

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

VANTAGE SPECIALTY CHEMICALS, INC.,

Petitioner,

v.

CARGILL, INC.,

Patent Owner.

Case No. IPR2023-00589

U.S. Patent No. 11,248,245

**DECLARATION OF DAVID A. ROCKSTRAW, Ph.D., P.E., IN SUPPORT
OF VANTAGE SPECIALTY CHEMICALS, INC.'S PETITION FOR *INTER*
PARTES REVIEW OF U.S. PATENT NO. 11,248,245**

I. INTRODUCTION

1. My name is David A. Rockstraw, Ph. D., P.E.

2. I have been retained by Petitioner Vantage Specialty Chemicals, Inc. (“Petitioner”) as an independent expert consultant in connection with Petitioner’s petition for *inter partes* review of U.S. Patent No. 11,248,245 (Exhibit 1001), which I refer to in my declaration as “the ’245 patent.” I have been asked to focus on the following claims of the ’245 patent: claims 1, 2, 3, and 5.

3. I am over 21 years of age and otherwise competent to make this declaration.

4. Although I am being compensated for my time at my normal rate in preparing this declaration, the opinions herein are my own, and I have no stake in the outcome of the *inter partes* review proceeding.

5. I am not an employee of Petitioner or any affiliate or subsidiary thereof.

6. This declaration summarizes the opinions I have formed to date. I reserve the right to modify my opinions, if necessary, based on further review and analysis of information that I receive subsequent to the filing of this report, including in response to positions that parties to the *inter partes* review proceeding, or their experts, may take that I have not yet seen.

II. MY EXPERIENCE AND QUALIFICATIONS

7. I obtained my Ph. D. in Chemical Engineering from The University of Oklahoma in 1989. Prior to that, I received a Bachelor of Science in Chemical Engineering from Purdue University in 1986.

8. I am a Fellow of the American Institute of Chemical Engineers (“AIChE”), and a former National Director of the National Society of Professional Engineers (“NSPE”), also receiving the 2009 Engineering Education Excellence Award from NSPE. I am a registered Professional Engineer in the States of Texas and New Mexico.

9. I have over 40 years of experience working in the chemical processing industries, academia, government laboratories, and private practice as a consultant and research and development (“R&D”) engineer. My diverse background of experience includes commodity chemicals; energy; water; petrochemicals; pharmaceuticals; agricultural chemicals; fluorochemicals; monomers, polymers and plastics; plutonium processing; membrane/electromembrane processes; process safety and chemical hygiene; biofuels; and processed foods.

10. I am recently retired from New Mexico State University (“NMSU”), where I served as Academic Department Head of the Department of Chemical & Materials Engineering, Robert Davis Distinguished Professor, and was Distinguished Achievement Professor. My former research areas included, but were

not limited to, lithium isotope separation by high-speed countercurrent chromatography; plastic pyrolysis to liquid fuels; additive manufacture of mechanoluminescent materials; core and shell nanoparticle synthesis by ultrasonic aerosol formation; activated carbon synthesis, characterization, and application; and manufacture of ethanol from transgenic alfalfa.

11. At NMSU, I taught both graduate and undergraduate level courses. In those classes, I taught students chemical process design and economic evaluation; chemical plant design; advanced process simulation; chemical kinetics and reaction engineering; equilibrium-staged separations; chemical process design and simulation, and economic evaluation; transport phenomena; and fundamentals of material and energy balances.

12. In addition to my professional experience as a university professor, I also have a decade of R&D experience at companies and research institutes, including DuPont de Nemours, Inc., Conoco Inc., Ethyl Corp., Kraft Inc., and Los Alamos National Laboratory.

13. At DuPont, I was a lead process research engineer for a multiple-step process to manufacture methyl 3-hydroxy-2-thiophenecarboxylate, an intermediate to the active compound in a dry flowable herbicide formulation. I also led the research effort to pilot DuPont's first commercial hydrofluorocarbon product, HFC-134a, which included both catalytic and non-catalytic technologies. I further helped,

among others, with design, construction, and operation of DuPont's pilot systems simulating modifications to the commercial operations of a spunbound polyethylene process and a polyester-polyurethane copolymer depolymerization facility.

14. I was also a visiting scientist at Los Alamos National Laboratory. There, I was responsible for the measurement and prediction of stability constants in the laboratory's complex nuclear materials systems and research into the modification of crystal habit reducing liquid pressure drop across accumulating cakes, thereby improving processing efficiency of plutonium waste water.

15. Furthermore, I serve and have served as a technical consultant for multiple domestic and international companies. For example, in 2021, I began consulting with BDO USA, LLP, as technical consultant on a team of investigators working to resolve a true-up dispute between Dow Inc. and DuPont. Also, in 2021, I provided consultation to Colbeck Capital Management on the viability of a biodiesel process and the related analytical standards. In 2018, I provided a technology evaluation for Jatro Renewables, Inc., concerning their new supercritical biodiesel manufacture process. In 2015, I provided consultation on redesign of Entegris, Inc.'s MegaVap metallic vapor feed system. Since 2011, I have been providing technical consultation to Waste2Fuel on a process to convert plastic into liquid fuels. More of my consulting experience can be found in my current Curriculum Vitae (Appendix A hereto).

16. I am a named inventor on three United States patents, all of which are listed in my Curriculum Vitae.

17. I have authored or co-authored over 80 peer-reviewed articles and conference papers. My publications have been cited over 1,000 times. A list of those publications is included in my Curriculum Vitae. I apprise myself of developments in the chemical process control area by reviewing industry trade publications and continuing to perform independent research.

18. I have received numerous awards and honors for my work. In addition to those mentioned above, I have also received:

- Frank Bromilow Award for Teaching Excellence, 2016
- NMSU Roush Teaching Award, 2014
- NMSU Environmental Health & Safety “Friend of Safety” Award, 2014
- Ed and Harold Foreman Engineering Education Excellence Award, 2012
- National Society of Professional Engineers, Professional Engineers in Higher Education Engineering Education Excellence Award, 2009
- E-Council Outstanding Engineering Professor Award, 2008
- AspenTech® Educational Innovation Award, 2004
- Outstanding Faculty Member, voted by the 2001 CH E graduating class
- Research Grand Prize, American Academy Environmental Engineers, 1998
- Level II DuPont Safety Sentinel Award, 1995
- DuPont Partnering Recognition for Suva® HFC development: 1992, 1991.

19. In forming the opinions expressed in this declaration, I have used my education and experience researching, publishing and working in the field of chemical processing, in particular the specialty chemicals industry, academia, government laboratories, and as an independent consultant, and my understanding of the knowledge, creativity, and experience of a person having ordinary skill in the chemical arts, to which the '245 patent relates, as well as any other materials discussed herein.

III. MATERIALS CONSIDERED

20. In forming my opinions, I read and considered the '245 patent and its prosecution history, the exhibits listed below (which I understand have been included as part of the petition for *inter partes* review), as well as other materials referenced herein. The exhibits I have analyzed include:¹

No.	Document
1001	U.S. Patent No. 11,248,245
1002	File History for U.S. Patent No. 11,248,245
1004	Melanie Cummings et al., <i>A natural alternative</i> , SOAP, PERFUMERY, AND COSMETICS (SPC) ASIA (May 1, 1999) <i>available at</i> https://www.floratech.com/PDFs/Articles_MKT/ART15.pdf (“Cummings”)

¹ Exhibit 1003 is my declaration.

No.	Document
1005	James Brown & Robert Kleinman, <i>Trans Isomers in Cosmetics</i> , SOAP & COSMETICS at 33 (May 2001) (“ <i>Trans Isomers 1</i> ”)
1006	James Brown & Robert Kleinman, <i>Trans Isomers in Cosmetics Part 2</i> , SOAP & COSMETICS at 44 (June 2001) (“ <i>Trans Isomers 2</i> ”)
1007	U.S. Patent No. RE38,141E1 to Brown et al. (“Brown”)
1008	Xuebing Xu, <i>Engineering of enzymatic reactions and reactors for lipid modification and synthesis</i> , 105 EUR. J. LIPID SCI TECH. 289 (2003) (“Xu”)
1009	David J. Sessa, <i>Derivation of a Cocoa Butter Equivalent from Jojoba Transesterified Ester via a Differential Scanning Calorimetry Index</i> , 72 J. SCI. FOOD AGRI. 295 (1996) (“Sessa”)
1010	U.S. Patent No. 5,968,530 to Arquette et al. (“Arquette”)
1011	U.S. Patent No. 6,280,746 to Arquette et al. (“the ’746 patent”)
1012	Barbara Fitch Haumann, <i>Tools: hydrogenation, interesterification</i> , 5 INFORM 668 (Jun. 1994)
1013	Otero et al., <i>Continuous Enzymatic Transesterification of Sesame Oil and a Fully Hydrogenated Fat: Effects of Reaction Conditions on Product Characteristics</i> , 94 BIOTECH. & BIOENG’G 877 (2006)
1014	James Brown & Robert Kleinman, <i>Trans Isomers in Cosmetics Parts 1 and 2</i> , Reprinted from SOAP & COSMETICS (May & June 2001) available at https://www.floratech.com/PDFs/Articles_MKT/ART17.pdf
1015	U.S. Patent App. Pub. No. 2005/0176597 to Kodali & Nivens
1016	U.S. Patent App. Pub. No. 2004/0208904 to Touitou & Bergelson

No.	Document
1017	X. Xu et al., <i>Chemical and enzymatic interesterification of lipids for use in food</i> , in <i>Modifying lipids for use in food</i> 234 (Frank D. Gunstone, ed., 2006)
1018	Arnaldo Lopez-Hernandez et al., <i>Lipase-catalyzed Transesterification of Medium-chain Triacylglycerols and a Fully Hydrogenated Soybean Oil</i> , 70 J. FOOD SCI. C365 (Jul. 13, 2005)
1020	Complaint (Dkt No. 1) filed in <i>Cargill, Inc. v. Vantage Specialty Chemicals, Inc.</i> , No. 1:22-cv-00979-RGA-SRF (D. Del. July 26, 2022)
1023	T. Haryati et al., <i>Determination of Iodine Value of Palm Oil Based on Triglyceride Composition</i> , 75 J. AM. OIL CHEMISTS' SOC. 789 (1998)
1024	ASTM Int'l, ASTM D5554-95 Standard Test Method for Determination of the Iodine Value of Fats and Oils (Reapproved 2006)
1025	Am. Oil Chemists' Soc., <i>AOCS Recommended Practice Cd 1c-85</i> (Reapproved 2009), in Am. Oil Chemists' Soc., <i>Official Methods and Recommended Practices of the AOCS</i> (David Firestone, ed., 2013)
1026	Excerpt of Richard O'Brien, <i>Fats and Oils: Formulating and Processing for Applications</i> (CRC Press 3rd Ed. 2008)
1027	Excerpt of <i>Physical and Chemical Characteristics of Oils, Fats, and Waxes</i> (AOCS Press, David Firestone, ed., 3rd ed. 2013).
1028	Cosmetic Ingredient Review, <i>Final Report of the Cosmetic Ingredient Review Panel: Safety Assessment of Simmondsia Chinensis (Jojoba) Seed Oil, Simmondsia Chinensis (Jojoba) Seed Wax, Hydrogenated Jojoba Oil, Hydrolyzed Jojoba Esters, Isomerized Jojoba Oil, Jojoba Esters, Simmondsia Chinensis(Jojoba) Butter, Jojoba Alcohol, and Synthetic</i>

No.	Document
	<i>Jojoba Oil</i> (Sept. 23, 2008) available at https://www.cir-safety.org/ingredient/simmondsia-chinensis-jojoba-seed-oil
1029	Junzo Otera, <i>Transesterification</i> , 93 CHEM. REV. 1449 (1993)
1030	Ramesh Chandra Gupta & Gulab Kanwar, <i>Determination of Iodine Numbers of Edible Oils</i> , 22 Biomedical Education 47 (1994)

21. For any future testimony I may give in this matter, I may use some or all of the documents and information cited to, referred to, and identified in this declaration, as well as any additional materials that are entered into evidence in this matter.

IV. LEGAL PRINCIPLES OF OBVIOUSNESS

22. I have been informed and I understand that a patent claim is unpatentable and invalid if the subject matter of the claim as a whole would have been obvious to a person of ordinary skill in the art in the field of the patent as of the time of the invention at issue. I have been informed and understand that the following factors must be evaluated to determine whether the claimed subject matter is obvious: (i) the scope and content of the prior art; (ii) the difference or differences, if any, between each claim of the patent and the prior art; (iii) the level of ordinary skill in the art at the time the patent was filed; and (iv) any objective indicia of non-obviousness in evidence.

23. I have been informed and I understand that the objective indicia of non-obviousness (or “secondary considerations”) that should be considered include, for example, the following: (i) commercial success; (ii) long-felt but unresolved needs; (iii) copying of the invention by others in the field; (iv) initial expressions of disbelief by experts in the field; (v) failure of others to solve the problem that the inventor solved; and (vi) unexpected results. I have been informed and understand that evidence of these objective indicia must be commensurate in scope with the claimed subject matter. I am not aware of any objective indicia of non-obviousness relevant to the claims of the ’245 patent.

24. With respect to secondary considerations, I note that, although applicants for the ’245 patent told the Patent Office that increased OSI (discussed at length below) is an unexpected result of transesterifying jojoba wax esters and hydrogenated jojoba wax esters using a lipase, that is not true, in my opinion.

25. For example, Cummings discloses that its transesterified product, “[j]ojoba esters[,] demonstrate remarkable stability with OSI values of all jojoba esters greater than 100 hours and as high as 675 hours”; this is significantly greater than the OSI of the refined jojoba oil that forms part of the feedstock, which “is around 35 hours.” Ex. 1004, 2; *see* Ex. 1004, 1-2 (“The structure of all jojoba esters is different from its starting material—jojoba oil. It is these compositional differences within the family of jojoba esters that create their expanded utility in

cosmetic preparations[,]" including oxidative stability). As another example, *Trans Isomers 2* discloses in Table 4 that the OSI of jojoba esters is greater than the OSI of partially hydrogenated jojoba oils exhibiting identical melting points. Ex. 1006, 4, Table 4; Ex. 1014, 6-8, Table 4. Specifically, the "Jojoba Esters 30" and "Jojoba Esters 60" had OSIs of 165 and 225, respectively, which were significantly greater than the OSIs of the partially hydrogenated jojoba oils exhibiting identical melting points, which were 27 and 108 hours, respectively. Ex. 1006, 4, Table 4; Ex. 1014, 6-8, Table 4.

26. It was, in fact, well-known that the transesterification of fats, oils, and waxes—including in lipase-catalyzed processes and processes involving jojoba wax esters and hydrogenated jojoba wax esters—can produce a product having improved, and thus greater, oxidative stability. *See, e.g.*, Ex. 1015, [0005] ("Transesterifying various short saturated fatty acid esters with a vegetable oil improves oxidative stability and low temperature properties due to the increased saturation and the heterogeneity of the fatty acids esterified to the polyols."); Ex. 1016, [0031] ("Jojoba Esters' is a complex mixture of esters produced by the transesterification of jojoba oil, hydrogenated jojoba oil, or a mixture of the tw[o] with organic alcohols. Jojoba esters are produced in a broad range of melting points and are colorless, odorless and extremely resistant to oxidative degradation. Jojoba esters are useful as components of highly pigmented cosmetic systems."); Ex. 1017, 245

(“The margarines produced from enzymatically interesterified fats generally had much lower peroxide values compared to the margarine produced from chemically randomized fats stored at 25 °C. . . . A similar observation was also apparent in a pure oil system. . . . This confirms that enzymatic interesterification has advantages for the oxidative stability of the products.”); Ex. 1018, C371 (“Structured lipids [(SL)] containing different levels of MCT [(medium-chain TAG (triacylglycerides))] were produced by lipase-catalyzed interesterification reactions. . . . The SL generated in these experiments contain only saturated fatty acid residues. . . . The absence of unsaturated fatty acids residues implies that the products of the synthesis reaction have enhanced stability with regard to oxidation processes.”).

27. I have also been informed and I understand that independently made, simultaneous inventions, made within a comparatively short space of time, are evidence that the claimed apparatus was the product only of ordinary mechanical or engineering skill.

28. Further, in determining whether the subject matter as a whole would have been obvious at the time that the invention was made to a person having ordinary skill in the art, I have been informed of and understand certain principles regarding the combination of elements of the prior art. A combination of familiar elements according to known methods is likely to be obvious when it yields predictable results. Also, if a person of ordinary skill in the art can implement a

predictable variation in a prior art device, and would see the benefit from doing so, such a variation would be obvious. In particular, when there is pressure to solve a problem and there are a finite number of identifiable, predictable solutions, it would be reasonable for a person of ordinary skill to pursue those options that fall within his or her technical grasp. If such a process leads to the claimed invention, then it is not a patentable invention, but the result of ordinary skill and common sense.

29. I have also been informed and understand that a teaching, suggestion or motivation is a useful guide in establishing a rationale for combining elements of the prior art. The test poses the question as to whether there is an explicit teaching, suggestion, or motivation in the prior art to combine prior art elements in a way that realizes the claimed invention. Though useful to the obviousness inquiry, I understand that this test should not be treated as a rigid rule. It is not necessary to seek out precise teachings; it is permissible to consider the inferences and creative steps that a person of ordinary skill in the art (who is considered to have an ordinary level of creativity and is not an automaton) would employ.

V. LEVEL OF ORDINARY SKILL IN THE ART

30. I have been informed and understand that the disclosure of patents and prior art references are to be viewed from the perspective of a person having ordinary skill in the art at the time of the alleged invention. I have been told I may use the shorthand “POSITA” to describe this person. I have provided my opinions from this

perspective. I understand that the relevant time period is around December 2014, the filing date of the application leading to the '245 patent.

31. I have been informed and understand that prior art references can provide evidence of the level of ordinary skill in the art, and that factors that may be considered in determining this level of skill can include the educational level of the inventors and active workers in the field, the types of problems encountered in the art, the prior art solutions to those problems, the rapidity with which innovations are made, and the sophistication of the technology.

32. Based on my education and experience, as described above and in my CV, as well as consistent with the '245 patent and the prior art described below, it is my opinion that those of ordinary skill in the art during the relevant period would have had at least a B.S. in Chemical Engineering, Chemistry, or a related field, and three years of experience working in the specialty chemicals industry. However, I note that this description is approximate, and a higher level of education or skill might make up for less experience, and additional experience could make up for a lower education level; for example, an M.S. in the above field or related field, and two years' experience would qualify as a person of ordinary skill, in my opinion.

VI. SUMMARY OF THE '245 PATENT

33. The '245 patent is entitled "Processes and Systems for Catalytic Manufacture of Wax Ester Derivatives," and issued from U.S. Patent Application

No. 14/578,075 (“the ’075 application”), which was filed on December 19, 2014.
Ex. 1001, Cover Page.

34. The ’245 patent describes transesterification processes. The basic disclosed and claimed process includes “providing a feedstock including wax esters, contacting the feedstock with a lipase, and catalytically transesterifying the wax esters in the feedstock with the lipase to form a transesterified product. An oxidative stability index (OSI) of the transesterified product may be greater than an OSI of the feedstock.” Ex. 1001, Abstract, 1:22-28.

35. The ’245 patent states that “[t]ransesterification for naturally occurring or structured or synthetic esters permits altering of various physical properties of the transesterified product when compared to the original feedstock[,]” including “oil (oxidative) stability index (OSI).” Ex. 1001, 3:38-46. “These changes take place at least in part because the chain lengths of the resulting ester products are randomized compared to the distribution in the original wax ester feedstock, which may alter the functionality of the transesterified material in a mixture and/or the thermal properties of the material.” Ex. 1001, 3:46-51.

36. The ’245 patent confirms that the use of chemical catalysis was well-known in the art for transesterifying wax esters, including jojoba oil; however, such processes were also known to lead to undesirable results. For example, the ’245 patent states that “[m]ethods and systems for transesterifying jojoba oil that include

the use of acidic bentonite-type clay at temperatures between 150C-350C” were disclosed in U.S. Patent No. 4,329,298, which issued on May 11, 1982, and U.S. Patent No. 4,360,387, which issued on November 3, 1982. Ex. 1001, 3:52-63. The patent continues: “Other conventional transesterification reactions use a chemical catalyst, such as sodium methylate (methoxide) or sodium hydroxide.” Ex. 1001, 3:63-4:1.

37. The '245 patent confirms that these well-known and conventional methods, employing chemical catalysis, were known to result in a “5%-10% loss of the original jojoba oil” and “side reactions [that] create byproducts that reduce the yield of the process and alter the properties of the transesterified product.” Ex. 1001, 4:1-6. According to the patent, “Some of the property changes occur because of the damage/changes to the feedstock esters caused by the high temperatures (100C-230C) and low pressures (<7 mmHg) required to carry out” these reactions. Ex. 1001, 4:6-10. Other property changes occurred “because these conditions and/or the chemical catalysts themselves degrade, destroy, or reduce the effectiveness of other subcomponents of the wax ester feedstock” or “the transesterified product may include artifacts of these components which are undesirable or have undesirable effects in the product or subsequent mixtures that include the product.” Ex. 1001, 4:11-25. The '245 patent further notes that “[c]hemically catalyzed transesterification of wax esters is carried out in a batch reactor, and the catalyst

cannot, accordingly, be recovered for reuse from the transesterification product.”

Ex. 1001, 4:26-29.

38. The '245 patent further states that it was known that these conventional methods result in “side reactions [that] form various fatty acid methyl esters and leave various free fatty alcohols when sodium methoxide is used,” which may result in the “transesterified product stream . . . includ[ing] 5% or less by weight of these fatty acid methyl esters, which may function as an emollient, and the free fatty alcohols, which may function as an emollient and viscosity controller.” Ex. 1001, 7:24-33. Also, “the reaction of the chemical catalyst removes or degrades the . . . tocopherols . . . in the jojoba oil,” which “changes the functionality and physical properties of the transesterified product stream.” Ex. 1001, 7:33-38. “In particular, the degradation and/or removal of the tocopherols and other naturally occurring antioxidants reduces the OSI of the transesterified product to below the OSI of the original jojoba oil.” Ex. 1001, 7:38-42.

39. The '245 patent states that enzymatically transesterified processes do not generate the undesirable results observed in chemically transesterified processes. In Table 1, which I have reproduced below, the '245 patent compares “process parameters and some characteristics of the transesterified product stream” processes using both chemical and enzymatic catalysts. Ex. 1001, 7:49-63.

