovative Environmental Technologies, Inc. on May 12, 2009, from U.S. Patent Application Serial No. 11/423,749, which was filed on June 13, 2006. The ‘709 Patent is a continuation of U.S. Patent Application Serial No. 10/610,558, which was filed July 2, 2003 for “Method for Accelerated Dechlorination of Matter” and issued as U.S. Patent No. 7,129,388 (the ‘388 Patent) on May 12, 2009. Both the ‘709 Patent and the ‘388 Patent claim priority to U.S. Provisional Patent Application Serial No. 60/437,983 for “Method for Accelerated Dechlorination of Matter,” filed on Jan. 6, 2003.

The ‘709 Patent is directed to a novel method for accelerated dechlorination of soil and water contaminated chlorinated solvents. The accelerated dechlorination is achieved by stimulating anaerobic microorganisms and thus increasing the rate of biological mineralization of the solvents. This is accomplished by a treatment process consisting of a colloidal suspension of metal powder, an organic hydrogen donor, chemical oxygen scavengers in solution with essential nutrients and vitamin stimulants delivered via compressed gases so as not to oxygenate an environment targeted for anaerobic processes. The treatment stimulates naturally occurring microorganisms while oxidizing dissolved phase



target compounds via the surface action of the iron particles. *See* PXY-1001, Abstract.

The zero valent metals have a moderately low toxicity and a good reducing power so that they can rapidly reduce higher concentrations of dissolved phase chlorinated solvents. *See* PXY-1001, col. 4, lines 16-18. Furthermore, the zero valent metal, when added with other compounds which provide a source of electron donors, nutrients, and reducing agents, will stimulate naturally occurring microorganisms while oxidizing dissolved phase target compounds via the surface action of the iron particles resulting in the breakdown of chlorinated solvents. *See* PXY-1001, col. 6, lines 15-21.

An organic hydrogen donor (electron donor) provides hydrogen so that the biodegradation process is initiated. The organic hydrogen donor is to be metabolized by indigenous anaerobic bacteria in order to produce dechlorinating conditions necessary for indigenous anaerobic bacteria to biodegrade residual concentrations of chlorinated solvents (solvents remaining after rapid reduction of higher concentrations of dissolved phase chlorinated solvents). The organic hydrogen donor is to ferment and provide a slow delivery of hydrogen at low concentrations which drives the anaerobic reductions. *See* PXY-1001, col. 4, lines 28-39.

## **B. Overview of Challenges and Asserted Prior Art**

The Petitioner proposes seven challenges, each of which is flawed, as explained in this Preliminary Response. Grounds 1-3 are anticipation grounds under 35 U.S.C. § 102. Each of the Grounds is used to reject independent claim 1 (the only independent claim), as well dependent claims 7 and 14. Grounds 1 and 2 further overlap in the rejection of dependent claim 9, while Grounds 2 and 3 further overlap on the rejection of claim 3. Ground 2 is further utilized to reject dependent claims 15 and 16. Petitioner has not provided any commentary regarding the relative strengths of the rejections. A brief synopsis of each anticipation ground is provided below.

Ground 1 asserts anticipation of claims 1, 7, 9, and 14 by U.S. Patent No. 6,265,205 (“Hitchens”) under 35 U.S.C. § 102(b). *See* Petition, pp. 23-30; PXY-1011, pp. 39-47. Petitioner fails to demonstrate that Hitchens teaches each limitation of independent claim 1.

Ground 2 asserts anticipation of claims 1, 3, 7, 9, and 14-16 by U.S. Patent Application Publication No. 2002/0151602 (“Vance”) under 35 U.S.C. § 102(a) or (e). *See* Petition, pp. 30-37; PXY-1011, pp. 47-59. Petitioner fails to demonstrate that Vance teaches each limitation of independent claim 1.

Ground 3 asserts anticipation of claims 1, 7, 9, and 14 by international PCT Patent Application Publication No. WO98/49106 (“Alvarez”) under 35 U.S.C. §

102(b). *See* Petition, pp. 37-44; PXY-1011, pp. 60-67. Petitioner fails to demonstrate that Alvarez teaches each limitation of independent claim 1.

Grounds 4-7 are obviousness grounds under 35 U.S.C. § 103. Ground 4 is used to reject independent claim 1 (the only independent claim) as well dependent claims 7 and 14, the same combination of claims rejected by 3 different anticipation grounds. Ground 4 further overlaps grounds 2 and 3 on the rejection of claim 3. Ground 4 further overlaps ground 2 on the rejection of dependent claims 15 and 16. Petitioner has not provided any commentary regarding the relative strength of the overlapping rejections. Grounds 5-7 utilize secondary references to make obviousness rejections of dependent claims. A brief synopsis of each obviousness ground is provided below.

Ground 4 asserts obviousness of Claims 1-3, 5, 7, 11, 12, and 14-16 over U.S. Patent No. 6,001,252 (“Rice”) in view of U.S. Patent No. 5,857,810 (“Cantrell”) under 35 U.S.C. § 103(a). *See* Petition, pp. 44-53; PXY-1011, pp. 67-82. Petitioner fails to show that sufficient motivation exists for combining the references or to demonstrate that the proposed combination teaches each limitation of independent claim 1.

Ground 5 asserts obviousness of claims 4, 10, and 13 in light of Vance in view of U.S. Patent No. 5,032,042 (“Schuring”) under 35 U.S.C. § 103(a). *See* Petition, pp. 54-57; PXY-1011, pp. 83-91. Petitioner fails to show that sufficient

motivation exists for combining the references or to demonstrate that the proposed combination teaches each limitation of independent claim 1.

Ground 6 asserts obviousness of claim 8 in light of Hitchens in view of a publication by Grasso (“Grasso”) under 35 U.S.C. § 103(a). *See* Petition, pp. 57-58; PXY-1011, pp. 91-93. Petitioner fails to demonstrate that the proposed combination teaches each limitation of independent claim 1.

Ground 7 asserts obviousness of claim 6 in light of Hitchens in view of U.S. Patent No. 5,587,317 (“Odom”) under 35 U.S.C. § 103(a). *See* Petition, pp. 58-59; PXY-1011, pp. 94-97. Petitioner fails to demonstrate that the proposed combination teaches each limitation of independent claim 1.

### **C. Overview of Petition’s Description of the State of the Art**

Petitioner and its Expert describe what they believe the state of the art was at the time of the invention of the ‘709 Patent. *See* Petition, pp. 15-19; PXY-1011, pp. 23-35. They describe the use of both zero valent iron and electron donors independently. Even assuming that what they describe is accurate, Patent Owner submits there was no disclosure or suggestion at the time of the invention to combine the two different methods for remediation.

Petitioner and its Expert further claim that the use of both zero valent metal and electron donors together were known. Patent Owner submits that this claim is erroneous. Patent Owner will address many of these claims in the specific

rejections. However, Petitioner and its Expert also note several references that they submit, which purportedly disclose the use of both zero valent metal and electron donors. However, neither Petitioner nor its Expert use these references in specific rejections of the claims. Patent Owner submits that Petitioner and its Expert have simply disclosed that these references disclose both elements without providing any details regarding where or how the combined use is disclosed. In addition, Petitioner's Expert has not provided any input regarding how a POSA would construe these references to disclose the invention claimed in the '709 Patent prior to the date of invention.

**D. A Person with Ordinary Skill in the Art**

A Person with Ordinary Skill in the Art ("POSA") is a hypothetical person who is presumed to be aware of all pertinent prior art at the time of the invention and is of ordinary creativity. The level of ordinary skill in the art of the POSA is determined by considering: (1) types of problems encountered in the art; (2) prior art solutions to those problems; (3) rapidity with which innovations are made; (4) sophistication of the technology; and (5) education level of active workers in the field. With respect to the '709 Patent, a POSA would have education and/or experience in the fields of environmental science or engineering (civil, environmental or chemical), and knowledge of the scientific literature concerning the same, specifically in the area of soil and groundwater remediation. The

education and experience levels may vary between persons of ordinary skill, with some persons holding a Bachelor's degree with sufficient years of relevant work experience, or others holding more advanced degrees, e.g. Masters or Ph.D., with fewer years of experience. With respect to the '709 Patent, a POSA would have at least several years of actual field experience in the area of soil and groundwater remediation. A POSA may work as part of a multi-disciplinary team and draw upon not only his or her own skills, but also take advantage of certain specialized skills of others on the team to solve a given problem (Manual of Patent Examining Procedure § 2141.03).

## **II. Claim Construction**

In determining whether to institute an *inter partes* review, the Board considers the parties' proposed construction of the challenged claims. The Board generally gives claims their broadest reasonable interpretation in light of the specification in which they appear to a person with ordinary skill in the art. *See* 37 CFR § 42.200(b). There is a "heavy presumption," however, that a claim term carries its ordinary and customary meaning. *See CCS Fitness, Inc. v. Brunswick Corp.*, 288 F.3d 1359, 1366 (Fed. Cir. 2002).

A patentee may act as his own lexicographer by redefining the meaning of particular claim terms away from their ordinary meaning, but only by clearly expressing that intent in the written description. *See Merck & Co., Inc. v. Teva*

*Pharmaceuticals USA Inc.*, 395 F.3d 1364, 1370 (Fed. Cir. 2005). If an inventor acts as his or her own lexicographer, the definition must be set forth in the specification, with clarity, deliberateness, and precision. *See Renishaw PLC v. Marposs Sociata` per Azioni*, 158 F.3d 1243, 1249 (Fed. Cir. 1998).

