UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

FRONTIER WATER SYSTEMS, LLC
Petitioner

v.

GENERAL ELECTRIC CORPORATION
Patent Owner

U.S. Patent No. 7,790,034
Filing Date: January 22, 2008
Issue Date: September 7, 2010
Title: Apparatus and Method for Treating FGD Blowdown or Similar Liquids

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Inter Partes Review Case No. IPR2017-01468

PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 7,790,034 UNDER 35 U.S.C. §§ 311-319 AND 37 C.F.R. § 42.100 *et seq*.

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FWS1003	File History for Canada Patent Application CA2,517,322 ("CA'322")
FWS1004	File History of Canada Patent Application CA2,615,945 ("CA'945)
FWS1005	Assignment Recordal History for US7,790,034
FWS1006	Complaint in *Frontier Water Systems v. General Electric Company*, Case No. 2:17-cv-00261-PMW (D. Utah) – April 6, 2017 (without exhibits)
FWS1007	Amended Complaint in *Frontier Water Systems v. General Electric Company*, Case No. 2:17-cv-00261-PMW (D. Utah) – April 13, 2017 (without exhibits).
FWS1008	June 8, 2016 letters from General Electric to Frontier Water Systems
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FWS1011	U.S. Patent No. 4,725,357 to Downing, et al. ("Downing")
FWS1012	JP-01-304100-A to Katagawa, et al. ("Katagawa") – Certified Translation and Affidavit – also published under JPH01304100
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FWS1014	CA Patent 1,274,925 to Downing, et al.
FWS1015	Ronald L. Droste, *Theory and Practice of Water and Wastewater Treatment*, 1st Ed., John Wiley and Sons 1997 (excerpts)

	("Droste")
FWS1016	Metcalf & Eddy, *Wastewater Engineering treatment and Reuse,* 4th Ed., McGraw-Hill 2003 (excerpts) ("Metcalf")
FWS1017	Eckenfelder, W. Wesley, Jr., *Water Quality Engineering for Practicing Engineers*, Barnes & Noble, Inc. 1970 (excerpts) ("Eckenfelder")
FWS1018	U.S. Patent No. 5,989,428 to Goronszy ("Goronszy")
FWS1019	Twidwell, et al., *Technologies and Potential Technologies for Removing Selenium from Process and Mine Wastewater*, retrieved from RESEARCHGATE (January 1999), https://www.researchgate.net/publication/264856347
FWS1020	JP-09-038694-A to Fukase, et al. – Bibliographic and Japanese Source Data – also published under JPH0938694
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FWS1022	JP-10-249392-A to Okazoe, et al. – Bibliographic and Japanese Source Data – also published under JPH10249392

I. INTRODUCTION

Frontier Water Systems, LLC ("Petitioner" and "FWS") hereby Petitions the Board to institute an *inter partes* review of U.S. Patent No. 7,790,034 ("US'034").

II. MANDATORY NOTICES UNDER 37 C.F.R. § 42.8

A. Real Parties-in-Interest Under 37 C.F.R. § 42.8(b)(1)

The Petitioner and real party-in-interest is Frontier Water Systems, LLC.

B. Related Matters Under 37 C.F.R. § 42.8(b)(2)

US'034 is currently the subject of a declaration judgment action for non-infringement in the United States District Court for the District of Utah, Case Number: 2:17-cv-00261-PMW. *See* **FWS1006 (**Utah Complaint); **FWS1007** (Amended Utah Complaint).

Current USPTO assignment records show that Zenon Technology Partnership ("Zenon") is the assignee and Owner of US'034. **FWS1005**. (Assignment records). However, in communications to Petitioner, General Electric Corporation ("GE") representative Ms. Barbara Toop alleged that it is the current owner and assignee of US'034. **FWS1008**. Ms. Toop also prosecuted US'034 on behalf of GE. **FWS1002** pp. 46, 48, 100, 102. Petitioner also believes that Zenon is currently owned and/or controlled by GE, and so GE is the properly named Patent Owner consistent with its representations.

C. Lead and Back-Up Counsel under 37 C.F.R. § 42.8(b)(3)

Petitioner provides the following designation and service information for lead and back-up counsel. 37 C.F.R. § 42.8(b)(3) and (b)(4).

Lead Counsel	Back-Up Counsel
Adam K. Yowell (Reg. No. 69,955) ayowell@bhfs.com **Brownstein Hyatt Farber Schreck** 5371 Kietzke Lane Reno, Nevada 89511 Tel: 775.324.4100	Paul J. Prendergast (Reg. No. 46,068) pprendergast@bhfs.com **Brownstein Hyatt Farber Schreck** 410 Seventeenth St, Suite 2200 Denver, CO 80202 Tel: 303.223.1100 Michael D. Rounds (*pro hac vice* pending) mrounds@bhfs.com **Brownstein Hyatt Farber Schreck** 5371 Kietzke Lane Reno, Nevada 89511 Tel: 775.324.4100

D. Service Information Under 37 C.F.R. § 42.8(b)(4)

Petitioner served a copy of this Petition, in its entirety, (i) to the address of the attorney of record for US'034 and (ii) to the address of Barbara Toop, Executive Counsel – IP for GE and the author of the June 8, 2016 letters. **FWS 1008.**

Petitioner may be served at the lead counsel address provided above in Section II(C). Petitioner consents to electronic service by e-mail.

E. Fee for *Inter Partes* Review under 37 C.F.R § 42.15(a)

The fee for this IPR has been paid via credit card. If any additional amounts are found to be owing, or refunds due, the Board is hereby authorized to debit or credit those amounts to Deposit Account 504621.

III. REQUIREMENTS UNDER 37 C.F.R. § 42.104

A. Grounds for Standing Under 37 C.F.R. § 42.104(a)

Petitioner certifies that US'034 is eligible for IPR; Petitioner is not barred or estopped from requesting IPR; and no real party-in-interest has ever been served with a complaint alleging infringement of US'034.

B. Identification of Challenge Under 37 C.F.R. § 42.104(b)

Petitioner requests that claims 1-3, 5-7, and 9-15 (the "Challenged Claims") be found unpatentable on all of the following grounds:

Ground	Claims	Basis	Reference(s)
Ground 1	1, 3	102	Fukase
Ground 2	1, 3, 5, 7, 9-10, 12-15	103	Fukase
Ground 3	1-3, 5-7, 9-15	103	Fukase in view of Downing
Ground 4	1-3, 6, 9-15	103	Katagawa in view of Downing

Ground	Claims	Basis	Reference(s)
Ground 5	1-3, 5-7, 9-15	103	Katagawa in view of Downing in further view of Okazoe
Ground 6	5-7	103	Fukase in view of Downing in further view of Okazoe

IV. SUMMARY OF US'034

A. Description of the Alleged Invention

US'034 describes a system and process for treating water comprising Flue Gas Desulfurization ("FGD") wastewater or "blow down" water. The claimed system and process recite pretreatment of the water to precipitate out some of the Total Suspended Solids ("TSS") (claims 1 and 9), and also to soften the water through the addition of lime or sulfides. Following pretreatment, the water is then treated by bioreactors for denitrification and selenium removal.

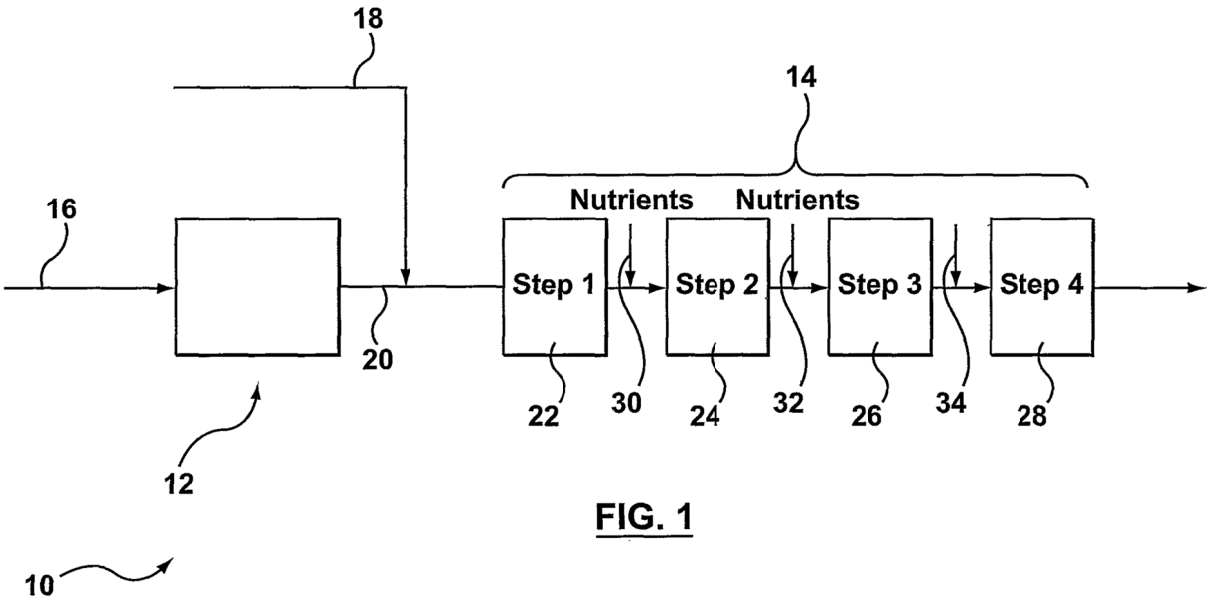


FIG. 1

Figure 1 above shows an overview of the claimed process and apparatus. Wastewater **16** flows into the pretreatment area **12**, where lime or sulfides or both are added; these chemicals are used to precipitate metals and other solids, coagulate the precipitate, and soften the water, which are then removed through use of a clarifier. US'034 6:18-24; Koon Decl. ¶ 39. The pretreated water is then passed through biological treatment area **14**, which can include multiple zones implemented in one or more bioreactors. US'034 6:43-53; Koon Decl. ¶ 39. Nutrients **30**, **32** may be added at one or more stages in this process as needed. US'034 6:53-58; Koon Decl. ¶ 39. The microbes in the bioreactors then perform denitrification (via biological reduction to nitrogen gas) and selenium removal via reduction of soluble selenite and selenate into elemental selenium, which is insoluble and is filtered out by the biological media substrate. US'034 11:33-48; Koon Decl. ¶ 39.

B. Summary of the Challenged Claims

1. Independent Claims

The two independent claims of US'034 are highly similar. Claim 1 recites a method while claim 9 recites a system. Both essentially claim a physicochemical pretreatment[1] followed by biological treatment to denitrify and remove selenium. The biological treatment portion of both claims are nearly identical. *Compare*

[1]As noted below, "physicochemical" refers to the prior art combination of physical and chemical pretreatments.

claim 1 ("wherein the steps of denitrifying the waste stream and removing selenium from the waste stream occur in one or more fixed film bioreactors") *with* claim 9 ("one or more reactors configured to provide denitrification and selenium removal by biological treatment.")