TABLE 1

Process Parameter	Chemical Catalyst	Enzymatic Catalyst
Reaction Temperature	100 C.-230 C.	10 C.-70 C.
Reaction Pressure	<7 mm Hg	760 mm Hg (ambient)
Product Color	Increased (changes color)	No changes
Soap Formation	Yes	No change
Transester- ification Yield	85%-95%	>98%

40. Further, in Table 2, which I have reproduced below, the '245 patent “shows [the] observed effect of the chemically catalyzed process and various enzymatically catalyzed processes on the various naturally present components in jojoba oil as well as side reaction byproducts.” Ex. 1001, 7:64-8:19.

TABLE 2

Transesterified Product Component	Skin Care Formula Function	Chemical Catalyst	Enzyme Catalyst
Steryl Esters	Skin Conditioning Agent	Removed/Degraded	Functionally Unaffected
Sterols	Skin Conditioning Agent	Removed/Degraded	Functionally Unaffected
Tocopherols	Antioxidant	Removed/Degraded	Functionally Unaffected
Hydrocarbons	Skin Conditioning Agent	Removed/Degraded	Unchanged
Fatty Acid Methyl Esters	Emollient	Formed, <5%	Not formed
Free Fatty Alcohols	Emollient, Viscosity Controller	Formed, <5%	Not formed
Volatile Ingredients	Sensory Attributes	Removed/Degraded	Functionally Unaffected

41. Relating to these tables, the '245 patent recites that enzymatically catalyzed processes “proceed[] without removing/degrading the tocopherols or volatiles naturally contained in the jojoba oil.” Ex. 1001, 8:23-8:25.

42. The '245 patent does not specifically discuss, or link with any technical explanation, the effect of the claimed 20% to 50% by weight of hydrogenated jojoba wax esters in the feedstock on the OSI of the transesterified product, which suggests to a POSITA that the claimed range is not critical to the claimed effect on OSI.

43. For example, the '245 patent includes an Example 3 discussing feedstocks containing jojoba wax esters and 0%, 20%, 30% and 50% by weight of hydrogenated jojoba wax esters that were enzymatically transesterified with a lipase, but its discussion is limited to comparing the yield and/or components of the resulting transesterified product, not its oxidative stability. Ex. 1001, 12:25-14:2.

44. As another example, the '245 patent in Figures 4 to 7, which I reproduced below, are graphs that compare “wax ester distributions of chemically catalyzed and enzymatically catalyzed transesterified jojoba wax esters” for feedstock containing pure jojoba wax ester and feedstocks containing 20%, 30%, and 50% hydrogenated jojoba wax ester, and notes that “the two differences between the two processes may contribute in part to the differences in functional performance and physical properties of the enzymatically catalyzed processed material from the chemically catalyzed material.” Ex. 1001, 14:3-23, Figs. 4-7. However, I note that the '245 patent does not actually compare the “functional performance and physical properties of the enzymatically catalyzed processed material” with each other. *See generally* Ex. 1001.

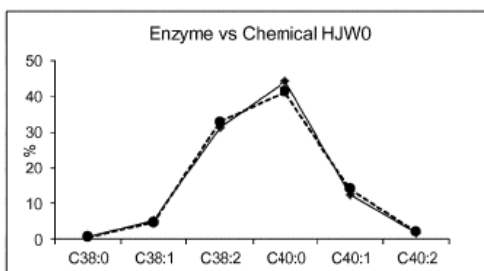


FIG. 4

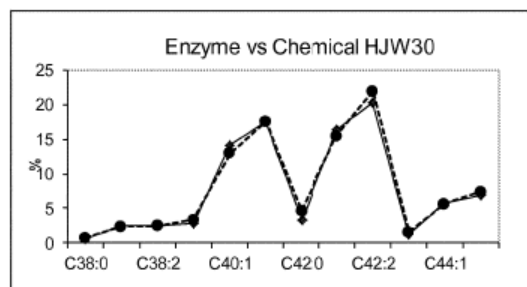


FIG. 6

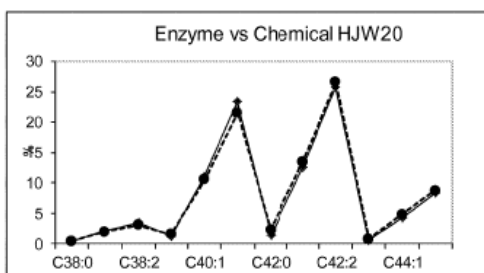


FIG. 5

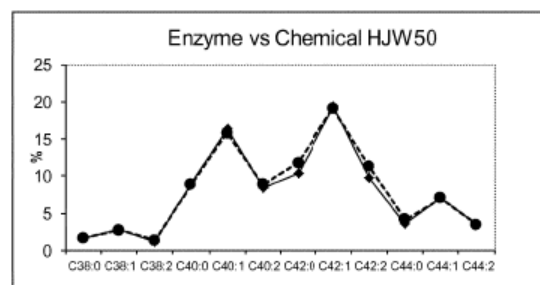


FIG. 7

VII. CLAIM CONSTRUCTION

45. I have been informed and understand that the United States Patent and Trademark Office interprets claim terms in an *inter partes* review proceeding under the same claim construction standard that is used in a United States federal court. I understand that, under this standard, the meaning of claim terms is considered from the viewpoint of a POSITA at the time of the alleged invention.

46. I have been informed and understand that claim terms are generally given their plain and ordinary meaning as understood by one of ordinary skill in the art in light of the specification and the prosecution history pertaining to the patent. I have been informed and understand, however, that claim terms are generally not limited by the embodiments described in the specification.

47. I have been informed and understand that, in addition to the claims, specification, and prosecution history, other evidence may be considered to ascertain the meaning of claim terms, including textbooks, encyclopedias, articles, and dictionaries. I have been informed and understand that this other evidence is often less significant and less reliable than the claims, specification, and prosecution history.

48. In comparing the claims of the '245 patent to the prior art, I have carefully considered the '245 patent and its file history based upon my experience and knowledge in the relevant field (discussed in Section II above and in my CV, attached to my declaration). As relevant to determining the validity of the claims of the '245 patent in this proceeding, the proper interpretation of the claim terms of the '245 patent is generally consistent with the terms' plain and ordinary meaning, as a POSITA would have understood them, as of the time of the invention of the '245 patent.

VIII. OVERVIEW OF THE STATE OF THE ART

49. All of the claimed steps of claims 1, 2, 3, and 5 were known in the prior art.

50. As evidenced by the prior art and state of the art discussed in this Section VIII and below in Section IX, it was well known and commonplace to a POSITA prior to the '245 patent that: wax esters and their hydrogenated analogs

could be transesterified by enzymatic catalysis (*i.e.*, with a lipase); that the physical properties of the transesterified product could be controlled by varying the ratio of the wax esters relative to the hydrogenated wax esters; and that oxidative stability could be improved through transesterification.

51. As I discuss further in this Section VIII and in Section IX below, transesterification—also referred to as interesterification—is a common class of chemical reactions employed in many sectors of the chemical process industry that has been both understood and practiced for decades. *See generally* Ex. 1008; Ex. 1012; 1017; Ex. 1029. Likewise, the many materials useful for catalyzing transesterification reactions (including lipases, a type of enzyme) have also been studied and their performance documented. *See generally* Ex. 1008; Ex. 1012; Ex. 1017; Ex. 1029. Finally, knowledge to design chemical reaction systems for the purpose of creating a product with desired physical properties, such as increased stability, specific melting point ranges, or other characteristics that may be important to the product, is inherent to the training of a POSITA.

1. Cummings

52. “A natural alternative,” was authored by Cummings, et al. and published in SOAP, PERFUMERY AND COSMETICS (SPC) ASIA in May 1999. Ex. 1004. I am informed that Cummings is prior art under at least AIA 35 U.S.C. § 102(a)(1).

53. Cummings explains, “the jojoba plant bears a peanut sized, dark chestnut coloured seed containing a unique oil that is chemically a liquid wax ester Jojoba oil is oxidatively stable and a popular cosmetic ingredient known for its non-greasy skin feel.” Ex. 1004, 1. Cummings further states, “[w]hile jojoba oil has unique and beneficial cosmetic properties its utility has been broadened significantly by using it as the base material of a new family of jojoba esters.” Ex. 1004, 1.

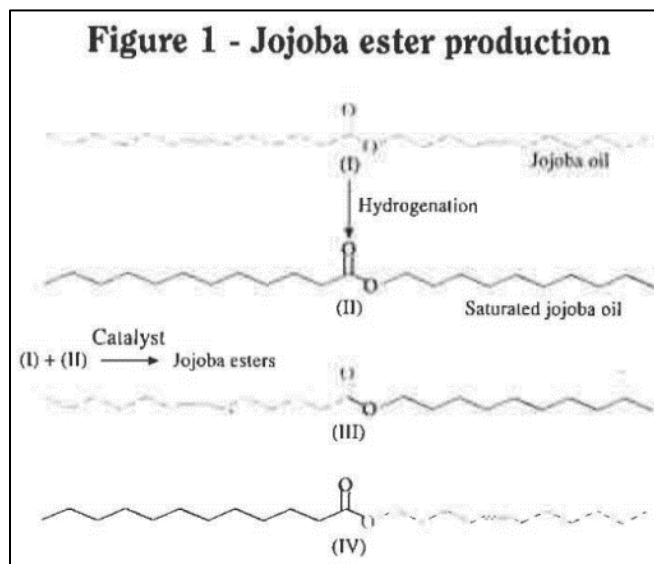
54. Cummings states, “jojoba esters are a new category of naturally derived, oil free emollients that offer good properties for a wide range of cosmetic products” and are “a new creation of oxidatively stable, plant-derived, oil-free emollients shown to be non-toxic, non-comedogenic, hypoallergenic, and biodegradeable.” Ex. 1004, 1-2.

55. Cummings in Figure 3, shown below, identifies various physical properties of jojoba esters, *see* Ex. 1004, 1, Figure 3:

Figure 3 - Jojoba ester differences				
Product	Melting point °C AOCS Cc 18-80	Iodine value g/100g AOCS Cd 1-25	Visual appearance	Colour AOCS Cc 13e-92
Jojoba esters (15)	10 - 15	78 - 85	Clear, colourless liquid	< 1.5 Red
Jojoba esters (20)	42 - 48	64 - 70	White, creamy paste	< 1.0 Red
Jojoba Esters (30)	47 - 51	57 - 61	White, soft paste	< 1.0 Red
Jojoba Esters (60)	56 - 61	40 - 44	White, firm paste	< 1.0 Red
Jojoba esters (70)	66 - 70	< 2	White crystalline powder	< 1.0 Red

56. Cummings continues to explain that “[j]ojoba oil is converted to jojoba esters through a process known as interesterification. In this process, different ratios

of unsaturated jojoba oil are combined with fully saturated jojoba oil and then interesterified. The process results in jojoba esters engineered to deliver specific physical, functional and chemical characteristics.” Ex. 1004, 2. Cummings, Ex. 1004, Fig. 1, illustrates the interesterification reaction in Figure 1:



57. Cummings states, “[i]nteresterification produces jojoba esters engineered to contain different ratios of molecules with either no double bonds (fully saturated), one double bond (monounsaturated) or two double bonds (fully unsaturated). [] It is these compositional differences within the family of jojoba esters that create their expanded utility in cosmetic preparation.” Ex. 1004, 2.

58. Cummings further explains, “[j]ojoba esters have demonstrated the capability to improve cosmetic, functional and structural properties of a broad array of personal products. They have shown distinctive utility in highly pigmented systems where emolliency and oxidative stability is sometimes lacking due to high

levels of particulate loading.” Ex. 1004, 1. Specifically, “Jojoba esters demonstrate remarkable stability with [Oxidative Stability Index (OSI)] values of all jojoba esters greater than 100 hours and as high as 675 hours. The OSI of refined jojoba oil is around 35 hours.” Ex. 1004, 2.

2. *Trans* Isomers 1

59. *Trans* Isomers 1, entitled “*Trans* Isomers in Cosmetics” was published in SOAP & COSMETICS in May 2001. Ex. 1005. *Trans* Isomers I is part of a two-part series, with the second article referred to as *Trans* Isomers 2, which I discuss in further detail below. See Ex. 1006, 1 and 6; Ex. 1014, 3 and 5. I am informed that *Trans* Isomers 1 is prior art under at least AIA 35 U.S.C. § 102(a)(1). The ’245 patent references *Trans* Isomers 1 as containing “background information on the structure, use, and of transesterification reaction using hydrogenated jojoba wax esters.” Ex. 1001, 12:34-39. I am informed that, as a result, *Trans* Isomers 1 is applicant-admitted prior art.

60. *Trans* Isomers 1 teaches: “[c]osmetic chemists may soon be called upon to identify the *trans* isomer content of their brand’s formulations and to certify that their products are ‘*Trans* Free.’ The impetus behind the movement is in part due to consumer concerns that *trans* fatty acids are not healthful in their diets and will be undesirable to use on their body as well.” Ex. 1014, 2; Ex. 1005, 1.

The challenge of cosmetic ingredient suppliers is therefore to provide manufacturers with oxidatively stable and affordable lipid based

emollients that exhibit a broad range of melting points yet which contain no *trans* fatty isomers. Oil phase emollients with these desirable characteristics can be obtained without the formation of *trans* isomers through a process known as ‘interesterification.’ Rozenaal [] discussed use of this interesterification process to modify the melting characteristics of triglycerides using various catalysts including enzymes. Another paper by Haumann [] points out that the interesterification process may be a means of addressing the growing consumer concern for *trans* fatty acids.

Ex. 1014, 3; Ex. 1005, 3.

61. *Trans* Isomers 1 continues, “[f]ully hydrogenated lipid materials contain neither *cis* nor *trans* fatty acid isomers.... Fully hydrogenated forms are...the most oxidatively stable of all possible chemical structures of lipids. Fully hydrogenated jojoba oil (melting point 68-70°C) contains neither *cis* nor *trans* isomers (there are no remaining double bonds in the molecule)....” Ex. 1014, 3; Ex. 1005, 2.

62. *Trans* Isomers 1 presents the following definition of the term *interesterification*: “[t]he catalyzed chemical reaction between two or more esters in which the acids and alcohols present are recombined in a random manner, also known as transesterification. This reaction does not alter the double bond geometry of unsaturated compounds, i.e., no *trans* isomers are formed as a result of interesterification reactions.” Ex. 1014, 4; Ex. 1005, 4.

3. *Trans* Isomers 2

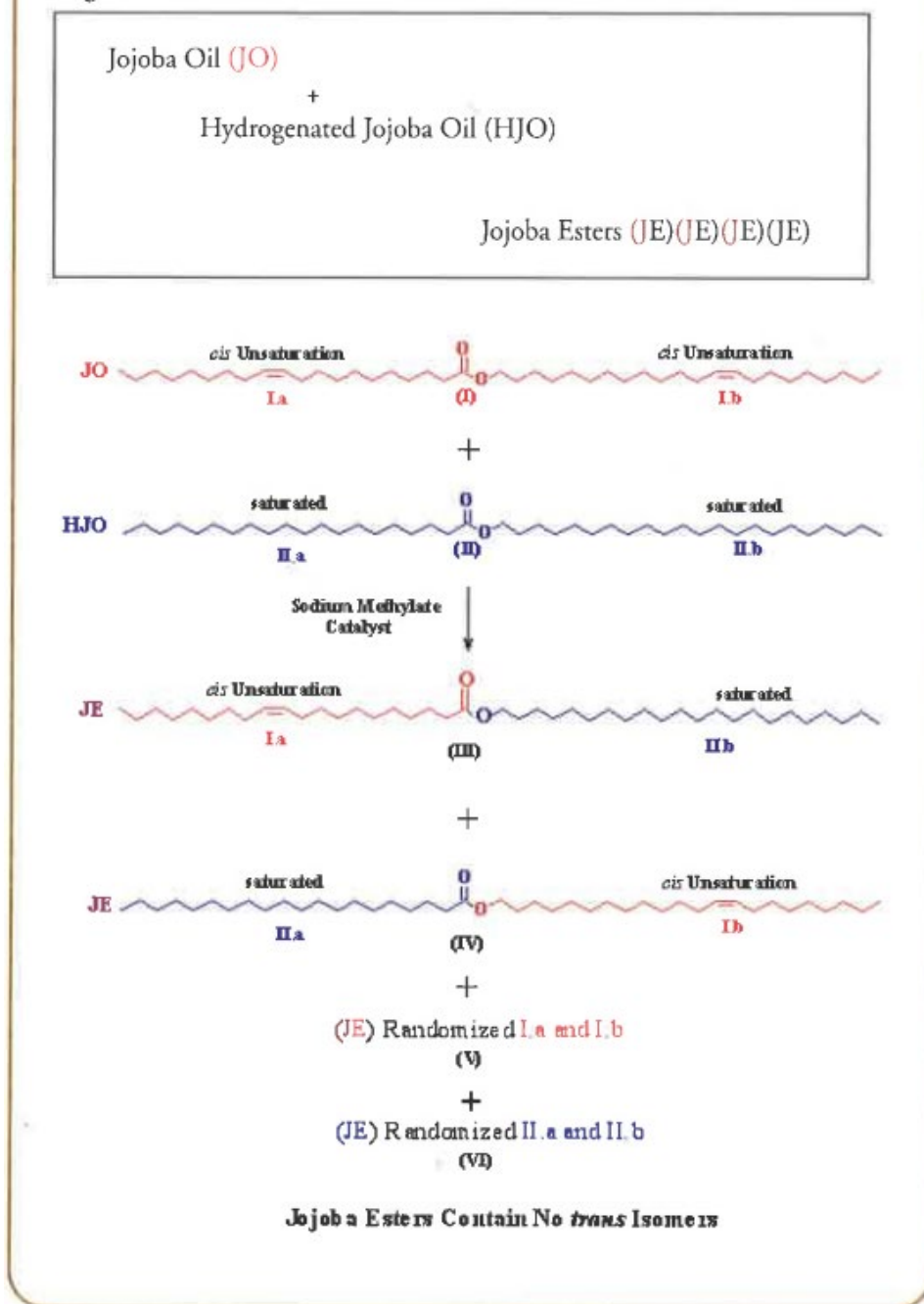
63. *Trans* Isomers 2, entitled “*Trans* Isomers in Cosmetics, Part 2” was published in SOAP & COSMETICS in June 2001. Ex. 1006. *Trans* Isomers 2 is part two of the two-part series with *Trans* Isomers 1. See Ex. 1006, 1, 6; Ex. 1014, 3, 5. I am informed that *Trans* Isomers 2 is prior art under at least AIA 35 U.S.C. § 102(a)(1). The ’245 patent references *Trans* Isomers 2 as containing “background information on the structure, use, and of transesterification reaction using hydrogenated jojoba wax esters.” Ex. 1001, 12:34-39. I am informed that, as a result, *Trans* Isomers 2 is applicant-admitted prior art.

64. *Trans* Isomers 2 continues the discussion regarding using interesterification to prepare *trans*-isomer-free products that began in *Trans* Isomers 1. *Trans* Isomers 2, Ex. 1006, 1; Ex. 1014, 5, states:

The interesterification reaction used to produce *trans* free emollients is one in which a fully hydrogenated lipid material (no *trans* isomers) is reacted with neat oil containing only *cis* isomers. The resulting product is an isomorphous mixture of partially saturated, saturated and unsaturated esters that contain no *trans* isomers. This route to produce “*Trans* Free” oxidatively stable emollients with a broad range of melting characteristics is considerably less practiced and more expensive than the partial (or selective) hydrogenation, selective saturation or transisomerization reaction, all of which produce unwanted *trans* isomers.

65. *Trans* Isomers 2 states, “[j]ojoba esters are an ideal model to use to demonstrate the *trans* free interesterification reaction and the properties of the resulting components.” Ex. 1014, 5; Ex. 1006, 1. *Trans* Isomers 2 also explains and illustrates the relevant chemistry as follows: “The CTFA Ingredient Dictionary defines Jojoba Esters as: A complex mixture of esters produced by the transesterification/ interesterification of Simmondsia Chinensis (Jojoba) Oil, Hydrogenated Jojoba Oil, or a transesterified mixture of the two. Figure 4 represents the interesterification reaction between (I) jojoba oil (only *cis* isomers) and (II) fully hydrogenated jojoba oil (no *cis* or *trans* isomers).” See Ex. 1014, 5; Ex. 1006, 1-2:

Figure 4



66. *Trans* Isomers 2 discloses that “Table 2 illustrates the range of properties achievable through this transesterification process that is used to produce ‘*Trans* Free’ Jojoba Esters.” Ex. 1014, 6-7; Ex. 1006, 2-3:

TABLE 2. CHEMICAL AND PHYSICAL PROPERTIES OF JOJOBA ESTERS						
Jojoba Ester	Melting Point °C	Iodine Value g I./100g	Oxidative Stability Value, Hours	Lubricity Degrees	Penetration, Mm	Monoene, Content, 0%
15	10-15	78-85	70	19.0	—	0
20	42-48	64-70	130	20.4	—	25-35
30	47-51	57-61	165	18.9	26.4	36-46
60	56-61	40-44	225	17.9	9.3	42-52
70	66-70	0-2	680	15.9	0.3	0

67. *Trans* Isomers 2 discloses that Table 4 compares a number of chemical and physical properties of interesterified jojoba esters relative to partially hydrogenated jojoba derivatives exhibiting identical melting points. Ex. 1006, 4; Ex. 1014, 6--8.