**A. Petitioner Fails to Construe Terms Material to the Claims**

A petition for *inter partes* review must include, for each challenged claim, an identification of “[h]ow the challenged claim is to be construed.” 37 C.F.R. § 42.204(b)(3). In the present Petition, Petitioner provides a proposed construction for only one term, “organic hydrogen donor.” *See* Petition, p. 12. Petitioner fails to construe a significant number of terms that are material to determining whether institution should be granted. Indeed, Petitioner fails to provide a construction for terms that are unquestionably material and that Petitioner clearly considers to have a meaning different from the terms’ ordinary and customary meanings. Indeed, Petitioner fails even to argue that these terms should have their ordinary meaning. This failure to provide the required claim construction means that Petitioner is unable to demonstrate a reasonable likelihood that the challenged claims will be found invalid. Accordingly, the Petition should be denied.

1. “soil pathways”

Claim Term	Petitioner Construction	Patent Owner Construction

soil pathways	None	More permeable zones within a soil through which liquids may pass
---------------	------	---

Claim 1 recites the term “soil pathways” in the context of “supplying the mixture including a zero valent metal into soil pathways” and “supplying an organic hydrogen donor into the soil pathways”. The ‘709 Patent specification describes that soil pathways “are believed to be those more permeable pathways along which chlorinated solvents are more likely to have migrated, both in the vadose and saturated zones.” *See* PXY-1001, col. 3, lines 64-67. The ‘709 Patent specification also describes the pathways being created by injecting gas into the subsurface. *See* PXY-1001, col. 2, lines 57-62; PXY-1001, col. 3, lines 59-64. *See also* IET 2003 (defining “pathway” as a “path or course”).

In the context of the claims, “into the soil pathways” references the mixture including zero valent metal and the organic hydrogen donor flowing into the subsoil matter through these more permeable zones.

2. “residual concentrations of chlorinated solvents”

Claim Term	Petitioner Construction	Patent Owner Construction
residual concentrations of chlorinated solvents	None	Chlorinated solvents remaining after the rapid reduction of higher concentrations by the mixture including a zero valent metal



Claim 1 recites the term “residual concentrations of chlorinated solvents” with regard to “supplying an organic hydrogen donor into the soil pathways to produce dechlorinating conditions such that indigenous anaerobic bacteria biodegrade residual concentrations of chlorinated solvents.” *See* PXY-1001, col. 6, lines 33-37. In addition, the claim recites “supplying a mixture including a zero valent into soil pathways to biologically react with the dissolved chlorinated solvents in the groundwater.” *See* PXY-1001, col. 6, lines 30-32.

Claim 1 clearly recites the mixture including the zero valent metal and the organic hydrogen donor each acting on the chlorinated solvents. As the element featuring the organic hydrogen donor is recited after the element featuring the mixture including the zero valent metal, and claim 1 also recites residual concentrations, it follows that the organic hydrogen donor is acting only after some action is taken by the mixture. The ‘709 Patent further describes:

“Zero valent metals have a moderately low toxicity and a good reducing power so that it can rapidly reduce higher concentrations of dissolved phase chlorinated solvents . . . .” PXY-1001, col. 4, lns. 16-18.

“With the addition of an electron donor source to provide hydrogen, the biodegradation process is initiated. An organic hydrogen donor such as a polylactate ester, glycerol tripolylactate, xylitol pentapolylactate, or sorbitol hexapolylactate, lactates, acetate, propionates, sugars, glucose, etc. is now injected with the intent of being cometabolized by indigenous anaerobic

bacteria to produce dechlorinating conditions necessary for indigenous anaerobic bacteria to biodegrade residual concentrations of chlorinated solvents. This slow release process is controlled over time, maintaining a slow delivery of hydrogen at low concentrations which drives the anaerobic reductions.” PXY-1001, col. 4, lines 28-39.

Based on the claim language and the support in the specification, it is clear that the zero valent metal acts rapidly to reduce higher concentrations of dissolved phase chlorinated solvents, and the organic hydrogen donor provides a slow release process that is controlled over time to maintain a slow delivery of hydrogen at low concentrations, which provide a food source for the anaerobic bacteria to biodegrade residual concentrations of chlorinated solvents after the higher concentrations have been reduced by the zero valent iron.

**B. Petitioner Misconstrues Terms Material to the Claims**

1. “organic hydrogen donor”

Claim Term	Petitioner Construction	Patent Owner Construction
Organic Hydrogen Donor	A biodegradable organic compound capable of producing hydrogen through microbiological activity	An organic compound delivered in sufficient quantity such that it will under subsurface anaerobic 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
--	--	--

Claim 1 recites “organic hydrogen donor” with regard to “supplying an organic hydrogen donor into the soil pathways to produce dechlorinating conditions such that indigenous anaerobic bacteria biodegrade residual concentrations of chlorinated solvents.” *See* PXY-1001, col. 6, lines 33-37. The organic hydrogen donor is clearly used for the purpose of producing dechlorinating conditions for the anaerobic bacteria. As a POSA would understand, dechlorinating conditions for the anaerobic bacteria would include an anaerobic environment and sufficient hydrogen to meet the hydrogen needs of the anaerobic bacteria in order for them to biodegrade residual concentrations of chlorinated solvents.

The ‘709 Patent describes:

“This is accomplished by a treatment process consisting of colloidal suspension of metal powder, an organic hydrogen donor, chemical oxygen scavengers in solution with essential nutrients, and vitamin stimulants such as B2 and B12 ...” PXY-1001, Abstract.

“This is accomplished 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 tripoly lactate, xylitol pentapoly lactate, and sorbitol hexapoly lactate, chemical oxygen scavengers in solution with essential nutrients, and vitamin stimulants such as B2 and B12.” PXY-1011, col. 2, lines 14-21.

“An anaerobic organic hydrogen source is ... to provide a slow release hydrogen source for the anaerobic dechlorination of the CVOCs.” PXY-1001, col. 3, lines 20-23.

“With the addition of an electron donor source to provide hydrogen, the biodegradation process is initiated. An organic hydrogen donor such as a poly lactate ester, glycerol tripoly lactate, xylitol pentapoly lactate, or sorbitol hexapoly lactate, lactates, acetate, propionates, sugars, glucose, etc. is now injected with the intent of being cometabolized by indigenous anaerobic bacteria to produce dechlorinating conditions necessary for indigenous anaerobic bacteria to biodegrade residual concentrations of chlorinated solvents. This slow release process is controlled over time, maintaining a slow delivery of hydrogen at low concentrations which drives the anaerobic reductions.” PXY-1001, col. 4, lines 28-39.

“The invention also confirms that zero valent metal, when added with other compounds which provide a source of electron donors, nutrients, and reducing agents, will stimulate naturally occurring microorganisms while oxidizing dissolved phase target compounds via the surface action of the iron particles resulting in the breakdown of chlorinated solvents.” PXY-1001, col. 6, lines 15-21.

Based on the claim language and the support in the specification, it is clear that the organic hydrogen donor is provided in sufficient quantity so that the fermentation thereof results in a slow delivery of hydrogen at low concentrations and in sufficient quantity to meet the hydrogen needs of the anaerobic bacteria to allow the anaerobic bacteria to biodegrade the residual concentrations of chlorinated solvents.

**III. The Board Should Not Institute Review on Any of the Purported Anticipation Grounds 1-3 Under 35 U.S.C. § 102(b)**

**A. The Board Should Deny Institution on Ground 1 Because Petitioner Has Not Demonstrated that the Claims were Anticipated by Hitchens**

The Petition sets forth as Ground 1 that claims 1, 7, 9, and 14 are anticipated under 35 U.S.C. § 102(b) by U.S. Patent No. 6,265,205 to Hitchens et al. (“Hitchens”). *See* Petition, pp. 23-30; PXY-1011, pp. 39-47. The Board should not institute review on ground 1 because the Petition fails to set forth a reasonable likelihood that Hitchens discloses each limitation of claim 1, from which the remaining challenged claims depend. Petitioner fails to demonstrate that Hitchens teaches supplying a mixture including zero valent metal and also supplying an organic hydrogen donor as required by independent claim 1.

**1. Overview of Hitchens**

Hitchens discloses a “novel method of bioremediation of soil and ground water based on supplying hydrogen ( $H_2$ ) to naturally occurring anaerobic bacteria . . . The hydrogen can be supplied from a number of sources, including; stored hydrogen, hydrogen generated above the ground on site, either electromechanically or by reforming a fuel source, or by electrolysis in the soil, either using an electric current supplied from above ground or an electronic current generated by the corrosion of metal particles in the ground. For the last of these cases, a novel multi-metallic particle especially useful for the generation of hydrogen, and a method for making these particles, are disclosed.” PXY-1003, Abstract.

Hitchens discloses bimetallic materials being used where hydrogen is formed by, for example, the corrosion of magnesium that acts as a sacrificial anode. Hydrogen may also be formed by the use of an electrocatalyst (e.g., palladium, nickel) to catalyze the iron. *See* PXY-1003, FIGs. 8 and 9, col. 3, lines 18-67. Hitchens further discloses the advantages of the bimetallic metal. *See* PXY-1003, col. 12, lines 30-59. It should be noted that Hitchens does not include any disclosure of the metal used in the bimetallic metal being zero valent, including equations 5-9 that depict the reactions thereof. *See* PXY-1003, col. 11.

In fact, Hitchens discloses how the use of bimetallic metal is different than the use of zero valent iron “where the hydrogen formation reaction “. . . is a ‘parasitic side reaction,’ in this invention, hydrogen generation is coupled to

dechlorination through biocatalytic processes. Although direct dechlorination reactions may still occur at the iron-solution interface, this reaction is unlikely to be significant in changing the concentration of toxicant present in the soil because of the small amount of reactive surface area available when compared to the volume of the soil permeated by the hydrogen produced.” PXY-1003, col. 11, lines 5-15; PXY-1003, col. 11, equation 4. Equation 4 is associated with reactions that occur if zero valent iron were to be used.

