

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Clean Chemistry, Inc.,
Petitioner

v.

Enviro Tech Chemical Services, Inc.,
Patent Owner

IPR2025-01471
U.S. Patent No. 9,363,997

TITLE: METHODS AND COMPOSITIONS FOR THE GENERATION OF PERACETIC ACID
ON SITE AT THE POINT-OF-USE

PETITION FOR *INTER PARTES* REVIEW

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EXHIBIT LIST

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1001	U.S. Patent No. 9,363,997 (“’997 patent”)
1002	Prosecution History of U.S. Patent No. 9,363,997
1003	Declaration of Alexander M. Klibanov, Ph.D.
1004	<i>Curriculum Vitae</i> of Alexander M. Klibanov, Ph.D.
1005	JP 2006-045147 A (“Okano”) (Translated)
1006	WO 2001/046519 (“Withenshaw”)
1007	U.S. Patent No. 3,432,546 (“Oringer”)
1008	U.S. Patent No. 7,271,137 (“Tucker”)
1009	U.S. Patent No. 2,448,252 to Cornthwaite et al. (“Cornthwaite”)
1010	U.S. Patent Application Publication No. US 2009/0043123 to Copenhafer et al. (“Copenhafer”)
1011	U.S. Patent Application Publication No. US 2009/0175956 to Buschmann et al. (“Buschmann ’956”)
1012	Luyben, Chemical Reactor Design and Control (2007) (“Luyben”)
1013	Hill, Chemical Engineering Kinetics & Reactor Design (1977) (“Hill”)
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1015	Patent Owner’s Complaint, <i>Enviro Tech Chemical Services, Inc. v. Clean Chemistry, Inc.</i> , No. 1:24-cv-1313 (W.D. Tex.) (D.I. 1)
1016	Patent Owner’s Executed Summons, <i>Enviro Tech Chemical Services, Inc. v. Clean Chemistry, Inc.</i> , No. 1:24-cv-1313 (W.D. Tex.) (D.I. 8)

I. INTRODUCTION

Petitioner Clean Chemistry, Inc. (“Clean Chem” or “Petitioner”) respectfully submits this Petition for *Inter Partes* review of claims 1-14 (“the Challenged Claims”) of U.S. Patent No. 9,363,997 (the “’997 patent”) (EX1001).

The claims of the ’997 patent recite methods for generating a non-equilibrium solution of peracetic acid (PAA) by reacting triacetin and hydrogen peroxide in water under alkaline conditions using an alkali metal hydroxide. The precise methods claimed in the ’997 patent, however, were well-known and extensively used in the prior art. For instance, Okano (EX1005), on which all of the Grounds in this Petition rely, expressly disclosed the same claimed method for generating PAA from triacetin and hydrogen peroxide in water, for example in Okano’s Example 1:

(A) 50 g of triacetin (made by Cognis Japan, active ingredient 100%) and (B) 25 g of hydrogen peroxide (made by Ube Chemira, active ingredient 60%) were mixed with 850 g of ion exchanged water, 75 g of an alkaline aqueous solution containing 27% sodium hydroxide and 1.3% of organic phosphonic acid (product name: Dequest 2010, made by Solucia) was poured in, and this was then mixed and stirred for 5 minutes.

(EX1005, [0057].)

During prosecution, only a single “Cited Reference” was identified, which

was a parent patent within the same family of the '997 patent used by the Examiner to make a double-patenting rejection. The Patent Owner never filed an IDS identifying material prior art to the claims of the '997 patent. Nor did the Examiner identify any prior art, including the highly material Okano reference, for application against the claims. Had the Patent Office found or been made aware of Okano by Patent Owner, the claims of the '997 patent would not have issued. The Board should correct the lack of scrutiny applied to the claims of the '997 patent during prosecution, institute an *inter partes* review, and find the claims unpatentable for obviousness based on the Grounds presented in this Petition.

II. MANDATORY NOTICES UNDER 37 C.F.R. § 42.8(A)(1)

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

Petitioner Clean Chemistry, Inc. and its corporate parent, Black Bay Energy, L.P., are the real parties in interest to this IPR petition.

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

The '997 patent, together with U.S. Patent Nos. 9,737,072 (the "'072 Patent"); 8,546,449 (the "'449 Patent"), and 9,730,443 (the "'443 Patent"), which are all part of the same patent family, is the subject of the following litigation involving Petitioner and Patent Owner in the U.S. District Court for the Western District of Texas in *Enviro Tech Chemical Services, Inc. v. Clean Chemistry, Inc.*, No. 1:24-cv-1313 (W.D. Tex.). The '997 patent was first asserted in Patent Owner's Complaint,

which was filed on October 29, 2024, but not served until January 27, 2025. (See EX1015; EX1016.)

In addition to the present Petition, Petitioner has filed IPR petitions challenging the asserted claims of the '072 Patent (IPR2025-01458), '443 Patent (IPR2025-01459) and '449 Patent (IPR2025-01472).

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

Petitioner provides the following designation of counsel.

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

This Petitioner is being served by Priority Mail Express® to the attorney of record for the '997 patent:

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Post Office Box 1449
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A courtesy copy of this Petition is also being served electronically on Patent Owner's counsel of record in the pending case *Enviro Tech Chemical Services, Inc. v. Clean Chemistry, Inc.*, No. 1:24-cv-1313 (W.D. Tex.).

E. Power of Attorney

Filed concurrently per 37 C.F.R. § 42.10(b).

III. FEE PAYMENT

Petitioner requests review of 14 claims, with a \$51,875 payment.

IV. REQUIREMENTS FOR *INTER PARTES* REVIEW UNDER 37 C.F.R. §§ 42.104 AND 42.108

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

Petitioner certifies that the '997 patent is available for IPR and that Petitioner is not barred or otherwise estopped.

B. Identification of Challenge

Petitioner requests institution of IPR based on the following grounds:

Ground	Claims	Obviousness under 35 U.S.C. §103
1	1-7, 9-14	Obvious in view of Okano
2	1, 4, 5, 13-14	Obvious in view of the combination of Okano and Withenshaw
3	8	Obvious in view of the combination of Okano and Oringer

C. Considerations under §§ 314(a) and 325(d)

§ 314(a): The *General Plastic* factors are not relevant as this is the first IPR petition filed against the '997 patent. Nor do the *Fintiv* factors support discretionary denial. The pending litigation against Petitioner is in its early stage, and the parties have begun claim construction briefing but no claim construction rulings have occurred. This Petition was filed well before the one-year deadline under §315(b).

§ 325(d): This Petition does not raise §325(d) concerns because it relies on the Okano prior art that was not considered and is not cumulative of the art considered during prosecution. During prosecution of the '997 patent, Patent Owner never submitted an IDS and did not identify any relevant prior art to the Patent Office. The Examiner also did not identify any prior art for consideration against the claims of the '997 patent and instead only identified a parent patent within the '997 patent family (U.S. Pat. No. 8,546,449) as the sole Reference Cited to support an obviousness-type double patenting rejection during prosecution. The challenges in this Petition correct the failure by the Patent Owner and the Examiner to identify and apply material prior art. In particular, the Okano prior art reference demonstrates the claims of the '997 patent are invalid and would not have issued had the Patent Office been aware of the references. For instance, the present Petition identifies Okano, which expressly discloses the same methods that are claimed in the '997 patent. Neither Okano nor the combination of Okano and the secondary references identified in this Petition were considered by the Examiner.

V. TECHNOLOGY BACKGROUND

A. Peracetic Acid (PAA)

Peracetic acid ("PAA") is a well-known disinfectant and sanitizing agent. (See, e.g., EX1001 ('997 patent), 1:15-24 (Background of the Invention); EX1008 (Tucker), 1:55-2:19; EX1009 (Cornthwaite), 1:1-7.) PAA's well-known disinfectant

and oxidizing properties have been used in many industries. (*See, e.g.*, EX1005 (Okano), [0002] (“food production plants, pharmaceutical production plants, hospitals, nursing homes, kitchens, bathrooms, and the like”); EX1009, 1:34-35 (PAA as a “bleaching agent”); EX1010, [0003], [0005] (“bactericide, fungicide, disinfectant and sterilant, and also for their bleaching properties”); EX1008, Abstract (“disinfection of food processing equipment, disinfection of areas containing livestock, mold remediation, sterilization of medical instruments and direct disinfection of food surfaces, such as beef carcasses.”).)

Organic peracids, such as PAA, can be chemically generated by reacting a compound containing an acetyl group (i.e., an acetyl precursor) with a nucleophilic oxidizing compound, such as the strongly nucleophilic hydroperoxy anion of hydrogen peroxide (i.e., OOH^-), as shown in the following example reaction:



(EX1008, 5:35-42, 5:51-64, 6:39-62; *see also, e.g.*, EX1009, 1:1-29; EX1005, [0008], [0015]; EX1011 (Buschmann '956), [0005], [0027].)

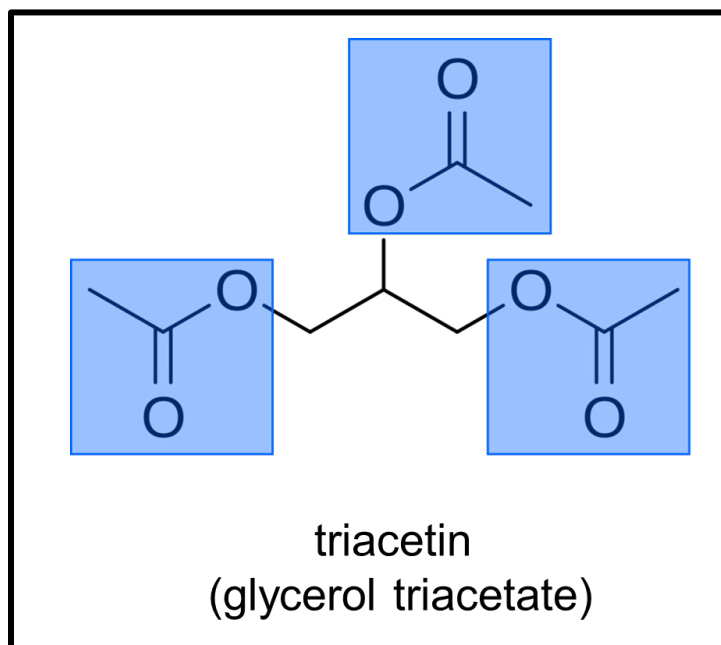
Acetyl precursors for generating PAA well-known in the art included acetic

acid, tetraacetyl ethylene diamine (TAED), monoacetin (glycerol acetate), diacetin (glycerol diacetate), and triacetin (glycerol triacetate). (EX1008, 6:52-53, 7:6-14; EX1005, [0008], [0015]; EX1011, [0027].) Hydrogen peroxide was known as a preferred oxidant. (EX1008, 5:51-53; EX1005, [0008]; EX1009, 2:46-50; EX1011, [0027].)

Non-equilibrium solutions of peracetic acid were known through the use of an acetyl source, hydrogen peroxide, and water under alkaline conditions. (EX1011, [0027]; EX1005, [0008], [0048].) Suitable bases to provide the alkaline reaction conditions include inorganic hydroxides, such as sodium hydroxide. (EX1008, 5:35-42, 6:17-38; *see also* EX1005, [0039], [0057].) Such peracetic acid solutions obtained under alkaline conditions were known to possess advantages over equilibrium solutions at lower pH because the hydrogen peroxide is primarily in the form of strongly nucleophilic hydroperoxy anions (OOH^-), which reacts more efficiently with the acetyl precursor to form PAA. (*See* EX1008, 6:39-49; EX1011, [0012], [0028].) As such, it was also well-known that the reaction to form PAA from an acetyl precursor and hydrogen peroxide is a base-catalyzed non-equilibrium reaction. (EX1003 (Klibanov Decl.), ¶¶38-39; EX1009, 1:1-29, 2:41-3:8; EX1008, 5:35-42, 6:17-38; EX1005, [0039]; EX1011, [0027].)

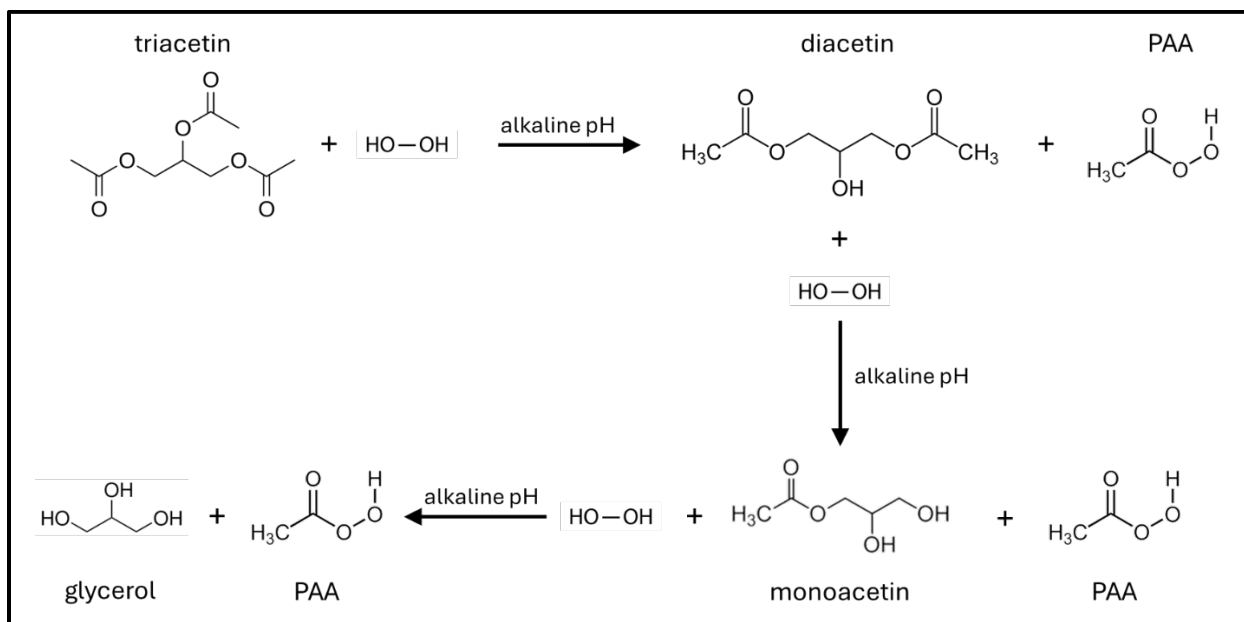
Triacetin was a well-known and preferred acetyl precursor for reacting with hydrogen peroxide to generate non-equilibrium PAA solutions. (EX1005, [0014];

see also EX1008, 7:12.) Triacetin is a triester of glycerol and acetic acid having three acetyl groups in the form of three carboxylic acid ester groups (blue boxes below):



(EX1003, ¶40.)