TABLE 4. PHYSICAL PROPERTIES OF INTERESTERIFIED JOJOBA ESTERS IN COMPARISON WITH LIKE MELTING PARTIAL HYDROGENATES								
Sample	Melting Point °C	Iodine Value g I./100g of Sample	% <i>Trans</i>	Oxidative Stability Index, Hours	Index of Refraction $\mu_{\text{D}}@80^{\circ}\text{C}$	Penetrometer, Mm	Slip, Cadcamo, Degress (1%)	Slip, IFT, Degress (100%)
Jojoba Esters 30	49	58	0	165	1.4418	26.4	18.9	23
Jojoba oil Partial Hydrogenate	49	69	11	27	1.4435	—	19.3	>25
Jojoba Esters 60	59	42	0	225	1.4403	9.3	17.9	14.1
Jojoba Oil Partial Hydrogenate	59	49	37	108	1.4408	5.2	18.1	15.4

68. *Trans* Isomers 2 discloses that “Iodine Value (IV) and Refractive Index (RI) of lipid materials are two measures commonly used to follow the progress of commercial hydrogenation reactions. Fully Hydrogenated Jojoba Oil exhibits an IV of less than 2 and an RI of 1.4368 @ 80° C. Iodine Values for Hydrogenated Jojoba Oil in this range indicate that the double bond positions of the molecule comprising jojoba oil have been completely filled or ‘saturated’ with hydrogen. The melting point of this Fully Hydrogenated Jojoba Oil is 68-70°C and it contains neither *cis* nor *trans* isomers.” Ex. 1014, 8; 1006, 4

4. Brown

69. U.S. Patent No. RE38,141 issued to James H. Brown and is entitled “Dry Emollient Compositions.” Ex. 1007. It was filed on October 12, 2001, and issued on June 10, 2003. Ex. 1007. I am informed that Brown is prior art under at least AIA 35 U.S.C. § 102(a)(1).²

² I understand that Brown is a reissue of U.S. Patent No. 6,280,746 (“the ’746 patent”), which is a continuation-in-part of U.S. Patent No. 5,968,530 to Arquette (“Arquette”). The ’746 patent (and therefore Brown) adds important new information to the specification of Arquette. *Compare* Ex. 1010 with Ex. 1007, Abstract, 7:7-19, 8:24-26, Ex. 1011, Abstract, 7:1-13, 8:13-15. Specifically, the specification of Brown discusses (i) that the disclosed processes prepare “[j]ojoba esters [having] a randomized molecular combination of saturated with unsaturated jojoba fatty acids and fatty alcohols”; (ii) that “[t]he melting point, consistency, and physical appearance of these jojoba esters can be manipulated to produce a family of wax esters ranging from pourable liquids to hard, crystalline waxes”; (iii) that the disclosed jojoba esters “are utilized as oxidatively stable carriers of fragrance oils” compared with jojoba oils that would have reacted with the fragrance oil; and (4) the properties of various jojoba esters products, including their iodine value. *Compare* Ex. 1010 with Ex. 1007, Abstract, 7:7-19, 8:24-26, 8:45-54. Brown also includes

70. Brown concerns “emollient compositions for use in cosmetic, personal care, and pharmaceutical preparations...and processes for their preparation.” Ex. 1007, 1:10-13, 3:21-5:38. Brown discloses “a very effective dry-feel emollient composition additive for use in personal care, cosmetic and pharmaceutical products and a novel method of producing that composition [that] can be produced from combinations of fatty alcohols, isopropyl esters and wax esters obtained from the oil contained in the seed of the jojoba plant (*Simmondsia chinensis*), jojoba oil.” Ex. 1007, 3:37-45.

71. Brown discloses, Ex. 1007, 7:7-19:

Jojoba esters are prepared by processes described herein, which processes result in a randomized molecular combination of saturated

the following information from Arquette: “the properties of the emollient depend upon the relative amounts of IIn [naturally occurring jojoba wax esters] and IIIn [naturally occurring hydrogenated jojoba wax esters]” and the disclosed reactions result in “the randomized distribution of wax esters”. *Compare* Ex. 1010, 7:67-8:7, 8:37-44 *with* Ex. 1007, 4:6-14, 4:48-55. Together, a POSITA would have understood from the teachings in Brown (carried over from Arquette and newly introduced in the ’746 patent) that jojoba esters may have improved physical properties compared to the jojoba oil from which it is prepared, including oxidative stability.

with unsaturated jojoba fatty acids and fatty alcohols. These esters are a complex mixture of different jojoba fatty acids and fatty alcohols combined randomly and composed of differing chain lengths. The fatty acids and fatty alcohols may be either fully saturated, monounsaturated or with both the fatty alcohol and the fatty acid containing one point of unsaturation, as described above. The melting point, consistency, and physical appearance of these jojoba esters can be manipulated to produce a family of wax esters ranging from pourable liquids to hard, crystalline waxes.

72. Brown also discloses that “[j]ojoba esters in the present invention are utilized as oxidatively stable carriers. . . .” Ex. 1007, 8:24-25.

73. Brown states, “[t]he compositions comprising fatty alcohols, isopropyl esters and jojoba wax esters (jojoba oil) may be obtained by the base catalyzed alcoholysis reaction between jojoba oil and an alkyl alcohol.” Ex. 1007, 3:59-62. Brown also discloses that “[a] process for producing an emollient may comprise the steps of,” Ex. 1007, 4:60-67:

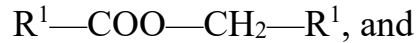
- a) providing a composition comprising jojoba oil,
- b) adding an alcohol...to said composition,
- c) effecting alcoholysis on said jojoba oil mixed with said alcohol to produce an emollient, and
- d) effecting interesterification of remaining wax esters.

74. “Starting materials [for the reaction] could include,” Ex. 1007, 4:4-13:

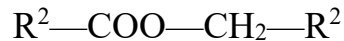
- I. The alcohol,

R^4-OH (with isopropyl alcohol (IPA, $HO-CH-(CH_3)_2$) being primarily emphasized),

II. Jojoba Wax Esters



III. Fully hydrogenated Jojoba Wax Esters



75. Brown explains, “[t]he basic reactions which may be used in the preparation of the emollient compositions of the invention derived from jojoba oil may include at least. . . Reaction C I, and II_n and III_n (catalyst)→IV, V, VI, VII, VIII, IX, II_r, III_r. This product is referred to herein as ‘the broad melting range emollient’ and the properties of the emollient depend upon the relative amounts of II_n and III_n[*sic*].” Ex. 1007, 4:39-51. “The subscripts n and r respectively represent n=the naturally occurring distribution of wax esters and r=the randomized distribution of wax esters resulting from rearrangements which occur during the reactions.” Ex. 1007, 4:52-55. Species IV, V, VI, VII, VIII, and IX are partially saturated wax esters, which are the “typical product components from the preferred synthetic reactions used in the practice of the present invention with jojoba oil.” Ex. 1007, 4:25-38. “As used in [Brown], Floraesters 70 is III, Floraesters 15 is II_r, Floraesters 20, 30 and 60 are combinations of II_r, IV, V, and III_r, Floraesters IPJ is a mixture of Ir, VI, and VIII, and Floraesters HIPJ is a combination of III_r, VII and IX.” Ex. 1007, 5:39-43.

76. Brown teaches an exemplary process for preparing the emollient composition:

In preparing the emollient composition, refined jojoba oil (or hydrogenated jojoba oil or a mixture of the oil and hydrogenated oil) is introduced into an appropriate vessel (capable of excluding air) equipped with stirring and means of heating and cooling. The jojoba oil is first dried under vacuum at a temperature of 90 C to remove most or all moisture. The anhydrous isopropyl alcohol (or other alcohol) is then added with the amount of isopropyl used being from about 20% to about 50% by weight of jojoba oil. The reactor is sealed and heat is applied to bring the temperature of the reaction mixture to about 70-75° C. It is important that air be excluded and that the reactor be vented through a condenser to recover any unreacted alcohol. When the temperature has reached 70-75° C., a first addition of catalyst (e.g., a catalyst for alcoholysis and interesterification such as sodium methoxide) is made. The amount added ranges from about 0.05 or from 0.1% to about 0.6% by weight of the jojoba oil with about 0.3% being preferred.

Ex. 1007, 5:1-20.

77. Brown discloses typical properties of jojoba esters as follows, Ex. 1007, 8:45-54:

TYPICAL PROPERTIES OF JOJOBA ESTERS:

	Melting Point	Iodine Value
Floraesters - 70	66–70° C.	<2
Floraesters - 60	56–60° C.	40–44
Floraesters - 30	47–51° C.	57–61
Floraesters - 20	42–48° C.	64–70
Floraesters - 15	10–15° C.	78–85
Floraesters IPJ	6–12° C.	75–85
Floraesters HIPJ	55–65° C.	<2

5. Xu

78. Xu is entitled “Engineering of enzymatic reactions and reactors for lipid modification and synthesis,” and was published in the EUROPEAN JOURNAL OF LIPID SCIENCE AND TECHNOLOGY in 2003. I am informed that Xu is prior art under 35 U.S.C. AIA § 102(a)(1).

79. Xu relates to considerations for the design of processes for enzymatic lipid modification and synthesis. Ex. 1008, 289.

80. Xu discloses, “[i]n 1984, *Zaks* and *Klibanov* published a paper in *Science*, indicating that enzymes could work in a solvent microaqueous medium at 100°C. . . . It means that enzymes can also be used for the catalysis of [the] reverse reaction, *i.e.* esterification. This opens up a variety of potential applications. In the lipid area, a reaction such as interesterification (acidolysis, alcoholysis, and ester-ester exchange) is also possible with the catalysis of lipases in a probable hydrolysis-esterification two-step mechanism. Thus chemical interesterification, which has

been implemented in the current industry can be fully replaced.” Ex. 1008, 289; *see* Ex. 1008, 301 (“In principle, many chemical methods can be replaced by enzymatic ones. Therefore lipid products that can be produced by enzymatic routes are numerous”).

81. Xu states, “[t]he driving forces for the involvement of industrial sectors can be also listed as follows:

- very interesting products and potential market demands,
- improvement of product quality refereeing to mild conditions,
- reduction of enzyme price and balanced economy in general,
- simple processes and low investment,
- environmental considerations,
- customer perception and marketing strategy,
- know-how preparation and technology takeover/control.”

Ex. 1008, 289.

82. According to Xu, “This list can be prolonged: ‘image’ strategy by using enzyme technology is important for many industrial companies; energy-efficiency of the technology is also often mentioned.” Ex. 1008, 289.

83. Xu discloses, Ex. 1008, 290:

The major enzymatic reactions for the modification of lipids are often referring to hydrolysis, esterification, acidolysis, alcoholysis, and ester-ester exchange from the reaction mechanisms. Interesterification or

transesterification is also commonly used in literature to describe some of the above reactions. A detail description is given below for the following two terms:

— **Interesterification**: a general term for the reactions between an ester and a fatty acid, an alcohol, or another ester, which includes acidolysis, alcoholysis, and ester-ester exchange. In literature, it sometimes describes only ester-ester exchange or alkaline-catalyzed randomization of oils and fats.

— **Transesterification**: a term often used for ester-ester exchange. It is also used in literature for the acidolysis reaction or as a general term for all the three reactions including alcoholysis.

84. Xu states, “[a]lcoholysis is the reaction between an ester and an alcohol” and that such reaction is reversible, as shown in Figure 15, Ex. 1008, 296:

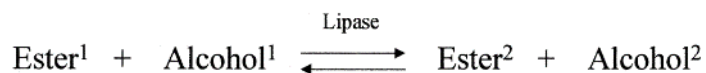
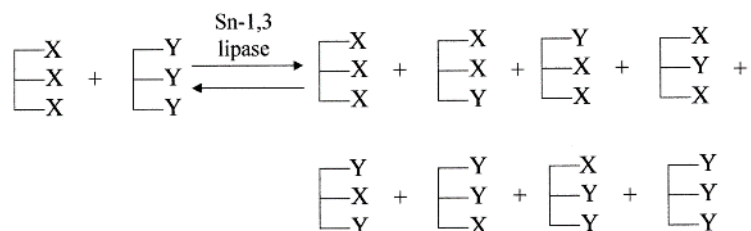


Fig. 15. An illustration enzymatic alcoholysis.

85. Xu discloses, “[c]hemical alcoholysis has been widely used in industry for the production of partial acylglycerols, such as MAGs and DAGs, and biodiesels such as fatty acid methyl esters or ethyl esters.... Enzymatic alcoholysis has been widely studied for the production of similar products.” Ex. 1008, 296.

86. Xu further discloses, “[e]ster-ester exchange is a reaction between two esters. Acids will be exchanged between the hydroxyl moieties. Chemical ester-ester exchange, often referring to as chemical interesterification, is dominantly used for the randomization of oils and fats, which has been widely applied in industry for

oil and fat modification. Enzymatic ester-ester exchange is an alternative to the chemical method for the modification of fats and oils. The reaction is given in Fig. 18.” Ex. 1008, 298-99. *See* Ex. 1008, 299:



X and Y are two types of fatty acids.

Fig. 18. Reaction scheme of enzymatic ester-ester exchange between two triacylglycerols (XXX and YYY) with *sn*-1,3 specific lipases.

6. Sessa

87. Sessa, entitled “Derivation of a Cocoa Butter Equivalent from Jojoba Transesterified Ester via a Differential Scanning Calorimetry Index,” was published in the JOURNAL OF THE SCIENCE OF FOOD AND AGRICULTURE in 1996. I am informed that Sessa is prior art under 35 U.S.C. AIA § 102(a)(1). The ’245 patent references Sessa as containing “background information on the structure, use, and of transesterification reaction using hydrogenated jojoba wax esters.” Ex. 1001, 12:34-39. I am informed that, as a result, Sessa is applicant-admitted prior art.

88. Sessa relates to a study investigating the preparation of cocoa butter equivalents made from “[a] series of wax ester blends [] constructed by transesterifying native jojoba oil with 50-500 g/kg⁻¹ completely hydrogenated jojoba wax esters.” Ex. 1009, Abstract, 295. Sessa discloses, “calibration sets consisting

of native jojoba wax esters that were transesterified with proportionate blends of completely hydrogenated [jojoba] wax esters to give a series of 50, 100, 150, 200, 300, 400 and 500 g kg⁻¹ saturated ester were provided by International Flora Technologies Ltd (Gilbert, AZ, USA).” Ex. 1009, 295-96. Using the disclosed calibration sets, the authors “could optimise the level of saturation [(i.e., the content of completely hydrogenated jojoba wax esters)] needed to best mimic the melt and crystallization properties of cocoa butter. The wax ester blend with 400 g kg⁻¹ saturation most closely resembled the thermal properties of cocoa butter where the monounsaturated species of the jojoba blend gave identical thermograms to tempered cocoa butter.” Ex. 1009, Abstract, 295.

IX. ANALYSIS OF THE PATENTABILITY OF '245 PATENT CLAIMS 1-3 AND 5

A. Cummings in view of Xu and/or in further view of Sessa Renders Obvious Claims 1, 2, 3, and 5.

89. In my opinion, the combination of Cummings and Xu alone and/or in further view of Sessa discloses and renders obvious claims 1, 2, 3, and 5. Cummings discloses the claimed steps, except: it does not expressly disclose (in words) the particular percentage by weight of the hydrogenated wax esters in the feedstock (albeit it does disclose detailed information that a POSITA can use to calculate such percentage) or expressly disclose the use of an enzyme as the catalyst. However, it would have been obvious to substitute an enzyme for a chemical catalyst as disclosed

Xu, and, to the extent it is found that Cummings itself does not disclose the claimed percentage, to adjust the feedstock composition of the hydrogenated wax esters as taught by Sessa.

90. As I discuss below for steps 1[a], 1[b], and 1[c], the combination of Cummings and Xu alone and/or in further view of Sessa discloses a process for transesterifying wax esters that includes each of the claimed steps. That is, Cummings discloses the transesterification of jojoba wax esters and hydrogenated jojoba wax esters except the use of an enzyme as the catalyst.

91. As I discuss below with respect to claims 1, 2, 3, and 5, it would have been obvious to a POSITA to (i) modify the process of transesterifying a feedstock comprising jojoba wax esters and fully hydrogenated jojoba wax esters taught in Cummings, which generates a transesterified product (jojoba esters) having an OSI greater than the OSI of the feedstock, with (ii) the lipase catalyst expressly taught in Xu and, (iii) to the extent it is found not to be disclosed by Cummings itself, the feedstock containing 20% to 50% by weight of hydrogenated jojoba wax esters expressly taught in Sessa.

92. As I also discussed above and below, a POSITA would have combined these references because they (i) pertain to the same fields (lipid chemistry, food and cosmetic ingredients); (ii) discuss the same class of chemical reactions (transesterification and interesterification); (iii) seek to achieve the same results

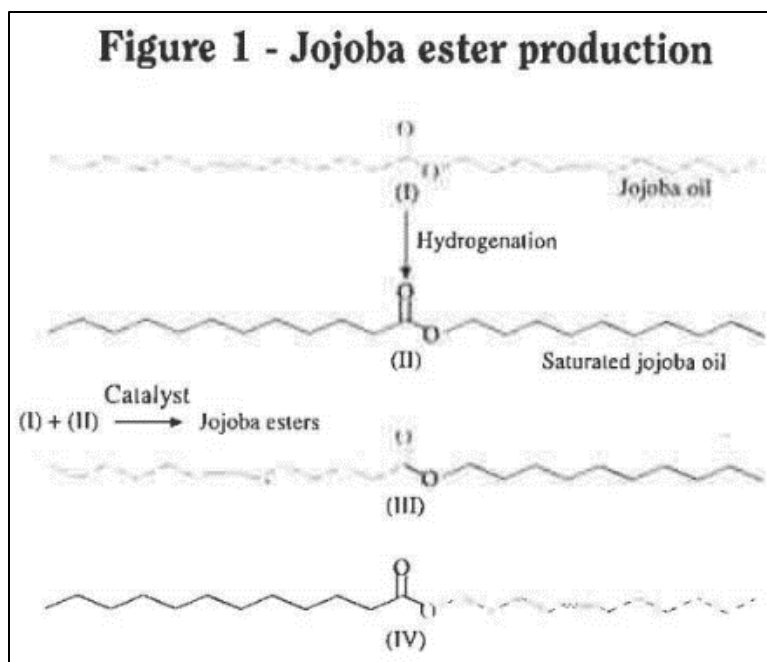
(improved physical properties); and, (iv) in Cummings and Sessa, identify common contributors (International Flora Technologies, Ltd. d/b/a/ FloraTech and Robert Kleiman).

1. Claim 1

1[preamble] “A process for transesterifying wax esters, the process comprising:”

93. Regardless of whether the preamble is found to limit claim 1, it is disclosed by Cummings alone or in view of Xu, as I discuss immediately below regarding 1[preamble] and further regarding limitations 1[a] to 1[c].

94. For example, Cummings discloses that “the jojoba plant bears a peanut sized, dark chestnut coloured seed containing a unique oil that is chemically a liquid wax ester”—that is, jojoba oil. Ex. 1004, 1. Cummings discloses that “[j]ojoba oil is converted to jojoba esters through a process known as interesterification. In this process, different ratios of unsaturated jojoba oil are combined with fully saturated jojoba oil and then interesterified.” Ex. 1004, 2. Cummings illustrates this process in Figure 1, Ex. 1004, 2:



95. Further, a POSITA would have understood that the interesterification process disclosed in Cummings is also referred to as a transesterification process.³ See Ex. 1004, 2, Fig. 1. For example, as Xu explains, Ex. 1008, 290:

The major enzymatic reactions for the modification of lipids are often referring to hydrolysis, esterification, acidolysis, alcoholysis, and ester-ester exchange from the reaction mechanisms. Interesterification or transesterification is also commonly used in literature to describe some

³ Similarly, Patent Owner has accused Petitioner's process, the "Inter-esterification between jojoba oil and jojoba wax," of infringing claim 1 in the related case, *Cargill, Inc., et al. v. Vantage Specialty Chemicals, Inc.*, No. 1:22-cv-00979-RGA-SRF, currently pending in the United States District Court for the District of Delaware. See Ex. 1020, ¶¶ 4, 31, 39.

of the above reactions. A detail description is given below for the following two terms:

- **Interesterification:** a general term for the reactions between an ester and a fatty acid, an alcohol, or another ester, which includes acidolysis, alcoholysis, and ester-ester exchange. In literature, it sometimes describes only ester-ester exchange or alkaline-catalyzed randomization of oils and fats.
- **Transesterification:** a term often used for ester-ester exchange. It is also used in literature for the acidolysis reaction or as a general term for all the three reactions including alcoholysis.

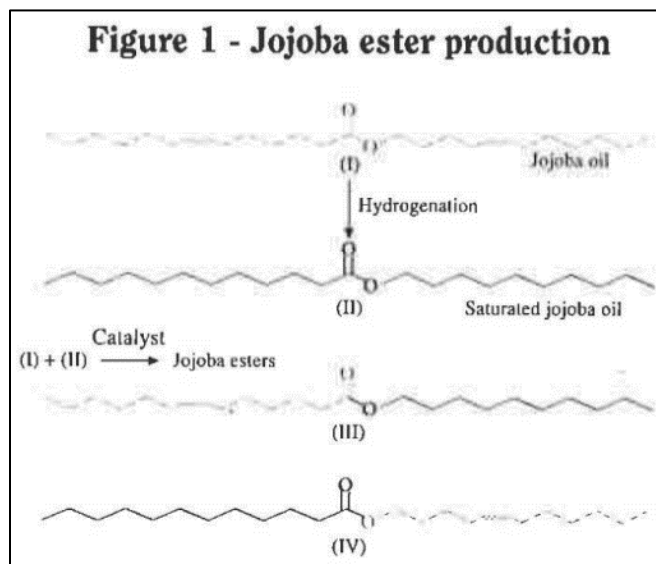
96. Combining Cummings and Xu (and Sessa) is further discussed below.

1[a] “providing a feedstock comprising jojoba wax esters and hydrogenated jojoba wax esters, wherein the amount of hydrogenated jojoba wax esters is 20% to 50% by weight of the feedstock;”

97. Cummings alone and/or in view of Sessa discloses the step of “providing a feedstock comprising jojoba wax esters and hydrogenated jojoba wax esters, wherein the amount of hydrogenated jojoba wax esters is 20% to 50% by weight of the feedstock.”

98. Cummings discloses providing a feedstock comprising jojoba wax esters and hydrogenated jojoba wax esters, wherein their respective amounts by weight in the overall feedstock may be varied (albeit it does not expressly disclose, in words, the particular claimed percentages, *i.e.*, “wherein the amount of hydrogenated jojoba wax esters is 20% to 50% by weight of the feedstock”). For

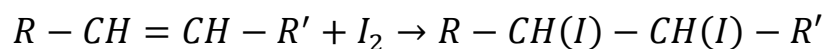
example, Cummings discloses that “Jojoba oil is converted to jojoba esters through a process known as interesterification. In this process, different ratios of unsaturated jojoba oil are combined with fully saturated jojoba oil and then interesterified.” Ex. 1004, 1-2, Fig. 1 (below).