## **2. Petitioner Provides a Misleading Overview of Hitchens**

Petitioner and its Expert contend that “Hitchens discloses a method for enhancing the biodegradation of chlorinated organic compounds in the ground by naturally occurring bacteria using a zero valent metal and organic hydrogen donor. *See* Petition, p. 23; PXY-1011, pp. 39-40. *See also* PXY-1003, col. 1, lines 10-15. Patent Owner points out that this section of Hitchens does not disclose anything related to zero valent metal or organic hydrogen donors as Petitioner and its Expert contend.

Petitioner contends that claims 42-44 of Hitchens disclose a method corresponding to the method recited in the challenged claims. Patent Owner points out that this contention is erroneous for at least the following reasons:

- Nowhere in claims 42-44 of Hitchens is “zero valent metal” disclosed, as is recited by independent claim 1 of the ‘709 Patent. Claim 43 of

Hitchens simply recites “corroding metal particles dispersed in the soil.”

In fact, Patent Owner submits that none of the 44 claims in Hitchens disclose a zero valent metal.

- Claims 42-44 of Hitchens do not disclose “soil pathways,” let alone supplying a mixture including zero valent metal into soil pathways, as is recited by independent claim 1 of the ‘709 Patent. Claim 43 of Hitchens simply recites “corroding metal particles dispersed in the soil.” The word “dispersed” does not mean that the metal was supplied to the soil, and even if it was construed to mean that the metal particles were supplied to the soil, there is no disclosure that the metal is supplied, i.e. dispersed, into soil pathways.
- Claims 42-44 of Hitchens do not disclose soil pathways, let alone supplying an organic hydrogen donor into the soil pathways, as is recited by independent claim 1 of the ‘709 Patent. Claim 42 of Hitchens simply recites “dissolving at least one organic electron donor in water . . . and delivering the water into the environment by electroosmosis.” FIG. 3 of Hitchens further illustrates how the water is supplied to the electrode wells, and the application of an electric current has the water flow from anode to cathode.



- Claims 42-44 of Hitchens do not disclose that the organic hydrogen donor produces dechlorinating conditions such that indigenous anaerobic bacteria biodegrade “residual concentrations” of chlorinated solvents. The claims do not make any distinctions regarding how the hydrogen produced by the metal, or the at least one organic electron donor in water, effect the biodegradation of chlorinated solvents, let alone anything related to the organic hydrogen donor biodegrading residual concentrations.

The Petitioner also contends that Hitchens recognizes the “symbiotic relationship between the presence of zero valent metal and an organic hydrogen donor” because Hitchens discloses that the “chemical degradation process is assisted by a parallel biological route . . . stimulated by produced hydrogen.” *See* Petition, p. 24; PXY-1011, pp. 39-40. *See also* PXY-1003, col. 3, lines 57-60. Petitioner further contends that Hitchens also discloses that the “the availability of a suitable electron [organic hydrogen] donor for this process is critical.”

Patent Owner submits that Hitchens does not disclose a symbiotic relationship between the presence of zero valent metal and an organic hydrogen donor, nor the fact that the availability of a suitable electron [organic hydrogen] donor is critical to the chemical degradation/parallel biological route, as the Petitioner contends. Neither the Petitioner nor its Expert have provided any real

rational for these contentions. The only possible logic provided by the Petitioner and its Expert is another passage from the background of Hitchens that states, “[u]nder anaerobic conditions, all chlorinated ethenes can be completely transformed into benign end products through sequential reductive dechlorination. In this biologically catalyzed process, chlorinated pollutants act as electron acceptors, the chloride moiety is removed from molecules and replaced by hydrogen. The availability of a suitable electron donor for this process is one of the key rate limiting elements.” PXY-1003, col. 2, lines 1-18.

Patent Owner argues that this background passage does not at all tie the use of metals and an organic hydrogen donor together as suggested by Petitioner and its Expert. Rather, Patent Owner submits that this portion of Hitchens simply identifies that the availability of hydrogen to be donated to the chlorinated pollutants is important. Patent Owner notes that various ways to provide hydrogen are discussed in the background of Hitchens including, “[c]ompounds such as lactate or ethanol . . . producing high short-lived peaks of hydrogen,” and “abiotic reductive dehalogenation . . . thought to involve the simultaneous oxidative corrosion of the reactive iron metal by both water and the chlorinated organic compounds . . . . This chemical process is assisted by a parallel biological route . . . stimulated by the produced hydrogen.” *See* PXY-1003, col. 3, lines 29-37; *see also* PXY-1003, col. 3, lines 40-60. There is no discussion in Hitchens of these

different methods being combined, nor any symbiotic relationship between the two or the availability of a suitable electron [organic hydrogen] donor being critical to the iron metal process, contrary to the contentions of Petitioner and Petitioner's Expert.

### **3. Errors in the Petitioner's Detailed Claim Analysis**

Petitioner errs in its detailed claim analysis as elaborated below. Petitioner's contentions that Hitchens discloses or describes the claim elements identified below are unfounded because such claim elements are not, in fact, to be found in Hitchens. Moreover, Petitioner's Expert, whose declaration purports to support Petitioner's arguments and allusions to Hitchens, basically repeats the averments made by Petitioner in the Petition and quotes cited portions of Hitchens without providing expert analysis nor opinion regarding how the disclosure of Hitchens is supposed to align with the challenged claim elements from the perspective of a person having ordinary skill in the art ("POSA"). As such, Petitioner's Expert declaration amounts to little more than additional attorney argument. Such failed declarations by Petitioner's Expert apply to each claim element discussed below.

#### **a. Supplying a mixture including zero valent metal element [1.1]**

Petitioner, along with Petitioner's Expert, points out various portions of the background of Hitchens as showing that "[c]hlorinated solvents . . . can be degraded by reactions with granular iron," and that the "iron is placed deep enough

to intercept the saturated thickness of the plume in a contaminated zone.” *See* Petition, pp. 26-28; PXY-1011, pp. 42-47. *See also* PXY-1003, col. 3, lines 39-56, col. 4, lines 17-19. Patent Owner maintains, however, that as has previously been noted, the background of Hitchens addresses the use of iron as simply one manner in which contaminants can be dechlorinated. The background also discloses the use of compounds (e.g., formate, glucose, lactate) to produce hydrogen for dechlorinating contaminants. *See* PXY-1003, col. 2, lines 33-47. However, as noted above, there is nothing in the background, the description of the invention, or the claims that discloses the use of iron in combination with these compounds.

Petitioner and its Expert contend that FIG. 7 of Hitchens discloses injection wells in which zero valent iron is placed in contact with ground water. Patent Owner points out, however, that contrary to Petitioner’s contention, FIG. 7 does not identify metal, let alone zero valent metal. Furthermore, even assuming the area between the contaminated plume and the plume remediated was actually a zero valent metal, it is used to form a barrier to limit the spread of contaminate or interact with the contaminant as it moves across the metal. *See* PXY-1110, col. 11, lines 1-4. Clearly, what is injected is not supplied into soil pathways, but rather is placed so the contaminant will eventually flow through it.

Petitioner and its Expert also note that Hitchens describes various ways in which the bimetallic particles, which are a key aspect of the invention, can be

distributed. *See* PXY-1003, col. 12, lines 18-29. As noted above, there is no disclosure in Hitchens that these bimetallic particles are zero valent, however. Furthermore, the methods described for distributing the bimetallic particles in this section of Hitchens, namely, “directly distributing loose particles freely in the soil by placing them in a trench . . . injecting them into holes or wells which may be closed, or left open and used for fluid removal,” or packaging them “. . . into pourous filter ‘socks,’” would not result in a mixture including zero valent metal entering into soil pathways. *See* PXY-1003, col. 12, lines 20-25. One skilled in the art would recognize that the emplacement of the metal in the wells would not result in movement of the metal into the groundwater, but instead in a solid mass within the well preventing water from moving across the metal particles. Moreover, neither Petitioner nor its Expert addressed the soil pathways, let alone supplying the mixture including zero valent metal into such pathways.

**b. Supplying an organic hydrogen donor [1.2]**

Petitioner and its Expert argue that Hitchens discloses the use of compounds (e.g., formate, glucose, lactate) to produce hydrogen for dechlorinating contaminants. *See* Petition, pp. 28-29; PXY-1011, pp. 42-47. *See also* PXY-1003, 2:33-47. However, as identified above, the use of these compounds is disclosed in Hitchens’ background as one manner in which contaminants can be dechlorinated. The use of iron is another. Moreover, there is nothing in the background, the

description of the invention, or the claims that discloses the use of these compounds in combination with iron as recited in the claims of the '709 Patent.

Furthermore, neither Petitioner nor Petitioner's Expert addressed the soil pathways, nor the act of supplying the organic hydrogen donor into the soil pathways. Petitioner and its Expert have also failed to address that the organic hydrogen donor produces dechlorinating conditions such that indigenous anaerobic bacteria biodegrade "residual concentrations" of chlorinated solvents. Petitioner and its Expert have not provided any disclosure, teaching, suggestion, or rationale from Hitchens that iron and an organic hydrogen donor are both supplied, so they clearly cannot provide any showing of the differences in how iron and an organic hydrogen donor dechlorinate the contaminants, there being residual concentrations for the organic hydrogen donor.

**4. Petitioner Has Not Met Its Burden of Showing Anticipation by Hitchens under 35 U.S.C. § 102(b)**

Petitioner has failed to carry its burden of showing anticipation of the challenged claims of the '709 Patent by Hitchens under 35 U.S.C. § 102(b). The Board should therefore properly deny institution of review on Ground 1.