Under alkaline conditions, the carboxylic acid esters of triacetin react with hydrogen peroxide to generate a non-equilibrium solution of PAA according to the following general step-wise generation of PAA from triacetin → diacetin → monoacetin, as follows:



(EX1003, ¶41.)

B. Peracetic Acid (PAA) Manufacturing Methods

It was well-known that PAA could be generated by liquid/aqueous reaction of an acetyl precursor with hydrogen peroxide under alkaline conditions in a variety of well-known manufacturing processes, including batch and continuous processes employing batch reactors, continuous stirred tank reactor(s), and/or a tubular reactor(s). (EX1003, ¶42; *see, e.g.*, EX1012 (Luyben), xiv, 19; *see also* EX1012, 19-24; EX1013 (Hill), 247-252.) The prior art disclosed a variety of exemplary methods for generating PAA solutions with each of these three standard chemical reactor processes. (EX1003, ¶42.)

1. Batch generation of PAA

Batch reactor processes are commonly used for liquid phase reactions,

particularly when the relative amount of production is small. (EX1003, ¶43; *see, e.g.*, EX1013, 248.) Okano discloses an exemplary, laboratory-scale batch production of a PAA solution as a sterilizing composition from triacetin. (EX1005, [0056]-[0057] (Example 1).)

2. Known methods for the continuous generation of PAA

Continuous manufacturing operations that combine and mix an acetyl precursor with hydrogen peroxide under alkaline conditions to generate PAA were also well known in the art. (EX1003, ¶44.) For instance, Withenshaw discloses a multi-step “Peroxyacid Delivery Process” for the continuous generation of peroxyacid from hydrogen peroxide solution and a “bleach activator” (i.e., an acetyl precursor), which may be used for pulp bleaching in papermaking. (*E.g.*, EX1006 (Withenshaw), Abstract.) As another example, Oringer discloses a method for the “Manufacture of Peracetic Acid” using a tubular reactor for continuously generating PAA by reacting an acetyl precursor and hydrogen peroxide “in the presence of an alkaline catalyst comprising continuously introducing the reactants into a tubular reaction zone[.]” (*See* EX1007 (Oringer), Abstract (1:11-21), 2:35-56.)

VI. OVERVIEW OF THE '997 PATENT

A. Summary of the '997 patent

The '997 patent describes and claims methods for generating non-equilibrium solutions of peracetic acid (PAA). (*See, e.g.*, EX1001 ('997 patent), Abstract.)

“These methods comprise introducing triacetin sad [sic] aqueous hydrogen peroxide to water, mixing, and *then* adding an aqueous source of an alkali metal or earth alkali metal hydroxide. Triacetin is converted rapidly and with a high conversion rate into peracetic acid.” (EX1001 (’997 patent), Abstract (emphasis added).) This method, which is further disclosed within the specification, is the method recited in claim 1 of the ’997 patent, which is the sole independent claim. (See EX1001, 5:45-6:24, 13:32-15:39; *see also* EX1003, ¶¶45-47.)

B. Summary of the Prosecution History of the ’997 Patent

The application for the ’997 patent was filed on April 8, 2015, as U.S. Application No. 14/681,938 (the “’938 Application”), and claims priority to March 24, 2011. (See EX1002, 1.) The application, as filed, included the 14 claims that issued in the ’997 patent (without any changes). (*Compare* EX1002, 62-63 (claims 1-14) *with* EX1001 claims 1-14.) Patent Owner never submitted an IDS (*i.e.*, Information Disclosure Statement) identifying relevant prior art to the patent office during prosecution of the ’938 Application that became the ’997 patent.

The sole cited reference identified on the face of the ’997 patent is applicant’s own parent, U.S. Patent No. 8,546,449 (the “’449 patent”). (See EX1001, Page 1 (References Cited).) That sole cited reference was used by the Examiner to reject all claims for obviousness-type double patenting, which the Patent Owner overcame by filing a Terminal Disclaimer. (See EX1002, 88-93, 98-100, 126, 129-131.)

Once the Terminal Disclaimer was accepted, on April 29, 2016, the Examiner issued a Notice of Allowability and stated that “Claims 1-14 are neither anticipated nor rendered obvious over the art of record, and are therefore allowable.” (EX1002, 151.) However, the Examiner never identified any “art of record” other than the related ’449 patent. Thus, the 14 claims of the ’997 patent issued as-filed without any claim amendments or specific identification by the Examiner of any relevant prior art. The ’997 patent issued on June 14, 2016.

VII. CLAIM CONSTRUCTION

In the underlying district court proceedings, Patent Owner contends that all recited claim language in the ’997 patent should be given its plain and ordinary meaning, i.e., that no construction of any claim term is necessary. For the purposes of this Petition only, with the single exception described below regarding the order of steps recited in claim 1, Petitioner adopts PO’s “no construction necessary” proposed constructions from the underlying district court litigation.

A. The Method Steps Recited in Claim 1 Must Be Performed in Order

The language of claim 1 “as a matter of logic or grammar, requires that the steps be performed in the order written[.]” *Mformation Techs., Inc. v. Rsch. in Motion Ltd.*, 764 F.3d 1392, 1398 (Fed. Cir. 2014). The plain language of the claim confirms that the steps necessarily occur in the recited order, else the antecedent

basis of terms recited within the claimed method would impermissibly be rendered meaningless. *See Baldwin Graphics Sys., Inc. v. Siebert, Inc.*, 512 F.3d 1338, 1342-43 (Fed. Cir. 2008) (subsequent use of the definite articles “the” or “said” refers back to the same term recited earlier in the claim); *see also Wi-Lan, Inc. v. Apple, Inc.*, 811 F.3d 455, 462-63 (Fed. Cir. 2016) (finding that the text of the claim and the subsequent use of the definite article “the” requires a specific order of steps); *Bicon, Inc. v. Straumann Co.*, 441 F.3d 945, 950 (Fed. Cir. 2006) (“[C]laims are interpreted with an eye toward giving effect to all terms in the claim.”).

Here, claim 1 of the ’997 patent recites step “a. ***providing water***,” followed by step “b. introducing triacetin and aqueous hydrogen peroxide to ***the water***,” indicating that step “a” must be performed before step “b.” Claim 1 also recites step “b. introducing ***triacetin and aqueous hydrogen peroxide*** to the water” is followed by step “c. mixing ***the triacetin and the aqueous hydrogen peroxide*** with the water to form a mixture,” indicating step “b” must be performed prior to step “c.” Claim 1 also recites that step “c. mixing the hydrogen peroxide-triacetin solution and water to form ***a mixture***” is followed by step “d. adding an aqueous source of an alkali metal or earth alkali metal hydroxide ***to the mixture***,” indicating that step “c” must be performed before step “d.” The antecedent basis for each step is annotated below:

1. A method of generating non-equilibrium solution of peracetic acid, comprising:
 - a. providing water;
 - b. introducing triacetin and aqueous hydrogen peroxide to the water;
 - c. mixing the triacetin and the aqueous hydrogen peroxide with the water to form a mixture;
 - d. adding an aqueous source of an alkali metal or earth alkali metal hydroxide to the mixture;
and
 - e. forming a reaction medium comprising a non-equilibrium solution of peracetic acid.

(EX1003, ¶57.)

Accordingly, for recited steps a-b-c-d in claim 1, each subsequent step necessarily requires the prior step to have been completed in order for “the [water/triacetin/aqueous hydrogen peroxide/mixture]” to have the requisite antecedent basis within the claim. *See Hytera Commc’ns Co. v. Motorola Sols., Inc.*, 841 F. App’x 210, 218 (Fed. Cir. 2021) (concluding the claim language demonstrated the order of steps because each step of the method provides antecedent basis for the steps that follow); *Kaneka Corp. v. Xiamen Kingdomway Grp.*, 790 F.3d 1298, 1306 (Fed. Cir. 2015) (construing a claim to require that the steps be performed in order when the language of the claimed step referred back to the completed results of the prior step).

Additionally, step “e” recites “e. forming a reaction medium comprising a non-equilibrium solution of peracetic acid.” A POSA would understand that “a reaction medium” would only occur after all the required reagents are added and

mixed together, and that the “reaction medium” could not logically be formed out of order. (EX1003, ¶58.) That is, the claimed “reaction medium” could only be formed after steps “a” through “d” have provided all of the reagents and appropriate alkaline pH conditions to create a reacting, non-equilibrium solution of peracetic acid. (*Id.*)

A POSA would therefore understand that the method of claim 1 requires that each of the steps be performed in the recited order.

VIII. OVERVIEW OF THE PRIOR ART

A. JP 2006-045147 A (Okano) (EX1005)

JP 2006-045147 A (“Okano”) was published on February 16, 2006, making it pre-AIA § 102(b) prior art with respect to the ’997 patent. (EX1005, p.1.) Okano is directed to “a sterilizing cleaner composition for hard surfaces” containing water and a peracid obtained by reacting an acetyl precursor with hydrogen peroxide under alkaline conditions:

Containing water and *an organic peracid obtained by reacting (A) an ester of a polyhydric alcohol and an organic acid with (B1) hydrogen peroxide in a specific molar ratio in water at a pH of 8 to 12*, and having a pH of 1 or more and less than 7 at 25°C.

(EX1005, Abstract (emphasis added).)

Okano further discloses that the acetyl precursor component (A) is preferably triacetin. (EX1005, [0014].) Okano teaches the generation of PAA by creating a

reaction mixture containing triacetin (A) and hydrogen peroxide (B1) under alkaline conditions (i.e., a pH of 8 to 12). (EX1005, [0015], [0048].) Example 1 of Okano expressly discloses a method for the “Preparation of Sterilizing Cleaner Composition (I)” that results in a PAA solution by mixing triacetin and aqueous hydrogen peroxide with water and reacting them under alkaline conditions induced by the addition of sodium hydroxide, as follows:

<Preparation of Sterilizing Cleaner Composition (I)>

(A) 50 g of *triacetin* (made by Cognis Japan, active ingredient 100%) and (B) 25 g of *hydrogen peroxide* (made by Ube Chemira, active ingredient 60%) *were mixed with 850 g of ion exchanged water, 75 g of an alkaline aqueous solution containing 27% sodium hydroxide and 1.3% of organic phosphonic acid (product name: Dequest 2010, made by Solucia) was poured in, and this was then mixed and stirred for 5 minutes.* Afterward, 75 g of a mixed acid solution containing 30% sulfuric acid and 6% phosphoric acid was immediately added to prepare the sterilizing cleaner composition (I) containing the organic peroxy acid. The pH (25°C) of the composition (I) was about 2, and the hydrogen peroxide content was about 1500 ppm.

(EX1005, [0057].)

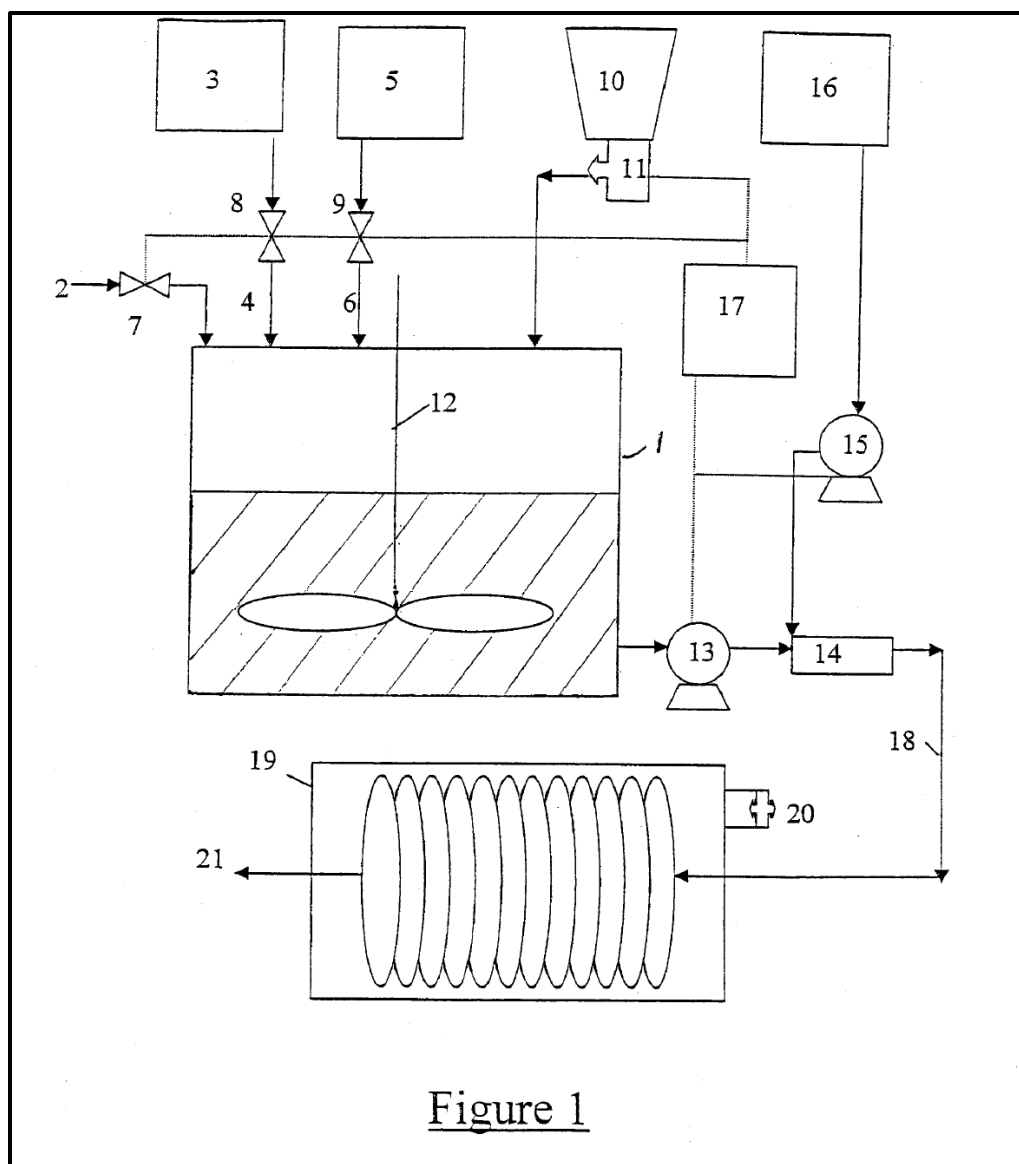
B. WO 2001/046519 (“Withenshaw”) (EX1006)

WO 2001/046519 (“Withenshaw”) is an International PCT publication titled “Peroxyacid Delivery Process.” (EX1006 (Withenshaw), Cover.) Withenshaw was published on June 28, 2001, and is therefore pre-AIA § 102(b) prior art to the ’997 patent.