99. However, a POSITA would have understood that Cummings nonetheless discloses the claimed limitation (*i.e.*, “wherein the amount of hydrogenated jojoba wax esters is 20% to 50% by weight of the feedstock”) based on its iodine value (“IV”) and additional disclosures which can be used to calculate the percentage. For example, Figure 3 of Cummings depicts certain physical properties of various grades of transesterified jojoba ester product (Jojoba esters (15), (20), (30), (60), and (70)), including the IV range of the various grades of jojoba ester in units of g/100 g of sample, as shown below. See Ex. 1004, 1, Fig. 3 (I have added the red-box annotation to highlight the IV):

Figure 3 - Jojoba ester differences				
Product	Melting point °C AOCS Cc 18-80	Iodine value g/100g AOCS Cd 1-25	Visual appearance	Colour AOCS Cc 13c-92
Jojoba esters (15)	10 - 15	78 - 85	Clear, colourless liquid	< 1.5 Red
Jojoba esters (20)	42 - 48	64 - 70	White, creamy paste	< 1.0 Red
Jojoba Esters (30)	47 - 51	57 - 61	White, soft paste	< 1.0 Red
Jojoba Esters (60)	56 - 61	40 - 44	White, firm paste	< 1.0 Red
Jojoba esters (70)	66 - 70	< 2	White crystalline powder	< 1.0 Red

100. It was known to a POSITA that IV is often expressed in units of g/100 g of sample (as in Figure 3) and that it is used to determine the degree of unsaturation in fats, oils, and waxes. *See* Ex. 1023, 789; Ex. 1024, 1-2; Ex. 1030, 47; *see also* Ex. 1006, 4; Ex. 1014, 8 (“Iodine Values [of less than 2 for Fully Hydrogenated Jojoba Oil] indicate that the double bond positions of the molecule comprising jojoba oils have been completely filled or ‘saturated’ with hydrogen”). To determine the IV of a material, the material is reacted with a solution containing iodine using a titration method. *See* Ex. 1024, 1-2; Ex. 1030, 47. Each molecule of iodine absorbed by the material used during the titration is added to the precursor alkene across a double bond to yield an organoiodine product, as illustrated by the following iodometry stoichiometry, *see also, e.g.*, Ex. 1030, 47:



101. Consequently, the amount of iodine absorbed by a material during such a titration process directly correlates to the average number double bonds in the material, and therefore the degree of unsaturation of a material. As a result, the

greater the IV, the more unsaturated the material. *See* Ex. 1023, 789, 792; Ex. 1024, 1; Ex. 1030, 47.

102. Because the IV of a material directly correlates to the number of double bonds in a material (which does not change due to transesterification), it is a constant that can be used to estimate the IV of a blend of materials using the IVs of the materials and the weight percent of each material used in the blend, and vice versa, using the following equation:

$$IV_{Blend} = \frac{\sum_i (wt \%_i)(IV_i)}{100}$$

See Ex. 1025, 3; Ex. 1026, 214-15 (“The calculated iodine value is determined simply by multiplying the percentage of each unsaturated fatty acid by its constant and addition of the results.”).

103. This information can be used by a POSITA to estimate the quantity of hydrogenated jojoba oil relative to untreated jojoba oil to be combined for interesterification to achieve a transesterified jojoba ester product with the desired physical properties using the following equations:

$$IV_{JE} = \frac{(wt \%_{JO})(IV_{JO}) + (wt \%_{HJO})(IV_{HJO})}{100}$$

$$100 = wt \%_{JO} + wt \%_{HJO}$$

104. These equations can be readily manipulated by a POSITA to derive an equation to calculate the weight percent of hydrogenated jojoba oil required to

achieve a transesterified jojoba ester product with the desired physical properties, as follows:

$$wt \%_{HJO} = 100 \times \frac{(IV_{JE} - IV_{JO})}{(IV_{JO} - IV_{HJO})}$$

105. It was also known to a POSITA that the IV of jojoba oil (IV_{JO}) ranges from 81 to 89. *See* Ex. 1027, 3 (reporting that the IV of jojoba oil is 81.8-89); Ex. 1028, 3 (reporting that the IV of jojoba oil is 81).

106. A POSITA would have understood from the disclosure of Cummings that the IV of fully hydrogenated jojoba oil (IV_{HJO}) is zero (0) because Cummings discloses that fully hydrogenated jojoba oil is fully saturated, meaning that—as I discussed in the above paragraphs—it has no double bonds (that are capable of absorbing iodine). *See* Ex. 1004, 2, Fig. 1; Ex. 1023, 789, 792; Ex. 1024, 1-2; Ex. 1030, 47.

107. As shown below in my Table A, below, of this Declaration, the estimated amount of hydrogenated jojoba oil—expressed as the weight percent of a feedstock consisting of jojoba oil and fully hydrogenated jojoba oil—required to achieve the Jojoba esters (15), (20), (30), (60), and (70) with the IV reported in Figure 3 of Cummings can be estimated using the method described immediately above. Also as shown below, a POSITA would have understood from Figure 3 of Cummings that the amount of fully hydrogenated jojoba wax esters is between 3.7%

and 100% by weight of the feedstock, which includes the range of 20% to 50% by weight of the feedstock claimed in claim 1 (also, individual products are inside the claimed range).

Table A			
Product	IV_{JE} Range From Cummings, Figure 3	IV_{HJO} From Cummings, 2, Fig. 1	Est. Hydrogenated Jojoba Oil Content Of Feedstock (Wt %)
Jojoba esters (15)	78-85	0	3.7-4.5
Jojoba esters (20)	64-70	0	21-21.3
Jojoba esters (30)	57-61	0	29.6-31.5
Jojoba esters (60)	40-44	0	50.6-50.6
Jojoba esters (70)	0-2	0	97.8-100

108. In addition, as I explained herein, a POSITA would have found it obvious to modify the process disclosed in Cummings to include 20% to 50% by weight of hydrogenated jojoba wax esters in the feedstock, as disclosed in Sessa. *See* Ex. 1009, 296.

109. Sessa discloses “[a] series of wax ester blends constructed by transesterifying native jojoba oil with 50-500 g kg⁻¹ completely hydrogenated jojoba wax esters,” and more particularly Sessa continues its disclosure, stating that: “calibration sets of consisting of native jojoba wax esters that were transesterified with proportionate blends of completely hydrogenated wax esters to give a series of 50, 100, 150, 200, 300, 400 and 500 g kg⁻¹ saturated ester.” Ex. 1009, Abstract, 295-96.

110. As shown in my Table B, below, of this Declaration, a POSITA would have known how to convert the content of completely hydrogenated jojoba wax ester content in each of Sessa's calibration sets, expressed in grams of hydrogenated jojoba wax ester per kilogram of blend (*i.e.*, native jojoba wax esters transesterified with completely hydrogenated jojoba wax esters), into a weight percent of the blend. Also as shown in Table B, below, a POSITA would have understood that these calibration sets disclose feedstocks comprising jojoba wax esters and hydrogenated jojoba esters (which are then transesterified) wherein the amount of fully hydrogenated jojoba wax esters is 5%, 10%, 15%, 20%, 30%, 40%, and 50% by weight of the feedstock, which includes the range of 20% to 50% by weight of the feedstock claimed in claim 1 (I note that individual products are inside the claimed range).

Table B		
Hydrogenated Jojoba Wax Ester Content of Blend (g kg⁻¹)		Wt% Hydrogenated Jojoba Wax Ester
50	$\times \frac{1 \text{ kg of Blend}}{1000 \text{ g of Blend}} \times 100 \text{ wt } \%$	5
100		10
150		15
200		20
300		30
400		40
500		50

111. To the extent Cummings does not itself disclose the claimed percentage (although it is my opinion that a POSITA would have found that it does, as I

discussed above), as evidenced by Cummings and Sessa and the state of the art, a POSITA would have thought to and found it advantageous (including finding it a matter of routine optimization) to vary the amount of hydrogenated jojoba wax esters in the feedstock disclosed in Cummings to an amount that is 20% to 50% by weight of the feedstock, as disclosed in Sessa, to obtain desirable and/or improved physical properties (such as oxidative stability and thermal properties) in the transesterified product, and would have had a reasonable expectation of success, as doing so was nothing more than routine variation. For example, Cummings discloses that jojoba esters “have shown distinctive utility in highly pigmented systems where . . . oxidative stability is sometimes lacking,” that jojoba esters demonstrate oxidative stabilities and melting points desirable for “cosmetic systems,” and that interesterifying “different ratios of unsaturated jojoba oil . . . with fully saturated jojoba oil . . . results in jojoba esters engineered to deliver specific physical, functional and chemical characteristics.” Ex. 1004, 1-2. Cummings further discloses that “[i]nteresterification produces jojoba esters engineered to contain different ratios of molecules with either no double bonds (fully saturated), one double bond (monounsaturated) or two double bonds (fully unsaturated). . . . It is these compositional differences within the family of jojoba esters that create their expanded utility in cosmetic preparations,” in particular with respect to oxidative stability. Ex. 1004, 1-2. Likewise, Sessa (and co-authors) teach that “[they] devised

mathematical indices . . . to define the level of saturation in transesterified wax ester blends and used them to select the optimum level of saturation needed for obtaining a cocoa butter equivalent” and that “[t]he wax ester blend with 400 g kg⁻¹ saturation [which is 40% by weight of hydrogenated jojoba wax ester] most closely resembled the thermal properties of cocoa butter. . . .” Ex. 1009, 298, Abstract.

112. Also, as evidenced by the state of the art herein and my above explanations, the ability to engineer specific physical properties in a transesterified product by manipulating the ratio of the reacting fats and oils in a feedstock would have been within the background knowledge possessed by a POSITA as such concepts are fundamental to the topic of chemical reaction engineering, a required course in the chemical engineering curriculum. *See* Ex. 1004, 1-2; Ex. 1009, 298, Abstract; Ex. 1012, 675 (Haumann in 1994 disclosing that “[t]he effect [of the interesterification⁴ processes] on melting and solidification properties ultimately depends on the type and mixture of the starting materials.”); Ex. 1013, 878 (Otero et

⁴ I again note that Patent Owner has accused Petitioner’s process, the “Interesterification between jojoba oil and jojoba wax,” of infringing claim 1 in the related case, *Cargill, Inc., et al. v. Vantage Specialty Chemicals, Inc.*, No. 1:22-cv-00979-RGA-SRF, currently pending in the United States District Court for the District of Delaware. *See* Ex. 1020, ¶¶ 4, 31, 39.

al. in 2006 disclosing that “[t]ransesterification between a fat and oil typically involves exchange of fatty acid residues between the precursor acylglycerols and is accompanied by a concomitant change in the properties of the original material. The properties of the product are in large measure governed by a convenient choice of the precursor reagents [and] their respective proportions in the starting mixture”).

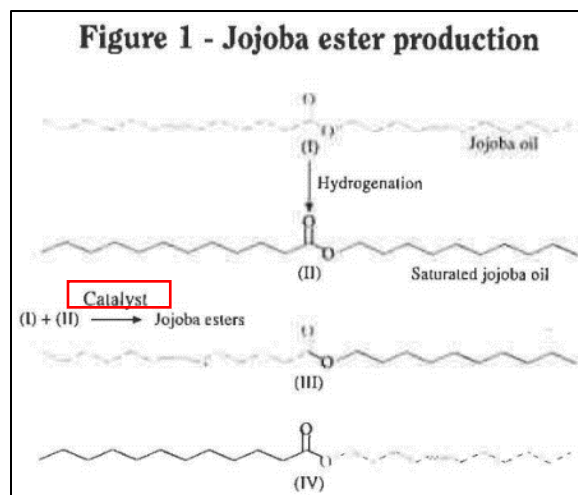
113. Therefore, based on these disclosures, a POSITA would have understood that Cummings alone and/or in view of Sessa disclose the claimed step of “providing a feedstock comprising jojoba wax esters and hydrogenated jojoba wax esters, wherein the amount of hydrogenated jojoba wax esters is 20% to 50% by weight of the feedstock.”

114. And, for the reasons explained above, in my opinion, it would have been obvious to a POSITA to apply the chemistry described by Cummings while varying the reactant ratios as found in Sessa.

1[b] “contacting the feedstock with a lipase; and transesterifying the jojoba wax esters and the hydrogenated jojoba wax esters in the feedstock with the lipase to form a transesterified product;”

115. The combination of Cummings and Xu discloses “contacting the feedstock with a lipase; and transesterifying the jojoba wax esters and the hydrogenated jojoba wax esters in the feedstock with the lipase to form a transesterified product.” I incorporate my discussion of the preamble here.

116. Cummings, Ex. 1004, Figure 1 (which I have annotated with a red box below to highlight the catalyst), discloses providing a feedstock including jojoba oil and hydrogenated jojoba oil and applying a catalyst to the combination of jojoba oil and hydrogenated jojoba oil. A POSITA would have understood this disclosure as showing the catalyst (red box) is interacting with (or “contacting”) the feedstock (which, in Cummings, consists only of jojoba oil and hydrogenated jojoba oil) to facilitate the transesterification process:



117. Cummings does not expressly disclose “contacting the feedstock with a lipase” but a POSITA would have found it obvious to modify the catalyzed process of Cummings to use the lipase, as disclosed in Xu, as the catalyst. Ex. 1008, 296-99, Figs. 15, 18. Xu discloses using lipases as a catalyst in interesterification/transesterification reactions and that interesterification and transesterification both refer to the same class of reactions, including alcoholysis

and/or ester-ester exchange reactions, and that lipases can be used to catalyze such class of reactions. Ex. 1008, 296-99, Figs. 15, 18 (reproduced below).

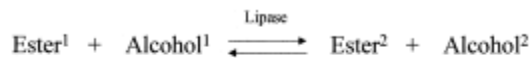
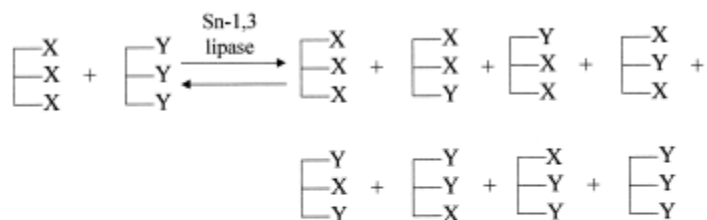


Fig. 15. An illustration enzymatic alcoholysis.



X and Y are two types of fatty acids.

Fig. 18. Reaction scheme of enzymatic ester-ester exchange between two triacylglycerols (XXX and YYY) with *sn*-1,3 specific lipases.

118. A POSITA would have been motivated to use, and had a reasonable expectation of success in using, a lipase as the catalyst in the Cummings reaction for the reasons stated in Xu. Ex 1008, 289, 301. For example, Xu discloses that the industry has several reasons to use lipase catalysts, including:

- “– very interesting products and potential market demands,
- improvement of product quality refereeing to mild conditions,
- reduction of enzyme price and balanced economy in general,
- simple processes and low investment,
- environmental considerations,
- customer perception and marketing strategy,

– know-how preparation and technology takeover/control.”

Ex. 1008, 289; *see also id.* (“This list can be prolonged: ‘image’ strategy by using enzyme technology is important for many industrial companies; energy-efficiency of the technology is also often mentioned.”).

119. Also, as evidenced by the state of the art herein and in my above explanations, replacing chemical catalysts in interesterification and/or transesterification processes with lipases would have been within the background knowledge possessed by a POSITA as the concepts of catalysis and catalytic materials are fundamental concepts in the chemical engineering curriculum. *See* Ex. 1012, 676 (Haumann in 1994 disclosing that “[c]hemical interesterification, however, is not the only route for this process. Also gaining scrutiny is enzymatic interesterification, now used commercially to produce high value-added products, such as structured triglycerides for confectionery use.”; “Intesterification using random lipases produces fat compositions similar to those obtainable from standard chemical methods. An advantage is that these lipases generally are perceived as ‘natural’ alternatives to chemical techniques. Current applications of lipases, however, center around exploitation of the *sn*-1,3 fatty acid specificity of most commercially available enzymes, which allows the manufacture of specific triglycerides in high yield. . . . Also . . . low levels can improve the processing or storage properties of products.”); Ex. 1013, 877 (Otero in 2006 disclosing that

“enzymatic transesterification reactions between a solid fat and a liquid oil can be employed for production of semi-solid fats that contain no *trans* fatty acid residues. Enzymatic processes based on the use of either *sn*-1,3 specific or nonspecific lipases are advantageous because of their selectivity (generation of fewer undesired byproducts), mild reaction conditions, and ease of product recovery. They also facilitate process control and minimize problems of waste disposal.”)

120. Therefore, based on these disclosures, a POSITA would have understood that Cummings in view of Xu disclose the claimed step of “contacting the feedstock with a lipase; and transesterifying the jojoba wax esters and the hydrogenated jojoba wax esters in the feedstock with the lipase to form a transesterified product[.]”

121. And, for the reasons explained above, in my opinion, it would have been obvious to a POSITA to contact the feedstock described by Cummings with a lipase catalyst as described in Xu to transesterify the jojoba wax esters and the hydrogenated jojoba wax esters in the feedstock with the lipase to form a transesterified product.

1[c] “wherein an oxidative stability index (OSI) of the transesterified product is greater than an OSI of the feedstock.”

122. Cummings discloses “wherein an oxidative stability index (OSI) of the transesterified product is greater than an OSI of the feedstock.” Cummings discloses that the transesterified product, “[j]ojoba esters[,] demonstrate remarkable stability

with OSI values of all jojoba esters greater than 100 hours and as high as 675 hours,” which I note is significantly greater than the OSI of the refined jojoba oil that forms part of the feedstock, which “is around 35 hours.” Ex. 1004, 2. Cummings further discloses that “[t]he structure of all jojoba esters is different from its starting material—jojoba oil” and that “[i]t is these compositional differences within the family of jojoba esters that create their expanded utility in cosmetic preparations,” including oxidative stability. Ex. 1004, 2. This demonstrates to a POSITA that such POSITA could achieve—and had a reasonable expectation of success of achieving—an OSI of the transesterified product (jojoba esters) that is greater than the OSI of a feedstock containing jojoba oil and hydrogenated jojoba oil.

123. My opinion in this regard is buttressed by the fact that it was well-known to a POSITA that the transesterification of fats, oils and wax esters (including in lipase-catalyzed processes and processes involving jojoba wax esters and hydrogenated jojoba wax esters) can produce a product having improved—and thus greater—oxidative stability, as demonstrated by the state-of-the-art literature. *See* Ex. 1015, [0005] (Kodali in 2005 disclosing that “[t]ransesterifying various short saturated fatty acid esters with a vegetable oil improves oxidative stability and low temperature properties due to the increased saturation and the heterogeneity of the fatty acids esterified to the polyols.”); Ex. 1016, [0031] (Touitou in the early 2000s disclosing that “‘Jojoba Esters’ is a complex mixture of esters produced by the

transesterification of jojoba oil, hydrogenated jojoba oil, or a mixture of the tw[o] with organic alcohols. Jojoba esters are produced in a broad range of melting points and are colorless, odorless and extremely resistant to oxidative degradation. Jojoba esters are useful as components of highly pigmented cosmetic systems.”); Ex. 1017, 245 (Xu in 2009 disclosing that “[t]he margarines produced from enzymatically interesterified fats generally had much lower peroxide values compared to the margarine produced from chemically randomized fats stored at 25 °C. . . . A similar observation was also apparent in a pure oil system. . . . This confirms that enzymatic interesterification has advantages for the oxidative stability of the products.”); Ex. 1018, C371 (Lopez-Hernandez in 2005 disclosing that “[s]tructured lipids [(SL)] containing different levels of MCT [short for medium-chain TAG (triacylglycerides)] were produced by lipase-catalyzed interesterification reactions. . . . The SL generated in these experiments contain only saturated fatty acid residues The absence of unsaturated fatty acids residues implies that the products of the synthesis reaction have enhanced stability with regard to oxidation processes.”).

124. My understanding from reviewing the prosecution history is that applicant asserted that this improved OSI was unexpected, but the above evidence from the art (including in this section, the state of the art in Section VIII, and as I explained in Paragraphs 24 to 26) shows that not to be the case at all. In my opinion, this further confirms the obviousness of claim 1 of the '245 patent.

2. Claim 2

“The process of claim 1, wherein the feedstock consists essentially of the jojoba wax esters and the hydrogenated jojoba wax esters.”

125. I am informed that claim 2—by use of “consists essentially of”—limits claim 1 by restricting the feedstock to only the jojoba wax esters, the hydrogenated jojoba wax esters, and only those additional materials that do not materially affect the basic and novel properties of the invention (such as indicated in the claim itself, improved OSI). The combination that renders claim 1 obvious also teaches such a feedstock, as there are no additional materials in the disclosed feedstock that materially affect the basic and novel properties of the invention (such as indicated in the claim itself, improved OSI) in such combination—there is, for example, no teaching of requiring the addition of other feedstock materials, such as an OSI-increasing antioxidant. *See* Ex. 1004, 1-2, Fig. 1; Ex. 1008, 289-90, 297-99, 301, Figs. 15, 18; Ex. 1009, 295-96; *see also* my discussion of claim 1 above (describing the combination including the feedstock composition).

126. It is my opinion that Cummings in view of Xu and/or in further view of Sessa renders obvious claim 2 for the same reasons as claim 1.

3. Claim 3

“The process of claim 1, wherein the feedstock does not comprise any free fatty alcohols.”

127. The combination that renders claim 1 obvious teaches a feedstock that “does not comprise any free fatty alcohols.” In particular, Cummings alone and/or in view of Sessa discloses this limitation for the reasons stated in reference to limitation 1[a]. A POSITA would have understood that the feedstock of Cummings alone or as modified by the teachings of Sessa, which discloses calibration sets “consisting of native jojoba wax esters that were transesterified with proportionate blends of completely hydrogenated wax esters,” does not comprise any free fatty alcohols. Ex. 1009, Abstract, 295-96; *see also* my discussion of claim 1 above (describing the combination including the feedstock composition).

128. It is my opinion that Cummings in view of Xu and/or in further view of Sessa renders obvious claim 3 for the same reasons as claim 1.

4. Claim 5

“The process of claim 1, wherein the feedstock does not comprise any methyl esters.”