As to physicochemical pretreatment, it is recited in claim 1 as "physical and chemical pretreatment to remove suspended solids from the waste stream and soften the waste stream." In claim 9, the physicochemical pretreatment is recited as "a system for adding lime or sulfide to the waste stream and a precipitate remover." US'034 discloses the use of lime or sulfides as the exemplary manner of accomplishing the removal of TSS and softening the waste stream. US'034 2:43-49. The physicochemical portion of claims 1 and 9, while phrased differently, are therefore very similar, as are the claims as a whole.

2. Dependent Claims

The dependent claims fall into three categories: A) adding optional steps to add to the process and apparatus of claims 1 and 9, respectively; B) narrowing a broad term into one of its obvious possibilities; and C) ORP ("oxidation-reduction potential") regulation.

a) Optional additional steps

The dependent claims that recite additional, optional steps are claims 2 (arsenic, mercury, or sulphur removal), 3 (COD removal or nitrification), 10 (COD removal), 11 (heavy metals or sulfur removal), and 15 (ammonia stripping).

These steps are described in minimal detail in the specification, and often only instruct the reader to perform the recited step to address the contaminant. US'034 2:34-58 (generally), 2:48-63 (COD), 5:45-52 (ammonia stripping and nitrification), 5:57-65 (heavy metals). The additional steps recited in this group of dependent claims are simply known techniques to be applied when wastewater conditions dictate, a task well within the capabilities of a person having ordinary skill in the art ("PHOSITA"). Koon Decl. ¶¶ 23, 26-32; **FWS1003** p. 111; US'034 2:34-58. None of the above-identified dependent claims alter claims 1 and 9 in a material way and they are insignificant to the alleged invention of US'034. *Id.*

b) Known selections from within a group

The dependent claims that recite known options from within a group are claims 13 (fixed film bioreactor) and 14 (activated carbon as the fixed film media bed). The additional recitations in these claims merely select from known options within a broader term. Fixed film configurations are one well-known alternative for a bioreactor. US'034 2:49-57, 7:35-57; Koon Decl. ¶¶ 37, 59. Similarly,

activated carbon as a media bed is a well-known design choice as a media bed for a fixed film bioreactor. US'034 2:49-57, 8:27-43; Koon Decl. ¶¶ 37, 60.

c) ORP Regulation

The dependent claims that recite process steps related to ORP regulation are claims 5 (maintaining ORP ranges before and after bioreactors), 6 (ORP after bioreactor treatment below a set ORP), and 7 (maintaining ORP ranges as in claim 5, specifically using nutrients).

The ORP of a bioreactor substantially affects what contaminants are removed; the ranges of effective removal for various contaminants are well-known in the wastewater art. US'034 13:2-16, Fig. 8; Koon Decl. ¶¶ 35-36. For example, nutrient addition is a well-known method of controlling ORP in a bioreactor until a proper range for a known contaminant is achieved. Koon Decl. ¶¶ 35-36.

C. Summary of the Prosecution History

US'034 claims its earliest priority to provisional application 60/701,996, filed on July 25, 2005. **FWS1002** pp. 189-210. US'034 also claims priority to PCT/CA2006/001220, with a priority date of August 26, 2005. *Id.* pp. 141-60. US'034 also claims priority to a second provisional application, 60/736,859, filed on November 16, 2005. *Id.* pp. 161-88. The first provisional and Canadian application share very similar specifications, with only minor differences. *Compare id.* pp. 189-210 *with* 141-60. The second (November 2005) provisional,

however, added twenty-three new paragraphs to the original thirty-three, including essentially the entire description of the operation of the claimed bioreactors. *Compare id.* pp. 141-60 *with* 161-88.[2] The final specification for US'034, filed January 22, 2008, significantly revised paragraphs 34-49 and 51-54 and added Figs. 4-9. *Compare* **FWS1002** pp. 161-88 *with* 3-40.

Claim 1, as filed, recited "[a] process having steps of anoxic treatment to denitrify a waste stream followed by anoxic treatment to remove selenium." **FWS1002** pp. 29-30. The Examiner rejected claim 1 under 35 U.S.C. §102(b) as anticipated by Downing (U.S. 4,725,357) or Reinsel et al. ("Anoxic BioTreatment ... Effluent Waters"). *Id.* pp. 238-42. The Examiner argued that both Downing and Reinsel teach anoxic denitrification followed by anoxic selenium removal. *Id.* The Examiner also rejected several dependent claims under 35 U.S.C §103(a) primarily as being unpatentably obvious over Downing and the knowledge of one skilled in the art. *Id.*

In response, Patent Owner did not dispute Downing's disclosure of one or more bioreactors that performed anoxic denitrification followed by anoxic selenium removal. *Id.* pp. 263-64. Patent Owner instead substantially amended claims 1 and 10 to recite that the waste stream comprises flue gas desulfurization

[2] Petitioner submits that, as a result of these significant changes, the proper priority date for US'034 can be no earlier than November 16, 2005. However, the determination of the priority date does not appear to be necessary for this Petition, as all art relied upon predates even the July 25, 2005 date.

blow down water, and added a step of physical and chemical pretreatment to remove suspended solids from the waste stream and to soften the waste stream (claim 1), and a system for adding lime or sulfides and a precipitate remover upstream (claim 10). *Id.* pp. 259-60.

The Patent Owner argued that neither Downing nor Reinsel disclose treatment of FGD wastewater, and that neither disclose a physical and chemical pretreatment to remove suspended solids and to soften the waste stream. *Id.* pp. 263-64.

The case was then allowed on May 4, 2010. *Id.* at 843-44. The Examiner's reasons of allowance only adopted Patent Owner's comments. *Id.* US'034 issued on September 7, 2010. US'034, cover page.

D. Summary of the Prosecution History for Related Applications

As of today, there are three pending Canadian applications related to US'034. CA2,517,322 ("CA'322") is relevant to this Petition. The entire file history for this application is included as **FWS1003**.[3] Discrete citations to the prosecution history of CA'322 are included when relevant below.

Petitioner is mindful that the Canadian prosecution proceedings are not binding in this Petition and are conducted under different (albeit similar) laws and rules. References to the prosecution of CA'322 are made instead to corroborate

[3] The attached file history for CA'322 (**FWS1003**) is current as of the time of filing, as prosecution of that application is still ongoing.

Petitioner's claims that 1) Fukase, Katagawa, and Downing are analogous art; 2) that a PHOSITA would be motivated and able to combine their teachings; 3) what a PHOSITA would understand is generally known, as evidenced in textbooks and the like; and 4) to rebut Patent Owner's arguments against the references and their combination that Patent Owner raise in the prosecution of that application.

Petitioner believes this evidence is relevant for the purposes for which it is offered. *Ericcson v. Intellectual Ventures*, IPR2014-00915, Paper 37 p. 7; *Google v. Intellectual Ventures*, IPR2014-01031, Paper 41 pp. 10-11. However, Petitioner's other evidence and arguments are independent of and sufficient without the references to CA'322.

V. LEVEL OF SKILL OF A PERSON HAVING ORDINARY SKILL IN THE ART

Based upon the below description of the prior art and US'034, as of either July 25, 2005 or November 16, 2005, a PHOSITA would have at least (1) a B.S. degree in environmental engineering or chemical and biochemical engineering, and at least eight to ten years of experience in the industrial wastewater treatment industry or (2) a M.S. degree in these same disciplines and five years of experience. Koon Decl. ¶¶ 43-44. A PHOSITA would also have a firm understanding of the basic principles of biological treatment and physicochemical treatment processes, which are complex. *Id.*

VI. CLAIM CONSTRUCTION

US'034 expires on January 7, 2027. A claim subject to IPR is given its "broadest reasonable construction in light of the specification of the patent in which it appears." 37 C.F.R. § 42.100(b). Applying this standard, claim terms should be interpreted according to their ordinary and customary meaning consistent with the specification. *See In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). Terms that lack a definition in the specification are also given a broad interpretation. *In re ICON Health & Fitness, Inc.*, 496 F.3d 1374, 1379 (Fed. Cir. 2007).

Petitioner bases this Petition on the "broadest reasonable constructions" of the broadly-worded and readily understood claims of US'034. In this Petition, therefore, Petitioner applies the following "broadest reasonable constructions" of the following claim language, which is the only claim language (if any) that is in need of interpretation:

Term	Construction	Support
"bioreactor" and "one or more reactors configured to provide…removal by biological treatment"	a reaction vessel where biological treatment occurs	US'034 2:57-61, 7:28-35, 8:28-31; Koon Decl. ¶ 22
"soften the waste stream"	add a chemical that reduces the hardness of the wastewater	US'034 5:18-22, 6:19-21, 7:6-62, Koon Decl. ¶ 30

VII. STATE OF THE ART

A. Approach to Wastewater Treatment Design

Wastewater treatment design is most often an assembly of known processes and technologies that focuses upon treatment of the contaminant, regardless of its origin. Koon Decl. (**FWS1009**) ¶¶ 20-21. For each contaminant, there is a known selection of treatment options through physical, chemical (together physicochemical or physical-chemical) or biological processes. *Id.* ¶¶ 20, 22 *citing* Droste (**FWS1015**) p. 227*and* Metcalf (**FWS1016**) pp. 216-17. *See also* **FWS1015** pp. 219-22, 227-30. For every treatment option, there is a known set of water conditions for which that treatment option is effective. Koon Decl. ¶ 20. A person skilled in the art solved wastewater problems through steps, with each step in the process removing a subset of the undesired contaminants, until the effluent was considered acceptable. *Id.* ¶ 20. The order of treatment operations was most often just a result of identifying where in the process satisfactory water conditions existed that were appropriate for that treatment operation. *Id.* ¶ 20

US'034 shows this known approach in practice. US'034 discloses the physicochemical system made by WesTech (7:60-66), which performs the steps of lime or sulfide addition and the use of clarifiers for removing suspended solids. US'034 notes that "others" sold this prior art system that removed solids and softened the water for biological treatment. US'034 7:63; Koon Decl. ¶ 22;

Metcalf p. 313, Fig. 5-1. Bioreactors were commonly known in the prior art as well, and had been used to provide denitrification and removal of a number of other contaminants besides selenium, such as other heavy metals, phosphorus, and sulfides. Koon Decl. ¶ 22; Metcalf pp. 616-17, 623-24, 644. US'034 provides several examples of known, commercially available bioreactors. US'034 7:35-36. It was known to combine bioreactors with physicochemical systems for the removal of degradable organic materials and nitrogen, including denitrification. US'034 7:3-11, 8:4-12; Droste p. 227; Metcalf pp. 216-17.

B. Certain Known Wastewater Treatments

1. Physicochemical Pretreatment

Industrial wastewaters have been pretreated upstream of biological treatment since the 1970's. Koon Decl. ¶ 23; Eckenfelder (**FWS1017**) pp. 108-10, 189-90, 205-06, Figure 6.1. Suspended solids, heavy metals, and alkalinity and acidity were common targets for pretreatment. Koon Decl. ¶ 23; Eckenfelder pp. 112-13. The most common form of pretreatment in the art was physicochemical pretreatment, which removed the biologically inhibitory contaminants of suspended solids and hardness (calcium, magnesium, and iron). Koon Decl. ¶ 26. As described in US'034, it was known to remove solids physically, through sedimentation, flotation, media filtration and membrane filtration. *See* US'034 5:30-35 (describing the removal of suspended solids chemically using coagulants

or flocculants and physically by settling or floating); US'034 6:13-24 (describing the use of lime or sulfides to chemically precipitate solids, optionally with the use of coagulants or polymers, and physical removal through settling in a clarifier); Koon Decl. ¶ 27; Metcalf pp. 314, 493-97, Table 5-1. A clarifier was an oft-used settling tank or basin for sedimentation, in which solids collected at the bottom and clarified water was then discharged. Koon Decl. ¶ 27.