**B. The Board Should Deny Institution on Ground 2 Because Petitioner Has Not Demonstrated that the Challenged Claims were Anticipated by Vance**

The Petition sets forth as Ground 2 that Claims 1, 3, 7, 9, and 14-16 are anticipated under 35 U.S.C. § 102(a), (e) by U.S. Patent Application Publication

No. 2002/0151602 to Vance et al. (“Vance”). *See* Petition, pp. 30-37, PXY-1011, pp. 47-59. The Board should not institute review on Ground 2 because the Petition fails to set forth a reasonable likelihood that Vance discloses each limitation of claim 1, from which the remaining challenged claims depend. For example, Petitioner fails to demonstrate that Vance teaches supplying an organic hydrogen donor as required by independent claim 1.

### **1. Overview of Vance**

Vance discloses the method of using elemental metal to reduce chlorinated compounds to harmless compounds. The production of extremely small particles containing elemental iron is imperative. The metal is kept in an elemental state by keeping it in an oxygen-scavenging environment which can be accomplished by either suspending the nanoscale metal in a carbohydrate solution or injecting a carbohydrate solution in atomized form. *See* PXY-1010, Abstract.

The method of producing the nanoscale metallic colloids includes supplying elemental metal, suspending the metal in a non-aqueous organic liquid that will not react with the surface of the metal and preferably has a high flash point (e.g., dodecane, butyl acetate, polypropylene glycol), adding a dispersant, and agitating the mixture. *See* PXY-1010, ¶¶ 106-113.

The nanoscale particles are injected into the soil by making a colloid suspension having metal particles in the presence of a carbohydrate and injecting

the colloid suspension into the soil through a well. Any carbohydrate solution that creates an oxygen scavenging environment may be mixed with the metal (preferably corn syrup). The corn syrup helps prevent the iron from rusting. *See* PXY-1010, ¶¶ 118-122.

## **2. Errors in the Petitioner's Detailed Claim Analysis**

Petitioner errs in its detailed claim analysis as elaborated below. Petitioner's contentions that Vance discloses or describes the claim elements identified below are unfounded because such claim elements are not, in fact, to be found in Vance. Moreover, Petitioner's Expert, whose declaration purports to support Petitioner's arguments and allusions to Vance, basically repeats the averments made by Petitioner in the Petition and quotes cited portions of Vance without providing expert analysis nor opinion regarding how the disclosure of Vance is supposed to align with the challenged claim elements from the perspective of a POSA. As such, Petitioner's Expert declaration amounts to little more than additional attorney argument. Such failed declarations by Petitioner's Expert apply to each claim element discussed below.

### **a. Supplying an organic hydrogen donor [1.2]**

Petitioner and its Expert contend that carbohydrate (corn syrup) is utilized in Vance in the colloid suspension to create an oxygen scavenging environment, which results in an anaerobic environment, and therefore the indigenous anaerobic



bacteria can biologically degrade residual concentrations of chlorinated solvents. *See* Petition, pp. 33-34; PXY-1011, pp. 52-59.

Patent Owner submits instead that Vance describes using the corn syrup as an oxygen scavenger so that rusting of the nanoscale particles can be prevented. However, Vance does not describe or suggest corn syrup being used for any other purpose. Specifically, Patent Owner points out that Vance does not disclose the corn syrup being used as an organic hydrogen donor that provides hydrogen. Vance does not disclose the corn syrup fermenting to provide hydrogen, let alone providing a sufficient quantity of corn syrup so that it will, under anaerobic conditions, ferment to provide hydrogen in sufficient quantity to meet the hydrogen needs of the indigenous anaerobic bacteria to enable them to biodegrade the residual chlorinated solvents. Petitioner and its Expert fail to address the corn syrup acting as an organic hydrogen donor. The production of hydrogen in sufficient quantities from the corn syrup is also not inherent based on the fact the corn syrup in Vance is disclosed as being utilized only to prevent rust.

Moreover, Petitioner and its Expert have not addressed the fact that the organic hydrogen donor produces dechlorinating conditions such that indigenous anaerobic bacteria biodegrade “residual concentrations” of chlorinated solvents. Vance describes the metal being used exclusively for dechlorination, so there would be no residual concentrations of chlorinated solvents remaining for

biodegradation. Additionally, if there were any residual concentrations left, there is no disclosure or suggestion of the corn syrup being utilized to produce dechlorinating conditions such that indigenous anaerobic bacteria biodegrade residual concentrations of chlorinated solvents.

**b. Wherein the mixture further includes nutrients  
[7.0]**

Petitioner and its Expert suggest that Vance describes “supplying, along with the zero valent iron in a colloidal suspension, a carbohydrate atomized in nitrogen: ‘The method of claim 11, wherein said carbohydrate is added in atomized form by injecting said carbohydrate into compressed nitrogen gas.’” See Petition, pp. 36-37; PXY-1011, pp. 47-59. *See also* PXY-1010, claim 20.

The Petitioner and its Expert then suggest that nitrogen is described as being a nutrient in the ‘709 Patent, and thus assert that the nitrogen gas used in Vance is a nutrient. Patent Owner submits that Petitioner and its Expert fail to explain that there is a difference between nitrogen used as a nutrient (NH<sub>4</sub>) and nitrogen gas (N<sub>2</sub>). A POSA would know that nitrogen gas is not a nutrient. Petitioner’s Expert is clearly looking to confuse the Board by simply matching words in the challenged claims with words in Vance. As noted above, Petitioner’s Expert repeated the Petition and quoted portions of Vance, but failed to provide opinion or insight regarding how a POSA would consider the disclosure of Vance in relation

to the challenged claim elements, as such insight would be completely counter to his argument.

The ‘709 Patent describes organic ammonia and ortho-phosphate as nutrients. *See* PXY-1001, col. 3, lines 5-10, col. 4, lines 10-14, claim 8. Grasso, a reference later utilized by the Petitioner in Ground 6, clearly states, “Nitrogen can be introduced in the nutrient media in either inorganic or organic forms. The most common inorganic forms are as *ammonium* or nitrate ions.” *See* PXY-1014, p. 34; PXY-1011, pp. 91-92 (*emphasis added*).

**3. Petitioner Has Not Met Its Burden of Showing Anticipation by Vance under 35 U.S.C. § 102(a), (e)**

Petitioner has failed to carry its burden of showing anticipation of the challenged claims of the ‘709 Patent by Vance under 35 U.S.C. § 102(a), (e). The Board should therefore properly deny institution of review on Ground 2.

**C. The Board Should Deny Institution on Ground 3 Because Petitioner Has Not Demonstrated that the Challenged Claims were Anticipated by Alvarez**

The Petition sets forth as Ground 3 that claims 1, 3, 7, and 14 are anticipated under 35 U.S.C. § 102(b) by international PCT Published Patent Application WO98/49106 to Alvarez et al. (“Alvarez”). *See* Petition, pp. 37-44; PXY-1011, pp. 60-67. The Board should not institute review on Ground 3 because the Petition fails to set forth a reasonable likelihood that Alvarez discloses each limitation of claim 1, from which the remaining challenged claims depend. Petitioner fails to

demonstrate that Alvarez teaches supplying an organic hydrogen donor as required by independent claim 1.

### **1. Overview of Alvarez**

Alvarez discloses bioremediation of mixed waste aquifers based on combination of reductive treatment using zero-valent iron and anaerobic biotransformations. *See* PXY-1005, Abstract. Alvarez further discloses “combining Fe(0) technologies with hydrogenotrophic microorganisms to exploit favorable biogeochemical interactions to detoxifying a variety of inorganic and organic compounds . . . . [T]he invention concerns iron-supported autotrophic methods which utilize a device comprising a composition containing zero-valent iron and a culture of one or more species of hydrogenotrophic bacteria to remove target contaminants.” *See* PXY-1004, p. 11, lines 10-21.

### **2. Petitioner Provides a Misleading Overview of Alvarez**

The Petitioner’s Expert contends that “[i]mportantly, Alvarez describes the metal composition may be advantageously augmented by introducing organic hydrogen donors to stimulate the natural reductive dechlorination process.” *See* PXY-1011, p. 60; *see generally* PXY-1004, pp. 23-24, 58. In his contention, however, the Expert has provided no guidance as to what content on these pages he believes supports his statement and has provided no rationale for what a POSA may believe is disclosed therein.

The Patent Owner submits that this contention is completely erroneous since, for example, Alvarez discloses:

“Fe(0) will enhance microbial activity by serving as electron donor (via water- derived hydrogen, produced by cathodic depolarization) to support hydrogenotrophic growth and reductive biotransformations. Bacterial viability may be further enhanced by abiotic removal of toxic compounds by Fe(0) below toxic levels. The bacteria, in turn, might enhance the abiotic process by removing the passivating (cathodic) hydrogen layer from the Fe(0) surface and by further degrading some products of reductive treatment with Fe(0) . . . . Electron donors that have been investigated for methanogenic biotransformation of CAHs include methanol (Mikesell and Boyd, 1990; Bagley and Gossett, 1995), acetate (Bouwer et al, 1981; Bouwer and McCarty, 1983; Hughes and Parkin, 1996), and hydrogen (DiStefano et al, 1992). Hydrogen is a more thermodynamically favorable electron donor than either methanol or acetate (Zinder, 1993), and its high diffusivity through biofilms ensures that the target CAHs would be flux-limiting to optimize removal rates. Nevertheless, practical problems exist with regard to the use of hydrogen due to its low solubility in water, about 1.6 mg/L at 20°C, based on a Henry's constant of  $6.83 \times 10^4$  atm/mol (Metcalf and Eddy, Inc., 1991). PXY-1004, p. 25, line 27-p. 26, line 15.