129. The combination that renders claim 1 obvious teaches a feedstock that “does not comprise any methyl esters.” In particular, Cummings alone and/or in view of Sessa discloses this limitation for the reasons stated in reference to limitation 1[a]. A POSITA would have understood that the feedstock of Cummings alone and/or as modified by the teachings of Sessa, which discloses transesterified blends “consisting of native jojoba wax esters that were transesterified with proportionate blends of completely hydrogenated wax esters,” does not comprise any methyl

esters. Ex. 1009, Abstract, 295-96; *see also* my discussion of claim 1 above (describing the combination including the feedstock composition).

130. It is my opinion that Cummings in view of Xu and/or in further view of Sessa renders obvious claim 5 for the same reasons as claim 1.

B. *Trans* Isomers 2 in view of Xu and/or in further view of Sessa Renders Obvious Claims 1, 2, 3, and 5.

131. In my opinion, the combination of *Trans* Isomers 2 in view of Xu and/or in further view of Sessa discloses and renders obvious claims 1, 2, 3, and 5. *Trans* Isomers 2 discloses the claimed steps. *Trans* Isomers 2 does not detail use of a lipase; nor does it expressly disclose (in words) the specific percentage by weight of the hydrogenated jojoba wax esters in the feedstock (albeit it does disclose detailed information that a POSITA can use to calculate such percentage). A POSITA would have found these obvious, however, by looking in Xu and, as necessary, Sessa, respectively.

132. As I discuss below with respect to claims 1, 2, 3, and 5, it would have been obvious to a POSITA to (i) modify the process of transesterifying a feedstock comprising jojoba wax esters and fully hydrogenated jojoba wax esters taught in *Trans* Isomers 2, which generates a transesterified product (jojoba esters) having an OSI greater than the OSI of the feedstock, with (ii) the lipase catalyst expressly taught in Xu and, (iii) to the extent it is found not to be disclosed by *Trans* Isomers

2 itself, the feedstock containing 20% to 50% by weight of hydrogenated jojoba wax esters expressly taught in Sessa.

133. As I discuss below for steps 1[a], 1[b], and 1[c], the combination of *Trans* Isomers 2 in view of Xu and/or in further view Sessa discloses a process for transesterifying wax esters that includes each of the claimed steps.

134. As I also discussed above and below, a POSITA would have combined these references because they (i) pertain to the same fields (lipid chemistry, food and cosmetic ingredients); (ii) discuss the same class of chemical reactions (transesterification and interesterification); (iii) seek to achieve the same results (improved physical properties); and (iv) in *Trans* Isomers 2 and Sessa, identify the same contributors (FloraTech and Kleiman).

1. Claim 1

1[preamble] “A process for transesterifying wax esters, the process comprising:”

135. Regardless of whether the preamble is found to limit claim 1, it is disclosed by *Trans* Isomers 2, as I discuss immediately below regarding 1[preamble] and further regarding limitations 1[a] to 1[c].

136. *Trans* Isomers 2 discloses a process for transesterifying wax esters. Ex. 1006, 1-2, Fig. 4; Ex. 1014, 5-6, Fig. 4 (explaining that jojoba esters are “[a] complex mixture of esters produced by the transesterification/ interesterification of *Simmondsia Chinensis* (Jojoba) Oil, Hydrogenated Jojoba Oil, or a transesterified

mixture of the two. Figure 4 represents the interesterification reaction between (I) jojoba oil (only *cis* isomers) and (II) fully hydrogenated jojoba oil (no *cis* or *trans* isomers).”).⁵ Combining *Trans* Isomers 2 and Xu (and Sessa) is further discussed below.

1[a] “providing a feedstock comprising jojoba wax esters and hydrogenated jojoba wax esters, wherein the amount of hydrogenated jojoba wax esters is 20% to 50% by weight of the feedstock;”

137. *Trans* Isomers 2 alone and/or in view of Sessa discloses the step of “providing a feedstock comprising jojoba wax esters and hydrogenated jojoba wax esters, wherein the amount of hydrogenated jojoba wax esters is 20% to 50% by weight of the feedstock.”

138. First, *Trans* Isomers 2 discloses providing a feedstock comprising jojoba wax esters and hydrogenated jojoba wax esters. For example, *Trans* Isomers 2 discloses that jojoba esters are “[a] complex mixture of esters produced by the transesterification/ interesterification of *Simmondsia Chinensis* (Jojoba) Oil, Hydrogenated Jojoba Oil, or a transesterified mixture of the two. Figure 4 represents the interesterification reaction between (I) jojoba oil (only *cis* isomers) and (II) fully

⁵ As I discussed in footnote 3 above, I again note that the Patent Owner has accused Petitioner’s interesterification process of infringement.

hydrogenated jojoba oil (no *cis* or *trans* isomers).” Ex. 1014, 5-6, Fig. 4; Ex. 1006, 1, Fig. 4.

139. Second, *Trans Isomers 2* does not expressly identify (in words) a specific numerical percentage of hydrogenated jojoba oil compared to its feedstock (*i.e.*, “wherein the amount of hydrogenated jojoba wax esters is 20% to 50% of the feedstock”). However, a POSITA would have understood that *Trans Isomers 2* nonetheless discloses the claimed limitation (*i.e.*, “wherein the amount of hydrogenated jojoba wax esters is 20% to 50% by weight of the feedstock”) based on the IV and additional disclosures which can be used to calculate the percentage. For example, Table 2 of *Trans Isomers 2* (below), depicts certain physical properties of various grades of transesterified jojoba ester product (Jojoba Esters 15, 20, 30, 60, and 70) including the IV range of the various grades of jojoba ester in units of g I₂/100 g of sample as shown below. *See* Ex. 1006, 3, Table 2; Ex. 1014, 7, Table 2 (I have added the red box annotation below for the IV):

TABLE 2. CHEMICAL AND PHYSICAL PROPERTIES OF JOJOBA ESTERS						
Jojoba Ester	Melting Point °C	Iodine Value g I ₂ /100g	Oxidative Stability Value, Hours	Lubricity Degrees	Penetration, Mm	Monoene, Content, 0%
15	10-15	78-85	70	19.0	—	0
20	42-48	64-70	130	20.4	—	25-35
30	47-51	57-61	165	18.9	26.4	36-46
60	56-61	40-44	225	17.9	9.3	42-52
70	66-70	0-2	680	15.9	0.3	0

140. As I discussed above, it was known to a POSITA that IV is used to determine the degree of unsaturation—or the number of double bonds—in fats, oils and waxes. *See supra* § IX.A.1 (limitation 1[a]); Ex. 1023, 789, 792; Ex. 1024, 1-2;

Ex. 1030, 47; *see also* Ex. 1006, 4; Ex. 1014, 8 (“Iodine Values [of less than 2 for Fully Hydrogenated Jojoba Oil] indicate that the double bond positions of the molecule comprising jojoba oils have been completely filled or ‘saturated’ with hydrogen”). It was also known to a POSITA how to estimate the IV of a transesterified product (the jojoba ester) based on the relative amounts of jojoba oil and hydrogenated jojoba oil, as well as the reverse—*i.e.*, how to estimate the relative amounts of jojoba oil and hydrogenated jojoba oil knowing the IV of the transesterified product (the jojoba ester). *See supra* § IX.A.1 (limitation 1[a]); Ex. 1025, 3; Ex. 1026, 214-15. Specifically, it was known to a POSITA how to derive the following equation to calculate the weight percent of hydrogenated jojoba oil required to achieve a transesterified jojoba ester product with the desired physical properties, as follows, *see supra* § IX.A.1 (limitation 1[a]):

$$wt \%_{HJO} = 100 \times \frac{(IV_{JE} - IV_{JO})}{(IV_{JO} - IV_{HJO})}$$

141. Further, as discussed above, the IV of jojoba oil was also known to a POSITA. *See supra* § IX.A.1 (limitation 1[a]); Ex. 1027, 3; Ex. 1028, 3.

142. *Trans* Isomers 2 further discloses that “Fully Hydrogenated Jojoba Oil exhibits an IV of less than 2.” Ex. 1006, 4; Ex. 1014, 8. Thus, a POSITA would have understood that the IV of hydrogenated jojoba oil (IV_{HJO}) may range from 0 to 2. *See* Ex. 1006, 4; Ex. 1014, 8.

143. As shown below in my Table C, below, of this Declaration, the estimated amount of hydrogenated jojoba oil—expressed as the weight percent of a feedstock consisting of jojoba oil and hydrogenated jojoba wax esters—required to achieve the Jojoba Esters 15, 20, 30, 60, and 70 with the IV reported in Table 2 of *Trans Isomers 2*, can therefore be calculated using the equation immediately above. Also, as shown below, a POSITA would have understood from Table 2 of *Trans Isomers 2* that the amount of fully hydrogenated jojoba wax esters is between 3.7% and 100% by weight of the feedstock, which includes the range of 20% to 50% by weight of the feedstock claimed in claim 1 (I note that individual products are inside the claimed range).

Table C			
Jojoba Ester	IV_{JE} Range From <i>Trans</i> Isomers 2, Table 2	IV_{HJO} Range From <i>Trans</i> Isomers 2, 47	Est. Hydrogenated Jojoba Oil Content Of Feedstock (Wt %)
15	78-85	<2 (<i>i.e.</i> , 0-2)	3.7-4.6
20	64-70	<2 (<i>i.e.</i> , 0-2)	21-21.8
30	57-61	<2 (<i>i.e.</i> , 0-2)	29.6-32.2
60	40-44	<2 (<i>i.e.</i> , 0-2)	50.6-51.7
70	0-2	<2 (<i>i.e.</i> , 0-2)	100

144. In addition, as I explained herein, to the extent *Trans Isomers 2* does not disclose the claimed percentage (it does, as I have discussed), a POSITA would still have found it obvious to modify the process disclosed in *Trans Isomers 2* to include 20% to 50% by weight of hydrogenated jojoba wax esters in the feedstock, as disclosed in Sessa. *See* Ex. 1009, 296.

145. As I discussed above, Sessa discloses the limitation, “wherein the amount of hydrogenated jojoba wax esters is 20% to 50% by weight of the feedstock.” *See supra* § IX.A.1 (limitation 1[a]); Ex. 1009, Abstract, 295-96.

146. That is, to the extent *Trans* Isomers 2 does not itself disclose the claimed percentage (although it is my opinion that a POSITA would have found that it does, as I discussed above), as evidenced by *Trans* Isomers 2 and Sessa and the state of the art, a POSITA would have thought to and found it advantageous (including finding it a matter of routine optimization) to vary the amount of hydrogenated jojoba wax esters in the feedstock disclosed in *Trans* Isomers 2 to an amount that is 20% to 50% by weight of the feedstock as disclosed in Sessa to obtain desirable and/or improved physical properties (such as oxidative stability and melting characteristics) in the transesterified product, and would have had a reasonable expectation of success, as doing so was nothing more than routine variation. For example, *Trans* Isomers 2 itself discloses that:

The interesterification reaction used to produce *trans* free emollients is one in which a fully hydrogenated lipid material (no *trans* isomers) is reacted with neat oil containing only *cis* isomers. The resulting product is an isomorphous mixture of partially saturated, saturated and unsaturated esters that contain no *trans* isomers. This route [] produce[s] “*Trans* Free” oxidatively stable emollients with a broad range of melting characteristics. . . .

Jojoba Esters are an ideal model to use to demonstrate the trans free interesterification reaction and the properties of the resulting components. The CTFA Ingredient Dictionary defines Jojoba Esters as: A complex mixture of esters produced by the transesterification/interesterification of Simmondsia Chinensis (Jojoba) Oil, Hydrogenated Jojoba Oil, or a transesterified mixture of the two.

Ex. 1014, 5; Ex. 1006, 1.

147. Likewise, as discussed in § IX.A.1 (limitation 1[a]), Sessa discloses that the thermal properties of a transesterified product can be optimized by varying the amount of hydrogenated jojoba wax esters in a feedstock. *See* Ex. 1009, Abstract, 298.

148. Further, also as evidenced by the state of the art herein and my above explanations, the ability to engineer specific physical properties in a transesterified product by manipulating the ratio of jojoba oil to hydrogenated jojoba oil in a feedstock would have been within the background knowledge possessed by a POSITA, as discussed in § IX.A.1 (limitation 1[a]). *See* Ex. 1004, 1-2; Ex. 1009, 298, Abstract; Ex. 1012, 675; Ex. 1013, 878.

149. Therefore, based on these disclosures, a POSITA would have understood that *Trans* Isomers 2 alone and/or in view of Sessa disclose the claimed step of “providing a feedstock comprising jojoba wax esters and hydrogenated

jojoba wax esters, wherein the amount of hydrogenated jojoba wax esters is 20% to 50% by weight of the feedstock.”

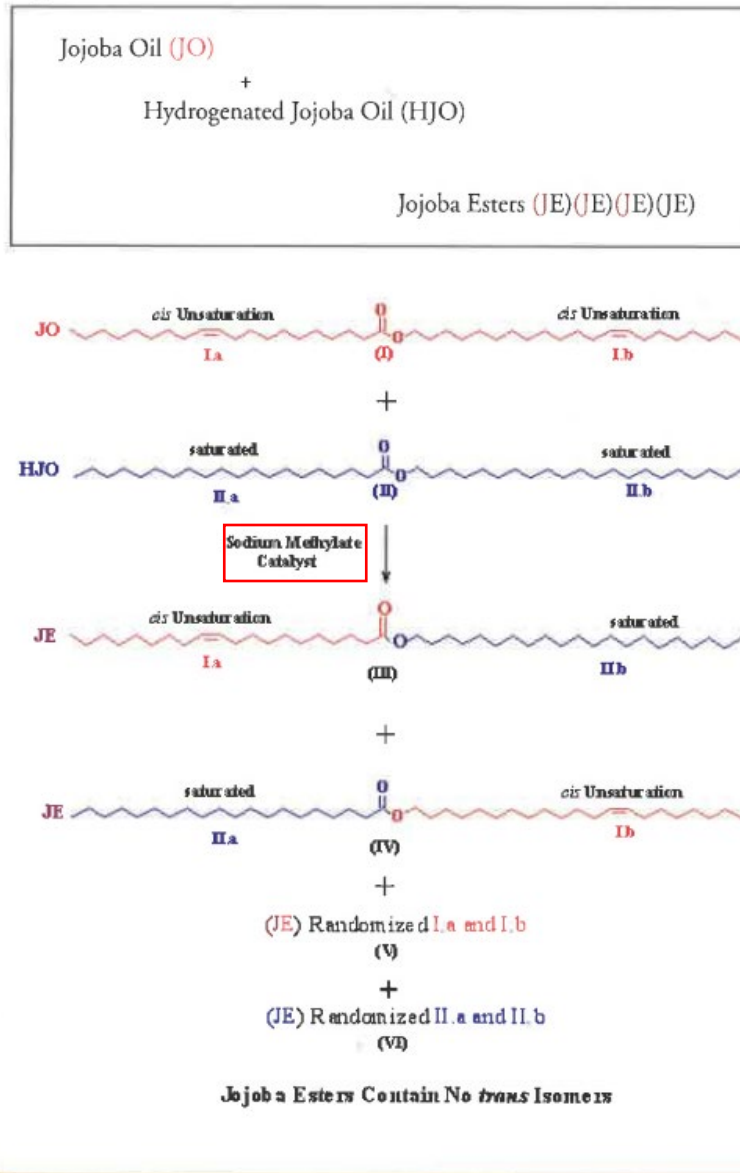
150. And, for the reasons explained above, in my opinion, it would have been obvious to a POSITA to combine *Trans* Isomers 2 in view of Sessa.

1[b] “contacting the feedstock with a lipase; and transesterifying the jojoba wax esters and the hydrogenated jojoba wax esters in the feedstock with the lipase to form a transesterified product;”

151. The combination of *Trans* Isomers 2 and Xu discloses “contacting the feedstock with a lipase; and transesterifying the jojoba wax esters and the hydrogenated jojoba wax esters in the feedstock with the lipase to form a transesterified product.” I incorporate my discussion of the preamble here.

152. *Trans* Isomers 2, Ex. 1006, 2, Figure 4 and Exhibit 1014, 6, Figure 4 (which I have annotated with a red box below to highlight the sodium methyllate catalyst), discloses providing a feedstock including jojoba oil and hydrogenated jojoba oil and applying a sodium methyllate catalyst (*i.e.*, a chemical catalyst) to the combination of jojoba oil and hydrogenated jojoba oil. A POSITA would have understood this disclosure as showing the catalyst is interacting with (or “contacting”) the feedstock (which, in *Trans* Isomers 2, consists only of jojoba oil and hydrogenated jojoba oil) to facilitate the transesterification process:

Figure 4



153. As I noted above, *Trans* Isomers 2 does not expressly disclose “contacting the feedstock with a lipase” but a POSITA would have found it obvious to modify the chemically catalyzed process of *Trans* Isomers 2 to use the lipase, as disclosed in Xu, as the catalyst. Ex. 1008, 296-99, Figs. 15, 18. As I have discussed, Xu discloses using lipases as a catalyst in interesterification/transesterification

reactions and that interesterification and transesterification both refer to the same class of reactions, including alcoholysis and/or ester-ester exchange reactions, and that lipases can be used to catalyze such class of reactions. Ex. 1008, 296-99, Figs. 15, 18 (below).

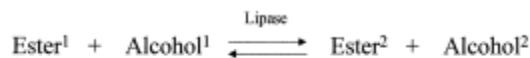
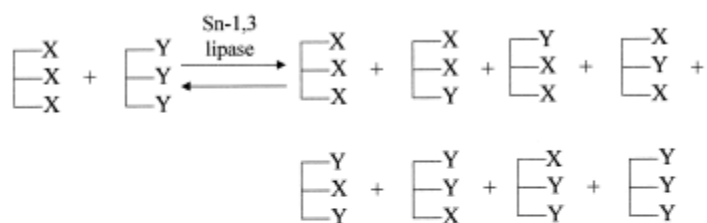


Fig. 15. An illustration enzymatic alcoholysis.



X and Y are two types of fatty acids.

Fig. 18. Reaction scheme of enzymatic ester-ester exchange between two triacylglycerols (XXX and YYY) with *sn*-1,3 specific lipases.

154. A POSITA would have been motivated to replace, and had a reasonable expectation of success in replacing, the chemical catalyst of *Trans* Isomers 2 with a lipase as disclosed in Xu as the catalyst in the *Trans* Isomers 2 reaction for the reasons stated in Xu. Ex 1008, 289, 301. For example, Xu discloses that the use of chemical catalysts in industry can be “fully replaced” with the use of lipases, and that the industry has several reasons to do so, including, Ex. 1008, 289:

- very interesting products and potential market demands,
- improvement of product quality refereeing to mild conditions,

- reduction of enzyme price and balanced economy in general,
- simple processes and low investment,
- environmental considerations,
- customer perception and marketing strategy,
- know-how preparation and technology takeover/control.

See also id. (“This list can be prolonged: ‘image’ strategy by using enzyme technology is important for many industrial companies; energy-efficiency of the technology is also often mentioned.”).

155. Further, as evidenced by the state of the art herein and in my above explanations, replacing chemical catalysts in interesterification and/or transesterification processes with lipases would have been within the background knowledge possessed by a POSITA, as discussed in § IX.A.1 (limitation 1[b]). *See* Ex. 1012, 676; Ex. 1013, 877.

156. Therefore, based on these disclosures, a POSITA would have understood that *Trans* Isomers 2 in view of Xu disclose the claimed step of “contacting the feedstock with a lipase; and transesterifying the jojoba wax esters and the hydrogenated jojoba wax esters in the feedstock with the lipase to form a transesterified product[.]”

157. And, for the reasons explained above, in my opinion, it would have been obvious to a POSITA to contact the feedstock described by *Trans* Isomers 2

with a lipase catalyst as described in Xu to transesterify the jojoba wax esters and the hydrogenated jojoba wax esters in the feedstock with the lipase to form a transesterified product.

1[c] “wherein an oxidative stability index (OSI) of the transesterified product is greater than an OSI of the feedstock.”

158. *Trans* Isomers 2 discloses “wherein an oxidative stability index (OSI) of the transesterified product is greater than an OSI of the feedstock.” *Trans* Isomers 2 discloses in Table 4 (below) that the OSI of jojoba esters is significantly greater than the OSI of partially hydrogenated jojoba oils exhibiting identical melting points. Ex. 1006, 4, Table 4; Ex. 1014, 6-7, Table 4.

Sample	Melting Point °C	Iodine Value g I/100g of Sample	% Trans	Oxidative Stability Index, Hours	Index of Refraction μ_D^{20} @ 80°C	Penetrometer, Mm	Slip, Cadcamo, Degress (1%)	Slip, IFT, Degress (100%)
Jojoba Esters 30	49	58	0	165	1.4418	26.4	18.9	23
Jojoba oil Partial Hydrogenate	49	69	11	27	1.4435	—	19.3	>25
Jojoba Esters 60	59	42	0	225	1.4403	9.3	17.9	14.1
Jojoba Oil Partial Hydrogenate	59	49	37	108	1.4408	5.2	18.1	15.4

159. For example, the “Jojoba Esters 30” and “Jojoba Esters 60” had OSIs of 165 and 225, respectively, which were significantly greater than the OSIs of the partially hydrogenated jojoba oils exhibiting identical melting points, which were 27 and 108 hours. Ex. 1006, 4, Table 4; Ex. 1014, 6-7, Table 4. This demonstrates to a POSITA that such POSITA could achieve—and had a reasonable expectation of success of achieving—an OSI of the transesterified product (jojoba esters) that is

greater than the OSI of a feedstock containing jojoba oil and hydrogenated jojoba oil.

160. Further, as evidenced by the state of the art herein and in my above explanations, the transesterification of fats, oils and wax esters—including in lipase-catalyzed processes and processes involving jojoba wax esters and hydrogenated jojoba wax esters—can produce a product having improved—and thus greater—oxidative stability would have been within the background knowledge possessed by a POSITA, as discussed in § IX.A.1 (limitation 1[c]). *See* Ex. 1015, [0005]; Ex. 1016, [0031]; Ex. 1017, 245; Ex. 1018, C371.

161. Again, the above evidence rebuts any assertion by Patent Owner that increased OSI is an unexpected result of transesterifying jojoba esters and hydrogenated jojoba esters, using a lipase. *See* § IX.A.1 (limitation 1[c]).

2. Claim 2

“The process of claim 1, wherein the feedstock consists essentially of the jojoba wax esters and the hydrogenated jojoba wax esters.”