It was known in the art that chemical additives made the physical removal of contaminants more effective through precipitation, coagulation, and flocculation. Koon Decl. ¶ 28; Metcalf p. 497. Precipitation is the creation of an insoluble constituent from a solution, while coagulants and flocculants encourage the precipitated contaminants to aggregate, making them easier to settle out and remove. Koon Decl. ¶ 29. Many chemicals can perform more than one of these functions, and their use greatly enhanced the physical removal process. *Id.*

Wastewater "softening" was a common chemical pretreatment that is combined with a physical pretreatment. *Id.* ¶ 30. "Softening" the water simply means precipitating out and removing calcium, magnesium, and iron. *Id.* ¶ 30. Alkali compounds were very well-known softening chemical treatments, particularly lime, soda ash, and caustic soda. *Id.* ¶ 30; Metcalf p. 494, Table 6-3; Droste pp. 223, 225, Figure 9.2. Lime is less costly compared to the other chemicals and also adjusts for acidic pH in wastewater. Koon Decl. ¶ 30. Sulfides

were another well-known class of chemical pretreatment additives, which can act as precipitants, coagulants, or both, depending on the particular sulfide. Koon Decl. ¶ 30; Metcalf pp. 514-16, Table 6-10. Alkali compounds such as lime or sulfides or both were therefore a known part of physicochemical pretreatment of wastewaters long prior to the time of the alleged US'034 invention. Koon Decl. ¶ 31.

2. Nitrification and Denitrification

Nitrification is the biological process by which the ammonia contaminant is oxidized to nitrite and then nitrate. Metcalf p. 611-13. Denitrification is the biological reduction of nitrate to nitrogen oxygen so it can be removed as a contaminant. Metcalf p. 616. It was known that both nitrification and denitrification occurred downstream from physicochemical pretreatment. Koon Decl. ¶ 32; Metcalf p. 549, Figs. 7-1, 8-21, Table 7-1. Biological nitrification and denitrification processes were also known, and bioreactors implementing these processes were commercially available. Koon Decl. ¶ 32; Metcalf pp. 616-617, 776-77, 795-96, 962, Figs. 7-20.

3. Selenium Removal

Prior to the time of the invention, several jurisdictions had begun to more strictly regulate selenium, and wastewater treatment plans were modified as a result. US'034; Koon Decl. ¶ 33. Biological treatment of selenium, however, was

well known prior art in industrial, agricultural and other applications. . Koon Decl. ¶¶ 33, 36; Downing 2:10-15, 3:13-35, 4:48-69. The biological reduction occurred through a microbial mass fed by nutrients, the amount of which could be varied as necessary to achieve target reactor conditions. *Id.*

The same biomass for selenium removal could be used for denitrification as well, as it was known that excess nitrates reduced the biological reduction of selenium. Downing 5:44-50. It was known to provide either a separate denitrifying bioreactor or simply a denitrifying zone within a bioreactor, as very nearly all nitrate could easily be removed in the very first stage, or in the initial section, of biological treatment. Downing 2:10-15, 3:13-35, 4:48-69, 5:44-50. It was therefore logical and known that the biological treatment of nitrate could occur before the biological treatment of selenium. *Id.*

4. ORP

The terms anoxic, aerobic, and anaerobic are often used by persons or ordinary skill in the treatment of wastewater. Koon Decl. ¶ 35. Aerobic means that dissolved oxygen is present. *Id.* Anaerobic refers to the absence of dissolved oxygen. *Id.* Anoxic means that dissolved oxygen is absent but that bound or combined oxygen is present, such as nitrate. *Id.*

The presence or absence of oxygen (and therefore the aerobic, anoxic, or anaerobic status) ties in directly with the ORP of a water source. *Id.* ¶ 35. The

ORP measures the tendency of the water to cause oxidization (positive ORP) or reduction (negative ORP). *Id.* In aerobic conditions, there is a positive ORP. *See* Goronszy (**FWS 1018)** 7:18-28; Droste p. 47, 474 (stating that biological oxidization of iron and manganese require dissolved oxygen, which means a positive ORP). In anaerobic conditions, there is a negative ORP. Goronszy 7:18-28; Droste pp. 47, 626. In anoxic conditions, there is no significant free oxygen, but also oxidized chemical species can exist, such as nitrate, nitrite, selenate, and selenite. *See* Goronszy 7:11-43; Droste p. 47.

Fig. 8 of US'034 shows the ranges of ORP at which certain contaminants are removed. However, Fig. 8 of US'034 appears to be nothing more than a slightly modified version of Fig. 5 in U.S. Patent 5,989,428 to Goronszy[4] that includes selenium. A person of skill would have known the information contained in the above paragraphs and in US'034 Fig. 8. Koon Decl. ¶ 35.

VIII. THERE IS A REASONABLE LIKELIHOOD THAT THE CHALLENGED CLAIMS ARE UNPATENTABLE

US'034 does not recite anything novel or non-obvious. US'034 simply combines two major, known components, a physicochemical plant (pretreatment zone **12**) and a bioreactor **14**. The physicochemical plant was well-known, and

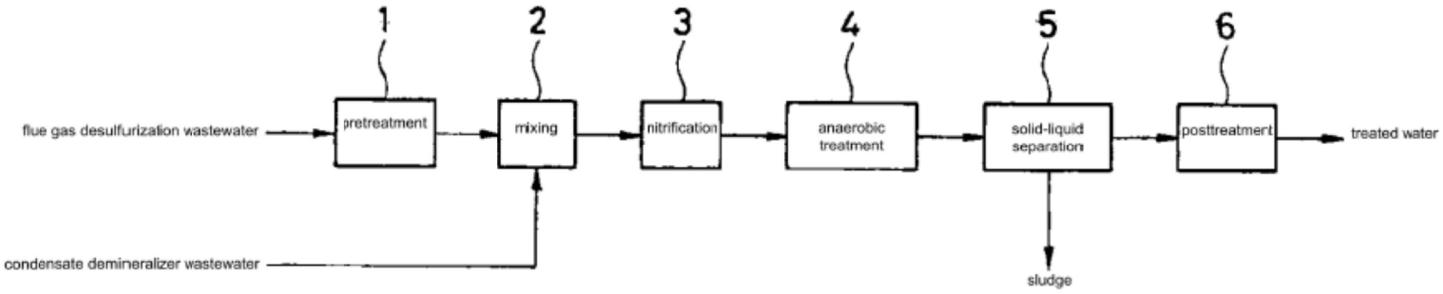
[4] Figure 5 appears to have a typo in it. Under the "Conditions" heading there are Oxic, Oxic, and Anaerobic entries. A PHOSITA would understand it should read Oxic, Anoxic, and Anaerobic. Goronszy 5:15-18, Fig. 5; Koon Decl. (**FWS1009**) ¶ 35, note 2.

US'034 even discloses a commercially available option that recites lime softening and/or sulfide addition, and suspended solids removal through settling in a clarifier. US'034 7:57-65. The denitrifying and selenium removing bioreactor was also well-known, and US'034 also discloses multiple commercially available bioreactors that do precisely what is claimed. US'034 2:9-13, 7:39-57. The ABMet reactor, commercially available before the time of the invention, forms the basis for US'034's disclosure on the operational details of the claimed bioreactor. *See* US'034 8:4-14:20 (describing the operation of the bioreactor in terms of the ABMet product); **FWS 1002** p. 758 (2003 description of ABMet bioreactor).

If anticipation does not exist, a combination of known components, used for their ordinary function, in the ordinary manner, yielding expected results, is a paradigm of obviousness. *KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 417, 420-21 (2007). Obviousness is also established by the simple substitution of one known element for another to obtain predictable results or the mere choice of a predictable solution from a finite number of identified solutions with a reasonable expectation of success. MPEP § 2143. For the reasons explained below, Petitioner submits it has shown more than a reasonable likelihood of success as to each ground for all of the Challenged Claims, and institution of all grounds on all Challenged Claims is respectfully requested.

A. Ground 1: Anticipated by Fukase (claims 1, 3)

JPH0938694A to Fukase et al. ("Fukase") teaches a treatment system for treating FGD wastewater. Fukase was filed on July 31, 1995, published on February 10, 1997, and is prior art under 35 U.S.C. § 102(b). Fukase (**FWS1010)**. Fukase is not of record for US'034. US'034, citing references. Fukase describes a biological wastewater treatment process for removal of selenium and other contaminants from FGD wastewater.



Fukase Fig. 1(a).

Fukase is in the same field of invention as US'034, biological wastewater treatment for FGD systems. Fukase is therefore in the same field of endeavor and is analogous to the claimed invention of US'034.

Fukase is also reasonably pertinent to the alleged problem(s) faced by the inventors of US'034. Specifically, US'034 purports to create an effective, cost-efficient treatment method for removing selenium from FGD wastewater. US'034 1:27-62, 6:1-13. Fukase discloses a system that not only is effective for treating

selenium and other contaminants, but also instructs that nutrients should only be added as needed to maintain high activity – thereby avoiding wasting nutrients and the associated cost of those nutrients. Fukase ¶ 19. Fukase is analogous to the claimed invention of US'034 for these reasons and a PHOSITA would have had reason to find and apply Fukase to the task disclosed in US'034. Koon Decl. ¶ 45; **FWS1003** p. 133[5].

Fukase anticipates claims 1 and 3 of US'034 as explained below. In addition, as explained further below in Ground 2, Fukase renders obvious claims 1, 3, 5, 7, 9-10, and 12-15.

1. Claim 1

Fukase discloses an FGD wastewater treatment process. Fukase ¶ 1, Fig. 1(a), Abstract. The process includes a physical and chemical pretreatment step which includes a precipitation treatment consisting of a coagulant (chemical) and settling (physical) to remove suspended solids, and a (chemical) softening treatment of adding soda ash (Na_2CO_3). Fukase ¶¶ 10, 30; Koon Decl. ¶ 46. The use of a coagulant and softening are chemical processes because they are chemical additives. Fukase ¶ 10; Koon Decl. ¶ 46. Settling is a physical process because it

[5] In the rejection cited, the examiner in CA'322 rejected pending claims that are nearly identical to the issued claims 1 and 9 of US'034. *Compare* **FWS1003** at 123-24 *with* US'034 claims 1, 9.

uses gravity. Fukase ¶ 10; Koon Decl. ¶ 46. Fukase's disclosure therefore teaches the physical and chemical pretreatment steps of claim 1.