Withenshaw discloses a “Peroxyacid Delivery Process” for the continuous generation of peroxyacid from hydrogen peroxide solution and a “bleach activator” (i.e., an acetyl precursor), which may be used for pulp bleaching in papermaking. (E.g., EX1005, Abstract.) The process disclosed in Withenshaw includes the hydrogen peroxide and acetyl precursor being added into water and mixed together in a tank. Thereafter, the water-hydrogen peroxide-acetyl precursor solution is combined and mixed with an alkaline material (such as sodium hydroxide) to initiate the alkaline catalyzed generation of peroxy acid within a tubular reactor. (EX1006, Abstract, 3:6-13.)

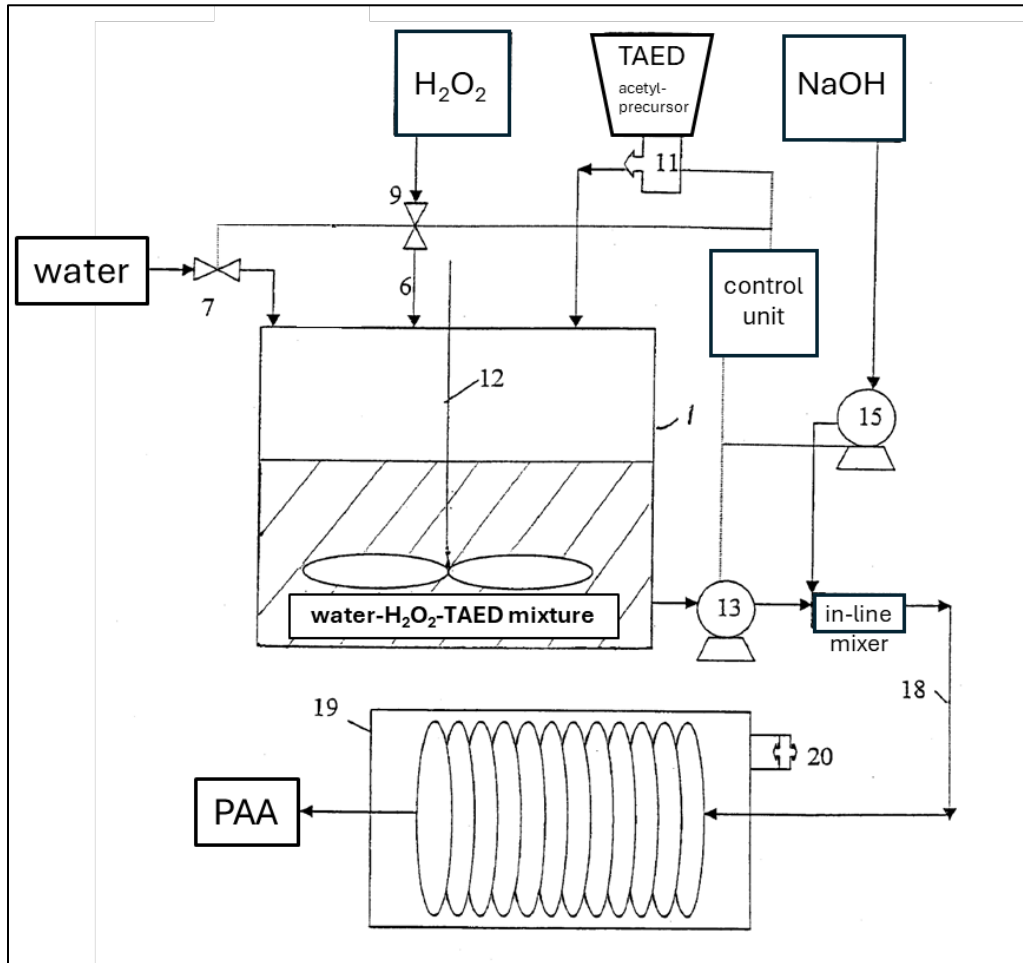
Withenshaw discloses the addition of the alkaline material “under continuous flow conditions” and provides “a continuous supply outlet for the peroxyacid containing product.” (EX1006, 3:29-4:2.) Withenshaw also teaches the preferred use of the acetyl precursor tetraacetylenediamine (TAED) as the “activator” and sodium hydroxide to provide an alkaline pH to increase yield of PAA. (EX1006, 4:14-26, 5:6-11.)

Withenshaw further discloses and teaches a system for the continuous generation of PAA using a water-fed, stirred tank containing a mixture of water, hydrogen peroxide, and an acetyl precursor (TAED) that outputs an aqueous feed stream containing the hydrogen peroxide and acetyl precursor that is co-fed into a mixer with the alkaline material to adjust the pH and form the PAA reaction product in Figure 1:



(EX1006, Figure 1, 3:6-15, 4:27-28, 5:1-2, 8:27-29.)

An annotated version of the schematic of Figure 1 according to Withenshaw's descriptions with respect to the introduction of water, H₂O₂, TAED, and NaOH, and PAA generation within the system (EX1006, 8:14-9:26) is provided below:



(EX1003, ¶74.)

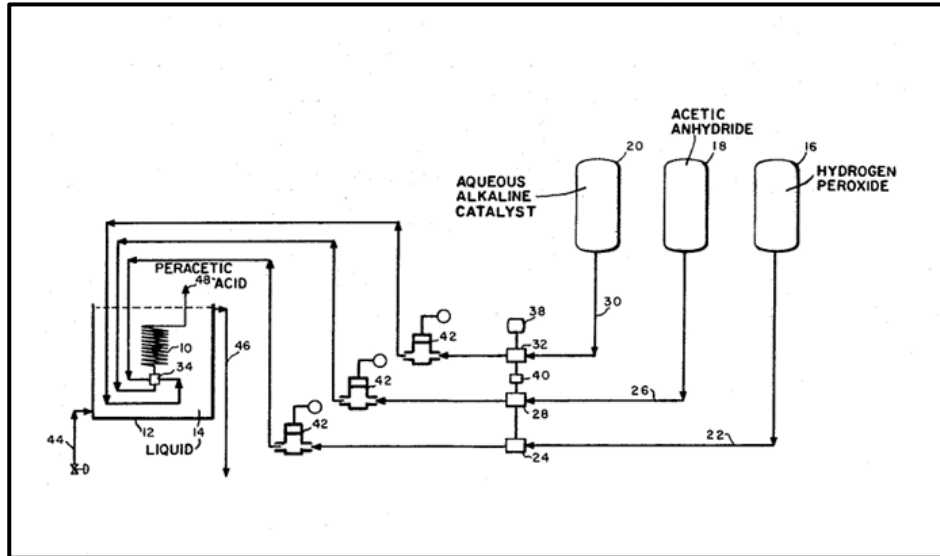
Withenshaw discloses that the reaction to form PAA within the in-line mixer can achieve greater than 85% conversion of TAED to PAA by controlling the reaction time through the flow rate and volume of pipe 18. (EX1006, 9:20-22.)

Withenshaw further discloses that the reaction pipe can have “a residence time of between 4 and 25 min.” (EX1006, 4:27-28.)

C. U.S. Patent No. 3,432,546 (“Oringer”) (EX1007)

U.S. Patent No. 3,432,546 (“Oringer”), titled “Manufacture of Peracetic Acid,” issued on March 11, 1969 and is therefore pre-AIA § 102(b) prior art to the ’997 patent. Oringer discloses a method using a tubular reactor for continuously generating PAA by reacting an acetyl precursor and hydrogen peroxide under alkaline conditions. (See EX1007 (Oringer), Abstract (1:11-21), 2:35-56.)

Oringer further discloses a system for implementing the continuous production of a PAA solution according to the disclosed method. (EX1007, 5:21-24, Figure, 2:49-54.) The reactor system involves feed tanks containing hydrogen peroxide (16), acetic anhydride (18), and an aqueous alkaline catalyst (20) that are fed into a mixer (34) tubular reactor (10) to continuously generate an aqueous peracetic acid reaction product (48), as follows:



(EX1007, 5:21-67, Figure.)

Oringer teaches that “[t]he combination of use of a tubular reaction zone and a turbulent flow of reactants therethrough results in quite rapid and efficient production of a peracetic acid solution[,]” achieving satisfactory yields of PAA in 30 seconds to one minute. (EX1007, 4:16-24.)

IX. SPECIFIC GROUNDS FOR INVALIDITY OF THE ’997 PATENT

Petitioner requests *inter partes* review of claims 1-14 of the ’997 patent based on the following identified Grounds.

A. Ground 1: Claims 1-7 and 9-14 are Obvious Based on Okano

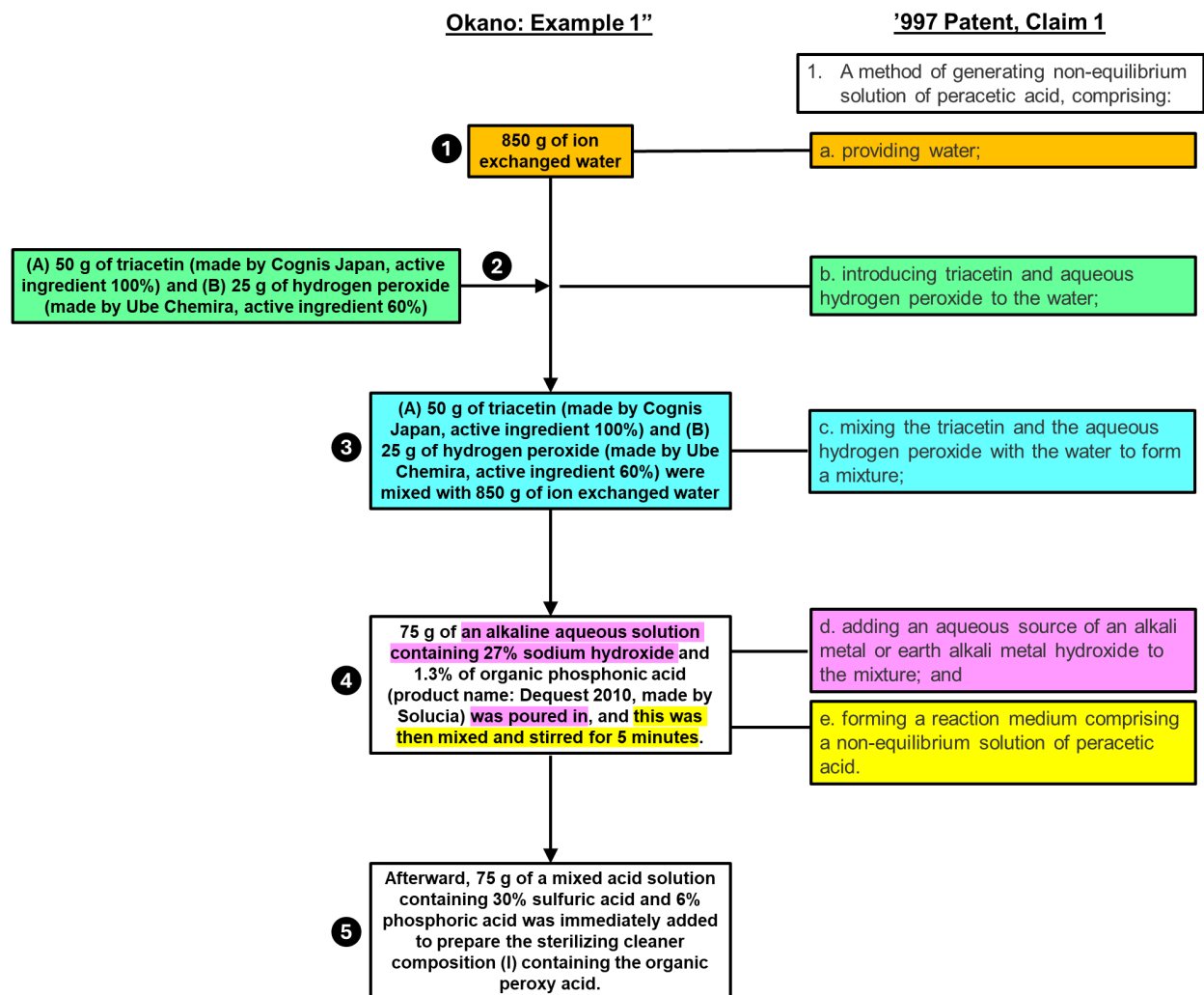
1. Claim 1 is obvious in view of Okano

As described in more detail below, all elements of the method of challenged claim 1 of the ’997 patent are disclosed by Okano, including Okano’s Example 1:

(A) 50 g of *triacetin* (made by Cognis Japan, active ingredient 100%)

and (B) 25 g of *hydrogen peroxide* (made by Ube Chemira, active ingredient 60%) *were mixed with 850 g of ion exchanged water*, 75 g of *an alkaline aqueous solution containing 27% sodium hydroxide* and 1.3% of organic phosphonic acid (product name: Dequest 2010, made by Solucia) *was poured in*, and *this was then mixed and stirred for 5 minutes*.