One way that hydrogen can be introduced into aqueous solution involves the use of iron metal. When Fe is immersed in anoxic water, hydrogen is produced (Reardon, 1996).” PXY-1004, p. 25, line 26-p. 26, line 17.

The cited pages of Alvarez above discuss that methanol and acetate are electron donors that have been used, but are not as effective as hydrogen, and further that iron can be utilized to create hydrogen. However, there is nothing in the referenced content in Alvarez that suggests using iron in addition to methanol and/or acetate, as suggested by Petitioner's Expert. Rather, Alvarez suggests using iron to create hydrogen in place of methanol and/or acetate. In summary, Alvarez simply describes methanol and acetate as being inefficient as compared to the use of iron alone to generate hydrogen directly, and in no way teaches their combined use or discusses the potential benefits thereof in terms of overall performance.

Alvarez discloses, "Reductive dechlorination is an electron-consuming process, the stimulation of which by the addition of an exogenous electron donor is common." PXY-1004, p. 60, lines 13-14. Patent Owner submits that this passage clearly does not disclose the use of an organic hydrogen donor in addition to the iron that creates the hydrogen, as the Expert contends.

In fact, Patent Owner refers to the claims of Alvarez as proof that the use of an electron hydrogen donor in addition to iron is not contemplated by Alvarez. Alvarez includes 58 claims, a majority of which are multiple dependent claims, and there is not a single claim related to the use of methanol, acetate, or any organic hydrogen donor, let alone using an organic hydrogen donor in addition to zero valent metal.

Petitioner and its Expert contend that Alvarez discloses, “[i]n addition ‘the composition may be augmented to provide one or more nutrients, vitamins, minerals, or substrates for utilization by the microbial colony.’” *See* Petition, pp. 38-39; PXY-1011, p. 61; *see also* PXY-1004, p. 11. Petitioner and its Expert further suggest that Alvarez discloses, “The substrate is an electron donor such as methanol or acetate.” *See id.*; *see also* PXY-1004, pp. 23-24.

Patent Owner submits that Petitioner’s and its Expert’s contentions that the substrate is methanol or acetate are completely erroneous. Alvarez discusses that the composition may be augmented. However, there is no suggestion that the substrate noted in the sentence pointed out by Petitioner and its Expert is any type of electron donor, let alone an organic hydrogen donor. In fact, Alvarez discusses various substrates that may be used and none of them have anything to do with methanol or acetate as suggested by Petitioner and its Expert. For example, Alvarez discloses:

“In preferred embodiments the culture of hydrogenotrophic bacteria (either alone or in combination with other microorganisms) is immobilized, mixed with, or in close proximity to the *solid or semi-solid substrate(s)* that comprise the Fe(0) compound. *The solid substrate may be, but is not limited to, matrices, columns, chromatographic media, glass or plastic beads, plates or surfaces, acrylic beads, acrylamides, polyacrylamides, beaded agarose, Sepharose, tubing, vials, metal supports, mesh, fibers, polymers, ceramics, or cloth and the like.* The Fe(0) component may be attached to the solid

substrate by any suitable means known to those of skill in the art.

Alternatively, *the iron itself, or the device housing may serve as a substrate for the growth of the bacterial cells.* The device may be a cartridge, a filter, a vessel (including e.g., a reactor, flask, beaker, funnel, bottle, canister, or tank), a flow-through tubing, radiator, fermenter, or such like. In the case of in situ remediation, the device may be comprised within a system or remediation apparatus, and may comprise a reactive barrier, a membrane, a cylindrical barrier, a gate-and-funnel apparatus, or any other apparatus suitable for placement in an environmental site, and suitable for providing a means for containing the bacterial--Fe(O) composition within the device.

The iron compound may be alone, or may be added to a porous medium or *semi-porous substrate*. This medium may contain one or more aluminosilicate minerals (e.g., bentonite, montmorillonite, kaolinite, gibbsite, microcline feldspar, albite feldspar) to enhance proton generation at the Fe(0) surface and accelerate corrosion, as described by Powell et al. (1997). The porous medium may also be amended with one or more zeolite minerals to retard the movement of halogenated and nitrated organic contaminants through reactive barriers. This increases both retention time and the removal efficiency. The medium may be formulated to promote adherence by the bacterial culture to the *iron substrate*, and may be formulated to promote growth or survival of the bacterial culture. Optionally, the medium may be formulated to contain one or more antifungal, antiviral, or antiparasitic agents to retard or prevent the growth of fungi, virus, or parasites in the composition. Also optionally, the composition may be augmented to provide one or more nutrients, vitamins, minerals, or substrates for utilization by the microbial colony. In certain



instances, sorbants, such as charcoal, zeolites, or the like, may be added to the composition.” PXY-1004, p. 13 (*emphasis added*).

As previously discussed, Alvarez simply discloses that methanol and acetate are electron donors that have been used in the art, but that they are not as effective as hydrogen, and also that hydrogen can be introduced as an aqueous solution through the use of iron. There is nothing disclosed in Alvarez that suggests the disclosed substrate could be methanol or acetate, contrary to the suggestion of Petitioner and its Expert. In fact, the portions of Alvarez cited by Petitioner make no mention of a substrate at all, so it is unclear how Petitioner came to its conclusion. Furthermore, as previously discussed, there is no disclosure or suggestion of using methanol and acetate in addition to hydrogen, let alone using either in addition to iron being the source of the hydrogen. As previously noted, iron is used to create hydrogen, and the hydrogen is used in place of methanol and acetate.

The Expert asserts in paragraph 100 of his report that “Alvarez discloses injecting zero valent iron and an organic hydrogen donor ... as described in Claims.” PXY-1011, p. 62. Patent Owner submits that Petitioner’s Expert has provided no rational basis for his statement.

### **3. Errors in the Petitioners Detailed Claim Analysis**

Petitioner errs in its detailed claim analysis as elaborated below. Petitioner's contentions that Alvarez discloses or describes the claim elements identified below are unfounded because such claim elements are not, in fact, to be found in Alvarez. Moreover, Petitioner's Expert, whose declaration purports to support Petitioner's arguments and allusions to Alvarez, basically repeats the averments made by Petitioner in the Petition and quotes cited portions of Alvarez without providing expert analysis nor opinion regarding how the disclosure of Alvarez is supposed to align with the challenged claim elements from the perspective of a POSA. As such, Petitioner's Expert declaration amounts to little more than additional attorney argument. Such failed declarations by Petitioner's Expert apply to each claim element discussed below.

**a. Supplying an organic hydrogen donor [1.2]**

Petitioner and its Expert note that "Alvarez discloses 'the composition may be augmented to provide . . . substrates for utilization by the microbial colony.'"

*See* Petition, pp. 41-42; PXY-1011, pp. 62-67; *see also* PXY-1004 p. 11.

Petitioner and its Expert then infer that the identified substrate is methanol and acetate, since "Alvarez notes 'organic substrates that are commonly used support biological denitrification' are methanol and acetate." *See id.*; *see also* PXY-1004, p. 26. Patent Owner in contrast submits that Petitioner and its Expert are completely misconstruing what Alvarez discloses in order to confuse the Board.

For example, as noted above, Alvarez does not give any indication that methanol and acetate are the substrate discussed, and in fact suggests that the substrate may be whatever is holding the iron or the iron itself.

With regard to Petitioner's inference about the Alvarez disclosure, Petitioner and its Expert simply took a portion of a sentence in Alvarez out of context in an attempt to mislead the Board. Reading the entire paragraph clearly demonstrates that methanol and/or acetate substrates referred to were previously used prior to the current invention. The current invention uses iron to produce hydrogen instead of these substrates, since it is an improvement over the substrates. Section 4.4 of Alvarez, where the Petitioner/Expert extracted the sentence from, discloses:

“[Iron-supported Autotrophic Denitrification (ISAD)] is an improvement over existing biological nitrate removal processes because the autotrophic organisms used in this process grow on hydrogen gas produced by the corrosion of zero-valent iron by water (i.e., "cathodic hydrogen",  $H_2$ , is derived from water,  $H_2O$ ). Hydrogen gas is thermodynamically a more favorable reductant and has a greater diffusivity through biofilms compared to the *organic substrates that are commonly used to support biological denitrification (e.g., methanol and acetate)*. While these properties are conducive to enhanced nitrate removal, previous use of hydrogen as a substrate to support denitrification has been limited by its low solubility and its hazardous (explosive) properties during handling and storage. These limitations are overcome by using  $Fe(0)$  to continuously generate cathodic hydrogen to support autotrophic denitrification. In this process,  $Fe(0)$  is also

used as a direct reductant to remove nitrates abiotically. In addition, autotrophic bacteria use CO<sub>2</sub> as carbon source to synthesize new cell tissue and thus have lower biomass production than the bacteria used in conventional denitrification systems fed organic substrates. Thus, adverse side-effects on water quality due to residual organic compounds and excessive biomass production are eliminated.” PXY-1004 (*emphasis added*).

Petitioner and its Expert contend that “because reductive dechlorination is an electron consuming process, Alvarez described ‘the stimulation of which by the addition of an exogenous electron donor is common.’” *See* Petition, p. 42; PXY-1011, pp. 62-67; *see also* PXY-1004, p. 58. Patent Owner submits in contrast that this passage clearly does not disclose the use of an organic hydrogen donor as the Petitioner and its Expert appear to infer. This section of Alvarez is clearly referring to the hydrogen produced by the iron.