Fukase discloses that, following pretreatment step 1, denitrification and selenium removal are performed by biological means in step 4, and can optionally be done in a single bioreactor. Fukase ¶¶ 6, 14-18, 21, 27, claim 1; Koon Decl. ¶¶ 47-48. Fukase discloses that the bioreactor can be of the fixed film type (called fixed bed in Fukase), and describes several options for media beds (called carriers in Fukase). Fukase ¶¶ 17, 21; Koon Decl. ¶¶ 47-48. Fukase therefore teaches and anticipates every element of claim 1.

2. Claim 3

Fukase discloses aerobic nitrification (step 3) upstream of denitrification and selenium removal (step 4). Fukase ¶ 6, claim 1; Koon Decl. ¶ 49. Fukase therefore teaches and anticipates every element of claim 3.

Institution of Ground 1 against claims 1 and 3 is respectfully requested.

B. Ground 2: Obvious over Fukase (claims 1, 3, 5, 7, 9-10, 12-15)

In the event Fukase were found not to anticipate as argued in Ground 1, then an obviousness analysis in view of the knowledge of a PHOSITA cures any deficiencies. Koon Decl. ¶ 50. In addition, the application of the knowledge of a PHOSITA and the shift to an obviousness analysis invalidates additional claims, specifically claims 5, 7, 9-10, and 12-15.

1. Claim 1

As explained above in Ground 1, Petitioner contends Fukase teaches every element of claim 1. If Fukase does not explicitly teach every element of claim 1 explicitly or inherently, it certainly renders claim 1 obvious.

If Fukase does not explicitly teach the claimed physical and chemical pretreatment step for removing solids and softening the waste stream, a PHOSITA would clearly understand that the alkali, coagulant, and settling pretreatment process of Fukase could be modified to meet the claimed pretreatment step of claim 1. Koon Decl. ¶ 50; Section VIII(C)(2), *supra*. At most it would require the substitution of one known pretreatment method for another, which is obvious and motivated by the known contaminants in FGD wastewater. Koon Decl. ¶ 50.

Likewise, if Fukase does not explicitly teach the claimed denitrification and selenium removal in fixed film bioreactors, then a PHOSITA would clearly understand that Fukase's bioreactors could be modified to meet the claimed bioreactor step of claim 1. Koon Decl. ¶ 50. Fukase therefore teaches or renders obvious every element of claim 1, and claim 1 as a whole.

2. Claim 9

Fukase discloses an FGD wastewater treatment system. Fukase ¶ 1, Fig. 1(a), Abstract. Fukase discloses a system for adding alkali and softening. Fukase ¶¶ 10, 30. Lime is both an alkali and a common choice for softening treatments in

industrial wastewater applications, and also functions as a precipitate remover. Koon Decl. ¶ 51. Fukase also discloses a precipitation pretreatment step (called settling in Fukase) that includes the addition of a coagulant. Fukase ¶¶ 10, 30. Sulfides can be a precipitant, coagulant, or both, and their use was common and well-known at the time of the invention for removal of suspended solids in industrial wastewater treatment applications. Koon Decl. ¶ 51.

If Fukase does not explicitly teach the claimed system for adding lime or sulfides, a PHOSITA would clearly understand that the alkali and coagulant pretreatment process of Fukase could be modified to use lime and/or sulfides specifically. *Id.* A PHOSITA would be motivated to make this modification, to the extent any modification is required, to ensure adequate pretreatment of known contaminants of FGD wastewater such that biological treatment will not be inhibited. *Id.* Therefore, the use of sulfides and lime are obvious to the extent they are not already disclosed. Koon Decl. ¶ 51; Section VII(B)(1), *supra*.

Fukase also discloses a precipitate remover in the form of settling in step 1, and the use of settling basins. Fukase ¶¶ 10, 30-31, Fig. 1(a); Koon Decl. ¶ 51. Even if Fukase did not explicitly disclose a precipitate remover, it would have been apparent to a PHOSITA that a precipitation chemical pretreatment would also require a precipitate remover to function properly. Koon Decl. ¶ 51. A PHOSITA would therefore clearly understand that the settling pretreatment and settling basin

disclosed in Fukase could be modified to use a precipitate remover such as a clarifier. *Id.* This element is also therefore obvious to the extent not already disclosed. Koon Decl. ¶ 51; Section VIII(C)(2), *supra*.

Fukase discloses that, following pretreatment step 1, denitrification and selenium removal are performed by biological means in step 4. Fukase ¶¶ 6, 14-18, 27, claim 1. Fukase therefore teaches or renders obvious every element of claim 9, and claim 9 as a whole.

3. Claim 3

Fukase teaches the aerobic removal of COD and a nitrification step as explained above in Ground 1. If Fukase does not explicitly teach the claimed aerobic COD removal or nitrification, a PHOSITA would clearly understand that either of the COD removal or nitrification processes of Fukase could be modified to meet the claimed process step of claim 3. In particular, biological aerobic COD removal and nitrification were commonly used, and commonly used together upstream of denitrification and other anaerobic biological treatments. Koon Decl. ¶¶ 52-53. Fukase renders obvious the additional element of Claim 3 and claim 3 as a whole.

4. Claim 5

Fukase teaches that organic matter (nutrients) should be added as necessary to ensure "high activity is maintained in the biological sludge . . . ." Fukase ¶ 19.

Fukase also discloses that nutrients may be necessary for both denitrification and selenium removal. Fukase ¶ 20. A PHOSITA at the time of the invention would know that denitrification and selenium removal occur in different ORP ranges, as US'034 shows in Fig. 5. Koon Decl. ¶ 54; Goronszy 7:12-43 (ORP ranges must be achieved to "enable all of the processing reactions to take place."); Droste p. 474 (stating that it is critical that ORP be adjusted to promote the activity of the microbes for the desired reaction); Metcalf pp.776-77 (ORP monitoring for nitrification-denitrification process).

In particular, a PHOSITA would understand that the ORP ranges specified in claim 5 "encompass the anoxic and anaerobic conditions occurring in the bioreactors during denitrification, selenium removal, and sulphur removal." **FWS1003** at 135; Koon Decl. ¶ 55. The examiner in CA'322 also stated that the ranges were so tied to the anoxic and anaerobic conditions that similar ORP ranges disclosed in a related Canadian application would be obvious. **FWS1003** at 135; **FWS1004** at 127[6].

Fukase's statement regarding ensuring "high activity" is simply another way of saying that the bioreactors are maintained within the appropriate ORP ranges for the respective processes, here denitrification and selenium removal. Koon Decl. ¶

[6] The then-pending claims of the related CA'945 application are cited here to establish that the examiner in CA'322 was referencing the same ORP ranges as in claim 5 of US'034.

54. A PHOSITA would have therefore understood from Fukase that the claimed treatment system should include, or be modified to include maintaining the claimed ORP ranges in order to ensure the denitrification and selenium removal processes operate effectively and efficiently. Koon Decl. ¶ 56.

Fukase and the knowledge of a PHOSITA therefore renders obvious the additional elements of claim 5 and claim 5 as a whole.

5. Claim 7

As noted, Fukase teaches that organic matter (nutrients) should be added as necessary to ensure "high activity is maintained in the biological sludge . . . ." Fukase ¶ 19. Fukase also discloses that nutrients may be necessary for both denitrification and selenium removal. Fukase ¶ 20.

Fukase therefore discloses that the manner and amount of nutrients added is a means to ensure "high activity," which is another way of saying the target ORP ranges are maintained, as discussed above. A PHOSITA would have therefore understood from Fukase that the "maintaining" step of claim 7 could be easily and effectively accomplished through nutrient dosing and implement that step. Koon Decl. ¶ 57.

Fukase therefore renders obvious the additional element of claim 7 and claim 7 as a whole.

6. Claim 10

Fukase discloses that COD can be removed by adsorption resin or a similar process, but does not appear to disclose aerobic biological removal of COD. Fukase ¶ 24; **FWS1003** at 141. Fukase also discloses that excess organic and oxidizable matter can be treated using biological means, specifically aerobic activated sludge treatment. Fukase ¶ 24; **FWS1003** at 141.

A PHOSITA would be aware that aerobic biological treatment was the most common approach to removing COD at the time of the invention. Koon Decl. ¶ 58. A PHOSITA would therefore understand from Fukase's disclosure of COD treatment that aerobic biological treatment in particular is an obvious modification to remove COD if the raw wastewater contained degradable COD. *Id.* A PHOSITA would also know to select this treatment in any instance in which COD removal was desired. *Id.*

US'034 fails to provide a single detail regarding how COD is to be removed by biological, aerobic treatment; in fact, the term COD and its synonyms only appear three times in the entire patent outside the claims. US'034 2:48, 2:63, Abstract. In order for such a lack of disclosure to comply with Patent Owner's obligations under 35 U.S.C. § 112, a PHOSITA must have been capable of configuring a bioreactor to additionally treat COD aerobically. Petitioner therefore contends this minimal disclosure supports Petitioner's claim that this element

would have been known and obvious to a PHOSITA, and similarly supports Petitioner's argument regarding claim 3 that aerobic COD treatment would be obvious.

Fukase therefore renders obvious the additional element of claim 10 and claim 10 as a whole.

7. Claim 12

US'034 admits that membrane supported biofilm reactors (MSBR) are well-known, and in fact incorporates by reference three different prior publications describing MSBRs. US'034 7:39-57.

The substitution of one known alternative for another is obvious when it yields predictable results. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007). A PHOSITA would therefore understand that the use of a MSBR is a simple design choice among known alternatives and be able to implement that design, and it would work exactly as expected. **FWS1003** at 141; Koon Decl. ¶ 59. Fukase in view of the knowledge of a PHOSITA therefore renders obvious the additional element of claim 12 and claim 12 as a whole.

8. Claim 13

Fukase discloses that the bioreactor can be of the fixed film type (called fixed bed). Fukase ¶¶ 17, 21; Koon Decl. ¶ 60. Fukase therefore teaches the additional element of claim 13 and renders claim 13 obvious as a whole.

9. Claim 14

Fukase discloses that the media bed can be activated carbon. Fukase ¶ 17. The purpose of a media bed is to support a population of microbes, and so this portion of the element is obvious to a PHOSITA. Koon Decl. ¶ 60. Fukase therefore renders obvious the additional element of claim 14 and claim 14 as a whole.

10. Claim 15

Ammonia stripping is a well-known process for treating ammonia in wastewater. **FWS1015** at 228; **FWS1003** at 75; Koon Decl. ¶ 61. A PHOSITA would be easily capable of modifying the treatment system of Fukase to include ammonia stripping. US'034 provides no disclosure on how an ammonia stripper functions or is to be implemented, supporting Petitioner's claims that it would have been well within the skill of a PHOSITA. US'034 2:65-3:3, 5:48-51, 6:65-7:2.

Fukase in view of the knowledge of a PHOSITA therefore renders obvious the additional element of claim 15 and claim 15 as a whole.

For each of the above reasons, Fukase renders obvious claims 1, 3, 5, 7, 9-10, and 12-15. Institution of Ground 2 on all of these claims is respectfully requested.

C. Ground 3: Obvious over Fukase in view of Downing (claims 1-3, 5-7, 9-15)

In addition to Grounds 1 and 2, an obviousness analysis of Fukase in view of Downing and the knowledge of a PHOSITA cures any perceived deficiencies in either ground. The application of the teachings of Downing also invalidates additional dependent claims, specifically claims 2, 6, and 11.