(EX1005, [0057].)



(See EX1003, ¶107.)

a) 1[pre] “A method of generating non-equilibrium solution of peracetic acid, comprising:”

To the extent the preamble is limiting, it is disclosed by Okano. (EX1003, ¶81.) Okano discloses that “the present invention” relates to a sterilizing composition “containing water and an organic peracid made by reacting (A) an ester of a polyhydric alcohol and an organic acid having a hydrocarbon group that may have a hydroxyl group (herein referred to as component (A)) and (B1) hydrogen peroxide” (EX1005, [0008].) Okano discloses “Component (A)” is preferably triacetin. (EX1005, [0011]-[0014].) Okano also discloses that “Component (B1)” is hydrogen peroxide and that “Component (B),” is “preferably hydrogen peroxide when the composition for producing sterilizing cleaner is liquid[.]” (EX1005, [0031]-[0033].)

Okano further discloses that component (A) and component (B1) react in water under alkaline conditions, and “a component that gives such a pH may be used as the component (C). Specifically, examples include alkali metal hydroxides such as sodium hydroxide” (EX1005, [0048].) Thus, Okano discloses and renders obvious a method of generating non-equilibrium solution of peracetic acid. (EX1003, ¶¶82-83.)

Okano’s Example 1 discloses a specific method of generating a non-

equilibrium solution of peracetic acid. (EX1003, ¶84.) Example 1 specifically discloses forming a solution containing 50 g triacetin, 25 g of hydrogen peroxide (60%), and 850 g of water to which “75 g of an alkaline aqueous solution containing 27% sodium hydroxide...was poured in, and this was then mixed and stirred for 5 minutes.” (EX1005, [0057].) A POSA would understand that the addition of the sodium hydroxide would substantially raise the pH of the solution such that the triacetin and the hydrogen peroxide would generate a non-equilibrium solution of peracetic acid. (EX1003, ¶84.) Thus, Example 1 of Okano also discloses the preamble of claim 1. (*Id.*)

Okano thus discloses, teaches, and renders obvious a method of generating a non-equilibrium solution of peracetic acid.

b) 1[a] “a. providing water;”

The method in Okano provides water as part of generating the sterilizing composition. (EX1003, ¶87.) Okano discloses that its sterilizing composition contains water and PAA and is generated by reacting component (A) (triacetin) and component (B1) (hydrogen peroxide) *in water*. (EX1005, [0015]; *see also id.*, [0029], [0030].) Additionally, Example 1 discloses a method wherein triacetin and hydrogen peroxide “were mixed with 850 g of ion exchanged water.” (EX1005, [0057].) Thus, Okano discloses, suggests and renders obvious the step of “providing water,” which must necessarily have occurred in order for the triacetin and hydrogen

peroxide to be “mixed” with the water. (EX1003, ¶¶87-88.)

Thus, Okano also discloses, suggests, and renders obvious a method that includes the initial step of “providing water” in Example 1.

c) 1[b] “b. introducing triacetin and aqueous hydrogen peroxide to the water;”

Okano discloses, teaches, and renders obvious introducing triacetin and aqueous hydrogen peroxide to the water as part of the method of making a sterilizing cleaner composition containing PAA. (EX1003, ¶¶90-93.) Okano discloses that the “present invention is prepared by reacting component (A) and component (B1) in water in a specific molar ratio...” (EX1005, [0015].) Okano expressly teaches that component (A) is preferably triacetin and component (B1) is hydrogen peroxide. (EX1005, [0011]-[0014]; *see also id.*, [0057], [0008], [0028]-[0030].) Accordingly, Okano discloses and teaches introducing triacetin as component (A) and hydrogen peroxide (B1) into water. (*See* EX1005, [0015], [0048], [0057].)

Okano’s Example 1 specifically discloses a method for introducing triacetin and aqueous hydrogen peroxide to the water. (EX1005, [0057]: EX1003, ¶94.) This example follows Okano’s general teachings of reacting component (A) (e.g., the preferred triacetin) and (B1) hydrogen peroxide “in a specific molar ratio *in water*.” (EX1005, [Abstract].) Okano’s Example 1 expressly discloses that “(A) 50 g of *triacetin* (made by Cognis Japan, active ingredient 100%) *and* (B) 25 g of *hydrogen*

peroxide (made by Ube Chemira, active ingredient 60%) **were mixed with 850 g of ion exchanged water...**” (*Id.*, [0057] (emphasis added).) Okano’s identification of the hydrogen peroxide as having “active ingredient 60%” indicates to a POSA that the hydrogen peroxide is “aqueous hydrogen peroxide” comprising 60% hydrogen peroxide and the remaining 40% of the “25g of hydrogen peroxide” being water. (EX1003, ¶95.) Thus, a POSA would have clearly understood and found obvious that the method disclosed in Okano’s Example 1 includes introducing triacetin (50 g) and aqueous hydrogen peroxide (25 g) to the water (850 g). (*Id.*)

Thus, Okano discloses, teaches, and/or renders obvious a step of introducing triacetin and aqueous hydrogen peroxide to the water, and that this step occurs after “providing [the] water.”

d) 1[c] “c. mixing the triacetin and the aqueous hydrogen peroxide with the water to form a mixture;”

Okano discloses mixing the triacetin and the aqueous hydrogen peroxide with the water to form a mixture. (EX1003, ¶97.)

Okano’s Example 1 expressly discloses that 50 g of triacetin and 25 g of 60% hydrogen peroxide “**were mixed with 850 g of ion exchanged water...**” (EX1005, [0057].) This “mixing” step of Okano’s Example 1 is shown below (annotated step 3), and necessarily occurs after the 850 g of water has been provided (annotated step 1) and the triacetin and aqueous hydrogen peroxide have been introduced to the

water (annotated step 2). (EX1003, ¶98.)

Thus, Okano discloses, teaches, and renders obvious to a POSA the step of “mixing the triacetin and the aqueous hydrogen peroxide with the water to form a mixture” and that this step occurs *after* the claimed step of “introducing triacetin and aqueous hydrogen peroxide to the water.” (EX1003, ¶99.)

e) 1[d] “d. adding an aqueous source of an alkali metal or earth alkali metal hydroxide to the mixture; and”

Okano discloses, teaches, suggests, and/or renders obvious this limitation. Okano states that the sterilizing non-equilibrium solution of peracetic acid is prepared “by setting the pH to 8 to 12, preferably to 9 to 11” where “an alkaline pH adjusting agent is preferably used.” (EX1005, [0037]; *see also id.*, [0046]; EX1003, ¶100.) Okano also discloses examples of alkaline pH adjusting agents, which includes sodium hydroxide. (EX1005, [0040], [0048] (“The component (A) and the component (B1) react under alkaline conditions . . . in water to generate an organic peroxy acid, and therefore, *a component that gives such a pH may be used as the component (C)*. Specifically, examples include *alkali metal hydroxides such as sodium hydroxide . . .*”).) Thus, Okano discloses “adding an aqueous source of an alkali metal or earth alkali metal hydroxide to the mixture.” (EX1003, ¶100.)

Okano’s Example 1 expressly discloses adding an aqueous source of an alkali metal to the mixture of triacetin, hydrogen peroxide, and water: “**75 g of an alkaline**

aqueous solution containing 27% sodium hydroxide ...was poured in, and this was then mixed and stirred for 5 minutes.” (EX1005, [0057]).) A POSA would have understood by this disclosure that the alkaline aqueous solution containing the sodium hydroxide is added in a step (i.e., “poured in”) that occurs after the “mixture” containing the triacetin-aqueous hydrogen peroxide-water was already previously mixed together. (EX1003, ¶101.)

Thus, Okano discloses, teaches, and/or renders obvious a method for creating a sterilizing cleaner solution with a step that includes “adding an aqueous source of an alkali metal or earth alkali metal hydroxide to the mixture,” and that this step occurs after the step of mixing the triacetin-aqueous hydrogen peroxide-water to form a mixture. (EX1003, ¶102.)

f) 1[e] “e. forming a reaction medium comprising a non-equilibrium solution of peracetic acid.”

Okano discloses, teaches, and renders this limitation obvious. (EX1003, ¶103.) Okano discloses that “[t]he present invention relates to a sterilizing cleaner composition for hard surfaces, containing water and an organic peracid.” (EX1005, [0008].)

As discussed in claims 1[pre]-1[d] above, Okano teaches a method of preparing a non-equilibrium solution of peracetic acid by combining triacetin, aqueous hydrogen peroxide, and water with an alkaline source (component (C)),

such as sodium hydroxide, to raise the pH and cause component (A) [triacetin] and component (B1) hydrogen peroxide to react and generate the peroxy acid [PAA]. (EX1005, [0048], [0057]; EX1003, ¶104.) Thus, a POSA would have found it obvious that Okano's teaching of the addition of an alkali metal hydroxide such as sodium hydroxide (i.e., reaction initiator component (C)) to the aqueous hydrogen peroxide-triacetin-water mixture would raise the pH to alkaline conditions, initiate the base-catalyzed generation of PAA, and thereby form a reaction medium comprising a non-equilibrium solution of peracetic acid. (*Id.*)

A POSA would also have recognized that such a reaction medium comprising a non-equilibrium solution of peracetic acid is also formed in Example 1 of Okano upon addition of the sodium hydroxide as well as during the 5 minutes of mixing and stirring. (EX1003, ¶105; EX1005, [0057].) Thus, Okano Example 1 discloses, teaches, suggests and renders obvious a method with a step of "forming a reaction medium comprising a non-equilibrium solution of peracetic acid." (EX1003, ¶105.)

Okano's Example 1 further discloses, after stirring the reaction mixture for 5 minutes, "75 g of a mixed acid solution containing 30% sulfuric acid and 6% phosphoric acid was immediately added to prepare the sterilizing cleaner composition (I) containing the organic peroxy acid" and that the resulting "hydrogen peroxide content was 1500 ppm." (EX1005, [0057].) 1500 ppm of residual hydrogen peroxide is about 0.15 wt% or a residual mass of hydrogen peroxide of

around 1.5 g. (EX1003, ¶106.) Since the amount of input hydrogen peroxide in Okano's Example 1 was 15 g (i.e., 60% of the 25 g of aqueous hydrogen peroxide added), Okano discloses that roughly 90% of the hydrogen peroxide was reacted to generate the non-equilibrium reaction solution of PAA. (EX1003, ¶106.)

In sum, Okano discloses, teaches, and renders obvious all limitations of claim 1. (EX1003, ¶107.) Because all elements of claim 1 are disclosed, taught, and/or rendered obvious by Okano, claim 1 is invalid for obviousness.

2. Claim 2: “The method of claim 1, wherein the triacetin and the aqueous hydrogen peroxide are introduced simultaneously.”

Okano discloses, teaches, and renders obvious this claim. In particular, Okano discloses that the acetyl-precursor component (A), such as the preferred triacetin, and the hydrogen peroxide component (B1) can be premixed together into a “first composition for producing the sterilizing cleaner,” i.e., for generating a solution containing the peroxy acid (i.e., PAA). (EX1003, ¶¶110-111; EX1005, [0034]-[0036].)

Okano discloses the compositional make-up of this pre-mixed “first composition” containing component (A) and component (B1) for use in generating the sterilizing cleaner containing the peroxy acid. (EX1005 (Okano), [0034]-[0035].) When following Okano's disclosure relating to the “first composition for generating a sterilizing cleaner” containing the peroxy acid, the component (A) and

component (B1) are combined into a single composition such that they would be introduced simultaneously, as recited in claim 2. (EX1003, ¶114.)

In particular, Okano discloses that “in order to suppress reaction between component (A) and component (B1) during storage and maintain the stability of the composition,” a restricted water content of between 1 to 25 wt% and “particularly preferably 5 to 15 wt%” is used. (EX1005 (Okano), [0034].) Okano further discloses that the concentration of component (A) in the “first composition” for producing sterilizing cleaner is “even more preferably between 40 and 80 wt%,” the concentration of component (B1) is “even more preferably between 10 and 25 wt%.” (EX1005 (Okano), [0035], [0034].) Thus, Okano discloses that the most preferred composition of the premixed “first composition” containing component (A), component (B) and a low amount of water is: component (A) “between 40 and 80 wt%,” component (B1) “between 10 and 25 wt%,” and water “between 10 and 25 wt%.” (EX1003, ¶112.)

A POSA would have recognized that the amounts of triacetin and aqueous hydrogen peroxide in Example 1 correlate to the most preferred values taught for Okano’s “first composition,” thereby showing that the amounts of these components within Example 1 are ideally suited to be combined and used within Okano’s “first composition” disclosures. (EX1003, ¶112.) That is, as further shown in the table below, a POSA would have understood that Okano discloses and teaches that the

triacetin and aqueous hydrogen peroxide of Example 1 be introduced as a single “first composition for producing a sterilizing cleaner” solution because the amounts of triacetin, aqueous hydrogen peroxide, and water in Okano’s Example 1 match and fall within the most preferred ranges of Okano’s disclosed “first composition”:

Okano’s Disclosure	“The <i>first composition for producing a sterilizing cleaner</i> of the present invention contains component (A) and component (B1)” (EX1005 (Okano), [0034]-[0035] (emphasis added))	Example 1: “(A) 50 g of triacetin (made by Cognis Japan, active ingredient 100%) and (B) 25 g of hydrogen peroxide (made by Ube Chemira, active ingredient 60%)” (EX1005 (Okano), [0057])
triacetin	40-80 wt% ¹	67 wt%
hydrogen peroxide	10-25 wt% ²	20 wt%
water	5-15 wt% ³	13 wt%

(See EX1003, ¶112.)