Petitioner and its Expert again note that “[m]ethanol and acetate are described as electron donors by Alvarez, [specifically,] ‘Electron donors that have been investigated for methanogenic biotransformation of [chlorinated aliphatic hydrocarbons] include *methanol . . . acetate . . . and hydrogen . . .*’” *See* Petition, p. 42; PXY-1011, pp. 62-67; *see also* PXY-1004, pp. 23-24 (*emphasis added*). As previously discussed, Patent Owner points out that pages 23-24 of Alvarez disclose that the invention utilizes iron as the electron [hydrogen] donor rather than

previously used electron donors such as methanol and acetate, and do not disclose using iron in addition to methanol and/or acetate.

To support Patent Owner's assertion, Patent Owner refers the Board to a more thorough look at section 4.2 of Alvarez that Petitioner cherry-picked passages from to make its arguments:

*“Fe(0) will enhance microbial activity by serving as electron donor (via water- derived hydrogen, produced by cathodic depolarization) to support hydrogenotrophic growth and reductive biotransformations. Bacterial viability may be further enhanced by abiotic removal of toxic compounds by Fe(0) below toxic levels. The bacteria, in turn, might enhance the abiotic process by removing the passivating (cathodic) hydrogen layer from the Fe(0) surface and by further degrading some products of reductive treatment with Fe(0). . . . Electron donors that have been investigated for methanogenic biotransformation of CAHs include methanol (Mikesell and Boyd, 1990; Bagley and Gossett, 1995), acetate (Bouwer et al, 1981; Bouwer and McCarty, 1983; Hughes and Parkin, 1996), and hydrogen (DiStefano et al, 1992). Hydrogen is a more thermodynamically favorable electron donor than either methanol or acetate (Zinder, 1993), and its high diffusivity through biofilms ensures that the target CAHs would be flux-limiting to optimize removal rates. Nevertheless, practical problems exist with regard to the use of hydrogen due to its low solubility in water, about 1.6 mg/L at 20°C, based on a Henry's constant of  $6.83 \times 10^4$  atm/mol (Metcalf and Eddy, Inc., 1991).*

*One way that hydrogen can be introduced into aqueous solution involves the use of iron metal. When Fe is immersed in anoxic water, hydrogen is produced (Reardon, 1996).*

*Fe<sup>0</sup> + 2H<sub>2</sub>O - Fe<sup>2+</sup> + 2OH<sup>-</sup> + H<sub>2</sub> (Equation 16).” PXY-1004, p. 25, line 26 – p. 26, line 18 (emphasis added to reflect what Petitioner and its Expert cited to support methanol and/or acetate being utilized as an electron donor and to reflect where Alvarez discusses *iron/hydrogen being utilized as the electron donor*).*

Petitioner and its Expert contend that “[a]s described by Alvarez, supplying acetate (an organic hydrogen donor) stimulates the dechlorination process by providing electrons that allow indigenous anaerobic bacteria to biologically degrade residual chlorinated solvents.” Petition, p. 42; PXY-1011, pp. 62-67. Patent Owner submits that Petitioner and its Expert have provided no support for this contention. As noted above, the various other passages referred to by Petitioner and its Expert have clearly been taken out of context. Patent Owner submits that Alvarez discloses using iron to produce hydrogen in place of methanol and acetate. As proof of Patent Owner’s position in this regard, Patent Owner calls the Board’s attention to the claims of Alvarez. Alvarez includes 58 claims, a majority of which are multiple dependent claims, and there is not a single claim related to the use of methanol, acetate or any organic hydrogen donor, let alone

using an organic hydrogen donor in addition to zero valent iron. *See* PXY-1004, pp. 76-85.

**4. Petitioner Has Not Met Its Burden of Showing Anticipation by Alvarez under 35 U.S.C. § 102(b)**

Petitioner has failed to carry its burden of showing anticipation of the challenged claims of the ‘709 Patent by Alvarez under 35 U.S.C. § 102(b). The Board should therefore properly deny institution of review on Ground 3.

**IV. The Board Should Not Institute Review on Any of the Purported Obviousness Grounds 4-7**

**A. The Board Should Deny Institution on Ground 4 Because Petitioner Has Not Demonstrated that the Challenged Claims are Obvious in Light of Rice in view of Cantrell**

The Petition sets forth as Ground 4 that claims 1-3, 5, 7, 11, 12, and 14-16 are rendered obvious under U.S.C. § 103 by U.S. Patent No. 6,001,252 to Rice et al. (“Rice”) in view of U.S. Patent No. 5,857,810 to Cantrell et al. (“Cantrell”). *See* Petition, pp. 44-53; PXY-1011, pp. 67-82. The Board should not institute review on Ground 4 because the Petition fails to set forth a reasonable likelihood that there is sufficient motivation to combine Rice and Cantrell, or a reasonable likelihood that a proposed combination of Rice and Cantrell discloses each limitation of claim 1, from which the remaining challenged claims depend.

**1. Overview of Rice and Cantrell**

Rice discloses a “method for in situ anaerobic dehalogenation of a halogenated organic compound in a groundwater plume reduces or prevents indigenous aerobic microorganisms from competing for a supplied electron donor with an anaerobic microorganism that reductively dehalogenates the organic compound when an electron donor is available. The method includes the step of injecting in situ into a groundwater-saturated matrix within or upgradient of a source of the organic compound a deoxygenated aqueous solution that comprises an electron donor to facilitate reductive dehalogenation of the organic compound.” PXY-1006, Abstract.

Cantrell discloses a “chemical barrier is formed by injecting a suspension of solid particles or colloids into the subsurface. First, a stable colloid suspension is made including a surfactant and a non-Newtonian fluid. This stable colloid suspension is characterized by colloid concentration, colloid size, colloid material, solution ionic strength, and chemical composition. A second step involves injecting the optimized stable colloid suspension at a sufficiently high flow rate to move the colloids through the subsurface sediment, but not at such a high rate so as to induce resuspending indigenous soil particles in the aquifer. While injecting the stable colloid suspension, a withdrawal well may be used to draw the injected colloids in a direction perpendicular to the flow path of a contaminant plume. The withdrawal well, may then be used as an injection well, and a third well, in line



with the first two wells, may then be used as a withdrawal well, thereby increasing the length of the colloid barrier. This process would continue until emplacement of the colloid barrier is complete.” PXY-1026, Abstract.

## **2. Motivation to Combined Rice and Cantrell is Insufficient**

Petitioner (Petition, pages 48, 49) and their Expert (PXY-1011, ¶¶ 111-113) provide insufficient motivation to combine Rice and Cantrell. *See* Petition, pp. 48-49; PXY-1011, pp. 71-72. An obviousness assertion must be supported by “some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007) (quoting *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)). Indeed, MPEP § 2143 states that “the key to supporting any rejection under 35 U.S.C. §103 is the clear articulation of the reasons why the claimed invention would have been obvious” and sets forth the seven “Exemplary Rationales” to support a conclusion of obviousness. When relying on Rationale G of the Exemplary Rationales in the MPEP (“Some teaching, suggestion, or motivation ... to modify the prior art reference or to combine prior art reference teachings ...”), as the Petition does, the following are required in order to support a conclusion of obviousness under that rationale:

- (1) A finding that there was some teaching, suggestion, or motivation, either in the references themselves or in the knowledge generally

available to one of ordinary skill in the art, to modify the reference or to combine reference teachings;

- (2) A finding that there was reasonable expectation of success; and
- (3) Whatever additional findings based on the Graham factual inquiries may be necessary, in view of the facts of the case under consideration, to explain a conclusion of obviousness.

Petitioner and its Expert have fallen well short of carrying the burden with respect to the motivation to combine Petitioner's cited references. Petitioner and its Expert simply recite several benefits of using zero valent iron without providing any disclosure, teachings, suggestion, rationale, evidence, or explanation (collectively referred to simply as "rationale") why the zero valent metal non-Newtonian stable colloid suspension (iron colloid) of Cantrell should be utilized in addition to the deoxygenated aqueous solution that comprises an electron donor ("electron donor") of Rice. *See* Petition, pp. 48-49; PXY-1011, pp.71-72.

Petitioner and its Expert have not provided any finding that there was some teaching, suggestion, or motivation, either in the references themselves or in the knowledge generally available to a POSA to modify the reference or to combine reference teachings to arrive at the invention claimed in the '709 Patent. Petitioner and its Expert have not provided any finding of the existence of reasonable expectations of success if the cited references were to be combined.

For example, Petitioner's first reason for combining the references is simply that the addition of zero valent iron to Rice's solution provides an additional (abiotic) mechanism to reductively dechlorinate solvents. However, Petitioner and its Expert have not provided any rationale, have not identified any teaching, suggestion, or motivation, in the references or in the knowledge generally available to a POSA, and have not provided any finding that there was reasonable expectation of success as to if (and if so, how) the iron colloid of Cantrell (the additional mechanism) could be utilized along with the electron donor of Rice, or that the abiotic mechanism utilized in Cantrell could be used along with the biotic mechanism utilized in Rice.

Petitioner's second reason is simply that the zero valent iron acts as an oxygen scavenger to maintain favorable conditions for biological dechlorination. Rice's deoxygenated aqueous electron donor solution enables anaerobic microorganisms to utilize the electron donor to reductively dehalogenate the organic compound without competition from anaerobic microorganisms, creating an anaerobic/oxygen scavenging environment. *See* PXY-1006, Abstract. Petitioner and its Expert once again failed to provide any rationale as to why Rice would be modified to include an iron colloid to produce an oxygen scavenging environment, particularly when the deoxygenated aqueous electron donor solution of Rice already has created such an environment. Furthermore, Petitioner and its Expert

have not provided any rationale, have not identified any teaching, suggestion, or motivation, in the references or in the knowledge generally available to a POSA, and have not provided any finding that there was reasonable expectation of success as to if (and if so, how) the iron colloid of Cantrell could be utilized along with the electron donor of Rice to maintain favorable conditions for biological dechlorination (anaerobic/oxygen scavenging environment).