162. I am informed that claim 2—by use of “consists essentially of”—limits claim 1 by restricting the feedstock to only the jojoba wax esters, the hydrogenated jojoba wax esters, and only those additional materials that do not materially affect the basic and novel properties of the invention (such as indicated in the claim itself, improved OSI). The combination that renders claim 1 obvious also teaches such a feedstock, as there are no additional materials in the disclosed feedstock that

materially affect the basic and novel properties of the invention (such as indicated in the claim itself, improved OSI) in such combination—there is, for example, no teaching of requiring the addition of other feedstock materials, such as an OSI-increasing antioxidant. *See* Ex. 1006, 1-2, Fig. 4; Ex. 1005, 2-3; Ex. 1014, 5-6, Fig. 4; Ex. 1008, 289-90, 296-99, 301, Figs. 15, 18; Ex. 1009, 295-96; *see also* my discussion of claim 1 above (describing the combination, including the feedstock composition).

163. It is my opinion that *Trans* Isomers 2 in view of Xu and/or in further view of Sessa renders obvious claim 2 of the same reasons as claim 1.

3. Claim 3

“The process of claim 1, wherein the feedstock does not comprise any free fatty alcohols.”

164. The combination that renders claim 1 obvious teaches a feedstock that “does not comprise any free fatty alcohols.” In particular, *Trans* Isomers 2 alone and/or in view of Sessa discloses this limitation for the reasons stated in reference to limitation 1[a]. A POSITA would have understood that the feedstock of *Trans* Isomers 2 modified by the teachings of Sessa, which discloses calibration sets “consisting of native jojoba wax esters that were transesterified with proportionate blends of completely hydrogenated wax esters,” does not comprise any free fatty alcohols. Ex. 1009, Abstract, 295-96; *see also* my discussion of claim 1 above (describing the combination, including the feedstock composition).

165. It is my opinion that *Trans* Isomers 2 in view of Xu and/or in further view of Sessa renders obvious claim 3 of the same reasons as claim 1.

4. Claim 5

“The process of claim 1, wherein the feedstock does not comprise any methyl esters.”

166. The combination that renders claim 1 obvious teaches a feedstock that “does not comprise any methyl esters.” In particular, *Trans* Isomers 2 alone and/or in view of Sessa discloses this limitation for the reasons stated in reference to limitation 1[a]. A POSITA would have understood that the feedstock of *Trans* Isomers 2 modified by the teachings of Sessa, which discloses calibration sets “consisting of native jojoba wax esters that were transesterified with proportionate blends of completely hydrogenated wax esters,” does not comprise any methyl esters. Ex. 1009, Abstract, 295-96; *see also* my discussion of claim 1 above (describing the combination, including the feedstock composition).

167. It is my opinion that *Trans* Isomers 2 in view of Xu and/or in further view of Sessa renders obvious claim 5 of the same reasons as claim 1.

C. *Trans* Isomers 2 in view of *Trans* Isomers 1 and/or in further view of Sessa Renders Obvious Claims 1, 2, 3 and 5.

168. In my opinion, the combination of *Trans* Isomers 2 in view of *Trans* Isomers 1 and/or in further view of Sessa discloses and renders obvious claims 1, 2, 3, and 5. *Trans* Isomers 2 discloses the claimed steps. *Trans* Isomers 2 does not detail use of a lipase; nor does it expressly disclose (in words) the specific percentage

by weight of the hydrogenated esters in the feedstock (albeit it does disclose detailed information that a POSITA can use to calculate such percentage). A POSITA would have found these obvious, however, by looking in *Trans* Isomers 1⁶ and, as necessary, Sessa, respectively.

169. As I discuss below with respect to claims 1, 2, 3, and 5, it would have been obvious to a POSITA to (i) modify the process for transesterifying jojoba oil and fully hydrogenated jojoba wax esters taught in *Trans* Isomers 2, which generates a transesterified product (jojoba esters), wherein the jojoba esters have an OSI greater than the feedstock, with (ii) the enzyme catalyst expressly taught in *Trans* Isomers 1 and, (iii) to the extent it is found not to be disclosed by *Trans* Isomers 2 itself, the feedstock containing 20% to 50% by weight of hydrogenated jojoba wax esters expressly taught in Sessa.

170. As I also discuss below for steps 1[a], 1[b], and 1[c], the combination of *Trans* Isomers 2 in view of *Trans* Isomers 1 and/or in further view of Sessa discloses a process for transesterifying wax esters that includes each of the claimed steps.

⁶ The '245 patent defines "lipase" broadly, reciting, "[a]s used herein, 'lipase' means any enzyme or protein capable of being used in a transesterification reaction of a wax ester." Ex. 1001, 4:63-65.

171. As I also discussed above and below, a POSITA would have combined these references because they (i) pertain to the same fields (lipid chemistry, food and cosmetic ingredients); (ii) discuss the same class of chemical reactions (transesterification and interesterification); (iii) seek to achieve the same results (improved physical properties and lack of *trans* isomers); and, (iv) with respect to *Trans* Isomers 1 and 2, being published as a series in two consecutive issues of the same publication and sharing the same authors, Brown and Kleiman, both from FloraTech (and, in effect, the latter being a continuation of the former, which a reader might consider a singular disclosure).

1. Claim 1

1[preamble] “A process for transesterifying wax esters, the process comprising:”

172. Regardless of whether the preamble is found to limit claim 1, it is disclosed by *Trans* Isomers 2, as I discuss immediately below regarding 1[preamble] and further regarding limitations 1[a] to 1[c].

173. *Trans* Isomers 2 discloses a process for transesterifying wax esters. Ex. 1006, 1-2, Fig. 4; Ex. 1014, 5-6, Fig. 4 (explaining that jojoba esters are “[a] complex mixture of esters produced by the transesterification/interesterification of Simmondsia Chinensis (Jojoba) Oil, Hydrogenated Jojoba Oil, or a transesterified mixture of the two. Figure 4 represents the interesterification reaction between (I)

jojoba oil (only *cis* isomers) and (II) fully hydrogenated jojoba oil (no *cis* or *trans* isomers).”).⁷

1[a] “providing a feedstock comprising jojoba wax esters and hydrogenated jojoba wax esters, wherein the amount of hydrogenated jojoba wax esters is 20% to 50% by weight of the feedstock;”

174. *Trans* Isomers 2 alone and/or in view of Sessa discloses the step of “providing a feedstock comprising jojoba wax esters and hydrogenated jojoba wax esters, wherein the amount of hydrogenated jojoba wax esters is 20% to 50% by weight of the feedstock” for the reasons I discussed above in § IX.B.1 (limitation 1[a]). *See* Ex. 1006, 1-2, Fig. 4; Ex. 1014, 5-6, Fig. 4; Ex. 1009, 296.

175. First, as I discussed above, *Trans* Isomers 2 discloses providing a feedstock comprising jojoba wax esters and hydrogenated jojoba wax esters. *See supra* § IX.B.1 (limitation 1[a]); Ex. 1006, 1-2, Fig. 4; Ex. 1014, 5-6, Fig. 4.

176. Second, as I discussed above, *Trans* Isomers 2 does not expressly identify a specific numerical percentage of hydrogenated jojoba oil compared to its feedstock (*i.e.*, “wherein the amount of hydrogenated jojoba wax esters is 20% to 50% of the feedstock”). However, as I also discussed above, a POSITA would have understood that *Trans* Isomers 2 nonetheless discloses the claimed limitation (*i.e.*,

⁷ As I discussed in footnote 3 above, I again note that the Patent Owner has accused Petitioner’s interesterification process of infringement.

“wherein the amount of hydrogenated jojoba wax esters is 20% to 50% by weight of the feedstock”) based on the IV and additional disclosures which can be used to calculate the percentage, for example Table 2 of *Trans* Isomers 2 (below), which depicts certain physical properties of various grades of transesterified jojoba ester product (Jojoba Esters 15, 20, 30, 60, and 70) including the IV range of the various grades of jojoba ester in units of g I₂/100 g of sample (as shown below). *See* Ex. 1006, 2-3, Table 2; Ex. 1014, 7, Table 2 (I have added the red box annotation):

TABLE 2. CHEMICAL AND PHYSICAL PROPERTIES OF JOJOBA ESTERS						
Jojoba Ester	Melting Point °C	Iodine Value g I ₂ /100g	Oxidative Stability Value, Hours	Lubricity Degrees	Penetration, Mm	Monoene, Content, 0%
15	10-15	78-85	70	19.0	—	0
20	42-48	64-70	130	20.4	—	25-35
30	47-51	57-61	165	18.9	26.4	36-46
60	56-61	40-44	225	17.9	9.3	42-52
70	66-70	0-2	680	15.9	0.3	0

177. As I discussed above, it was known to a POSITA that IV is used to determine the degree of unsaturation—or the number of double bonds—in fats, oils and waxes. *See supra* §§ IX.A.1 (limitation 1[a]), IX.B.1 (limitation 1[a]); Ex. 1023, 789, 792; Ex. 1024, 1-2; Ex. 1030, 47; *see also* Ex. 1006, 4; Ex. 1014, 7. It was also known to a POSITA how to estimate the IV of a transesterified product (the jojoba ester) based on the relative amounts of jojoba oil and hydrogenated jojoba oil, as well as the reverse—*i.e.*, how to estimate the relative amounts of jojoba oil and hydrogenated jojoba oil knowing the IV of the transesterified product (the jojoba ester). *See supra* § IX.A.1 (limitation 1[a]); Exs. 1025, 3; Ex. 1026, 214-15. Further, as discussed above, the IV range of jojoba wax esters was also known to a POSITA

and *Trans* Isomers 2 discloses the IV of fully hydrogenated jojoba oil. *See supra* §§ IX.A.1 (limitation[a]), IX.B.1 (limitation 1[a]); Ex. 1006, 4; Ex. 1014, 7; Ex. 1027, 3; Ex. 1028, 3; *see also* Ex. 1004, 2, Fig. 1. Using such knowledge, and as shown immediately below in my Table C of this Declaration, a POSITA would have known how to estimate the weight percentage of hydrogenated jojoba oil the feedstock used to prepare each of Jojoba Esters 15, 20, 30, 60, and 70 using the IV of such materials listed in Table 2 of *Trans* Isomers 2 and the IV of fully hydrogenated jojoba oil identified in page 47 of *Trans* Isomers 2. Also, as shown below, a POSITA would have understood from Table 2 of *Trans* Isomers 2 that the amount of fully hydrogenated jojoba wax esters is between 3.7% and 100% by weight of the feedstock, which includes the range of 20% to 50% by weight of the feedstock claimed in claim 1.

Table C			
Jojoba Ester	IV_{JE} Range From <i>Trans</i> Isomers 2, Table 2	IV_{HJO} Range From <i>Trans</i> Isomers 2, 47	Est. Hydrogenated Jojoba Oil Content Of Feedstock (Wt %)
15	78-85	<2 (<i>i.e.</i> , 0-2)	3.7-4.6
20	64-70	<2 (<i>i.e.</i> , 0-2)	21-21.8
30	57-61	<2 (<i>i.e.</i> , 0-2)	29.6-32.2
60	40-44	<2 (<i>i.e.</i> , 0-2)	50.6-51.7
70	0-2	<2 (<i>i.e.</i> , 0-2)	100

178. In addition, as I explained herein, to the extent *Trans* Isomers 2 does not disclose the claimed percentage (it does, as I have discussed), a POSITA would still have found it obvious to modify the process disclosed in *Trans* Isomers 2 to

include 20% to 50% by weight of hydrogenated jojoba wax esters in the feedstock, as disclosed in Sessa. *See* § IX.B.1 (limitation 1[a]); Ex. 1009, 296.

179. As I discussed in § IX.A.1 (limitation 1[a]), Sessa discloses the limitation, “wherein the amount of hydrogenated jojoba wax esters is 20% to 50% by weight of the feedstock.” *See supra* § IX.A.1 (limitation 1[a]); Ex. 1009, Abstract, 295-96. And, to the extent *Trans Isomers 2* does not itself disclose the percentage (although, again, it is my opinion that a POSITA would have found that it does, as I discussed above), as discussed in § IX.B.1 (limitation 1[a]), a POSITA would have thought to and found it advantageous (including finding it a matter of routine optimization) to vary the amount of hydrogenated jojoba wax esters in the feedstock disclosed in *Trans Isomers 2* to an amount that is 20% to 50% by weight of the feedstock as disclosed in Sessa to obtain desirable and/or improved physical properties (such as oxidative stability and melting characteristics) in the transesterified product, and would have had a reasonable expectation of success, as doing so was nothing more than routine variation. Ex. 1014, 5; Ex. 1006, 1. Likewise, as discussed in § IX.A.1 (limitation 1[a]), Sessa discloses that the thermal properties of a transesterified product can be optimized by varying the amount of hydrogenated jojoba wax esters in a feedstock. *See* Ex. 1009, Abstract, 298.

180. Further, also as evidenced by the state of the art herein and my above explanations, the ability to engineer specific physical properties in a transesterified

product by manipulating the ratio of jojoba wax esters to hydrogenated jojoba wax esters in a feedstock would have been within the background knowledge possessed by a POSITA, as discussed in § IX.A.1 (limitation 1[a]). *See* Ex. 1004, 1-2; Ex. 1009, 298, Abstract; Ex. 1012, 675; Ex. 1013, 878.

181. Therefore, based on these disclosures, a POSITA would have understood that *Trans* Isomers 2 alone and/or in view of Sessa disclose the claimed step of “providing a feedstock comprising jojoba wax esters and hydrogenated jojoba wax esters, wherein the amount of hydrogenated jojoba wax esters is 20% to 50% by weight of the feedstock.”

182. And, for the reasons I discussed in § IX.B.1 (limitation 1[a]), above, in my opinion, it would have been obvious to a POSITA to combine *Trans* Isomers 2 in view of Sessa.

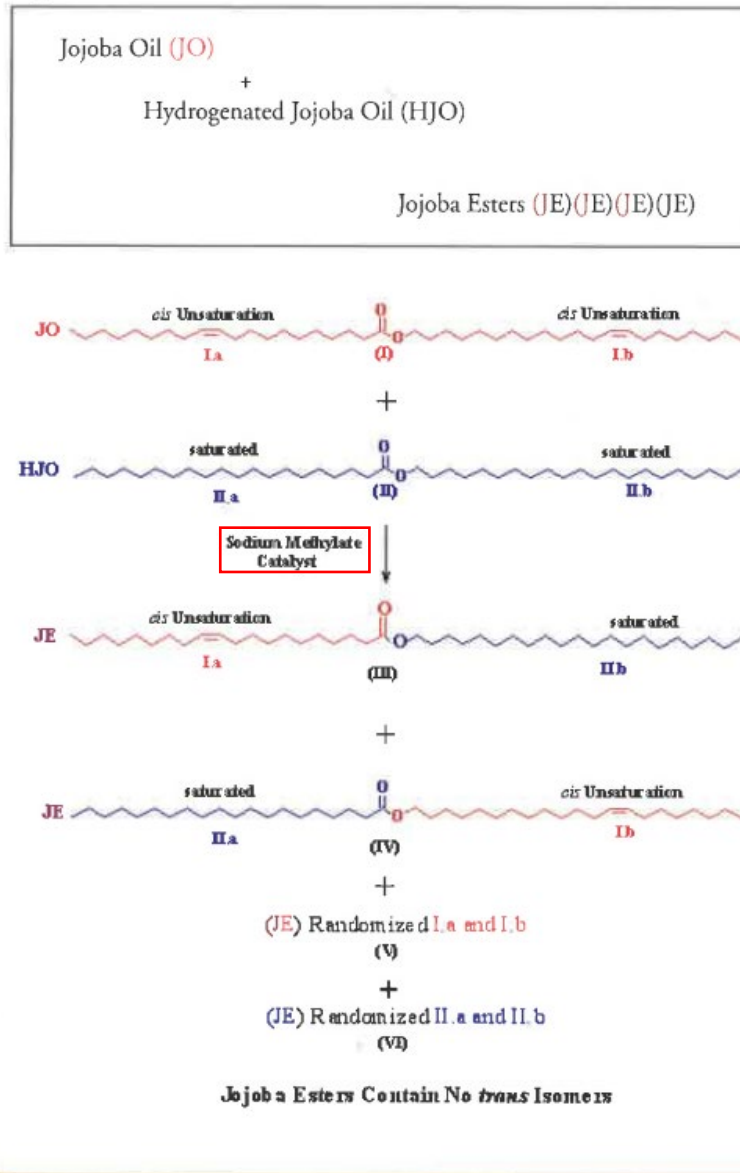
1[b] “contacting the feedstock with a lipase; and transesterifying the jojoba wax esters and the hydrogenated jojoba wax esters in the feedstock with the lipase to form a transesterified product;”

183. The combination of *Trans* Isomers 2 and *Trans* Isomers 1 discloses “contacting the feedstock with a lipase; and transesterifying the jojoba wax esters and the hydrogenated jojoba wax esters in the feedstock with the lipase to form a transesterified product.” I incorporate my discussion of the preamble here.

184. *Trans* Isomers 2, Ex. 1006, 2, Fig. 4 and Ex. 1014, 6, Fig. 4 (which I have annotated with a red box below to highlight the sodium methylate catalyst),

discloses providing a feedstock including jojoba oil and hydrogenated jojoba oil and applying a sodium methyleate catalyst (*i.e.*, a chemical catalyst) to the combination of jojoba oil and hydrogenated jojoba oil. A POSITA would have understood this disclosure as showing the catalyst is interacting with (or “contacting”) the feedstock (which, in *Trans* Isomers 2, consists only of jojoba oil and hydrogenated jojoba oil) to facilitate the transesterification process:

Figure 4



185. As I noted above, *Trans* Isomers 2 does not expressly disclose “contacting the feedstock with a lipase” but, a POSITA would have found it obvious to modify the catalyzed process of *Trans* Isomers 2 to use the enzyme⁸, as disclosed

⁸ See *supra* n. 6.

in *Trans* Isomers 1 as the catalyst. Ex. 1005, 3-4; Ex. 1014, 3. *Trans* Isomers 1—the first in the two-part series with *Trans* Isomers 2—discloses using enzymes as a catalyst in interesterification/transesterification reactions and that interesterification and transesterification refer to “[t]he catalyzed chemical reaction between two or more esters in which the acids and alcohols present are recombined in a random manner” and that enzymes can be used to catalyze such reactions. Ex. 1005, 3 (“Rozenaal discussed use of th[e] interesterification process...using various catalysts including enzymes.”); Ex. 1014, 3.

186. A POSITA would have been motivated to use, and had a reasonable expectation of success in replacing, the chemical catalyst of *Trans* Isomers 2 with an enzyme disclosed in *Trans* Isomers 1 as the catalyst in the *Trans* Isomers 2 reaction to, for example, as disclosed in *Trans* Isomers 1, “provide manufacturers with oxidatively stable and affordable lipid based emollients that exhibit a broad range of melting points yet which contain no *trans* fatty isomers.” Ex. 1014, 3; Ex. 1005, 3. A POSITA would further have been motivated to combine the teachings of *Trans* Isomers 2 with the teachings of *Trans* Isomers 1 because *Trans* Isomers 2 specifically refers and cites to *Trans* Isomers 1, calling it “Part 1 of this series.” See Ex. 1006, 1 and 5; Ex. 1014, 5 and 7.

187. Further, as evidenced by the state of the art herein and in my above explanations, replacing chemical catalysts in interesterification/ transesterification

processes with lipases would have been within the background knowledge possessed by a POSITA, as discussed in § IX.A.1 (limitation 1[b]). *See* Ex. 1012, 676; Ex. 1013, 877.

188. Therefore, based on these disclosures, a POSITA would have understood that *Trans* Isomers 2 in view of *Trans* Isomers 1 disclose the claimed step of “contacting the feedstock with a lipase; and transesterifying the jojoba wax esters and the hydrogenated jojoba wax esters in the feedstock with the lipase to form a transesterified product[.]”

189. And, for the reasons explained above, in my opinion, it would have been obvious to a POSITA to contact the feedstock described by *Trans* Isomers 2 with an enzyme⁹ catalyst as described in *Trans* Isomers 1 to transesterify the jojoba wax esters and the hydrogenated jojoba wax esters in the feedstock with the lipase to form a transesterified product.

1[c] “wherein an oxidative stability index (OSI) of the transesterified product is greater than an OSI of the feedstock.”

190. *Trans* Isomers 2 discloses “wherein an oxidative stability index (OSI) of the transesterified product is greater than an OSI of the feedstock.” *Trans* Isomers

⁹ Again, the '245 patent defines “lipase” broadly, reciting, “[a]s used herein, ‘lipase’ means any enzyme or protein capable of being used in a transesterification reaction of a wax ester.” Ex. 1001, 4:63-65.

2 discloses, in Table 4 (below), that the OSI of jojoba esters is significantly greater than the OSI of partially hydrogenated jojoba oils exhibiting identical melting points. Ex. 1006, 4, Table 4; Ex. 1014, 6-7, Table 4.

Sample	Melting Point °C	Iodine Value g I/100g of Sample	% Trans	Oxidative Stability Index, Hours	Index of Refraction μ @80°C	Penetrometer, Mm	Slip, Cadcamo, Degress (1%)	Slip, IFT, Degress (100%)
Jojoba Esters 30	49	58	0	165	1.4418	26.4	18.9	23
Jojoba oil Partial Hydrogenate	49	69	11	27	1.4435	—	19.3	>25
Jojoba Esters 60	59	42	0	225	1.4403	9.3	17.9	14.1
Jojoba Oil Partial Hydrogenate	59	49	37	108	1.4408	5.2	18.1	15.4

191. For example, as I have discussed, the “Jojoba Esters 30” and “Jojoba Esters 60” had OSIs of 165 and 225, respectively, which were significantly greater than the OSIs of the partially hydrogenated jojoba oils exhibiting identical melting points, which were 27 and 108 hours. Ex. 1006, 4, Table 4; Ex. 1014, 6-7, Table 4. This demonstrates to a POSITA that such POSITA could achieve—and had a reasonable expectation of success of achieving—an OSI of the transesterified product (jojoba esters) that is greater than the OSI of a feedstock containing jojoba oil and hydrogenated jojoba oil.