A POSA would also have recognized that such a “first composition” according to Okano’s Example 1 would have 0.23 moles (50 g) of triacetin and 0.44 moles (15 g) of hydrogen peroxide, which gives a mole ratio of triacetin

¹ See EX1005 (Okano), [0035] (“The amount of component (A)...even more preferably 40 to 80 wt%”); *see also* Okano, [0014] (“component (A)...triacetin is preferable”).

² See EX1005 (Okano), [0035] (“the amount of component (B1)...even more preferably 10 to 25 wt%”); *see also* Okano, [0009] (“(B1) hydrogen peroxide”), [0029] (“(B1) hydrogen peroxide”), [0030] (“(B1) hydrogen peroxide”).

³ See EX1005 (Okano), [0034] (“the moisture content of the composition is...particularly preferably 5 to 15 wt%”).

(A)/hydrogen peroxide (B) of 0.52 that likewise falls within the “even more preferably 1/5 to 10/1” molar ratio disclosed and taught by Okano for the “first composition.” (EX1003, ¶113; EX1005 (Okano), [0035].) Additionally, the molar ratio of hydrogen peroxide (component (B1)) per ester group of triacetin (component (A)) in Okano’s Example 1 is 0.64 (based on the ratio of 0.44 moles of hydrogen peroxide / (3 x 0.23 moles triacetin)). (*Id.*) This value also falls well within the “particularly preferable” ratio value of “0.3 to 2, from the viewpoints of efficiently generating an organic peracid and reducing unreacted hydrogen peroxide” taught by Okano. (*Id.*; EX1005 (Okano), [0035].)

Thus, in sum, Okano’s Example 1 discloses amounts of triacetin, aqueous hydrogen peroxide, and water consistent with the most preferred features of Okano’s “first composition for producing a sterilizing cleaner” in its paragraphs [0034]-[0035]. (EX1003, ¶114.)

Accordingly, a POSA would have found the amounts of triacetin and aqueous hydrogen peroxide used within Okano’s Example 1 as ideally-suited to be combined into a single premixed “first composition” for producing the sterilizing cleaner of Okano’s “present invention.” (EX1003, ¶114.) The use of this premixed “first composition” within Example 1 in Okano, would entail creating a “first composition” containing 50 g of triacetin and 25 g of 60% hydrogen peroxide, and then introducing and mixing this triacetin-aqueous hydrogen peroxide composition

with the water. (*Id.*) Thus, Okano discloses the formation of a premixed “first composition” of triacetin and aqueous hydrogen peroxide and a POSA would have found it obvious that, for example in the context of Example 1, that this “first composition” could and would be introduced to the water such that the triacetin and the aqueous hydrogen peroxide would be simultaneously introduced to the water and thereby satisfy the step of claim 2. (*Id.*)

3. Claim 3: “The method of claim 1, wherein the triacetin and the aqueous hydrogen peroxide are introduced sequentially with either one first.”

Okano discloses, teaches, and renders obvious a method for generating PAA wherein the triacetin and the aqueous hydrogen peroxide are introduced sequentially with either one first. (EX1003, ¶116.) As explained above, with respect to claim limitation 1[b], component A is preferably triacetin and component B1 is hydrogen peroxide, including as expressly disclosed in Okano’s Example 1. (EX1003, ¶116; EX1005, [0014], [0057].)

Okano’s Example 1 expressly discloses that “(A) 50 g of *triacetin* (made by Cognis Japan, active ingredient 100%) *and* (B) 25 g of *hydrogen peroxide* (made by Ube Chemira, active ingredient 60%) *were mixed with 850 g of ion exchanged water...*” (EX1005 (Okano), [0057].) It would have been clear to a POSA that Okano’s specifically disclosed amounts of 50 g of 100% triacetin and 25g of 60% aqueous hydrogen peroxide in Example 1 could and would have been introduced to

the 850 g of water, and that the triacetin and the hydrogen peroxide could be introduced into the water sequentially, with either one first. (EX1003, ¶117.)

Accordingly, Okano discloses and hence renders obvious a method for generating a non-equilibrium solution of PAA according to claim 1 (as discussed above) “wherein the triacetin and the aqueous hydrogen peroxide are introduced sequentially with either one first” as recited in claim 3. (EX1003, ¶118.)

4. Claim 4: “The method of claim 1, wherein the provided water is an aqueous stream.”

Okano discloses, teaches, and renders obvious that the “provided water” is in an aqueous stream. A POSA would have found it obvious that water in Okano’s method for forming PAA from an aqueous solution containing triacetin and hydrogen peroxide was provided in the form of an aqueous stream. (EX1003, ¶119.)

As explained above, with respect to claim element 1[a], Okano teaches the method step of providing water to which a triacetin and aqueous hydrogen peroxide is introduced to water, such as disclosed in Okano’s Example 1. (*E.g.*, EX1005, [0057].) Water, as a liquid, is essentially always transported in the form of a stream and a stream of water is, by definition, an *aqueous* stream. (EX1003, ¶119.) Additionally, a POSA would have found it obvious that the 850 g of water used in Okano’s Example 1 would have been provided directly from a tap as an aqueous stream or poured in as an aqueous stream from a bottle, beaker, or some other

container. (*Id.*) Thus, claim 4 is obvious in view of Okano.

5. Claim 5: “The method of claim 1, wherein the provided water is contained in a mixing tank or other vessel.”

Okano discloses, teaches, and renders obvious that the “provided water” is contained in a mixing tank or other vessel. Okano’s Example 1 discloses that triacetin and hydrogen peroxide were “mixed” with 850 g of water. (EX1005, [0057].) Water is a liquid that is not a free-standing composition. (EX1003, ¶120.) A POSA would have known that the 850 g of “provided water” to which the reagents for generating PAA solution are added and mixed would necessarily have to be held in some type of reaction vessel. (*Id.*) Okano teaches that the triacetin and hydrogen peroxide were “mixed” with 850 g of water, thus indicating that the vessel served as a mixing tank. (*Id.*) Likewise, a POSA would have found it obvious that the 850 g of “provided water” would have been provided to the reaction vessel from another vessel, such as a bottle, beaker, or pipe. (*Id.*) Thus, claim 5 is rendered obvious by Okano.

6. Claim 6: “The method of claim 1, wherein the aqueous source of the alkali metal or earth alkali metal hydroxide is sodium hydroxide.”

Okano discloses, teaches, and renders obvious that “the aqueous source of the alkali metal or earth alkali metal hydroxide is sodium hydroxide.” Okano states sterilizing composition is prepared “by setting the pH to 8 to 12, preferably to 9 to 11” where “an alkaline pH adjusting agent is preferably used[.]” (EX1005, [0039].)

Okano also discloses examples of alkaline pH adjusting agents, which includes sodium hydroxide. (EX1005, [0040] (“alkaline pH adjusting agents include alkali metal hydroxides such as sodium hydroxide”).) A POSA would therefore understand that Okano discloses sodium hydroxide as a source of the alkaline pH adjusting agent. (EX1003, ¶121.)

Okano’s Example 1 also specifically teaches the addition of an aqueous sodium hydroxide solution to the aqueous triacetin-hydrogen peroxide-water mixture. (EX1005, [0057].) A POSA would have known that the sodium hydroxide that is poured into the mixture in Okano’s Example 1 is an “aqueous source of the alkali metal or earth alkali metal hydroxide [that] is sodium hydroxide.” (EX1003, ¶122.) Thus, a POSA would have found claim 6 obvious in view of Okano.

7. Claim 7: “The method of claim 6, wherein the sodium hydroxide is about 1.82% to about 7.28%.”

Okano discloses, teaches, and renders obvious that “the sodium hydroxide is about 1.82% to about 7.28%.” As explained above with respect to claim 6, Okano discloses the use of sodium hydroxide as a pH adjusting agent for the generation of PAA. (EX1005, [0040], [0057].) Okano’s Example 1 teaches a method of generating PAA where 75 g of an aqueous solution containing 27% sodium hydroxide is added to the mixture. (EX1005, [0057].) A POSA would understand that 75 g of 27% sodium hydroxide is equal to 20 g of sodium hydroxide that is

added to the mixture. (EX1003, ¶124.) A POSA would also understand that the total mixture at step 4 (after the addition of the sodium hydroxide solution) includes 50 g of triacetin, 25 g of hydrogen peroxide solution, 850 g of water and 75 g of the sodium hydroxide solution, totaling 1000 g. (*Id.*) The concentration of 20 g of sodium hydroxide in a mixture of 1000 g is 2% sodium hydroxide. (*Id.*) A POSA would understand this 2% concentration of sodium hydroxide falls within the claimed range of 1.82% to about 7.28%. (*Id.*) Thus, claim 7 is rendered obvious by Okano.

8. Claim 9: “The method of claim 1, further comprising allowing the reaction medium sufficient time to maximize the conversion of the hydrogen peroxide and the triacetin into peracetic acid.”

Okano discloses, teaches, and renders obvious that “allowing the reaction medium sufficient time to maximize the conversion of the hydrogen peroxide and the triacetin into peracetic acid.” (EX1003, ¶126.) Okano discloses that the molar ratio of hydrogen peroxide per ester group of triacetin is “preferably mole increased by a factor of 2 or less, and particularly preferably mole increased by a factor of 0.3 to 2, from the viewpoints of *efficiently generating an organic peracid and reducing unreacted hydrogen peroxide.*” (EX1005, [0035].) Consistent with minimizing the amount of unreacted hydrogen peroxide in the generated PAA solutions, Okano further discloses that “it is preferable that the hydrogen peroxide content of the

sterilizing cleaner composition for hard surfaces of the present invention is 0.5 wt% or less, more preferably 0.3 wt% or less, and even more preferably 0.2 wt% or less.” (EX1005, [0023].) Thus, a POSA would understand that the methods and resulting PAA solutions disclosed in Okano suggest and teach maximizing the conversion of hydrogen peroxide triacetin to PAA at a given molar ratio of hydrogen peroxide per ester group of triacetin by providing reaction conditions that minimize the amount of unreacted hydrogen peroxide, and thereby maximize the conversion of hydrogen peroxide triacetin into PAA. (EX1003, ¶128.)

A POSA would have found it obvious and would have been further motivated to optimize the conversion of Okano’s input reagents hydrogen peroxide and triacetin to PAA based on commonly known design principles seeking to optimize cost-efficiency by minimizing the amount of unreacted reagents that do generate the PAA reaction product since they would amount to excess and unused reagents. (EX1003, ¶¶127-128; *see also, e.g.*, EX1013, 245.) A POSA would understand that, for example, the concentration of input reagents, the relative molar ratio of the input reagents, the rate of reaction, and time of reaction are outcome-determinative variables that could be easily controlled to optimize the generation of PAA based on a desired output for such production. (EX1003, ¶¶127-128; EX1013, 245, 246.)

Okano’s Example 1, for example, teaches that the mixture of triacetin, hydrogen peroxide, water, and sodium hydroxide is “mixed and stirred for 5

minutes.” (EX1005, [0057].) Coupled with Okano’s stated desire to “efficiently generat[e] an organic peracid and reducing unreacted hydrogen peroxide,” (EX1005, [0035]), a POSA would understand and have found obvious that Okano’s identified time of reaction under the conditions of Example 1 was likely meant to be consistent with Okano’s desired teaching of a method that allows the reaction medium sufficient time to efficiently convert the hydrogen peroxide triacetin into peracetic acid by reducing the amount of unreacted hydrogen peroxide. (EX1003, ¶128.)

After 5 minutes, Okano’s Example 1 discloses the addition of an acid solution that changes the pH of the mixture from alkaline to acidic conditions (i.e., to a pH of 2) and effectively quenches the reaction of hydrogen peroxide triacetin to PAA. (EX1003, ¶128; EX1005, at [0057].) Okano discloses that the amount of unreacted hydrogen peroxide in Okano’s Example 1 after 5 minutes of reaction time under the specific conditions in the example is 1500 ppm. (EX1005, [0057].) This amount of residual hydrogen peroxide (i.e., 1500 ppm = 0.15 wt%) falls within the maximum desired conversion of hydrogen peroxide to PAA taught by Okano since it falls within the smallest identified amount for the preferred amount of residual hydrogen peroxide taught by Okano. (EX1003, ¶129; EX1005, [0023] (“*even more preferably 0.2 wt% or less.*”).) A POSA would therefore have recognized and found obvious that Okano’s Example 1 provides 5 minutes of reaction time to maximize the conversion of the hydrogen peroxide and the triacetin into peracetic acid. (EX1003,

¶129.)

Moreover, to the extent it would be argued that 5 minutes is not sufficient time to maximum conversion of the hydrogen peroxide triacetin into peracetic acid under the specific alkaline pH reaction conditions of Example 1, a POSA would have understood and found it obvious that additional conversion of hydrogen peroxide triacetin into peracetic acid could be readily achieved in a straightforward manner, such as, for example, by: modifying the pH of the alkaline solution (such as by using a higher concentration of sodium hydroxide), which will modify the reaction rate of the generation of PAA, and assessing the conditions under which the amount of residual hydrogen peroxide may be reduced even further than Okano's identified 5 minutes of reaction time. (EX1003, ¶130.) In this regard, Okano expressly discloses that an acceptable range for the alkaline pH for the reaction of hydrogen peroxide with triacetin to form PAA is "a pH of 8 to 12." (EX1003, ¶130; EX1005, [0009], [0015], [0029], [0030], [0039], [0054].)