Petitioner's and its Expert's third reason is that in an anaerobic environment, the corrosion of zero valent iron results in generation of hydrogen, which is also favorable to indigenous anaerobic bacteria. Rice's deoxygenated aqueous electron donor solution has available hydrogens that can act as an electron donor during dehalogenation. *See* PXY-1006, col. 4, lines 7-21. Petitioner and its Expert have not provided any rationale why Rice would be modified to include an iron colloid to produce additional hydrogen when the deoxygenated aqueous electron donor solution of Rice already provides available hydrogens. Furthermore, Petitioner and its Expert have not provided any rationale, have not identified any teaching, suggestion, or motivation, in the references or in the knowledge generally available to a POSA, and have not provided any finding that there was reasonable expectation of success as to if (and if so, how) the iron colloid of Cantrell could be utilized along with the electron donor of Rice to produce hydrogen.

Petitioner's fourth reason is that the addition of zero valent iron to Rice's deoxygenated aqueous electron donor solution reduces the amount of the electron donor (e.g., lactate) that needs to be provided, since iron also serves as an electron donor. However, as previously, Petitioner and its Expert have not provided any rationale as to why reducing the electron donor in the deoxygenated aqueous electron donor solution of Rice would be beneficial (e.g., is there a cost or performance benefit to using iron instead of lactate, etc.). Furthermore, Petitioner and its Expert have not provided any rationale, have not identified any teaching, suggestion, or motivation, in the references or in the knowledge generally available to a POSA, and have not provided any finding that there was reasonable expectation of success as to if (and if so, how) the iron colloid of Cantrell could be utilized to provide an electron donor while the aqueous electron donor solution provided in the Rice provides an electron donor.

Petitioner and its Expert contend that "[g]iven 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." PXY-1011, pp. 71-72. Patent Owner submits that the Expert has not provided any evidence of the so-called known symbiotic characteristics of the two different

methods and simply makes a hollow argument that a POSA would be confident in combining the teachings of Rice and Cantrell.

Petitioner's Expert maintains that "it would have been obvious to one skilled in the art to add the mixture including a zero valent metal as taught by Cantrell to the solution used in the dechlorination method described by Rice for reasons listed above." PXY-1011, p. 72. As noted above, however, the reasons provided by the Expert are not supported by any rationale, have not identified any teaching, suggestion, or motivation, in the references or in the knowledge generally available to a POSA, and have not provided any finding that there was reasonable expectation of success. The Expert simply makes a hollow statement regarding the likelihood of success with no support.

In addition, Patent Owner maintains that Rice is related to an aqueous solution PXY, while Cantrell is related to a non-Newtonian fluid. *Compare* PXY-1006, Abstract *with* PXY-1026, Abstract. As a POSA would know, an aqueous solution and a non-Newtonian fluid are not the same. An aqueous solution is a non-Newtonian fluid whose viscosity does not depend on gradients in flow speed. *See* IET 2004, p. 1. A non-Newtonian fluid is a fluid whose viscosity changes when the gradient in flow speed changes. Examples of non-Newtonian fluids include ketchup and starch/water paste. *See id.* As a POSA would know, one could not easily mix a Newtonian and a non-Newtonian fluid, let alone supply a

Newtonian and a non-Newtonian fluid to the ground together as suggested by the proposed combination advanced by Petitioner and its Expert. Neither Petitioner nor its Expert addressed the fact that the fluids of Rice and Cantrell are different or provide any rationale as to how the two different fluids could be combined as proposed by the Petitioner/Expert. The different fluid types of Rice (aqueous solution) and Cantrell (non-Newtonian fluid) in fact would teach against the combination thereof.

Moreover, the aqueous solution of Rice is injected within or up-gradient to the source of the contaminant. *See* PXY-1006, Abstract, FIGs. 1-2. The non-Newtonian fluid of Cantrell is used to create a barrier zone that is capable of intercepting chemicals and preventing passage of the chemicals beyond the zone (is downgradient). *See* PXY-1026, col. 3, lines 38-53. Neither Petitioner nor its Expert have addressed the fact that the aqueous solution of Rice and the non-Newtonian fluid of Cantrell are provided at different locations. Neither has provided any rationale related to whether it is possible to, or why one skilled in the art would, move the location of where the Newtonian fluid of Cantrell is supplied (down-gradient) to the location where the aqueous solution of Rice is being supplied (up-gradient or within). The different locations where the aqueous solution of Rice and the non-Newtonian fluid of Cantrell are provided in fact would teach against the combination thereof.

### **3. Errors in the Petitioners Detailed Claim Analysis**

Petitioner errs in its detailed claim analysis as elaborated above and more specifically below. Petitioner's contentions that Rice discloses or describes the claim elements identified below are unfounded because such claim elements are not, in fact, to be found in Rice. Moreover, neither Petitioner nor Petitioner's Expert provide sufficient motivation to combine the references cited by Petitioner, i.e. Rice and Cantrell, and in fact, in many cases, the references teach away from the combination thereof. As such, Petitioner's Expert declaration amounts to little more than additional attorney argument with no expert analysis or opinion as to why the challenged claims are rendered obvious by the combination of the cited references based on a motivation to combine and/or modify. Such failed declarations by Petitioner's Expert apply to each claim element discussed.

#### **a. Supplying a mixture including zero valent iron [1.1]**

Petitioner and its Expert submit that Rice discloses supplying a mixture to biologically react with dissolved solvents in the ground water, including a substrate. *See* Petition, pp. 45-47; PXY-1011, pp. 72-82. Patent Owner points out, however, that the mixture is a deoxygenated aqueous electron donor solution. *See* PXY-1006, Abstract.

Petitioner and its Expert acknowledge that the mixture disclosed in Rice (deoxygenated aqueous electron donor solution) does not include zero valent



metal. However, Petitioner and its Expert describe how Cantrell discloses forming a chemical barrier by injecting a zero valent metal non-Newtonian stable colloid suspension. As noted above, Patent Owner submits that neither Petitioner nor its Expert provided sufficient motivation to combine the references, and in fact, the references teach away from the combination thereof. Accordingly, Petitioner has not provided a disclosure of supplying a mixture including zero valent metal.

Even assuming there was motivation to combine the references, Patent Owner submits that the proposed combination does not disclose supplying a mixture including a zero valent metal. The zero valent metal non-Newtonian stable colloid is not supplied into the soil pathways as required. Rather, the zero valent metal non-Newtonian stable colloid is utilized to create a barrier zone that is capable of intercepting chemicals and preventing passage of the chemicals beyond the zone

**b. Supplying an organic hydrogen donor [1.2]**

Petitioner (Petition page 47-48) and their Expert (PXY-1011, ¶ 114 [1.2]) submit that Rice disclose supplying organic hydrogen donors. *See* Petition, pp. 47-48; PXY-1011, p. 72-82. Patent Owner points out that the mixture is a deoxygenated aqueous electron donor solution. *See* PXY-1006, Abstract.

As noted above, Patent Owner maintains that neither Petitioner nor its Expert have provided sufficient motivation to combine the references, and in fact, the

references teach away from the combination thereof. Accordingly, Petitioner and its Expert have not provided a disclosure of supplying a mixture including zero valent metal. The deoxygenated aqueous electron donor solution cannot produce dechlorinating conditions such that indigenous anaerobic bacteria biodegrade “residual concentrations” of chlorinated solvents.

Even assuming there was motivation to combine the references, Patent Owner points out that Petitioner already equated this solution to the mixture including zero valent metal in its proposed combination. While the claims do not preclude the mixture including zero valent metal and the electron donor from being supplied together as one solution, the claims clearly require the organic hydrogen donor to be supplied in addition to the mixture including zero valent metal, while Petitioner and its Expert have provided no indication as to such being the case.

Moreover, Petitioner and its Expert have not addressed the fact that the proposed combination includes an organic hydrogen donor that produces dechlorinating conditions, such that indigenous anaerobic bacteria biodegrade “residual concentrations” of chlorinated solvents.

**c. Mixture including zero valent metal is a colloidal suspension in a sodium sulfite solution [11.0]**

Petitioner’s Expert asserts that “[t]he aqueous solution of Rice forms the colloidal suspension with iron and includes sodium sulfite.” PXY-1011, pp. 72-

82. Patent Owner points out that the Expert has provided no support or rationale for this assertion. Patent Owner further maintains that the zero valent metal of Cantrell is included in a non-Newtonian stable colloid suspension. *See* PXY-1026, Abstract. There is no disclosure in Cantrell related to including a reducing agent in the non-Newtonian suspension. There is also no disclosure in Rice that the deoxygenated aqueous electron donor solution includes iron.

**d. Colloidal suspension includes a reducing agent  
[16.0]**

Petitioner's Expert asserts that "[t]he aqueous solution of Rice forms the fluid of the colloidal suspension contains sodium sulfite." PXY-1011, pp. 72-82. Patent Owner points out that the Expert has provided no support or rationale for this assertion. Patent Owner further maintains that the non-Newtonian stable colloid suspension does not include a reducing agent, and there is no suggestion in Cantrell of including one. There is no disclosure that the deoxygenated aqueous electron donor solution of Rice includes a colloidal suspension.

**4. Petitioner Has Not Met Its Burden of Showing  
Obviousness in Light of Rice in view of Cantrell  
under 35 U.S.C. § 103**

Petitioner has failed to carry its burden of showing obviousness of the challenged claims of the '709 Patent in light of Rice in view of Cantrell under 35 U.S.C. § 103. The Board should therefore properly deny institution of review on Ground 4.