US4,725,357 to Downing et al. ("Downing") was filed on July 11, 1986, and issued on February 16, 1988; it is prior art under 35 U.S.C. § 102(b) (pre-AIA). Downing (**FWS1011**). Downing was cited during prosecution of US'034. US'034, citing references.

Downing is in a similar field of invention as US'034, biological wastewater treatment for wastewater. Although the claims of US'034 as issued recited FGD wastewater, the specification discloses that the alleged invention can be used for other wastewaters, such as mining, agricultural and other industrial applications. US'034 1:45-50, 3:23-30. Downing is therefore in the same field of endeavor and is analogous to the claimed invention of US'034.

Downing is also reasonably pertinent to the alleged problem(s) faced by the inventors of US'034. Specifically, US'034 purports to create an effective biological treatment method for denitrification and removing selenium from FGD wastewater. US'034 1:27-62, 6:1-13. Downing discloses an effective biological

treatment for selenium and denitrification. Downing is analogous to the claimed invention of US'034 for these reasons and a PHOSITA would have had reason to find and apply Downing to the task disclosed in US'034. Koon Decl. ¶¶ 62-64. It is important to further note that the examiners in US'034 and CA'322 each found that Downing[7] taught anoxic denitrification followed by anoxic selenium removal, and anaerobic removal of sulfur and heavy metals. **FWS1002** p. 239; **FWS1003** pp. 40-41.

There was more than sufficient reason to combine these references. While the claims of US'034 were amended to recite FGD blow down water in an attempt to avoid Downing, the specification teaches that invention can be used for treating other types of wastewater, such as mining and agricultural wastewaters. US'034 3:23-30. US'034 further states that the apparatus and method disclosed in US'034 may be particularly useful "where the waste stream also has significant concentrations of one or more of COD, nitrate, ammonia, TDS, TSS, hardness, $CaSO_4$, or sulfate." *Id.* Essentially, US'034 purports to treat a number of undesirable water conditions that occur in FGD blow down water; when

[7] The examiner in CA'322 relied upon the related Canadian Downing patent, CA1274925. Both the US and Canada Downing patents rely upon the same three United Kingdom applications for priority. In Petitioner's review, the Canadian and US version of Downing are substantively identical, but paginated differently. The full text of Downing CA1274925 is included as exhibit **FWS1014**.

wastewater with similar undesirable conditions is found in other industries, US'034 contends it will be useful in those industries as well.

Petitioner agrees with that assertion; it directly supports Petitioner's claim that prior art from non-FGD wastewater applications are analogous art. Wastewater treatment plans are based on the contaminants more so than the industry. Koon Decl. ¶ 21. A PHOSITA would consider known effective treatment options from other industries if that PHOSITA is addressing the same or a similar contaminant. Koon Decl. ¶ 21; **FWS1003** at 112. Moreover, a PHOSITA would understand that a process may only treat certain contaminants, and so combine it with one or more other processes to achieve the target water quality. Koon Decl. ¶ 22; **FWS1003** at 112.

During prosecution of US'034 Patent Owner did not dispute that Downing was relevant and analogous art, only arguing that Downing did not explicitly teach the treatment of FGD blow down water. **FWS1002** at 263. In addition, the examiner in CA'322 applied the combination of Fukase and Downing in rejecting a proposed claim that does not have an analogue in US'034. **FWS1003** at 142.

In sum, to the extent that Fukase's teachings are not sufficient to render the Challenged Claims obvious on their own, there is a clear motivation to incorporate the teachings of Downing to improve the bioreactor design and function, remove additional contaminants, and to achieve particular ORP targets. Koon Decl. ¶ 64.

1. Claim 1

Fukase renders obvious the entirety of claim 1 as explained above in Ground 2. In addition, Downing also discloses anoxic biological denitrification followed by anoxic biological removal of selenium in one or more fixed film bioreactors. Downing 2:57-67, 3:13-54, 5:24-32, 6:8-23, 6:48-7:4, claims 1, 3-8, 10; Koon Decl. ¶ 63. To the extent Fukase is not sufficient, Fukase and Downing therefore render obvious claim 1 for the reasons articulated in Ground 2. Koon Decl. ¶ 64.

2. Claim 9

Fukase renders obvious the entirety of claim 9 as explained above in Ground 2. In addition, Downing also discloses anoxic biological denitrification followed by anoxic biological removal of selenium in one or more fixed film bioreactors. Downing 3:13-35, 5:24-32, 6:8-23, 6:48-7:4, claims 1, 3-8, 10; Koon Decl. ¶ 65. To the extent Fukase is not sufficient, Fukase and Downing therefore render obvious claim 9. Koon Decl. ¶¶ 64-65.

3. Claim 2

Downing discloses that the biological reactor can also remove heavy metals under anaerobic conditions. Downing 9:5-15, 11:2-5. Arsenic and mercury are heavy metals. Koon Decl. ¶ 66. Downing also discloses that the reactor can be configured for sulfate removal. Downing 4:28-47. Sulfate is a sulfur compound.

Koon Decl. ¶ 66. Fukase in view of Downing therefore renders obvious the additional element of claim 2 and claim 2 as whole. *Id.*

4. Claim 3

Fukase teaches and renders obvious the aerobic removal of COD or a nitrification step as explained above in Grounds 1 and 2. Fukase in view of Downing therefore renders obvious the additional element of claim 3 and claim 3 as a whole.

5. Claim 5

As explained above in Ground 2, Fukase teaches that organic matter (nutrients) should be added as necessary to ensure "high activity is maintained in the biological sludge . . . ." Fukase ¶ 19. Fukase also discloses that nutrients may be necessary for both denitrification and selenium removal. Fukase ¶ 20. Downing also discloses that nutrients dosage should be controlled such that there is minimal to no leftover nutrient in the bioreactor effluent. Downing 4:48-63; Koon Decl. ¶ 67.

A PHOSITA at the time of the invention would know that denitrification and selenium removal occur in different ORP ranges, as US'034 shows in Fig. 5. In particular, a PHOSITA would understand that the ORP ranges specified in claim 5 "encompass the anoxic and anaerobic conditions occurring in the bioreactors during denitrification, selenium removal, and sulphur removal." **FWS1003** at 135;

Koon Decl. ¶ 67; US'034 Fig. 8. Fukase's statement regarding ensuring "high activity" is another way of saying that the bioreactors are maintained within the appropriate ORP ranges for the respective processes, here denitrification and selenium removal. Koon Decl. ¶ 54. A PHOSITA would have therefore understood from Fukase in view of Downing that it would be beneficial to maintain the claimed ORP ranges in order to ensure the denitrification and selenium removal processes operate effectively and implement that step. Koon Decl. ¶ 67.

Fukase in view of Downing and the knowledge of a PHOSITA therefore render obvious the additional elements of claim and claim 5 as a whole.

6. Claim 6

Downing discloses that the ORP after one or more of the bioreactors is below -100 mV. Downing 11:21-27. Similar to claim 5, a PHOSITA would have understood from Fukase in view of Downing that it would be beneficial to maintain the effluent in the claimed ORP range in order to ensure the denitrification and selenium removal processes operate effectively and implement that step. Koon Decl. ¶ 68. Fukase in view of Downing therefore renders obvious the additional element of claim 6 and claim 6 as a whole.

7. Claim 7

As explained above in Ground 2, Fukase teaches that organic matter (nutrients) should be added as necessary to ensure "high activity is maintained in the biological sludge . . . ." Fukase ¶ 19. Fukase also discloses that nutrients may be necessary for both denitrification and selenium removal. Fukase ¶ 20. Fukase therefore discloses that the manner and amount of nutrients added is a means to ensure "high activity," which as explained above is another way of saying the target ORP ranges are maintained. Koon Decl. ¶ 54.

Downing also discloses that nutrients dosage should be controlled such that there is minimal to no leftover nutrient in the bioreactor effluent. Downing 4:48-63. A PHOSITA would have therefore understood from Fukase in view of Downing that the "maintaining" step of claim 5 could be easily and effectively accomplished through nutrient dosing and implement that step. Koon Decl. ¶ 69. Fukase in view of Downing therefore renders obvious the additional elements of claim 7 and claim 7 as a whole.

8. Claim 10

Fukase renders obvious the aerobic biological removal of COD step as explained above in Ground 2. Fukase in view of Downing and the knowledge of a PHOSITA therefore renders obvious the additional element of claim 10 and claim 10 as a whole.

9. Claim 11

Downing discloses that the biological reactor can also remove heavy metals under anaerobic conditions. Downing 9:5-15, 11:2-5. Downing also discloses that the reactor can be configured for sulfate removal. Downing 4:43-47. Sulfate is a sulfur compound. Koon Decl. ¶¶ 66, 70. Fukase in view of Downing therefore renders obvious the additional element of claim 11and claim 11 as a whole.

10. Claim 12

Fukase renders obvious the use of a membrane bioreactor as discussed in Ground 2, above, and claim 12 as a whole is obvious over Fukase in view of Downing.

11. Claim 13

As discussed above in Ground 2, Fukase discloses that the bioreactor can be of the fixed film type (called fixed bed). Fukase ¶¶ 17, 21; Koon Decl. ¶ 60. Downing also discloses that the bioreactor can be of the fixed film type (called fixed bed). Downing 2:63-66, 5:55-60, 6:8-9, 7:1-4, claim 8. Fukase in view of Downing therefore renders obvious the additional element of claim 13 and claim 13 as a whole.

12. Claim 14

Fukase teaches or renders obvious the use of a fixed film bioreactor with activated carbon as the media bed as discussed in Ground 2, above. Claim 14 is therefore obvious as a whole over Fukase in view of Downing.

13. Claim 15

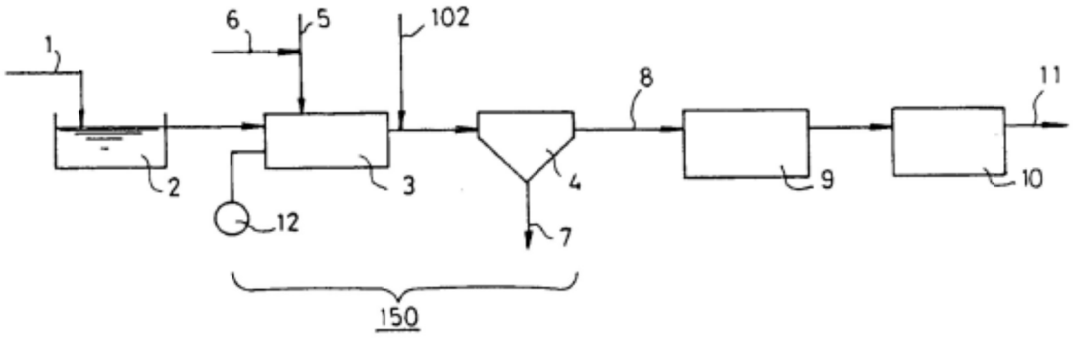
Fukase renders obvious the use of an ammonia stripper as discussed in Ground 2, above. Claim 15 is therefore obvious as a whole over Fukase in view of Downing.