A POSA would also have known and found obvious various other parameters that would be expected to affect the extent of reaction for the conversion of the hydrogen peroxide triacetin into peracetic acid in Example 1, such as the temperature of the reaction conditions and/or the time permitted for the reaction to proceed. (EX1003, ¶131.) Thus, a POSA would have found it obvious to follow the teachings of Okano to maximize the conversion of the triacetin into peracetic acid within, for

example, the five minutes of time in Okano's example 1. Okano therefore renders claim 9 obvious. (EX1003, ¶132.)

9. Claim 10: "The method of claim 9, wherein the time to maximize the conversion of the hydrogen peroxide and the triacetin into peracetic acid is about 30 seconds to about five minutes."

As explained above regarding claim 9, Okano discloses and teaches the efficient generation of organic peracid by minimizing the amount of unreacted hydrogen peroxide, "even more preferably 0.2 wt% or less" unreacted hydrogen peroxide. (EX1005, [0035], [0023].) Okano's Example 1 teaches that the reaction mixture containing triacetin, hydrogen peroxide, water, and sodium hydroxide is "mixed and stirred for 5 minutes." (EX1005, [0057].) Okano's disclosure of mixing the aqueous hydrogen peroxide triacetin solution and stirring for 5 minutes overlaps with the claimed range of 30 seconds to five minutes. (EX1003, ¶133.)

A POSA would have understood and would have been motivated by Okano's stated desire to minimize the amount of unreacted hydrogen peroxide, coupled with the common knowledge a POSA had of the general desire to optimize conversion of reagents to product, to follow Okano's Example 1 and, if necessary, modify the reaction conditions to ensure minimal residual hydrogen peroxide after the stated 5 minute reaction time, as described above with respect to claim 9. (EX1003, ¶134.) Time and rate of reaction are variables a POSA would have known can affect the

extent of reaction. (*Id.*) As such, a POSA would easily be able to determine the reaction conditions that would optimize the rate of conversion to PAA (and thereby minimize the amount of unreacted hydrogen peroxide per Okano's teaching) in 5 minutes of reaction time as set forth in Okano's Example 1, such as by determining the maximum conversion based on modification of the reaction mixture's pH within Okano's identified range of a pH of 8 to 12. (*Id.*) Thus, a POSA would have found that Okano also renders claim 10 obvious.

10. Claim 11: "The method of claim 10, wherein [] the percent of triacetin that is converted into peracetic acid is about 40.9% to about 85.7%."

The '997 patent discloses that "[w]hen triacetin is used as the acetyl precursor and *assuming all three acetyl groups are reacted*, about 40.9% to about 85.7% of the triacetin is converted into peracetic acid, and the percent of hydrogen peroxide remaining is about 0.078% to about 1.88%." (EX1001, 6:6-11, 17:48-50.) Following this specific manner of determining "the percent of triacetin that is converted into peracetic acid" by "assuming all three acetyl groups are reacted," Okano's Example 1 satisfies and therefore renders obvious claim 11. (EX1003, ¶135; *see* EX1001 ('997 patent), 18:54-56 ("The percent of the triacetin acetyl donor converted to PAA was calculated, assuming all three acetyl groups were available for perhydrolysis").)

In Example 1, Okano teaches that the reaction is comprised of 50 g of triacetin,

25 g of 60% hydrogen peroxide – which is equal to 15 g of hydrogen peroxide in the solution – 850 g of water, and 75 g of an alkaline aqueous solution containing sodium hydroxide. (EX1005, [0057].) Okano further discloses that following the reaction, the hydrogen peroxide content was about 1500 ppm. (EX1005, [0057]; EX1003, ¶136.)

The reaction solution after step 4 (and prior to the addition of the acidic quenching solution) totals 1000 g, or roughly 1 liter. (EX1003, ¶137.) A remainder of 1500 ppm of hydrogen peroxide in a 1 liter solution is about 1.5 g of hydrogen peroxide (amounting to ~0.15 wt% hydrogen peroxide). (*Id.*) Because the reaction in Okano’s Example 1 began with 15 g of hydrogen peroxide and 1.5 g is left over, a POSA would understand that about 90%, or 13.5 g, of the hydrogen peroxide was reacted. (*Id.*)

A POSA would know that 13.5 g of hydrogen peroxide is about 0.4 moles of hydrogen peroxide and 50 g of triacetin is 0.23 moles of triacetin. (EX1003, ¶138.) Thus, “assuming all three acetyl groups are reacted” is the measure of the ’997 patent for determining the conversion of triacetin into PAA, a POSA would have understood that 0.4 moles of hydrogen peroxide would have reacted with 0.23 moles of triacetin. (*Id.*) Dividing 0.40 moles of hydrogen peroxide by 3, a POSA would have concluded that 0.133 moles of triacetin would theoretically have been reacted (assuming all three acetyl groups per triacetin were involved in the reaction). (*Id.*)

Accordingly, the percent of conversion of triacetin into PAA “assuming all three acetyl groups are reacted” can be calculated as $100\% \times 0.13/0.23 = 57\%$. (*Id.*) Accordingly, Okano’s Example 1 discloses a method wherein, based on the foregoing calculations and “assuming all three acetyl groups are reacted,” about 57% of all the triacetin’s acetyl groups were converted to PAA. (*Id.*)

Thus, Okano’s Example 1 discloses a method wherein, based on the foregoing stated approximations, about 57% of the triacetin is converted to PAA, which falls well within the claimed range of “about 40.9% to about 85.7%.” (*Id.*) Thus, claim 11 is obvious in view of Okano.

11. Claim 12: “The method of claim 6, wherein the mole ratio of the sodium hydroxide to the hydrogen peroxide to the triacetin is about 4.2:3.8:1.”

Okano teaches and renders obvious a method “wherein the mole ratio of the sodium hydroxide to the hydrogen peroxide to the triacetin is about 4.2:3.8:1.”

A POSA would have understood that Okano’s Example 1, after the “75 g of an alkaline aqueous solution containing 27% sodium hydroxide and 1.3% of organic phosphonic acid ...was poured in” that the reaction medium would have contained 0.51 moles of sodium hydroxide and 0.44 moles of hydrogen peroxide. (EX1003, ¶¶140-141; EX1005, [0057].) A POSA would have known that hydrogen peroxide is a weak acid and, as such, would have known and expected that the ratio of the amount of the strong alkaline base sodium hydroxide solution would need to

overcome the relatively weak acidity of the hydrogen peroxide to convert the reaction medium to a range within Okano's desired alkaline pH of 8 to 12. (EX1003, ¶141.) Thus, a POSA would have looked to Okano's Example 1 as having exemplary reaction conditions for Okano's sterilizing cleaner to achieve the desired pH range, which in Okano's Example 1 is at an NaOH:H₂O₂ molar ratio of 1.1:1, which scales to a ratio of 4.2:3.8. (*Id.*) This molar ratio for NaOH:H₂O₂ of 4.2:3.8 and is the same as the claimed "mole ratio of the sodium hydroxide to the hydrogen peroxide" of "about 4.2:3.8. (*Id.*)

With respect to the molar ratio of hydrogen peroxide:triacetin, Okano discloses that the sterilizing composition of peracetic acid is "obtained by reacting component (A) and component (B1) in water in a molar [and hence mole] ratio of (A)/(B1) = 1/10 to 20/1[.]" (EX1005 (Okano), [0015]; *see also id.*, [0029], [0030].) This Okano's "preferabl[e] 1/10 to 20/1" range of triacetin to hydrogen peroxide molar/mole ratios corresponds to the inverse, hydrogen peroxide to triacetin, "preferabl[e]" range of molar/mole ratios of 0.05:1 to 10:1. (EX1003, ¶142.)

A POSA would have recognized that Okano's aforementioned "preferabl[e]" molar/mole ratios of 0.05:1 to 10:1 for H₂O₂:triacetin could be readily used within Okano's Example 1 while maintaining the same relative molar ratio of NaOH:H₂O₂ within the example (*i.e.*, 4.2:3.8) to achieve the desired alkaline pH of 8 to 12 for the reaction medium. (EX1003, ¶143.) In other words, Okano discloses a method in

accordance with its Example 1, wherein the molar ratio of NaOH:H₂O₂ is 4.2:3.8 and the disclosed molar ratios of H₂O₂:triacetin are within 0.05:1 to 10:1. (*Id.*) This 0.05:1 to 10:1 range clearly encompasses and overlaps with the 3.8:1 mole ratio of hydrogen peroxide to triacetin recited in claim 12 of the '997 patent. (*Id.*) Likewise, Okano's even narrower 0.1:1 to 10:1 ("more preferabl[e]") and 0.1:1 to 5:1 ("even more preferabl[e]") ranges of molar ratios of hydrogen peroxide to triacetin (EX1005 (Okano), [0035]) also overlap and encompass the claimed 3.8:1 mole ratio of hydrogen peroxide to triacetin. (EX1003, ¶143.)

Accordingly, Okano discloses and teaches of a method for generating PAA wherein the molar ratio of NaOH:H₂O₂:triacetin overlaps and encompasses with the claimed "mole ratio of the sodium hydroxide to the hydrogen peroxide to the triacetin is about 4.2:3.8:1" and claim 12 is therefore obvious in view of Okano. (EX1003, ¶144.)

12. Claim 13: "The method of claim 1, wherein steps (a) through (e) are performed on a continuous basis."

Okano discloses, teaches, and renders obvious generating PAA by performing steps (a) through (e) on a continuous basis.

As explained above, Okano discloses generating peracetic acid according to steps (a) through (e) of claim 1. A POSA would understand that, based on demand, the steps outlined in Example 1 of Okano would be performed on a continuous basis.

(EX1003, ¶146.) Okano teaches that sterilization of hard surfaces in large environments, such as “food production plants, pharmaceutical production plants, hospitals, nursing homes, kitchens, bathrooms, and the like” is necessary to maintain a hygienic environment. (EX1005, [0002].) Sterilization can be incorporated into an industrial process and “steps such as supplying, mixing, and applying (painting, spraying, and the like) the active ingredient are often automated.” (EX1005, [0003].) A POSA would thus understand from Okano’s disclosure that there would be high demand for the sterilizing cleaner comprising peracetic acid. (EX1003, ¶146.) It would have been obvious to a POSA that the peracetic acid solution would be generated continuously, and could be automated. (*Id.*)

For example, a POSA would have been motivated to generate peracetic acid continuously for larger spaces, such as manufacturing and industrial plants, hospitals, nursing homes, and the like as disclosed in Okano. (EX1003, ¶147.) A POSA would have had a reasonable expectation of success in generating peracetic acid on a continuous basis based on Okano because Example 1 discloses the components and quantities necessary to generate peracetic acid solutions using an alkaline catalyzed reaction of triacetin and hydrogen peroxide. (*Id.*; see EX1005, [0057].) It therefore would have been obvious to a POSA that Okano discloses and teaches perform steps (a) through (e) of claim 1 on a continuous basis. (EX1003, ¶148.)

13. Claim 14: “The method of claim 1, wherein steps (a) through (e) are performed on an intermittent basis.”

Okano discloses, teaches, and renders obvious a method for generating PAA “wherein steps (a) through (e) are performed on an intermittent basis.” As described above regarding claim 1, Okano discloses and teaches a method whereby triacetin and hydrogen peroxide are mixed with water, and then sodium hydroxide is added to form an alkaline reaction medium for generating PAA. (EX1005, [0057] (Example 1); EX1003, ¶150.)

A POSA would have understood and found obvious that the generation of PAA according to Okano’s teachings could be performed on an intermittent basis to supply a desired quantity of the PAA solution for use. (EX1003, ¶151.) Okano discloses the testing of various PAA compositions in Table 1, including with respect to “Sterilizing cleaner composition (I)” and “Sterilizing cleaner composition (II).” (EX1005, [0069]; *see also id.*, [0057] and [0058].) A POSA would readily understand and find obvious that if the amount of the PAA composition made in a single batch of a PAA composition was insufficient to perform all of the desired “Oil stain cleaning rate,” “Protein stain cleaning rate,” and “Sterilization power” testing of the composition (e.g., “Sterilizing cleaner composition (I)” made according to the method of Okano’s Example 1), then the method of generating the PAA sterilizing cleaner composition could be performed on an intermittent basis based on need for

additional quantities of the solution to undertake additional tests related to the compositions. (EX1003, ¶151.)

Thus, a POSA would have understood and found obvious from the teachings of Okano a method for generating PAA that includes performing steps (a) through (e) of claim 1 on an intermittent basis. (EX1003, ¶152.)

B. Ground 2: Claims 1, 4, 5, and 13-14 are Obvious in view of the Combination of Okano (Ground 1) and Withenshaw

1. Motivation to Combine and Reasonable Expectation of Success

A POSA would have had a motivation to combine Okano and Withenshaw and would have been able to successfully do so with routine and ordinary skill.

Okano and Withenshaw are both directed to the same rather narrow and interrelated field of art, namely to generating and using peracetic acid solutions made from an acetyl precursor and hydrogen peroxide. (*See* EX1006, 1:1-3, 5:6-11; EX1005, [0011], [0014]; EX1003, ¶154.) The '997 patent specification itself describes Withenshaw as disclosing a “process for generating non-equilibrium solution of PAA on site at the point-of-use.” (EX1001, 4:19-37 (“WO 01/46519”); EX1003, ¶155.)

Okano and Withenshaw both also disclose generating non-equilibrium peracetic acid solutions through the same alkaline-catalyzed reaction of an acetyl precursor and hydrogen peroxide, including the preferred use of sodium hydroxide

to raise the pH to alkaline reaction levels. (EX1006, 3:6-10, 4:14; EX1005, [0008], [0039]-[0040], [0057] (Example 1); EX1003, ¶156.)