192. Further, as evidenced by the state of the art herein and in my above explanations, the transesterification of fats, oils and wax esters—including in lipase-catalyzed processes and processes involving jojoba wax esters and hydrogenated jojoba wax esters—can produce a product having improved—and thus greater—oxidative stability would have been within the background knowledge possessed by

a POSITA, as discussed in § IX.A.1 (limitation 1[c]). *See* Ex. 1015, [0005]; Ex. 1016, [0031]; Ex. 1017, 245; Ex. 1018, C371.

193. Again, the above evidence rebuts any assertion by Patent Owner that increased OSI is an unexpected result of transesterifying jojoba esters and hydrogenated jojoba esters, using a lipase. *See* § IX.A.1 (limitation 1[c]).

2. Claim 2

“The process of claim 1, wherein the feedstock consists essentially of the jojoba wax esters and the hydrogenated jojoba wax esters.”

194. I am informed that claim 2—by use of “consists essentially of”—limits claim 1 by restricting the feedstock to only the jojoba wax esters, the hydrogenated jojoba wax esters, and only those additional materials that do not materially affect the basic and novel properties of the invention (such as indicated in the claim itself, improved OSI). The combination that renders claim 1 obvious also teaches such a feedstock, as there are no additional materials in the disclosed feedstock that materially affect the basic and novel properties of the invention (such as indicated in the claim itself, improved OSI) in such combination—there is, for example, no teaching of requiring the addition of other feedstock materials, such as an OSI-increasing antioxidant. *See* Ex. 1006, 1-2, Fig. 4; Ex. 1005, 2-3; Ex. 1014, 5-6, Fig. 4; Ex. 1008, 289-90, 296-99, 301, Figs. 15, 18; Ex. 1009, 295-96; *see also* my discussion of claim 1 above (describing the combination, including the feedstock composition).

195. It is my opinion that *Trans* Isomers 2 in view of *Trans* Isomers 1 and/or in further view of Sessa renders obvious claim 2 of the same reasons as claim 1.

3. Claim 3

“The process of claim 1, wherein the feedstock does not comprise any free fatty alcohols.”

196. The combination that renders claim 1 obvious teaches a feedstock that “does not comprise any free fatty alcohols.” In particular, *Trans* Isomers 2 alone and/or in view of Sessa discloses this limitation for the reasons stated in reference to limitation 1[a]. A POSITA would have understood that the feedstock of *Trans* Isomers 2 modified by the teachings of Sessa, which discloses calibration sets “consisting of native jojoba wax esters that were transesterified with proportionate blends of completely hydrogenated wax esters,” does not comprise any free fatty alcohols. Ex. 1009, Abstract, 295-96; *see also* my discussion of claim 1 above (describing the combination, including the feedstock composition).

197. It is my opinion that *Trans* Isomers 2 in view of *Trans* Isomers I and/or in further view of Sessa renders obvious claim 3 of the same reasons as claim 1.

4. Claim 5

“The process of claim 1, wherein the feedstock does not comprise any methyl esters.”

198. The combination that renders claim 1 obvious teaches a feedstock that “does not comprise any methyl esters.” In particular, *Trans* Isomers 2 alone/or in view of Sessa discloses this limitation for the reasons stated in reference to limitation

1[a]. A POSITA would have understood that the feedstock of *Trans* Isomers 2 modified by the teachings of Sessa, which discloses calibration sets “consisting of native jojoba wax esters that were transesterified with proportionate blends of completely hydrogenated wax esters,” does not comprise any methyl esters. Ex. 1009, Abstract, 295-96; *see also* my discussion of claim 1 above (describing the combination, including the feedstock composition).

199. It is my opinion that *Trans* Isomers 2 in view of *Trans* Isomers I and/or in further view of Sessa renders obvious claim 5 of the same reasons as claim 1.

D. Brown in view of Xu and Cummings and/or in further view of Sessa Renders Obvious Claims 1, 2, 3 and 5.

200. In my opinion, the combination of Brown in view of Xu and Cummings and/or in further view of Sessa discloses and renders obvious claims 1, 2, 3, and 5. Brown discloses the claimed steps. Brown does not detail use of a lipase; nor does it expressly disclose (in words) the specific percentage by weight of the hydrogenated jojoba wax esters in the feedstock (albeit it does disclose detailed information that a POSITA can use to calculate such percentage); nor does it disclose that the claimed steps generate a transesterified product (jojoba esters) having an OSI greater than the OSI of the feedstock. A POSITA would have found these obvious, however, by looking in Xu, Sessa (as necessary), and Cummings, respectively.

201. As I discuss below with respect to claims 1, 2, 3, and 5, it would have been obvious to a POSITA to (i) modify the process for transesterifying jojoba oil and fully hydrogenated jojoba wax esters taught in Brown with (ii) the lipase catalyst expressly taught in Xu and (iii) to the extent it is found not to be disclosed by *Trans Isomers 2* itself, with the feedstock containing 20% to 50% by weight of hydrogenated jojoba wax esters expressly taught in Sessa; and, (iv) based on the teachings of Cummings, a POSITA would have had a reasonable expectation of success in generating a transesterified product (jojoba esters), wherein the jojoba esters have an OSI greater than the feedstock. *See* claims 1-3, 5, directly below.

202. As I discuss below for steps 1[a], 1[b], and 1[c], the combination of Brown in view of Xu and Cummings and/or in further view of Sessa discloses a process for transesterifying wax esters that includes each of the claimed steps.

203. As I also discussed above and below, a POSITA would have combined these references because they (i) pertain to the same fields (lipid chemistry, food and cosmetic ingredients); (ii) discuss the same class of chemical reactions (transesterification and interesterification); (iii) seek to achieve the same results (improved physical properties); and (iv) in Brown, Sessa, and Cummings, identify the same contributors (FloraTech, Brown, and Kleiman).

1. Claim 1

1[preamble] “A process for transesterifying wax esters, the process comprising:”

204. Regardless of whether the preamble is found to limit claim 1, it is disclosed by Brown, as I discuss immediately below regarding 1[preamble] and further regarding limitations 1[a] to 1[c].

205. For example, a POSITA would have understood that Brown discloses a process for transesterifying wax esters consistent with the description of transesterification in the '245 patent at 3:28-37. *See* Ex. 1007, 4:4-5:31. Specifically, Brown states, “[t]he compositions comprising fatty alcohols, isopropyl esters and jojoba wax esters (jojoba oil) may be obtained by the base catalyzed alcoholysis reaction between jojoba oil and an alkyl alcohol.” Ex. 1007, 3:59-62. Brown also discloses that “[a] process for producing an emollient may comprise the steps of, Ex. 1007, 4:60-67:

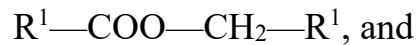
- a) providing a composition comprising jojoba oil,
- b) adding an alcohol...to said composition,
- c) effecting alcoholysis on said jojoba oil mixed with said alcohol to produce an emollient, and
- d) effecting interesterification of remaining wax esters.

206. “Starting materials [for the reaction] could include,” Ex. 1007, 4:4-24:

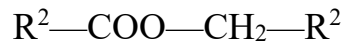
IV. The alcohol,

R⁴—OH (with isopropyl alcohol (IPA, HO—CH—(CH₃)₂) being primarily emphasized),

V. Jojoba Wax Esters



VI. Fully hydrogenated Jojoba Wax Esters



207. Brown explains, “[t]he basic reactions which may be used in the preparation of the emollient compositions of the invention derived from jojoba oil may include at least. . . Reaction C I, and II_n and III_N (catalyst)→IV, V, VI, VII, VIII, IX, II_r, III_r.” Ex. 1007, 4:39-49.

208. Further, a POSITA would have understood that the alcoholysis reaction disclosed in Brown is also referred to as a transesterification process. *See* Ex. 1007, 4:4-5:31. For example, as Xu explains, Ex. 1008, 290:

The major enzymatic reactions for the modification of lipids are often referring to hydrolysis, esterification, acidolysis, alcoholysis, and ester-ester exchange from the reaction mechanisms. Interesterification or transesterification is also commonly used in literature to describe some of the above reactions. A detail description is given below for the following two terms:

— **Interesterification:** a general term for the reactions between an ester and a fatty acid, an alcohol, or another ester, which includes acidolysis, alcoholysis, and ester-ester exchange. In literature, it sometimes describes only ester-ester exchange or alkaline-catalyzed randomization of oils and fats.

— **Transesterification:** a term often used for ester-ester exchange. It is also used in literature for the acidolysis reaction or as a general term for all the three reactions including alcoholysis.

209. Xu further explains that alcoholysis is “the reaction between an ester and an alcohol.” Ex. 1008, 297.

210. Combining the references in this Ground 4 is further discussed below.

1[a] “providing a feedstock comprising jojoba wax esters and hydrogenated jojoba wax esters, wherein the amount of hydrogenated jojoba wax esters is 20% to 50% by weight of the feedstock;”

211. Brown alone and/or in view of Sessa discloses the step of “providing a feedstock comprising jojoba wax esters and hydrogenated jojoba wax esters, wherein the amount of hydrogenated jojoba wax esters is 20% to 50% by weight of the feedstock.”

212. First, Brown discloses providing a feedstock comprising jojoba wax esters and hydrogenated jojoba wax esters. For example, Brown discloses that, “[i]n preparing the emollient composition, refined jojoba oil (or hydrogenated jojoba oil or a mixture of the oil and hydrogenated oil) is introduced into an appropriate vessel. . . .” *See* Ex. 1007, 5:1-31; Ex. 1007, 4:4-24, 4:39-55;.

213. Second, Brown does not expressly identify a specific numerical percentage of hydrogenated jojoba oil compared to its feedstock (*i.e.*, “wherein the amount of hydrogenated jojoba wax esters is 20% to 50% of the feedstock”).

However, a POSITA would have understood that Brown nonetheless discloses the claimed limitation (*i.e.*, “wherein the amount of hydrogenated jojoba wax esters is 20% to 50% of the feedstock”) based on the IV and additional disclosures which can be used to calculate the percentage. For example, the below table of Brown depicts certain physical properties of various grades of transesterified jojoba ester product (including Floraesters 60, 30, 20, 15, IPJ, HIPJ), including the IV range of the various grades of jojoba ester as shown below. *See* Ex. 1007, 8:45-54 (I have added the red box annotation):

<u>TYPICAL PROPERTIES OF JOJOBA ESTERS:</u>		
	Melting Point	Iodine Value
Floraesters - 70	66–70° C.	<2
Floraesters - 60	56–60° C.	40–44
Floraesters - 30	47–51° C.	57–61
Floraesters - 20	42–48° C.	64–70
Floraesters - 15	10–15° C.	78–85
Floraesters IPJ	6–12° C.	75–85
Floraesters HIPJ	55–65° C.	<2

214. It was known to a POSITA that IV is used to determine the degree of unsaturation—or the number of double bonds—in fats, oils and waxes. *See supra* § IX.A.1 (limitation 1[a]); Ex. 1023, 789, 792; Ex. 1024, 1-2; Ex. 1030, 47; *see also* Ex. 1006, 4 (“Iodine Values [of less than 2 for Fully Hydrogenated Jojoba Oil] indicate that the double bond positions of the molecule comprising jojoba oils have been completely filled or ‘saturated’ with hydrogen”); Ex. 1014, 8. It was also

known to a POSITA how to estimate the IV of a transesterified product (the jojoba ester) based on the relative amounts of jojoba wax esters and hydrogenated wax esters, as well as the reverse—*i.e.*, how to estimate the relative amounts of jojoba wax esters and hydrogenated jojoba wax esters knowing the IV of the transesterified product (the jojoba ester). *See supra* § IX.A.1 (limitation 1[a]); Ex. 1025, 3; Ex. 1026, 214-15. Specifically, it was known to a POSITA how to derive the following equation to calculate the weight percent of hydrogenated jojoba oil required to achieve a transesterified jojoba ester product with the desired physical properties, as follows, *see supra* § IX.A.1 (limitation 1[a]):

$$wt \%_{HJO} = 100 \times \frac{(IV_{JE} - IV_{JO})}{(IV_{JO} - IV_{HJO})}$$

215. Further, as discussed above, the IV of jojoba wax esters, otherwise known as jojoba oil, was also known to a POSITA. *See supra* § IX.A.1 (limitation 1[a]); Ex. 1027, 3; Ex. 1028, 3.

216. Brown discloses that “Floraesters 70 is III,” which species is “[f]ully hydrogenated Jojoba wax esters.” *See* Ex. 1007, 4:4-24, 5:39-40. Thus, a POSITA would have understood that the IV of hydrogenated jojoba oil (IV_{HJO}) may range from 0 to 2. *See* Ex. 1007, 5:39-40, 8:45-54.

217. As shown below in my Table D, below, of this Declaration, the estimated amount of hydrogenated jojoba oil—expressed as the weight percent of a

feedstock consisting of jojoba oil and hydrogenated jojoba wax esters—required to achieve the Floraesters 60, 30, 20, 15, IPJ, HIPJ with the IV reported in Brown, Ex. 1007, 8:45-54, can therefore be calculated by a POSITA using the equation immediately above. Also, as shown below, a POSITA therefore would have understood from Brown, 8:45-54, that the amount of fully hydrogenated jojoba wax esters is between 3.7% and 100% by weight of the feedstock, which includes the range of 20% to 50% by weight of the feedstock claimed in claim 1 (I note that individual products are inside the claimed range).

Table D			
	IV_{JE} Range From Brown, 8:45-54	IV_{HJO} Range From Brown, 4:4-24, 5:39-40, 8:45-54	Est. Hydrogenated Jojoba Oil Content Of Feedstock (Wt %)
Floraesters – 60	40-44	<2 (<i>i.e.</i> , 0-2)	50.6-51.7
Floraesters – 30	57-61	<2 (<i>i.e.</i> , 0-2)	29.6-32.2
Floraesters – 20	64-70	<2 (<i>i.e.</i> , 0-2)	21-21.8
Floraesters – 15	78-85	<2 (<i>i.e.</i> , 0-2)	3.7-4.6
Floraesters IPJ	75-85	<2 (<i>i.e.</i> , 0-2)	4.6-7.4
Floraesters HIPJ	<2 (<i>i.e.</i> , 0-2)	<2 (<i>i.e.</i> , 0-2)	100

218. In addition, as I explained herein, to the extent Brown does not disclose the claimed percentage (it does, as I have discussed), a POSITA would have found it obvious to modify the process disclosed in Brown to include 20% to 50% by weight of hydrogenated jojoba wax esters in the feedstock, as disclosed in Sessa. *See* Ex. 1009, 296.

219. As I discussed above, Sessa discloses the limitation, “wherein the amount of hydrogenated jojoba wax esters is 20% to 50% by weight of the feedstock.” *See supra* § IX.A.1 (limitation 1[a]); Ex. 1009, Abstract, 295-96.

220. That is, to the extent Brown does not itself disclose the claimed percentage (although it is my opinion that a POSITA would have found that it does, as I discussed above), as evidenced by Brown and Sessa itself and the state of the art, a POSITA would have thought to and found it advantageous (including finding it a matter of routine optimization) to vary the amount of hydrogenated jojoba wax esters in the feedstock disclosed in Brown to an amount that is 20% to 50% by weight of the feedstock as disclosed in Sessa to obtain desirable and/or improved physical properties such as oxidative stability and melting characteristics in the transesterified product, and would have had a reasonable expectation of success, as doing so was nothing more than routine variation. For example, Brown discloses that:

Jojoba esters are prepared by processes described herein, which processes result in a randomized molecular combination of saturated with unsaturated jojoba fatty acids and fatty alcohols. These esters are a complex mixture of different jojoba fatty acids and fatty alcohols combined randomly and composed of differing chain lengths....The melting point, consistency, and physical appearance of these jojoba esters can be manipulated to produce a family of wax esters ranging from pourable liquids to hard, crystalline waxes....

Jojoba esters in the present invention are utilized as oxidatively stable carriers of fragrance oils[.]

Ex. 1007, 7:7-19, 8:24-26.

221. Brown itself also discloses that the transesterification of a mixture of jojoba wax esters and hydrogenated jojoba wax esters results in a “broad melting range” product which properties are not obtainable by the mixture of the products of the transesterification of jojoba wax esters alone and the transesterification of hydrogenated jojoba wax esters alone. *See* Ex. 1007 4:4-69. A POSITA would have understood this disclosure to teach that the relative amounts of jojoba wax esters and hydrogenated jojoba wax esters may be used to manipulate the physical properties of the resulting jojoba ester product.

222. Likewise, as discussed in § IX.A.1 (limitation 1[a]), Sessa discloses that the thermal properties of a transesterified product can be optimized by varying the amount of hydrogenated jojoba wax esters in a feedstock. *See* Ex. 1009, Abstract, 298.

223. Further, also as evidenced by the state of the art herein and my above explanations, the ability to engineer specific physical properties in a transesterified product by manipulating the ratio of jojoba wax esters to hydrogenated jojoba wax esters in a feedstock would have been within the background knowledge possessed

by a POSITA, as discussed in § IX.A.1 (limitation 1[a]). *See* Ex. 1004, 1-2; Ex. 1009, 298, Abstract; Ex. 1012, 675; Ex. 1013, 878.

224. Therefore, based on these disclosures, a POSITA would have understood that Brown alone and/or in view of Sessa discloses the claimed step of “providing a feedstock comprising jojoba wax esters and hydrogenated jojoba wax esters, wherein the amount of hydrogenated jojoba wax esters is 20% to 50% by weight of the feedstock.”

225. And, for the reasons explained above, in my opinion, it would have been obvious to a POSITA to combine Brown in view of Sessa.

1[b] “contacting the feedstock with a lipase; and transesterifying the jojoba wax esters and the hydrogenated jojoba wax esters in the feedstock with the lipase to form a transesterified product”

226. The combination of Brown and Xu discloses “contacting the feedstock with a lipase; and transesterifying the jojoba wax esters and the hydrogenated jojoba wax esters in the feedstock with the lipase to form a transesterified product.”

227. Brown discloses providing a feedstock including jojoba wax esters and hydrogenated jojoba wax esters and applying “a catalyst for alcoholysis and interesterification such as sodium methoxide” (*i.e.*, a chemical catalyst) to the combination of jojoba wax esters and hydrogenated jojoba wax esters. Ex. 1007, 5:13-16; *see* Ex. 1007, 3:59-4:3 (“The compositions comprising fatty alcohols, isopropyl esters and jojoba wax esters (jojoba oil) may be obtained by the base

catalyzed alcoholysis reaction between jojoba oil and an alkyl alcohol.”). A POSITA would have understood this disclosure as showing the catalyst is interacting with (or “contacting”) the feedstock (which, in Brown, consists only of jojoba wax esters and hydrogenated jojoba wax esters) to facilitate the transesterification process.

228. Brown does not expressly disclose “contacting the feedstock with a lipase” but a POSITA would have found it obvious to modify the chemically catalyzed process of Brown to use the lipase, as disclosed in Xu, as the catalyst. Ex. 1008, 296-99, Figs. 15, 18. Xu discloses using lipases as a catalyst in interesterification/transesterification reactions and that interesterification and transesterification both refer to the same class of reactions, including alcoholysis and/or ester-ester exchange reactions, and that lipases can be used to catalyze such class of reactions. Ex. 1008, 296-99, Figs. 15, 18.

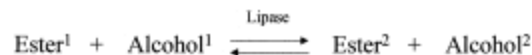
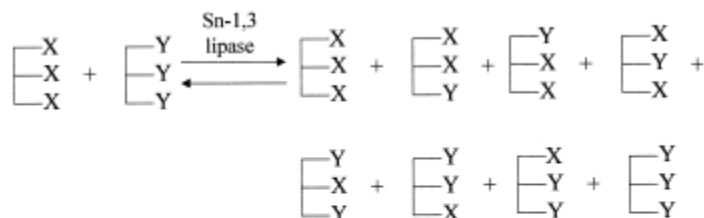


Fig. 15. An illustration enzymatic alcoholysis.



X and Y are two types of fatty acids.

Fig. 18. Reaction scheme of enzymatic ester-ester exchange between two triacylglycerols (XXX and YYY) with *sn*-1,3 specific lipases.

229. A POSITA would have been motivated to replace, and had a reasonable expectation of success in replacing, the chemical catalyst of Brown with a lipase as the catalyst in the Brown reaction for the reasons stated in Xu. Ex 1008, 289, 301. For example, Xu discloses that the use of chemical catalysts in industry can be “fully replaced” with the use of lipases, and that the industry has several reasons to do so, including, Ex. 1008, 289:

- very interesting products and potential market demands,
- improvement of product quality refereeing to mild conditions,
- reduction of enzyme price and balanced economy in general,
- simple processes and low investment,
- environmental considerations,
- customer perception and marketing strategy,

– know-how preparation and technology takeover/control.

See also id. (“This list can be prolonged: ‘image’ strategy by using enzyme technology is important for many industrial companies; energy-efficiency of the technology is also often mentioned.”).

230. Further, as evidenced by the state of the art herein and in my above explanations, replacing chemical catalysts in interesterification and/or transesterification processes with lipases would have been within the background knowledge possessed by a POSITA, as discussed in § IX.A.1 (limitation 1[b]). *See* Ex. 1012, 676; Ex. 1013, 877.

231. Therefore, based on these disclosures, a POSITA would have understood that Brown in view of Xu disclose the claimed step of “contacting the feedstock with a lipase; and transesterifying the jojoba wax esters and the hydrogenated jojoba wax esters in the feedstock with the lipase to form a transesterified product[.]”

232. And, for the reasons explained above, in my opinion, it would have been obvious to a POSITA to contact the feedstock described by Brown with a lipase catalyst as described in Xu to transesterify the jojoba wax esters and the hydrogenated jojoba wax esters in the feedstock with the lipase to form a transesterified product.

1[c] “wherein an oxidative stability index (OSI) of the transesterified product is greater than an OSI of the feedstock.”

233. The combination of Brown and Cummings discloses “wherein an oxidative stability index (OSI) of the transesterified product is greater than an OSI of the feedstock.”

234. Brown discloses the transesterification of a feedstock of jojoba wax esters and hydrogenated jojoba esters to prepare jojoba esters. Ex. 1007, 4:4-24, 4:39-55, 5:1-31; Ex. 1007, Abstract (“The compositions of the present invention may be obtained by a novel process of a base catalyzed alcoholysis reaction between jojoba oil and an alcohol, such as isopropyl alcohol. These components, whether exclusively jojoba esters or when combined with other carrier and vehicle components. . . can form excellent carrier composition for use in the cosmetic, personal care and/or pharmaceutical field.”).