For the reasons stated above, Fukase in view of Downing renders obvious claims 1-3, 5-7, and 9-15 of US'034, and institution under this ground is respectfully requested.

D. Ground 4: Obvious over Katagawa in view of Downing (claims 1-3, 6, 9-15)

JPH01304100A to Katagawa et al. ("Katagawa") teaches a treatment system for treating FGD wastewater. Katagawa was filed on June 1, 1998, and issued as JP2758607B on May 28, 1998, and is prior art under 35 U.S.C. § 102(b). Katagawa (**FWS1012)**. Katagawa is not of record for US'034. US'034, citing references. A PHOSITA would understand Katagawa teaches a pretreatment system that would remove contaminants sufficiently to then apply biological treatment.

FIG. 1



1: desulfurization wastewater
3: reaction tank
4: settling tank
5: fly ash
6: slaked lime
9: COD treatment system
10: nitrogen treatment system
11: treated wastewater
102: aggregating agent

Katagawa Fig. 1.

Katagawa is in a similar field of invention as US'034, wastewater treatment for FGD systems. Although the Challenged Claims require biological treatment as well, the need for pretreatment of FGD wastewater to remove biologically inhibitory contaminants is stressed in US'034. US'034 5:3-56. Katagawa is therefore in the same field of endeavor and is analogous to the claimed invention of US'034.

Katagawa is also reasonably pertinent to the alleged problem(s) faced by the inventors of US'034. Specifically, US'034 purports to create an effective biological treatment method for removing selenium from FGD wastewater.

US'034 1:27-62, 6:1-13. However, FGD wastewater contains biologically inhibitory contaminants that must be removed for effective operation of the biological reactors. US'034 5:3-56. Katagawa discloses a system that effectively removes suspended solids and other contaminants from FGD wastewater. Koon Decl. ¶ 74. Katawaga is analogous to the claimed invention of US'034 for these reasons, and a PHOSITA would have had reason to find and apply Katagawa to the task disclosed in US'034. Koon Decl. ¶¶ 72-73; **FWS1003** at 135-36.

A PHOSITA would have been motivated to combine these references. Koon Decl. ¶ 73; **FWS1003** at 135-36. As explained in detail above, it was well-known that biological treatment of selenium such as described in Downing had advantages over other available options. Koon Decl. ¶ 24. It was also well-known to pretreat the wastewater prior to using biological treatment, so that the pretreated influent to the biological reactors were within acceptable ranges. Koon Decl. ¶ 25. Katagawa teaches an FGD wastewater treatment system that uses lime and a coagulant, followed by a settling tank and filter, to precipitate out and remove suspended solids and to soften the waste stream. A PHOSITA would know that the biological treatment of Downing requires pretreatment and so be led directly and without difficulty to prior art physicochemical pretreatments such as the one disclosed in Katagawa. Koon Decl. ¶ 76.

During prosecution of CA'322, Patent Owner made two arguments in rebuttal to the combination of Katagawa and Downing, after which the examiner relied principally on Fukase. First, Patent Owner argued that a PHOSITA would not be motivated to combine Downing with Katagawa to more completely remove selenium or to choose biological treatment of selenium. **FWS1003** at 138.

Patent Owner's first argument is wrong. There is no requirement that Katagawa, which was original filed in 1988, provide an explicit teaching to incorporate biological treatment when biological treatment for selenium was only then being discovered.[8] By the time of the invention, nearly two decades later, it was known that wastewater treatment plans would need to be designed and modified to comply with recent, more stringent selenium regulations. US'034 1:56-58; Koon Decl. ¶ 33.

As selenium was not a simple contaminant to treat, it is logical to start a treatment plan design by selecting a selenium treatment process. While there are other selenium removal options, by the time of the invention biological selenium removal was considered advantageous over other options. Koon Decl. ¶ 24. This leads directly and without difficulty into a selection of bioreactors as taught in Downing as an advantageous selenium treatment method.

[8] Downing issued less than four months before Katagawa was filed. Downing p. 1; Katagawa p. 1.

Furthermore, once Downing is selected, the application of a pretreatment system such as that described in Katagawa is also straightforward, as pretreatment was known to be needed prior to bioreactors when untreated water conditions were inhospitable to the microbes used for biological treatment. Koon Decl. ¶ 25.

Second, Patent Owner argued that Katagawa teaches away from Downing because the precipitative pretreatment in Katagawa would remove some selenium. **FWS1003** at 138-39.

Patent Owner's second argument is also unfounded. As stated previously, selenium regulations were becoming more restrictive prior to the time of the invention. US'034 1:56-58; Koon Decl. ¶ 33. This same change in selenium regulation provided the motivation for US'034. *Id.* The fact that Katagawa may have been sufficiently effective in 1988, and so may not require additional selenium reduction, does not mean it was sufficient to meet the new stricter regulations.

In addition, Patent Owner's argument is misleading, as the precipitation removal step of US'034 would also remove a portion of selenium. Okazoe ¶ 5; Koon Decl. ¶ 24. It was well-known, however, that a standard precipitation step did not sufficiently remove selenium to comply with the more stringent

regulations. Okazoe ¶ 5; Koon Decl. ¶ 24; **FWS1002** p. 718[9]. The selection of Downing is therefore straightforward to remedy the insufficient removal of selenium. Koon Decl. ¶ 73. The further motivation to combine Katagawa with Downing to form a complete wastewater treatment plan is also straightforward, just as it was to the inventors of US'034, to meet a newly created market need that did not exist at the time of Katagawa. Koon Decl. ¶ 73.

The fact that Katagawa is concerned with reducing lime used in existing processes is irrelevant. The fact remains that Katagawa teaches a prior art process of pretreatment using lime, a coagulant, and a precipitate remover as claimed in US'034. Katagawa p. 1. It is unimportant that Katagawa sought to refine and improve that prior art process, as it still discloses the processes at issue here and combining those processes with Downing is within the skill of a PHOSITA. Koon Decl. ¶ 73. Petitioner therefore submits that the combination is appropriate and well-motivated by the needs of the industry and knowledge of one skilled in the art at the time of the invention. *Id.*

1. Claim 1

Katagawa describes a "desulfurization wastewater treatment apparatus" for treating FGD wastewater. Katagawa p. 1. Katagawa also teaches that it was

[9] The face of the US'034 reflects that the cited paper Twidwell, et al., "Technologies and Potential Technologies for Removing Selenium from Process and Mine Wastewater," is undated, and the copy included in the file history is also undated. The article was in fact published in 1999. **FWS1019**.

known in the prior art that FGD wastewater contains contaminants such as "suspended matter, heavy metals, inorganic ions, organic matter, and the like . . . ." *Id.* p. 1. Katagawa further teaches that it was known in the art to treat these contaminants chemically by adding slaked lime **6,** coagulant **102**, and flocculant **106** to precipitate suspended solids such as heavy metals. *Id.* pp. 1-3, Figs. 1, 3. The precipitated contaminants are then physically removed in precipitation tanks **103** and **107** and filter **108**, thereby removing suspended solids. *Id.* pp. 1-2, Figs. 1, 2. The addition of lime would have also softened the wastewater. US'034 2:43-46, 5:18-23, 6:13-24, 7:58-63; Koon Decl. ¶ 74.

Katagawa therefore teaches the physical and chemical pretreatment steps to remove suspended solids and soften the waste stream of claim 1.

Downing discloses anoxic biological denitrification followed by anoxic biological removal of selenium in one or more fixed film bioreactors. Downing 2:57-67, 3:13-35, 5:24-32, 6:8-23, 6:48-7:4, claims 1, 3-8, 10; **FWS1003** at 111-12. Downing therefore teaches the biological treatments steps to denitrify and remove selenium in fixed film bioreactors of claim 1.

During prosecution of CA'322, Patent Owner argued that Katagawa did not teach that the nitrogen compound processing unit **10** of Katagawa biologically reduced nitrates. **FWS1003** at 138. That is irrelevant, as Petitioner is relying upon Downing's disclosure of biological denitrification.

As noted, it would have been obvious to arrange the system such that the pretreatment steps of Katagawa are before (and therefore upstream of) Downing's biological treatment, as it was known that biological treatment methods required pretreatment when wastewater included biological inhibitory contaminants such as FGD wastewater. Koon Decl. ¶ 76. Claim 1 is therefore obvious over Katagawa in view of Downing.

2. Claim 9

As to the physicochemical step of claim 9, Petitioner additionally notes that sulfides are a well-known means to precipitate metals. Koon Decl. ¶ 77. For the same reasons as articulated with respect to claim 1 then, Katagawa teaches the pretreatment system components of a system for adding lime and a precipitate remover.

Downing discloses anoxic biological denitrification followed by anoxic biological removal of selenium in one or more fixed film bioreactors. Downing 3:13-35, 5:24-32, 6:8-23, 6:48-7:4, claims 1, 3-8, 10; Koon Decl. ¶ 63. Downing therefore teaches the biological treatments components to denitrify and remove selenium.

It would have been obvious to arrange the system such that the pretreatment steps of Katagawa are before (and therefore upstream of) Downing's biological treatment, as it was known that biological treatment methods required pretreatment

when wastewater included biological inhibitory contaminants such as FGD wastewater. Koon Decl. ¶ 77. Claim 9 is therefore obvious over Katagawa in view of Downing.

3. Claim 2

Downing discloses that the biological reactor can also remove heavy metals under anaerobic conditions. Downing 9:5-15, 11:2-5. Arsenic and mercury are heavy metals. Koon Decl. ¶ 66. Downing also discloses that the reactor can be configured for sulfate removal. Downing 4:43-47. Sulfate is a sulfur compound. Koon Decl. ¶ 66. Katagawa in view of Downing therefore renders obvious the additional element of claim 2 and claim 2 as a whole. Koon Decl. ¶ 78.

4. Claim 3

Katagawa discloses a COD treatment device **111** and Fig. 1 item **9**. Katagawa pp. 1-2, Figs. 1-2. A PHOSITA would understand that aerobic treatment of COD is very common and well-known; in particular, aerobic biological treatment is the most common choice. Koon Decl. ¶ 79; US'034 6:59-61. US'034 provides no details regarding how COD is to be treated, other than it is to be an aerobic treatment. US'034 2:48-49, 2:61-62, 6:59-61. This supports Petitioner's contention that including an aerobic COD treatment device was well within the knowledge and skill of a PHOSITA for claim 3 and for claim 10 below.

In addition, a nitrification/denitrification process was well-known to those skilled in the art well before the time of invention. US'034 5:45-56; Koon Decl. ¶ 79; Okazoe ¶ 13. It would have been obvious to include such a process if ammonia removal was necessary. US'0345 5:45-56; Koon Decl. ¶¶ 32, 79. Katagawa in view of Downing therefore renders obvious the additional element of claim 3 and claim 3 as a whole.

5. Claim 6

Downing discloses that the ORP after one or more of the bioreactors is below -100 mV. Downing 11:21-27. Koon Decl. ¶ 68. Downing therefore teaches the additional element of claim 6 and claim 6 as a whole is obvious in combination with Katagawa.