A POSA would have known that peracids, including specifically PAA, possess strong oxidizing potential for use in a variety of applications. (EX1003, ¶157; *see, e.g.*, EX1010, [0003], [0005]; EX1008, Abstract.) Indeed, both Withenshaw and Okano expressly describe and suggest overlapping, alternative, and complementary uses for the strongly oxidizing peracid solutions. (*See* EX1003, ¶157.) Withenshaw notes that “[i]t has been proposed to use peroxyacid, especially peracetic acid, as a bleach or disinfectant.” (EX1006, 1:15-16.) Okano similarly teaches the benefits of peracetic acid solutions due to their strong disinfectant properties, and can be used in “food production plants, pharmaceutical production plants, hospitals, nursing homes, kitchens, bathrooms, and the like.” (EX1005, [0026]; *see also* EX1005, [0002].) Thus, a POSA would have recognized that the methods for generating peracetic acid solutions disclosed and taught by both Withenshaw and Okano could be readily and interchangeably deployed for use in a variety of end-use applications. (EX1003, ¶157.)

Okano and Withenshaw also both aim to teach improved methods for efficiently generating peracetic acid solutions. (EX1003, ¶158; EX1005, [0037]; EX1006, 3:4-5.) Considering they are in the same field and teach the use of chemically similar reagents (an acetyl precursor and hydrogen peroxide) using the

same sodium hydroxide-based alkaline-catalyzed reaction conditions for similar and overlapping applications, a POSA would have been motivated to combine the respective teachings of Okano and Withenshaw. (EX1003, ¶158.) Since both references use old, standard, and well-established reagents and chemical methods, a POSA would have had a reasonable expectation of success in combining the respective teachings of Okano and Withenshaw. (*Id.*)

Additionally, a POSA would also have been specifically motivated to combine Okano's preferred triacetin-hydrogen peroxide method for efficiently generating peracetic acid solutions with Withenshaw's disclosed "continuous peroxyacid generating system" to automate and scale-up Okano's method into an industrial production process with desirable features. (EX1003, ¶159.) While Okano expressly acknowledges that the sterilization and cleaning process are often automated, (EX1005, [0003]), Okano does not expressly disclose a specific automated, industrially-applicable system for implementing the methods for generating PAA solutions from triacetin-hydrogen peroxide disclosed therein. A POSA, however, would have recognized that the system taught by Withenshaw would be well-suited to implement, automate and scale up Okano's methods for efficiently generating PAA. (EX1003, ¶159; *see* EX1006, 9:4-10.)

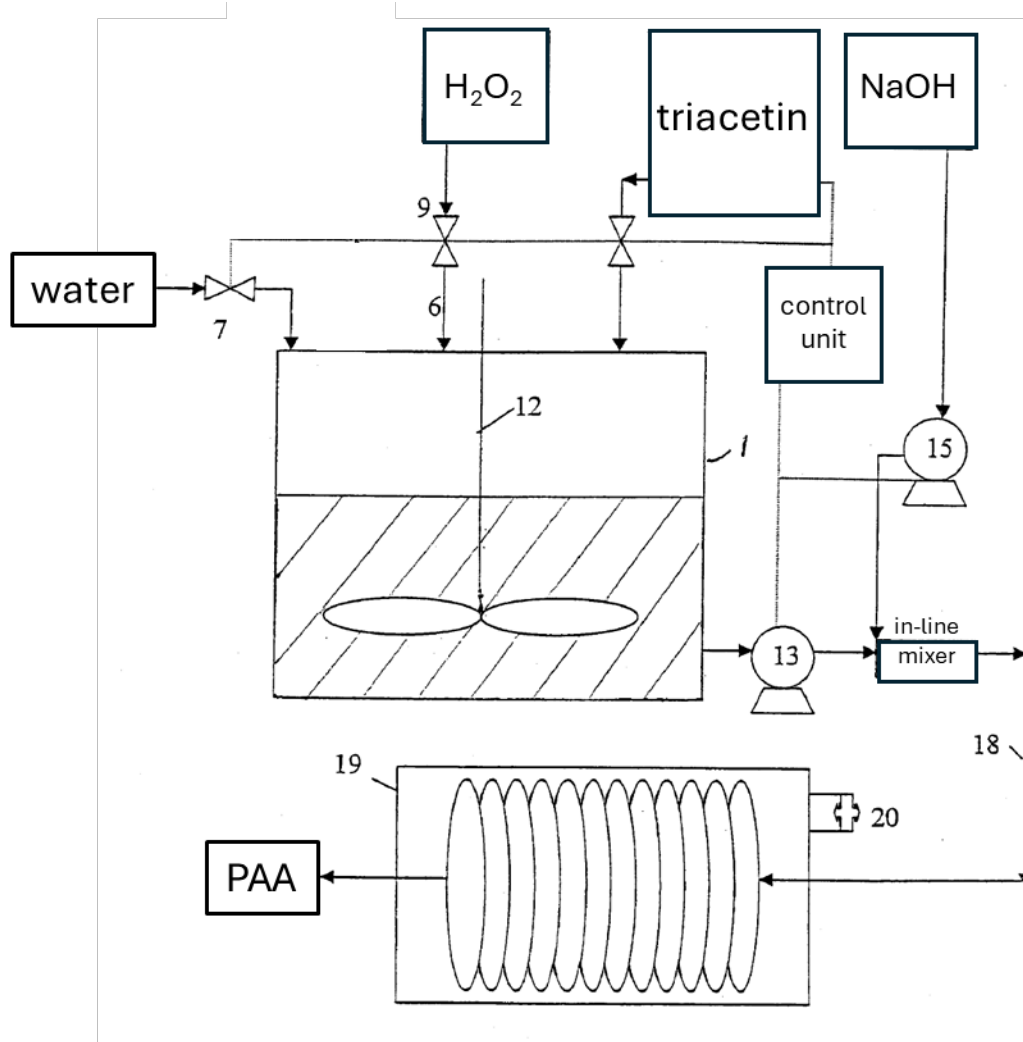
A POSA would also have understood that Withenshaw's system would not only provide the benefit of automation and increased production of Okano's PAA

solutions, but also provide other desirable benefits that would have further motivated the combination. (EX1003, ¶160.) For example, Withenshaw suggests that its system is desirable because it provides “a safe, continuous process for on-site generation of peroxyacid with low capital cost and short residence time,” and a POSA would have been motivated to use Withenshaw’s system for these benefits. (EX1006, 3:4-5; *see also* EX1003, ¶160; EX1006, 8:5-9 (“A further advantage of generating the peroxyacid continuously is that it may easily be controlled...Another advantage of the continuous process is that it can easily be scaled up...”).) With respect to safety, a POSA would have recognized the benefit of Withenshaw’s system “because the system is then enclosed, exposure of an operator to peracetic anion solution is reduced.” (EX1006, 7:16-17; EX1003, ¶160.)

Another benefit touted by Withenshaw that would have further motivated the use of Withenshaw’s system in combination with Okano’s triacetin-hydrogen peroxide method is the flexibility of the system regarding location and reaction pipe bore and length. (EX1006, 7:3-5; EX1003, ¶161.) Moreover, Withenshaw notes a variety of drawbacks in using a solid or “agglomerated” TAED as the acetyl precursor with respect to solubility, undesirable side reactions, and scum formation. (EX1006 (Withenshaw), 2:3-3:3; EX1003, ¶¶162-163.) A POSA would immediately recognize that these shortcomings and potential complications associated with the use of an agglomerated solid acetyl precursor (TAED) would not

be present when using the liquid triacetin acetyl precursor taught by Okano, which a POSA would find as more desirable than a solid acetyl precursor for use within a scaled and automated process. (EX1003, ¶163.)

Because Withenshaw's system was designed to implement a materially identical chemical process and is adaptable, implementing Okano's preferred input of triacetin as the acetyl precursor instead of Withenshaw's preferred TAED within Withenshaw's system would have been well within the routine skill of a POSA. (EX1003, ¶¶162, 164.) Withenshaw's system, such as in the exemplary Figure 1, uses standard tanks, pumps, valves, in-line mixer, and controls that would be well known to a POSA and could be readily implemented to use Okano's preferred triacetin acetyl precursor. (EX1003, ¶164; *see, e.g.*, EX1006, 8:13-26, Figure 1.) This straightforward combination of Okano's disclosures, particularly relating to Example 1 in using a liquid triacetin acetyl precursor in lieu of Withenshaw's solid TAED, for generating PAA in water from the base-catalyzed reaction of triacetin and hydrogen peroxide within Withenshaw's disclosed system is schematically depicted as follows:



(EX1003, ¶164.)

Thus, based on the foregoing, a POSA would have been motivated to combine the teachings of Okano and Withenshaw to generate PAA solutions that could be used in a variety of applications with a reasonable expectation of success. (EX1003, ¶165.)

2. Claim 1 is obvious in view of the combination of Okano and Withenshaw

Okano's disclosures and teachings (as set forth under Ground 1) implemented according to Withenshaw's "continuous peroxyacid generating system," renders claim 1 obvious.

a) 1[pre] "A method of generating non-equilibrium solution of peracetic acid, comprising:"

To the extent the preamble is limiting, it is disclosed by both Okano and Withenshaw. Ground 1 with respect to Okano for claim element 1[pre] is incorporated herein. (*See supra*, Ground 1, 1[pre].)

Withenshaw discloses a "peroxyacid delivery process for the continuous generation of peroxyacid" using hydrogen peroxide and bleach activator, such that the pH of the mixture is adjusted using sodium hydroxide. (EX1006, 3:6-10.) Withenshaw further discloses that a pH of about 8 to 9.5 is recommended for "greater than 90% yield based on TAED." (EX1006, 4:16-18.) Withenshaw thus also discloses the formation of an alkali-catalyzed non-equilibrium solution of peracetic acid. (EX1003, ¶168.)

Accordingly, both Okano and Withenshaw disclose "a method of generating non-equilibrium solution of peracetic acid."

b) 1[a] "a. providing water;"

As set forth above in Ground 1 (1[a]), Okano discloses and teaches a method

for generating PAA that includes providing water. (*See supra*, Ground 1, 1[a]; EX1003, ¶170.)

Withenshaw also discloses the step of “providing water” as part of a method for generating PAA solutions. Withenshaw’s Figure 1 discloses that a batch make-up tank is fed water via “pipe 2.” (EX1006, 8:14-15.) Withenshaw further discloses that “[t]he continuous process operates as follows: the control unit 17 opens valve 7 to allow approximately 100 kg of water to enter the batch make-up tank 1 along supply pipe 2.” (EX1006 (Withenshaw), 8:27-29.) Thus, Withenshaw also discloses the step of “providing water.” (EX1003, ¶171.)

Accordingly, both Okano and Withenshaw disclose the step of “providing water” in a method for generating PAA and both thereby satisfy claim element 1[a].

c) 1[b] “b. introducing triacetin and aqueous hydrogen peroxide to the water;”

As described in Ground 1 with respect to claim element 1[b], Okano renders obvious introducing triacetin and aqueous hydrogen peroxide to the water such as in Okano’s Example 1. (*See supra*, Ground 1, 1[b].)

Withenshaw similarly discloses the addition of an acetyl precursor (TAED) and hydrogen peroxide to water in the batch make-up tank. (EX1006, 8:14-18.) Accordingly, Withenshaw discloses that the acetyl precursor and hydrogen peroxide are introduced into the water. (EX1003, ¶174.) A POSA would have found obvious

that implementing Okano's method for generating PAA using triacetin instead of TAED would also follow the same order of steps, in that the triacetin and the aqueous hydrogen peroxide would be added into the water in Withenshaw's batch make-up tank. (EX1003, ¶174.)

Although Withenshaw suggests that the sequestrant and TAED can be added "at the same time" as the water, a POSA would have understood that the TAED is "agglomerated" and the addition of the sequestrant is included in Withenshaw's process because the acetyl precursor (TAED) is in a solid, agglomerated form. (EX1006, 8:27-9:5; EX1003, ¶¶175-176.) The method of Okano using a hydrogen peroxide-triacetin solution would not require such a sequestrant and would not have to account for the agglomerated nature of the TAED since both hydrogen peroxide and triacetin are liquids. (EX1003, ¶176.) Accordingly, a POSA would have found it obvious to "dose" Okano's liquid triacetin acetyl precursor into the batch make-up tank in a manner similar to how Withenshaw discloses for the TAED in relation to the aqueous hydrogen peroxide—i.e., the batch make-up tank would have the water added first, then introducing the triacetin, and then "[t]owards the end of the cycle the hydrogen peroxide is dosed." (EX1006, 9:3-5; EX1003, ¶176.) Thus, a POSA would have found that the combination of Okano and Withenshaw discloses introducing triacetin and aqueous hydrogen peroxide to the water as recited in claim element 1[b]. (EX1003, ¶¶176-177.)

d) 1[c] “c. mixing the triacetin and the aqueous hydrogen peroxide with the water to form a mixture;”

As described above, Okano renders obvious mixing the triacetin and the aqueous hydrogen peroxide with the water to form a mixture, such as in Okano’s Example 1. (*See supra*, Ground 1, 1[c]; EX1003, ¶178.)

Withenshaw likewise discloses that during the fill cycle, in which the water, acetyl precursor, and hydrogen peroxide is dosed into the batch make-up tank 1, “the agitator 12 is in continuous operation.” (EX1006, 9:2-3, Fig. 1.) A POSA would understand that agitator 12 is used to form a mixture of the components dosed into batch make-up tank 1. (EX1006, 8:18-19; EX1003, ¶179.)

The combination of Okano and Withenshaw thus discloses, teaches, and renders obvious to a POSA that the triacetin and the aqueous hydrogen peroxide is mixed with the water to form a “mixture” within Withenshaw’s batch make-up tank. (EX1003, ¶180.)

e) 1[d] “d. adding an aqueous source of an alkali metal or earth alkali metal hydroxide to the mixture; and”

As demonstrated in Ground 1, Okano discloses this limitation, such as in Example 1 which adds sodium hydroxide. (*See supra*, Ground 1, 1[d]; EX1003, ¶182.)