**B. The Board Should Deny Institution on Ground 5 Because Petitioner Has Not Demonstrated that the Challenged Claims are Obvious in Light of Vance in view of Schuring**

The Petition sets forth as Ground 5 that claims 4, 10, and 13 are rendered obvious under 35 U.S.C. § 103 by Vance in view of U.S. Patent No. 5,032,042 to Schuring et al. (“Schuring”). *See* Petition, pp. 54-57; PXY-1011, pp. 83-91. The Board should not institute review on Ground 5 because the Petition fails to set forth a reasonable likelihood that there is sufficient motivation to combine Vance and Schuring, or a reasonable likelihood that a proposed combination of Vance and Schuring disclose each limitation of claim 1, from which the challenged claims depend.

**1. Overview of Schuring**

Schuring discloses a fracturing assembly to increase soil permeability in the vadose zone (zone above water table). *See* PXY-1024, FIGs. 6-7. “The biodegradation method that has been found most effective in treatment of the vadose soil zone has been aerobic microbial process. With this process, oxygen and often nutrients are injected or infiltrated into the subsurface environment, using wells or a percolation process.” PXY-1024, col. 3, lines 6-13.

**2. Motivation to Combined Vance and Schuring is Insufficient**

Petitioner and its Expert provide insufficient motivation to combine Vance and Schuring. *See* Petition, p. 55; PXY-1011, pp. 87-88. An obviousness assertion must be supported by “some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.” *See KSR Int’l Co.*, 550 U.S. at 418 (quoting *In re Kahn*, 441 F.3d at 988). Indeed, MPEP § 2143 states that “the key to supporting any rejection under 35 U.S.C. §103 is the clear articulation of the reasons why the claimed invention would have been obvious.”

Petitioner and its Expert have fallen well short of carrying the burden with respect to the motivation to combine their cited references. In fact, Petitioner and its Expert simply recite several possible benefits of soil pathways without providing any rationale, identifying any teaching, suggestion, or motivation, in the references or in the knowledge generally available to a POSA, or providing any finding that there was reasonable expectation of success. *See* Petition, p. 55; PXY-1011, pp. 87-88.

Patent Owner points out that Schuring is related to fracturing the soil in the vadose zone (an aerobic environment above water table), and not the anaerobic environment below the water table as discussed in Vance. Accordingly, one would not be motivated to combine these references.

### **3. Errors in the Petitioners Detailed Claim Analysis**

Petitioner errs in its detailed claim analysis as discussed above and more specifically below. Neither Petitioner nor Petitioner's Expert provide sufficient motivation to combine the references cited by Petitioner, i.e. Vance and Schuring, and in fact, in many cases, the references teach away from the combination thereof. As such, Petitioner's Expert declaration amounts to little more than additional attorney argument with no expert analysis or opinion as to why the challenged claims are rendered obvious by the combination of the cited references based on a motivation to combine and/or modify. Such failed declarations by Petitioner's Expert apply to each claim element discussed.

**a. Injecting gas under pressure ... to establish preferential delivery pathways [4.0]**

As noted above, there is no motivation to combine Vance and Schuring. Furthermore, even if the references were combined, the pathways created would be in the vadose zone, so it clearly would not provide a preferential delivery pathway. Moreover, claim 4 is dependent on claim 1 and is therefore submitted to be patentable over Vance as noted above. Schuring does not disclose the elements of claim 1 missing from the teachings of Vance.

**4. Petitioner Has Not Met Its Burden of Showing Obviousness in Light of Vance in view of Schuring under 35 U.S.C. § 103**

Petitioner has failed to carry its burden of showing obviousness of the challenged claims of the '709 Patent in light of Vance in view of Schuring under

35 U.S.C. § 103. The Board should therefore properly deny institution of review on Ground 5.

**C. The Board Should Deny Institution on Ground 6 Because Petitioner Has Not Demonstrated that the Challenged Claims are Obvious in Light of Hitchens in view of Grasso**

The Petition sets forth as Ground 6 that claim 8 is rendered obvious under 35 U.S.C. § 103 by Hitchens in view of Grasso. *See* Petition, pp. 57-58; PXY-1011, pp. 91-93. The Board should not institute review on Ground 6 because the Petition fails to set forth a reasonable likelihood that a proposed combination of Hitchens and Grasso disclose each limitation of claim 1, from which the challenged claim depends.

**1. Motivation to Combined Hitchens and Grasso is Insufficient**

Petitioner and its Expert provide insufficient motivation to combine Hitchens and Grasso. *See* Petition, p. 59; PXY-1011, p. 92. An obviousness assertion must be supported by “some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.” *See KSR Int’l Co.*, 550 U.S. at 418 (quoting *In re Kahn*, 441 F.3d at 988 ). Indeed, MPEP § 2143 states that “the key to supporting any rejection under 35 U.S.C. §103 is the clear articulation of the reasons why the claimed invention would have been obvious.”

Petitioner and its Expert have fallen well short of carrying the burden with respect to the motivation to combine the cited references. Petitioner and its Expert

simply recite several possible benefits of ammonia and orthophosphate as nutrients, but fail to provide any rationale, identify any teaching, suggestion, or motivation, in the references or in the knowledge generally available to a POSA, or provide any finding that there was reasonable expectation of success. *See* Petition, p. 55; PXY-1011, pp. 87-88.

**2. Proposed Combination of Hitchens and Grasso  
Insufficient Teachings**

Neither Petitioner nor its Expert rely on Grasso to disclose the elements of claim 1 missing from the teachings of Hitchens, and the Patent Owner submits that Grasso does not disclose these elements.

**3. Petitioner Has Not Met Its Burden of Showing  
Obviousness in Light of Hitchens in view of Grasso  
under 35 U.S.C. § 103**

Petitioner has failed to carry its burden of showing obviousness of the challenged claims of the ‘709 Patent in light of Hitchens in view of Grasso under 35 U.S.C. § 103. The Board should therefore properly deny institution of review on Ground 6.

**D. The Board Should Deny Institution on Ground 7 Because  
Petitioner Has Not Demonstrated that the Claims are  
Obvious in Light of Hitchens in view of Odom**

The Petition sets forth as Ground 7 that claim 6 is rendered obvious under 35 U.S.C. § 103 by Hitchens in view of U.S. Patent No. 5,587,317 to Odom (“Odom”). *See* Petition, pp. 57-58; PXY-1011, pp. 94-97. The Board should not



institute review on Ground 7 because the Petition fails to set forth a reasonable likelihood that a proposed combination of Hitchens and Odom disclose each limitation of claim 1, from which the challenged claim depends.

**1. Motivation to Combined Hitchens and Odom is Insufficient**

Petitioner and its Expert provide insufficient motivation to combine Hitchens and Odom. *See* Petition, p. 59; PXY-1011, pp. 95-96. Petitioner and its Expert have fallen well short of carrying the burden with respect to the motivation to combine the cited references. Petitioner and its Expert simply offer conclusions without providing any rationale, identifying any teaching, suggestion, or motivation, in the references or in the knowledge generally available to a POSA, or providing any finding that there was reasonable expectation of success. *See* Petition, p. 59; PXY-1011, pp. 95-96.

**2. Proposed Combination of Hitchens and Odom Insufficient Teachings**

Neither Petitioner nor its Expert rely on Odom to disclose the elements of claim 1 missing from the teachings of Hitchens, and Patent Owner submits that Odom does not disclose these elements.

**3. Petitioner Has Not Met Its Burden of Showing Obviousness in Light of Hitchens in view of Odom under 35 U.S.C. § 103**

Petitioner has failed to carry its burden of showing obviousness of the challenged claims of the '709 Patent in light of Hitchens in view of Odom under 35 U.S.C. § 103. The Board should therefore properly deny institution of review on Ground 7.

## **V. Redundant Grounds**

In conjunction with consideration whether to institute this *inter partes* review upon examination of Petitioner's arguments in its Petition and Patent Owner's Preliminary Response, Patent Owner urges the Board to eliminate from consideration any vertically or horizontally redundant grounds for unpatentability presented by Petitioner. Under 37 C.F.R. § 42.108(b), the Board may deny institution of review on some or all grounds that it deems redundant with others presented.

## **VI. Conclusion**

In light of the foregoing arguments and responses presented in reference to the Petition for *Inter Partes* Review filed by Petitioner, Patent Owner urges the Board to deny institution of this proceeding.

Respectfully submitted,

Ryder, Lu, Mazzeo & Konieczny LLC

Date: March 10, 2016

By: /DouglasJRyder/  
Douglas J. Ryder  
USPTO Regis. No. 43,073

## **CERTIFICATE OF SERVICE**

The undersigned hereby certifies that a true and correct copy of the foregoing Patent Owner's Preliminary Response was served via Express Mail on the date set forth below to the following:

D. Joseph English  
Patrick C. Muldoon  
Duane Morris LLP  
505 9<sup>th</sup> Street NW, Suite 1000  
Washington, DC 20004

Samuel W. Apicelli  
Duane Morris LLP  
IP Department  
30 South 17<sup>th</sup> Street  
Philadelphia, PA 19103-4196

*Attorneys for Petitioner*

Date: March 10, 2016

By: /DouglasJRyder/  
Douglas J. Ryder  
USPTO Regis. No. 43,073  
Ryder, Lu, Mazzeo & Konieczny LLC  
808 Bethlehem Pike, Suite 200  
Colmar, PA 18915  
Tel: 215-997-0248  
Fax: 215-997-0266  
dryder@ryderlu.com  
*Attorneys for Patent Owner*