6. Claim 10

Katagawa discloses a COD treatment device **111** and Fig. 1 item **9**. Katagawa pp. 1-2, Fig. 2. A PHOSITA would understand that aerobic treatment of COD is very common and well-known; in particular, aerobic biological treatment is the most common choice. Koon Decl. ¶¶ 79-80; US'034 6:59-61. Including COD removal would have been obvious when COD removal was needed. Koon Decl. ¶ 58. Katagawa in view of Downing therefore teaches the additional element of claim 10 and renders the claim as a whole obvious.

7. Claim 11

Downing discloses that the biological reactor can also remove heavy metals under anaerobic conditions. Downing 9:5-15, 11:2-5. Downing also discloses that the reactor can be configured for sulfate removal. Downing 4:43-47. Sulfate is a sulfur compound. Koon Decl. ¶¶ 66, 82. Downing therefore teaches this element of claim 11, and Katagawa in view of Downing renders the claim as a whole obvious. *Id.*

8. Claim 12

US'034 admits that membrane supported biofilm reactors (MSBR) are well-known, and in fact incorporates by reference three different prior publications describing MSBRs. US'034 7:39-57.

A PHOSITA would therefore understand that the use of a MSBR is a simple design choice among known alternatives and be able to implement that design. **FWS1003** at 141; Koon Decl. ¶¶ 59, 82. Katagawa in view of Downing therefore renders obvious the additional element of claim 12 and claim 12 as a whole. Koon Decl. ¶¶ 59, 82.

9. Claim 13

Downing discloses that the bioreactor can be of the fixed film type (called fixed bed). Downing 2:63-66, 5:55-60, 6:8-9, 7:1-4, claim 8; Koon Decl. ¶ 37.

Katagawa in view of Downing therefore renders obvious the additional element of claim 13 and claim 13 as a whole. Koon Decl. ¶ 37.

10. Claim 14

US'034 admits that fixed film reactors using activated carbon as the media bed were available to the public prior to the time of the invention. US'034 7:40-57. In addition, activated carbon was a well-known option among possible fixed bed media. US'034 8:36-40; Koon Decl. ¶ 81. A well-known purpose of a media bed is to support a population of microbes. Koon Decl. ¶¶ 37, 60. Katagawa in view of Downing and the knowledge of a PHOSITA therefore render obvious the additional element of claim 14 and claim 14 as a whole. *Id.*

11. Claim 15

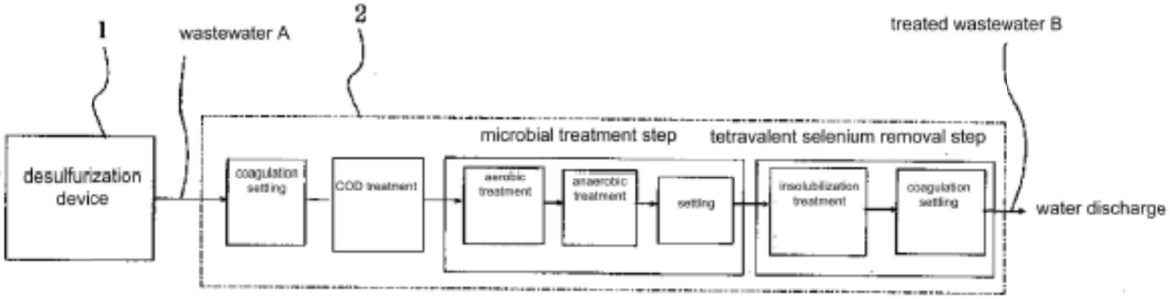
Ammonia stripping is a well-known process for treating ammonia in wastewater. **FWS1015** at 228; **FWS1003** at 75; Koon Decl. ¶ 61. A PHOSITA would be easily capable of modifying the treatment system of Katagawa and Downing to include ammonia stripping. Koon Decl. ¶¶ 61, 82. US'034 provides no disclosure on how an ammonia stripper functions or is to be implemented, supporting Petitioner's claims that it would have been well within the skill of a PHOSITA. US'034 2:65-3:3, 5:48-51, 6:65-7:2. Katagawa in view of Downing and the knowledge of a PHOSITA therefore renders obvious the additional element of claim 15 and claim 15 as a whole.

For the reasons stated above, Katagawa in view of Downing renders obvious all of the Challenged Claims of US'034. Institution under this ground on all Challenged Claims is respectfully requested.

E. Ground 5: Obvious over Katagawa in view of Downing further in view of Okazoe (claims 1-3, 5-7, 9-15)

JPH10249392 to Okazoe, et al. ("Okazoe") was filed on March 12, 1997, and published on September 22, 1998, and is therefore prior art under 35 U.S.C. § 102(b) (pre-AIA). Okazoe (**FWS1013**). Okazoe is not prior art of record for US'034. US'034, cited references. Okazoe describes a FGD wastewater treatment apparatus that includes pretreatment to remove suspended solids, COD removal, aerobic biological nitrification, and anaerobic biological denitrification and selenium removal. Okazoe ¶¶ 5-8; Koon Decl. ¶ 83.

[FIG. 6]

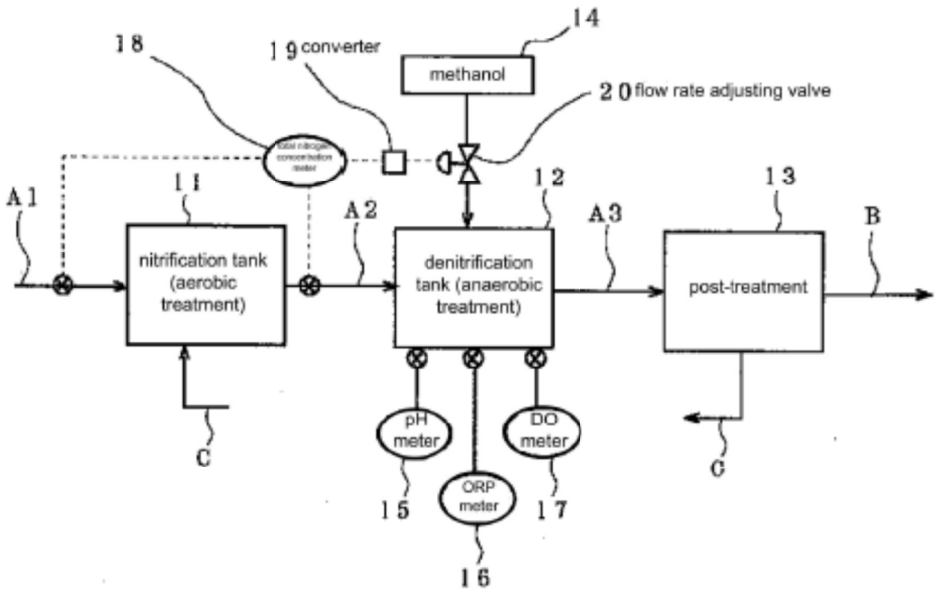


Okazoe, Fig. 6.

In addition, Okazoe describes the importance of ORP on the effective operation of a biological wastewater treatment system, and teaches a monitoring

and maintenance protocol for varying nutrient dosages to maintain effective ORP ranges. Okazoe ¶¶ 16, 33, 34, 46, Figs. 3, 5.

[FIG. 3]



Okazoe, Fig. 3.

Okazoe is in the same field of invention as US'034, biological wastewater treatment for FGD systems. Okazoe is therefore in the same field of endeavor and is analogous to the claimed invention of US'034.

Okazoe is also reasonably pertinent to the alleged problem(s) faced by the inventors of US'034. Specifically, US'034 purports to create an effective, cost-efficient treatment method for removing selenium from FGD wastewater. US'034 1:27-62, 6:1-13. Okazoe discloses a system that not only is effective for treating selenium and other contaminants, but also controls nutrient dosage to minimize wasted nutrient (and therefore the cost of those nutrient materials) and ensure

effective operation. Okazoe is analogous to the claimed invention of US'034 for these reasons and a PHOSITA would have had reason to find and apply Katagawa to the task disclosed in US'034. Koon Decl. ¶¶ 83-84.

A PHOSITA would also recognize that Okazoe further refines the wastewater treatment systems described in Katagawa and Downing to solve the same problem identified by US'034, as described above. A PHOSITA would therefore be motivated to apply Okazoe's teaching to arrive at a more refined, effective, and cost-efficient process.

1. Claim 1

Katagawa teaches the physical and chemical pretreatment steps as described in Ground 3 above. Downing teaches the biological treatment steps as described in Ground 3 above.

In addition, Okazoe teaches an FGD wastewater treatment process that includes a pretreatment step using a coagulation sedimentation device for removing suspended solids. Okazoe ¶ 5, Fig. 6. Okazoe specifically describes this as a "normal" step and process, supporting Petitioner's claims throughout this Petition that such pretreatment is well-known and understood. Okazoe ¶ 22. A PHOSITA would understand that this process can be accomplished by conventional means through the use of lime and/or sulfides, and a clarifier to

remove precipitated solids. Koon Decl. ¶ 86. The lime would also soften the water, removing dissolved calcium and magnesium. Koon Decl. ¶¶ 30-31.

Okazoe further teaches that the pretreatment step is followed by anaerobic biological denitrification and selenium removal in a bioreactor in the form of a stirring tank. Okazoe ¶ 8. Okazoe does not disclose that the bioreactor is a fixed film bioreactor. However, a fixed film bioreactor is one of a limited number of known choices of bioreactors. **FWS1015** at 650-56; Koon Decl. ¶ 87. A PHOSITA would appreciate that fixed film could accomplish the goals of Okazoe in its ordinary usage and application.

Okazoe therefore discloses or renders obvious every element of claim 1. And unlike in Ground 3, the order of operations of claim 1 is explicitly disclosed. Claim 1 is therefore obvious over Katagawa in view of Downing in further view of Okazoe.

2. Claim 9

Katagawa teaches the physical and chemical pretreatment components as described in Ground 3 above. Downing teaches the biological treatment components as described in Ground 3 above.

In addition, Okazoe teaches an FGD wastewater treatment process that includes a pretreatment step using a coagulation sedimentation device for removing suspended solids. Okazoe ¶ 5, Fig. 6. A PHOSITA would understand

that this process can be accomplished by conventional means through the use of lime and/or sulfides, and a clarifier to remove the precipitated solids. Koon Decl. ¶¶ 86-87.

Okazoe further teaches that the pretreatment step is followed by anaerobic biological denitrification and selenium removal in a bioreactor in the form of a stirring tank. Okazoe ¶ 8; Koon Decl. ¶ 87.

Okazoe therefore teaches every element of claim 9. And unlike in Ground 3, the order of operations of claim 9 is explicitly disclosed. Claim 9 is therefore obvious over Katagawa in view of Downing in further view of Okazoe.