Withenshaw discloses a “peroxyacid delivery process for the continuous generation of peroxyacid” wherein the acetyl precursor, hydrogen peroxide, and

water are “mixed together in a tank (1), the pH of the mixture is adjusted by the addition or injection of an alkaline material (16) selected from the group consisting of sodium hydroxide....” (EX1006, Abstract, 3:6-11, 4:14-18.) As Withenshaw further teaches with respect to the disclosed system in Figure 1, “[t]he outlet from tank 1 is fed by pump 13 to in-line mixer 14. The in-line mixer is also fed through pump 15 with caustic soda solution from tank 16.” (EX1006, 8:18-21.) Thus, Withenshaw discloses that the alkali metal hydroxide (e.g., sodium hydroxide) is added to and mixed with the acetyl precursor, hydrogen peroxide, water mixture from tank 1 as a downstream step associated with in-line mixer 14. (EX1003, ¶183.)

Accordingly, Okano and Withenshaw individually and in combination disclose, teach, and/or render obvious a method for generating PAA with a step that includes “adding an aqueous source of an alkali metal or earth alkali metal hydroxide to the mixture,” and that this step occurs after the step of mixing the hydrogen peroxide, triacetin, and water to form a mixture. (EX1003, ¶184.)

f) 1[e] “e. forming a reaction medium comprising a non-equilibrium solution of peracetic acid.”

As explained in Ground 1 regarding claim element 1[e], Okano discloses the formation of a reaction medium comprising a non-equilibrium solution of peracetic acid, such as upon addition of the sodium hydroxide to the triacetin-hydrogen

peroxide-water mixture in Okano's Example 1. (*See supra*, Ground 1, 1[e]; EX1003, ¶186.)

Withenshaw likewise discloses the formation of a reaction medium to generate a non-equilibrium solution of peracetic acid upon the addition of an alkaline material to raise the pH and initiate the conversion of an acetyl precursor and hydrogen peroxide to peracetic acid. (*See* EX1006, Abstract, 3:6-11, 3:29-4:2, 9:24-26, 12:17-19; EX1003, ¶187.) The '997 patent specification admits that Withenshaw discloses a "process for *generating non-equilibrium solution of PAA* on site at the point-of-use." (EX1001, 4:19-37.)

Because all elements of claim 1 are disclosed, taught, and/or rendered obvious by the combination of Okano and Withenshaw, claim 1 is invalid for obviousness under Ground 2. (EX1003, ¶188.)

3. Claim 4: "The method of claim 1, wherein the provided water is an aqueous stream."

A POSA would have found that Okano discloses, teaches, and/or suggests that the provided water is an aqueous stream as explained above regarding Ground 1. (*See supra*, Ground 1, Claim 4.)

Withenshaw also discloses providing water as an aqueous stream, particularly in connection with the system disclosed in Figure 1. (EX1006, 8:13.) In part, Withenshaw describes the operation of the system in Figure 1 as providing water in

the form of an aqueous stream from a pipe (2) to the batch make-up tank (1). (EX1006, 8:14-29; EX1003, ¶191.)

Thus, the combination of Okano and Withenshaw renders claim 4 of the '997 patent obvious to a POSA. (EX1003, ¶192.)

4. Claim 5: “The method of claim 1, wherein the provided water is contained in a mixing tank or other vessel.”

As explained above, Okano discloses claim 5. (*See supra*, Ground 1, Claim 5.)

The method and system disclosed in Withenshaw also discloses that the provided water is contained in a mixing tank or other vessel. Withenshaw discloses that the batch make-up tank is fed with water along delivery pipe 2. (EX1006, 8:14-15.) Withenshaw's batch make-up tank is a “mixing tank.” (EX1006, 8:18-19.) Thus, either Withenshaw's batch make-up tank (a “mixing tank”) or delivery pipe 2 (“other vessel”) contains the water that is provided. (EX1003, ¶193; *see also* EX1006, 8:27-9:5)

Thus, Okano and Withenshaw, both individually and in combination, disclose a method for generating peracetic acid wherein the provided water is contained in a mixing tank or other vessel. (EX1003, ¶194.)

5. Claim 13: “The method of claim 1, wherein steps (a) through (e) are performed on a continuous basis.”

As explained above in Ground 1, Okano's method for generating PAA renders

claim 13 obvious. (See *supra*, Ground 1, Claim 13.)

The implementation of Okano's method for generating PAA from the preferred triacetin and hydrogen peroxide in combination with Withenshaw further discloses performing steps (a) through (e) on a continuous basis. (EX1003, ¶196.) Withenshaw explains its process is "for the continuous generation of peroxyacid." (EX1006, Abstract.) Withenshaw further discloses how the system of Figure 1 implements a continuous batch-fed or ongoing automated continuous process utilizing metering pumps and/or using control sensors. (EX1006, 8:13-9:19; EX1003, ¶196.)

It would have been obvious to a POSA to combine Okano's method for perform steps (a) through (e) of claim 1 using Withenshaw's disclosed continuous manufacturing system. (EX1003, ¶197.) Thus, claim 13 is obvious under the combination of Okano and Withenshaw.

6. Claim 14: "The method of claim 1, wherein steps (a) through (e) are performed on an intermittent basis."

As explained above in Ground 1, Okano's method for generating PAA renders claim 14 obvious. (See *supra*, Ground 1, Claim 14.) Withenshaw's ideally suited system for implementing Okano's PAA generating methods also renders this claim obvious. (EX1003, ¶199.)

Withenshaw discloses that the exemplary system can be implemented by

dosing the acetyl precursor and hydrogen peroxide into water within tank 1 intermittently in conjunction with fill cycles: “At the end of this fill cycle the level in tank 1 is at its maximum. Pump 13 empties tank 1 continuously and at a defined lower level of liquid in tank 1 the fill cycle starts again.” (EX1006 (Withenshaw), 9:4-7.) That is, Withenshaw discloses that the system can be operated on an intermittent basis by dosing tank 1 with the hydrogen peroxide and acetyl precursor components to given level (or amount) and then further processing those reagents into the downstream steps involving the in-line mixer on an as-needed basis. (EX1003, ¶200.)

Thus, a POSA would have understood and found obvious from the disclosures of Okano and Withenshaw a method for generating PAA that includes performing steps (a) through (e) of claim 1 on an intermittent basis. (EX1003, ¶201.) Thus, claim 14 is obvious under the combination of Okano and Withenshaw.

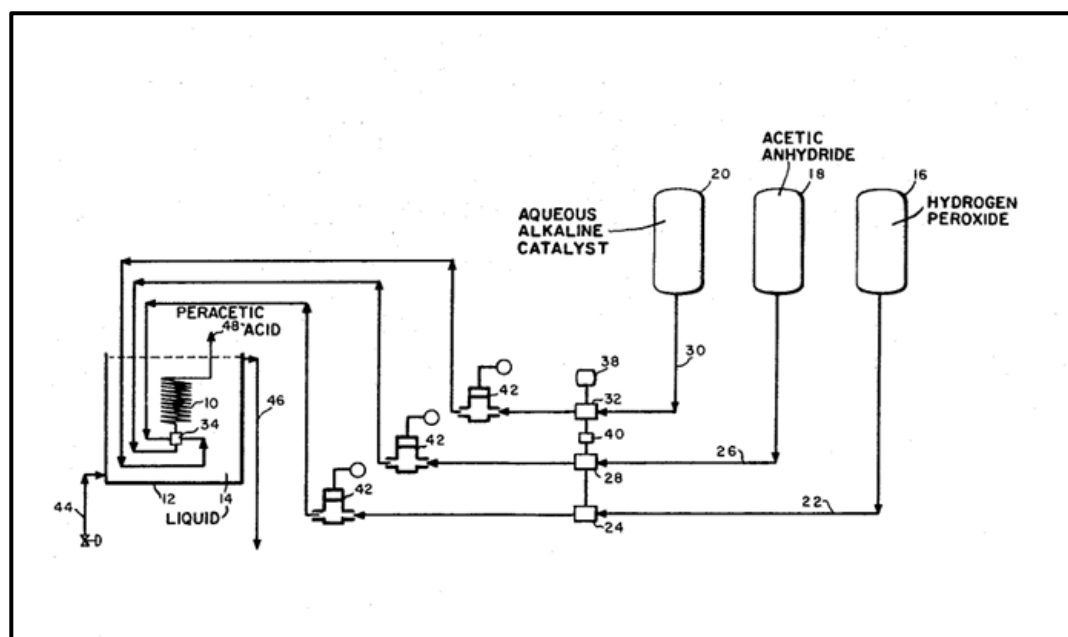
C. Ground 3: Claim 8 is Obvious in view of the Combination of Okano (Ground 1) and Oringer

1. Motivation to Combine and a Reasonable Expectation of Success

Both Okano and Oringer are directed to methods for efficiently producing peracids, including specifically peracetic acid. (*See, e.g.*, EX1005, [0006], [0057], [0059]; EX1007, Title (“Manufacture of Peracetic Acid”).) Like Okano, Oringer discloses a method of reacting hydrogen peroxide with an acetyl precursor under

alkaline conditions, such as sodium hydroxide. (*See, e.g.*, EX1007, Abstract (1:11-21), 4:49-51, 4:61-64.) Thus, Okano and Oringer are directed to the same narrow and interrelated field of methods for making solutions containing peracetic acid and a POSA would have been motivated to combine them together with a reasonable expectation of success. (EX1003, ¶202.)

Oringer discloses the use of a “mixer 34” that mixes the hydrogen peroxide, acetyl precursor, and alkaline catalyst in a continuous process using a tubular reactor for generating PAA. (EX1007, Abstract (1:11-21), 4:49-51, 4:61-64.) Oringer’s figure illustrates the process (EX1007, 5:21-24):



(EX1007, 5:21-67, Figure.)

Oringer’s figure discloses that reactants are fed into a tubular coiled reaction zone 10 from three feed tanks: tank 16 containing hydrogen peroxide; tank 18

containing the acetyl precursor acetic anhydride; and tank 20 containing the aqueous alkaline catalyst. (EX1007, 5:25-32.) The reactants are then fed into mixer 34 and blended into reaction zone 10 by metering pumps that maintain a predetermined ratio of feed of the reactants. (EX1007, 5:33-39.) Oringer further discloses that the system has a “magnetic clutch 40” (i.e., a control valve) to permit the aqueous hydrogen peroxide feed to be introduced alone into the reactor coil 10” in order to “flush[] the system” during “start-up and shut-down of the apparatus.” (EX1007, 5:41-49.)

A POSA would have recognized Oringer’s process to be well suited for generating PAA in combination with Okano’s methods teaching the use of triacetin, hydrogen peroxide, and an alkaline catalyst as a feed streams to be introduced into and mixed with water to generate an aqueous peracetic acid solution. (EX1003, ¶205.) A POSA would have been able to modify Oringer’s specifically described apparatus using only common skill and routine effort to implement Okano’s method. (*Id.*) A POSA would have made such a modification to Oringer’s apparatus by: (1) providing a feedstock of Okano’s triacetin as the acetyl precursor instead of Oringer’s acetic anhydride within tank 18 and (2) adding a water input to “mixer 34” to achieve Okano’s teaching in Example 1 that the triacetin and aqueous hydrogen peroxide “were mixed” with the water, such as using the control valve with a water feed to enable “flushing the system” of any of the reagents during start-up and shut-

down of the system. (*Id.*)

2. Claim 8: “The method of claim 1, wherein step (d) is performed simultaneously with step (b).”

The method of claim 1 is disclosed and taught by Okano as explained in Ground 1. (*See supra*, Ground 1, Claim 8.) Claim 8 requiring that “step (d) is performed simultaneously with step (b)” cannot be reconciled with the language of claim 1 that requires the steps to be performed in order. (*See* Section VII.A.)

However, Patent Owner contends that claim 1 does not require any order of steps. Although this interpretation of claim 1 is incorrect, Claim 8 would be obvious under the combination of Okano’s method for generating PAA using Oringer’s apparatus for the manufacture of PAA under Patent Owner’s interpretation of the claims. (EX1003, ¶207.)

Oringer’s method depicts an apparatus wherein each of the reagent feed streams for generating peracetic acid are simultaneously introduced into mixer 34. (EX1007, Figure, 5:25-48.) Implementing Okano’s method in a similar manner by simultaneously mixing the triacetin, hydrogen peroxide, water and alkaline catalyst (e.g., sodium hydroxide) would form a reaction medium that would generate PAA according to the method and apparatus taught in Oringer. (EX1003, ¶208.) Thus claim 8 of the ’997 patent would be obvious in view of the combination of Okano and Oringer under Patent Owner’s interpretation of the claims. (EX1003, ¶209.)

X. CONCLUSION

Claims 1–14 are unpatentable and should be canceled.

DATED: September 2, 2025

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CERTIFICATE OF COMPLIANCE WITH WORD COUNT

Pursuant to 37 C.F.R. §42.24(d), I certify that this petition complies with the type-volume limits of 37 C.F.R. §42.24(a)(1)(i) because it contains 13,251 words, according to the word-processing system used to prepare this petition, excluding the parts of this petition that are exempted by 37 C.F.R. §42.24(a) (including the table of contents, a table of authorities, mandatory notices, a certificate of service or this certificate word count, appendix of exhibits, and claim listings).

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CERTIFICATE OF SERVICE

I hereby certify, pursuant to 37 C.F.R. §§ 42.6 and 42.105, that a complete copy of the attached **PETITIONER'S POWER OF ATTORNEY** and related documents, are being served via Priority Mail Express® on September 2, 2025, the same day as the filing of the above-identified document in the United States Patent and Trademark Office/Patent Trial and Appeal Board, upon Patent Owner by serving the correspondence address of record with the USPTO as follows:

22827 - DORITY & MANNING, P.A.
c/o Timothy A. Cassidy
Post Office Box 1449
Greenville, SC 29602

And, via electronic mail upon counsel of record for the PO in the litigation pending before the U.S. District Court for the Western District of Texas captioned as *EnviroTech Chem. Servs., Inc. v. Clean Chemistry, Inc.*, Case No. 1:24-cv-1313-ADA (W.D. Tex.) as follows:

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