3. Claim 2

Downing discloses that the biological reactor can also remove heavy metals under anaerobic conditions. Downing 9:5-15, 11:2-5. Arsenic and mercury are heavy metals. Koon Decl. ¶ 66. Downing also discloses that the reactor can be configured for sulfate removal. Downing 4:43-47. Sulfate is a sulfur compound. Koon Decl. ¶ 66. Katagawa in view of Downing in further view of Okazoe therefore renders obvious the additional element of claim 2 and claim 2 as a whole. *Id.*

4. Claim 3

Katagawa discloses a COD treatment device **111** and Fig. 1 item **9**. Katagawa pp. 1-2, Fig. 2. A PHOSITA would understand that aerobic treatment of

COD is very common and well-known; in particular, aerobic biological treatment is the most common choice. Koon Decl. ¶; US'034 6:59-61. US'034 provides no details regarding how COD is to be treated, other than it is to be an aerobic treatment. US'034 2:48-49, 2:61-62, 6:59-61. This supports Petitioner's contention that an aerobic COD treatment device was well within the knowledge and skill of a PHOSITA, which applies for claim 3 and for claim 10. Koon Decl. ¶ 79.

Okazoe also discloses the removal of COD as part of the pretreatment process. Okazoe ¶ 5, Fig. 6; Koon Decl. ¶ 89. Aerobic COD removal would have been a common and obvious means to remove COD. Koon Decl. ¶ 79. Okazoe also discloses aerobic nitrification. Okazoe ¶¶ 6, 13, 22-23, Figs. 3, 6. It would have been obvious to include such a process if ammonia removal was necessary. US'034 5:45-56; Okazoe ¶ 6; Koon Decl. ¶ 89.

Katagawa in view of Downing in further view of Okazoe therefore renders obvious the additional element of claim 3 and claim 3 as a whole.

5. Claim 5

The primary point of the invention in Okazoe is the approach of tailoring nutrient dosages to changing wastewater and bioreactor conditions, for the purpose of ensuring sufficient nutrients are provided for effective denitrification and selenium removal. Okazoe ¶¶ 16, 17, 28-30, 33, 43, 46, 73, claim 1, 3, 4, 5, Figs.

4, 5. In particular, Okazoe describes the use of an ORP meter **16**, as well as a flow rate adjusting valve **20** that controls the rate of nutrient (methanol **12**) addition. Okazoe also discloses that achieving the targeted ORP ranges has a significant effect on the effectiveness of the bioreactor. Okazoe ¶ 46, Fig. 5

A PHOSITA would understand that the ORP ranges specified in claim 5 "encompass the anoxic and anaerobic conditions occurring in the bioreactors during denitrification, selenium removal, and sulphur removal." **FWS1003** at 135; Koon Decl. ¶ 90; US'034 Fig. 8. A PHOSITA would further understand that although Okazoe uses nitrogen meter **18** to control the nutrient flow valve **20**, the end result is that the nutrient dosage is altered such that the ORP ranges recited in claim 5 are achieved. Okazoe claims 3, 4, ¶ 46; Koon Decl. ¶ 91. Furthermore, it would be trivial to configure nutrient valve **20** to use ORP meter **16** as its control signal source to directly ensure the claimed ORP ranges are maintained. Koon Decl. ¶ 91.

Okazoe also specifically discloses water conditions with ORP between 0 and +100 mV. Okazoe ¶¶ 20, 33. A PHOSITA would understand that if the ORP conditions in the bioreactor were between 0 and +100 mV that the conditions at the inlet of the anaerobic bioreactor would be equal or higher, as ORP decreases as water progresses through the biological treatment reactions. *See, e.g.,* US'034 Fig.

5. Similarly, the water at the outlet of the anaerobic bioreactor would be negative. Koon Decl. ¶ 92.

A PHOSITA would therefore understand that Katagawa in view of Downing in further view of Okazoe renders obvious the additional elements of claim 5 and claim 5 as a whole.

6. Claim 6

Downing discloses that the ORP after one or more of the bioreactors is below -100 mV. Downing 11:21-27. Okazoe discloses that the ORP in the bioreactor is below -100 mV. Okazoe ¶¶ 33, 46. A PHOSITA would understand that if the ORP conditions in the bioreactor were below -50 mV, that the conditions at the inlet of the anaerobic bioreactor would meet the claimed range. Koon Decl. ¶ 92; US'034 Fig. 5. Claim 6 is therefore obvious over Katagawa in view of Downing in further view of Okazoe.

7. Claim 7

Claim 7 differs from claim 5 only in that the method of ORP maintenance is required to be "controlling the place or rate of a nutrient feed to the one or more fixed film bioreactors." As described above, Okazoe specifically describes controlling the rate of nutrients as the primary method of ORP maintenance. Koon Decl. ¶ 90. Claim 7 is therefore obvious over Katagawa in view of Downing in further view of Okazoe. *Id.*

8. Claim 10

Katagawa discloses a COD treatment device **111** and Fig. 1 item **9**. Katagawa pp. 1-2, Figs. 1-2. Exactly as in claim 3, a PHOSITA would understand that aerobic treatment of COD is very common and well-known; in particular, aerobic biological treatment is the most common choice. Koon Decl. ¶ 89; US'034 6:59-61. Katagawa in view of Downing in further view of Okazoe therefore renders obvious the additional element of claim 10 and claim 10 as a whole.

9. Claim 11

Downing discloses that the biological reactor can also remove heavy metals under anaerobic conditions. Downing 9:5-15, 11:2-5. Downing also discloses that the reactor can be configured for sulfate removal. Downing 4:43-47. Sulfate is a sulfur compound. Koon Decl. ¶¶ 66, 70. Katagawa in view of Downing in further view of Okazoe therefore renders obvious the additional element of claim 11 and claim 11 as a whole. *Id.*

10. Claim 12

US'034 admits that membrane supported biofilm reactors (MSBR) are well-known, and in fact incorporates by reference three different prior publications describing MSBRs. US'034 7:39-57. A PHOSITA would therefore understand that the use of a MSBR is a simple design choice among known alternatives.

FWS1003 at 141; Koon Decl. ¶ 59. Katagawa in view of Downing in further view of Okazoe therefore renders obvious the additional element of claim 12 and claim 12 as a whole.

11. Claim 13

Downing discloses that the bioreactor can be of the fixed film type (called fixed bed). Downing 2:63-66, 5:55-60, 6:8-9, 7:1-4, claim 8; Koon Decl. ¶ 37. Katagawa in view of Downing in further view of Okazoe therefore renders obvious the additional element of claim 13 and claim 13 as a whole. Koon Decl. ¶ 37.

12. Claim 14

US'034 admits that fixed film reactors using activated carbon as the media bed were available to the public prior to the time of the invention. US'034 7:40-57. In addition, activated carbon was a well-known option among possible fixed bed media. US'034 8:36-40; Koon Decl. ¶ 81. A well-known purpose of a media bed is to support a population of microbes. Koon Decl. ¶¶ 37, 60. Katagawa in view of Downing in further view of Okazoe and the knowledge of a PHOSITA therefore render obvious the additional element of claim 14 and claim 14 as a whole. *Id.*

13. Claim 15

Ammonia stripping is a well-known process for treating ammonia in wastewater. **FWS1015** at 228; **FWS1003** at 75; Koon Decl. ¶ 61. A PHOSITA

would be easily capable of modifying the treatment system of Katagawa, Downing and Okazoe to include ammonia stripping. US'034 provides no disclosure on how ammonia stripping functions or is to be implemented, supporting Petitioner's claims that it would have been well within the skill of a PHOSITA. US'034 2:65-3:3, 5:48-51, 6:65-7:2. Katagawa in view of Downing in further view of Okazoe and the knowledge of a PHOSITA therefore renders obvious the additional element of claim 15 and claim 15 as a whole.

For the reasons stated above, Katagawa in view of Downing in further view of Okazoe renders obvious all of the Challenged Claims of US'034. Institution under this ground on all Challenged Claims is respectfully requested.

F. Ground 6: Obvious over Fukase in view of Downing in further view of Okazoe (claims 5-7)

Okazoe is analogous prior art reasonably pertinent to the problem addressed by US'034 for the reasons discussed in Ground 5 above.

A PHOSITA would recognize that Okazoe further refines the wastewater treatment systems described in Fukase and Downing to solve the same problem identified by US'034 as described in Ground 5 above. A PHOSITA would therefore be motivated to apply Okazoe's teaching to arrive at a more refined, effective, and cost-efficient process using nutrient dosing to maintain effective ORP ranges. Koon Decl. ¶ 94.

1. Claim 5

As discussed above in Ground 3, Petitioner believe Fukase and Downing are sufficient to render claim 5 obvious. To the extent it does not, Okazoe cures any deficiency. As described above in Ground 5, the primary point of the invention in Okazoe is the approach of tailoring nutrient dosages to changing wastewater and bioreactor conditions, for the purpose of ensuring sufficient nutrients are provided for effective denitrification and selenium removal. Okazoe ¶¶ 16, 17, 28-30, 33, 43, 46, 73, claim 1, 3, 4, 5, Figs. 4, 5. Okazoe therefore renders obvious the monitoring of ORP conditions within the bioreactor, and achieving the claimed ORP ranges of claim 5. Fukase in view of Downing in further view of Okazoe renders obvious the additional elements of claim 5 and claim 5 as a whole. Koon Decl. ¶ 94.

2. Claim 6

Downing discloses that the ORP after one or more of the bioreactors is below -100 mV. Downing 11:21-27. Okazoe discloses that the ORP in the bioreactor is below -100 mV. Okazoe ¶¶ 33, 46. Claim 6 is therefore obvious over Fukase in view of Downing in further view of Okazoe. Koon Decl. ¶ 94.

3. Claim 7

As discussed above in Ground 3, Petitioner believe Fukase and Downing are sufficient to render claim 7 obvious. To the extent it does not, Okazoe cures any

deficiency as discussed in Ground 5. Claim 7 differs from claim 5 only in that the method of ORP maintenance is required to be "controlling the place or rate of a nutrient feed to the one or more fixed film bioreactors." Okazoe specifically describes controlling the rate of nutrients as the primary method of ORP maintenance as discussed in Ground 5 above. Claim 7 is therefore obvious over Fukase in view of Downing in further view of Okazoe. Koon Decl. ¶¶ 90-92.

For the reasons stated above, Fukase in view of Downing in further view of Okazoe renders obvious claims 5-7 of US'034 and institution under this ground is respectfully requested.

IX. CONCLUSION

Petitioner respectfully requests IPR be instituted on all grounds for all of the challenged claims, and that all challenged claims thereafter be invalidated.

Dated: May 24, 2017

Respectfully submitted,

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CERTIFICATION OF WORD COUNT

The undersigned certifies pursuant to 37 C.F.R. §42.24 that the foregoing Petition for *Inter Partes* Review, excluding any table of contents, mandatory notices under 37 C.F.R. §42.8, certificates of service or word count, or appendix of exhibits, contains 12,568 words according to the word-processing program used to prepare this document (Microsoft Word 2010).

Dated: May 24, 2017

/ Adam K. Yowell /
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CERTIFICATE OF SERVICE

The undersigned certifies service pursuant to 37 C.F.R. §§ 42.6(e) and 42.105(b) on the Patent Owner by overnight mail of a copy of this Petition for *Inter Partes* Review and Exhibits FWS1001-FWS1022, at the correspondence address of record for U.S. Patent No. 7,790,034, and also Barbara Toop, corporate counsel for GE, at the following addresses:

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Dated: May 24, 2017

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