235. Cummings explicitly discloses that the transesterified product, “[j]ojoba esters[,] demonstrate remarkable stability with OSI values of all jojoba esters greater than 100 hours and as high as 675 hours;” this is significantly greater than the OSI of the refined jojoba oil that forms part of the feedstock, which “is around 35 hours.” Ex. 1004, 2; Ex. 1004, 1-2 (“The structure of all jojoba esters is different from its starting material—jojoba oil. It is these compositional differences within the family of jojoba esters that create their expanded utility in cosmetic preparations[,]” including regarding to oxidative stability).

236. Thus, like Cummings, Brown discloses the transesterification¹⁰ of a feedstock of jojoba wax esters and hydrogenated jojoba esters to prepare jojoba esters. Ex. 1004, 2; Ex. 1007, 4:4-24, 4:39-55, 5:1-31. A POSITA would have found it reasonable to expect that the process of Brown would result in a transesterified jojoba ester product with the same properties as those disclosed in Cummings. Indeed, as shown below, the processes of both Brown and Cummings prepare jojoba esters having nearly identical melting points and identical iodine values. *Compare* Ex. 1004, 1, Figure 3 *with* Ex. 1007, 8:45-54:

Figure 3 - Jojoba ester differences				
Product	Melting point °C AOCS Cc 18-80	Iodine value g/100g AOCS Cd 1-25	Visual appearance	Colour AOCS Cc 13c-92
Jojoba esters (15)	10 - 15	78 - 85	Clear, colourless liquid	< 1.5 Red
Jojoba esters (20)	42 - 48	64 - 70	White, creamy paste	< 1.0 Red
Jojoba Esters (30)	47 - 51	57 - 61	White, soft paste	< 1.0 Red
Jojoba Esters (60)	56 - 61	40 - 44	White, firm paste	< 1.0 Red
Jojoba esters (70)	66 - 70	< 2	White crystalline powder	< 1.0 Red

¹⁰ As Xu explains, “[i]nteresterification or transesterification is also commonly used in literature to describe” the same major enzymatic reactions for the modification of lipids, including alcoholysis. Ex. 1008, 290.

TYPICAL PROPERTIES OF JOJOBA ESTERS:

	Melting Point	Iodine Value
Floraesters - 70	66–70° C.	<2
Floraesters - 60	56–60° C.	40–44
Floraesters - 30	47–51° C.	57–61
Floraesters - 20	42–48° C.	64–70
Floraesters - 15	10–15° C.	78–85
Floraesters IPJ	6–12° C.	75–85
Floraesters HIPJ	55–65° C.	<2

237. Further, as evidenced by the state of the art herein and in my above explanations, the transesterification of fats, oils and wax esters—including in lipase-catalyzed processes and processes involving jojoba wax esters and hydrogenated jojoba wax esters—can produce a product having improved—and thus greater—oxidative stability would have been within the background knowledge possessed by a POSITA, as discussed in § IX.A.1 (limitation 1[c]). *See* Ex. 1015, [0005]; Ex. 1016, [0031]; Ex. 1017, 245; Ex. 1018, C371.

238. Again, the above evidence rebuts any assertion by Patent Owner that increased OSI is an unexpected result of transesterifying jojoba esters and hydrogenated jojoba esters, using a lipase. *See* § IX.A.1 (limitation 1[c]).

2. Claim 2

“The process of claim 1, wherein the feedstock consists essentially of the jojoba wax esters and the hydrogenated jojoba wax esters.”

239. I am informed that claim 2—by use of “consists essentially of”—limits claim 1 by restricting the feedstock to only the jojoba wax esters, the hydrogenated jojoba wax esters, and only those additional materials that do not materially affect the basic and novel properties of the invention (such as indicated in the claim itself, improved OSI). The combination that renders claim 1 obvious also teaches such a feedstock, as there are no additional materials in the disclosed feedstock that materially affect the basic and novel properties of the invention (such as indicated in the claim itself, improved OSI) in such combination—there is, for example, no teaching of requiring the addition of other feedstock materials, such as an OSI-increasing antioxidant. *See* Ex. 1004, 1-2, Fig. 1; Ex. 1007, 4:4-5:31; Ex. 1008, 289-90, 296-99, 301, Figs. 15, 18; Ex. 1009, 295-96; *see also* my discussion of claim 1 above (describing the combination including the feedstock composition).

240. It is my opinion that Brown in view of Xu and Cummings and/or in further view of Sessa renders obvious claim 2 of the same reasons as claim 1.

3. Claim 3

“The process of claim 1, wherein the feedstock does not comprise any free fatty alcohols.”

241. The combination that renders claim 1 obvious teaches a feedstock that “does not comprise any free fatty alcohols.” In particular, Brown alone and/or in

view of Sessa discloses this limitation for the reasons stated in reference to limitation 1[a]. A POSITA would have understood that the feedstock of Brown, which consists of an anhydrous isopropyl alcohol and refined jojoba oil, hydrogenated jojoba oil, or a mixture of the two, does not comprise any free fatty alcohols. Ex. 1007, 4:4-5:20; *see also* my discussion of claim 1 above (describing the combination including the feedstock composition).

242. It is my opinion that Brown in view of Xu and Cummings and/or in further view of Sessa renders obvious claim 3 of the same reasons as claim 1.

4. Claim 5

“The process of claim 1, The process of claim 1, wherein the feedstock does not comprise any methyl esters.”

243. The combination that renders claim 1 obvious teaches a feedstock that “does not comprise any methyl esters.” In particular, Brown alone and/or in view of Sessa discloses this limitation for the reasons stated in reference to limitation 1[a]. A POSITA would have understood that the feedstock of Brown, which consists of an anhydrous isopropyl alcohol and refined jojoba oil, hydrogenated jojoba oil, or two, does not comprise any methyl esters. Ex. 1007, 4:4-5:20; *see also* my discussion of claim 1 above (describing the combination including the feedstock composition).

244. It is my opinion that Brown in view of Xu and Cummings and/or in further view of Sessa renders obvious claim 5 of the same reasons as claim 1.

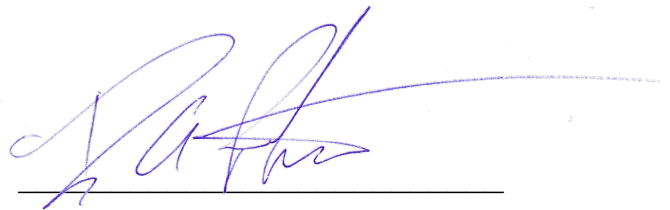
X. CONCLUDING STATEMENTS

245. In signing this declaration, I understand that the declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I acknowledge that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-examination.

246. I declare that all statements made herein of my knowledge are true and correct and that all statements made on information and belief are believed to be true. I also declare that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 35 U.S.C. § 1001.

247. I declare under the penalty or perjury that the foregoing is true and correct.

Executed on February 23, 2023

A handwritten signature in blue ink, appearing to read 'D. A. Rockstraw', is written over a horizontal line.

David A. Rockstraw, Ph. D., P. E.

APPENDIX A

David A. Rockstraw, Ph. D., P. E.

David A. Rockstraw, Ph. D., P. E., Inc.
2201 E. Mills Ave., El Paso, TX 79901
davidarockstrawphdpe.com

email: david@davidarockstrawphdpe.com
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EDUCATION

The University of Oklahoma, Norman, Oklahoma Aug 1986 – Sep 1989
Ph.D., Chemical Engineering: *Experimental & Theoretical Electrodialysis Investigations*

Purdue University, West Lafayette, Indiana Aug 1980 – Jun 1986
B.S., Chemical Engineering

EXPERIENCE

David A. Rockstraw, Ph. D., P. E., Inc., El Paso, TX
CHEMICAL PROCESS DESIGN/REVIEW/FORENSIC ANALYSIS & EXPERT WITNESS since 1997

New Mexico State University, Las Cruces, New Mexico

ACADEMIC DEPARTMENT HEAD, CHEMICAL & MATERIALS ENGINEERING	JUL 2012 – AUG 2021
ROBERT DAVIS DISTINGUISHED PROFESSOR	SEP 2013 – AUG 2021
NMSU DISTINGUISHED ACHIEVEMENT PROFESSOR	AUG 2012 – AUG 2021
INTERIM ACADEMIC DEPARTMENT HEAD, MECHANICAL & AEROSPACE ENGINEERING	AUG 2018 – AUG 2019
DIRECTOR & CREATOR, NMSBREW BREWERY ENGINEERING PROGRAM	JAN 2016 – APR 2019
PROFESSOR, CHEMICAL & MATERIALS ENGINEERING	AUG 2004 – AUG 2012
ASSOCIATE PROFESSOR, CHEMICAL ENGINEERING	MAY 1998 – AUG 2004
ASSISTANT PROFESSOR, CHEMICAL ENGINEERING	AUG 1995 – MAY 1998

Los Alamos National Laboratory, Los Alamos, New Mexico

VISITING SCIENTIST- NUCLEAR MATERIALS TECHNOLOGY DIVISION 1997 - 2000

- Fundamental studies of crystal habit and specific cake resistance of hydroxide neutralization precipitates from actinide processing.

E.I. DuPont de Nemours Co., Inc. / Conoco, Inc., Ponca City, Oklahoma

RESEARCH ENGINEER - CORPORATE PROCESS DEVELOPMENT Aug 1990 Jul 1995

- Directed pilot plant research at many scales, leading to commercial implementation.

Ethyl Corporation, Orangeburg, South Carolina

SENIOR R&D ENGINEER, RESEARCH & DEVELOPMENT

Sep 1989 – Jul 1990

- Developed, patented, commercialized novel sodium/potassium catalyst and catalytic process for production of isobutylbenzene, a pharmaceutical intermediate.

Kraft, Inc., Glenview, Illinois

ENGINEER I / CO-OP STUDENT- R & D DIVISION

Aug 1981 – Aug 1986

- Performed material and energy balances on ethanol process (ultrafiltration, reverse osmosis, fermentation, and azeotropic distillation). Supported R&D processes including extrusion, ultrafiltration, evaporation, emulsification, spray drying, evaporation, et al.

PATENTS

- 6,225,256, May 1, 2001, Activated carbon feedstock.
- 5,157,186, Oct 20, 1992, Catalytic Coupling of an Alkene with an Aromatic.
- 5,104,843, Apr 14, 1992, Catalyst Composition for Coupling Process.

HONORS & RECOGNITIONS

- Frank Bromilow Award for Teaching Excellence, 2016
- AIChE Fellow, 2015
- NMSU Roush Teaching Award, 2014
- NMSU Environmental Health & Safety “Friend of Safety” Award, 2014
- Robert Davis Distinguished Professorship, 2013
- NMSU Distinguished Achievement Professor Award, 2012
- Ed and Harold Foreman Engineering Education Excellence Award, 2012
- NSPE, Prof. Engineers in Higher Ed. Engineering Education Excellence Award, 2009
- E-Council Outstanding Engineering Professor Award, 2008
- AspenTech® Educational Innovation Award, 2004
- Outstanding Faculty Member, voted by the 2001 CH E graduating class
- Research Grand Prize, American Academy Environmental Engineers, 1998
- Level II DuPont Safety Sentinel Award, 1995.
- DuPont Partnering Recognition for Suva® HFC development: 1992, 1991

PROFESSIONAL SERVICE

American Institute of Chemical Engineers (AIChE)

- Fellow, 2015 – present
 - Fellow's Council (2016 – 2019)
- Faculty Advisor to NMSU Student AIChE Chapter, 2007-2020
 - Outstanding Chapter recognition; 2008, 2009, 2010, 2011, 2016, 2018, 2019

National Society of Professional Engineers

- Board of Directors, 2013 - 2015
- House of Delegates, 2012 - 2014
- Licensure and Qualifications to Practice Committee, 2013 – 2015
- Legislative & Government Affairs Committee, 2014 - 2015
- Chair, Professional Engineers in Higher Education (PEHE) Interest Group, 2010-11
- SW Region Vice Chair, Professional Engineers in Higher Education (PEHE), 2008-09

CONTINUING EDUCATION

- Ethics and Standards of Professional Conduct (PDH Pro ET-02-001), 2 PDH, Dec. 24, 2022
- Wastewater Design - Granular Activated Carbon Systems (PDH Pro CH-02-905), 12 PDH, Dec. 24, 2022
- Biomass Oil Analysis (PDH Pro CH-02-600), 9 PDH, Dec. 24, 2022
- Fuel Cells (PDH Pro CH-02-180), 3 PDH, Dec. 24, 2022
- Introduction to Valves (PDH Pro CH-02-210), 4 PDH, Dec. 24, 2022
- Professional Ethics: Emerging Technology Issues (TSPE-TX Virtual Ethics Presentation), 1 PDH, Instructor: William D. Lawson, PE, PhD, D.GE, F.NSPE, Dec. 15, 2022
- Ethics for Licensed Professionals (PDHOnline.org Course No. G100), 2 PDH, Instructor: John C. Huang, Ph.D., PE, Oct. 21, 2022
- Professional Ethics for New Mexico Engineers & Land Surveyors (PDHOnline.org Course No. R602), 2 PDH, Instructor: John C. Huang, Ph.D., PE, Nov. 21, 2019
- Ethics for U.S. Engineers (SunCam Course Number 224), 1 PDH Instructor: By William C. Dunn, P.E., Dec. 23, 2015

PEER-REVIEWED PUBLICATIONS

1. Corrected rate law for sulfite oxidation mechanism with ethanol-inhibition, D. A. Rockstraw, *Industrial & Engineering Chemistry Research*, **51**(35), p. 11587 (2012).
2. Old Dead Guy Trading Cards, D. A. Rockstraw, *Chem. Eng. Educ.*, **46**(1), Winter 2012.

3. Synthesis of Nanowires by Spray Pyrolysis, K. C. Pingali, S. Deng, and D. A. Rockstraw, *Journal of Sensors*, Article ID 683280, 2009, doi: 10.1155/2009/683280.
4. Synthesis of Ru-Ni Core-Shell Nanoparticles for Potential Sensor Applications, S. Deng, K. C. Pingali, D. A. Rockstraw, *Institute of Electrical and Electronics Engineers Sensors Journal: Nanosensors for Defense and Security*, **8**(5-6), pp. 730-734 (2008).
5. Synthesis and Thermal Stability of Carbon Supported and Carbon Coated Ru-Ni Core-and-Shell Nanoparticles, K. C. Pingali, S. Deng, D. A. Rockstraw; *Powder Tech.*, **187** (2008) 19–26.
6. Effect of Ammonium Nitrate on Nanoparticle Size Reduction, K. C. Pingali, S. Deng, D. A. Rockstraw; *Res. Letters in Nanotech.*, Vol. 2008, Article ID 756843, doi:10.1155/2008/756843.
7. Direct Synthesis of Ru-Ni Core-Shell Nanoparticles by Spray-Pyrolysis: Effects of Temperature and Precursor Constituent Ratio, K. C. Pingali, S. Deng, D. A. Rockstraw; *Powder Technology*, **183**(2), p.282-289 (2008).
8. Deposition of Ru-Ni-S Nanoparticles on Carbon by Spray-Pyrolysis: Effects of Solvent, K. C. Pingali, S. Deng, D. A. Rockstraw; *Current Nanoscience*, 2007, **3**, 215-221.
9. Physicochemical properties of carbons prepared from pecan shell by phosphoric acid activation, Y. Guo and D. A. Rockstraw, *Bioresource Tech.*; 98(8), 1513-1521. (May 2007).
10. Direct synthesis of Ru-Ni nanoparticles with core-and-shell structure, K. C. Pingali, S. Deng, D. A. Rockstraw; *Chemical Engineering Communications*, **194**(6), 780-786 (2007).
11. Activated carbons prepared from rice hull by one-step phosphoric acid activation, Y. Guo and D. A. Rockstraw, *Microporous & Mesoporous Matls*, **100**(1-3); 12-19, March 23, 2007.
12. Synthesis of carbon nanoparticle thin film with spray pyrolysis, K. C. Pingali, S. Deng, D. A. Rockstraw; *New Mexico Journal of Science*, **44**, 149-163, August 2006.
13. Physical and chemical properties of carbons synthesized from xylan, cellulose, and Kraft lignin by H₃PO₄ activation, Y. Guo, D. A. Rockstraw, *Carbon*, **44**(8); 1464-1475 (July 2006).
14. Silver nanoparticles from ultrasonic spray pyrolysis of aqueous silver nitrate, K. C. Pingali, D. A. Rockstraw, S. Deng; *Aerosol Science & Technology*, **39**:1010–1014, 2005.
15. ASPEN Plus® in the Chemical Engineering Curriculum: Suitable Course Content and Teaching Methodology, D. Rockstraw, *Chemical Engineering Education*, **39**(1), Winter 2004.
16. A Generating Equation for Mixing Rules and Two New Mixing Rules for Interatomic Potential Energy Parameters, A. K. Al-Matar, D. A. Rockstraw, *Journal of Computational Chemistry*; **25**(5), p.660-668 (Apr. 2004).
17. Rapid oxidation of sulfide mine tailings by reaction with potassium ferrate, M. Murshed, D.A. Rockstraw, A.T. Hanson, M.D. Johnson, *Environ. Pollution*, **125**(2), 245-253 (Sep 2003).
18. A model for adsorption of multiple metal ion solutes in aqueous solution onto carbon produced from pecan shells, S.A. Dastgheib, D.A. Rockstraw, *Carbon*, **40**(11), 1853-61 (2002).
19. Copper and strontium adsorption by a novel carbon material manufactured from pecan shells; RA Shawabkeh, DA Rockstraw, RK Bhada, *Carbon*, **40**(5), 781-786 (2002).
20. Rare Earths and Actinides: Science, Technology and Applications IV, (ISBN: 0-87339-470-4), Bautista and Mishra, editors, "Vitrified Magnesite Dissolution and Its Impact on Plutonium Residue Processing," K.W. Fife, J.L. Alwin and D.A. Rockstraw, pp. 123-135.

21. Pecan shell activated carbon: synthesis, characterization, & application for removal of Cu from aqueous solution, S. A. Dastgheib, D.A. Rockstraw, *Carbon*, **39**(12), 1849-55 (2001).
22. Modeling Substrate Particle Degradation by *Bacillus Coagulans* Biofilm, S. Rajagopalan, D. Rockstraw, S. M. McGee, *Bioresource Tech.*, **61**, (1997).
23. An Integrated Course/Project in Chemical Process Design, D.A. Rockstraw, S. Bellner, J.A. Eakman, N. Nabours, *Chemical Engineering Education*, **31**(1), Spring 1997.
24. Use of Electrodialysis to Remove Acid, Salt, & Heavy Metal Mixtures from Aqueous Solutions, D.A. Rockstraw, J.F. Scamehorn, *Separation Science. & Tech.*, **32**(11), (1997).
25. An Integrated Electrodialysis/Evaporation Process for the Treatment of Aqueous Process Streams Containing Electrolytes, D.A. Rockstraw, J.F. Scamehorn, E.A. O'Rear III, *J. of Membrane Science*, **52** (1990) 43-56.

OTHER PROFESSIONAL PUBLICATIONS AND/OR PRESENTATIONS

1. *With a Grain of Salt: Crystallization and Dissolution in Salt Attack*. E. Liefeld, D. A. Rockstraw, P. Taylor, G. Figeroua, D. Ellis, Earth USA 2019 Conference, Santa Fe, NM Oct. 25-27, 2019.
2. *Brewing Education & Training* (Topical Conference: Food Innovation & Engineering). Chairs: C. E. Brewer, D. A. Rockstraw, American Institute of Chemical Engineers Meeting, Oct. 29-31, 2018, Pittsburgh, PA.
3. *Designing a Brewery Engineering Minor within Chemical Engineering to Meet MBAA Specifications*; David Rockstraw, Catherine E. Brewer, and Stephen Taylor, American Institute of Chemical Engineers National Meeting, October 29-31, 2018, Pittsburgh, PA.
4. *Development of the New Mexico State University Brewery Engineering program of study in Chemical Engineering*, David A. Rockstraw, Oklahoma University Department of Chemical & Biological Engineering Graduate Seminar, Norman, OK, October 16, 2018 (invited).
5. *Teaching Safety in Research through a Rigorous Experimental Safety Program*, J. Miller and D.A. Rockstraw, 2018 Am. Society of Engineering Educ., June 24-27, 2018, Salt Lake City, UT.
6. *Industrial Safety Curriculum for Chemical Engineering Education*, J. Miller & D.A. Rockstraw, Am. Institute of Chemical Engineers Natl Meeting, Oct. 30, 2017, Minneapolis, MN.
7. *Experimental Safety Plan (ESP) for Safety Management in Chemical Engineering Research*, Juanita Miller, David Rockstraw, Martha Mitchell, and Derrik Wootton, Institute of Chemical Engineers National Meeting, October 30, 2017, Minneapolis, MN.
8. *A Field Kit and Methodology for Detecting and Measuring Salts in Adobe*, Eric Liefeld and David Rockstraw, Earth USA 2017; Santa Fe, NM, Sept. 29 – Oct. 1, 2017
9. *Salt Migration Rates in Adobe Walls Constructed of Mesilla Valley Soils*, David Rockstraw, Pat Taylor, Eric Liefeld, Earth USA 2017; Santa Fe, NM, Sept. 29 – Oct. 1, 2017
10. *Additive Manufacturing of Mechanoluminescent Materials* (LA-UR- 17-26157), M. Martinez, D. Rockstraw, 2nd Annual Ultrascale Systems Res. Ctr., Los Alamos Nat'l Lab., Aug. 3, 2017.
11. *Alliance of Faculty and EHS towards Safety Goals*, D. Wootton and D.A. Rockstraw, Campus Safety, Health, & Environmental Management Assoc. (CSHEMA), July 15, 2017, Tucson, AZ.

12. *Electrochemical Conversion of CO₂ to Formic Acid Using Rotating Lead Electrode*, David Rockstraw, Reyad Shawabkeh, Aban Sakheta, American Institute of Chemical Engineers Meeting, November 16, 2016, San Francisco, CA.
13. Panel: What You Need to Know about Being an Expert Witness (invited panelist), Chemical Engineering & the Law Forum, American Institute of Chemical Engineers Meeting, November 14, 2016, San Francisco, CA.
14. Panel: Ethics and Expert Witnessing for Scientists & Engineers (invited panelist), Daniel B. Jett Chapter of the American Society of Civil Engineers, November 4, 2016, Las Cruces, NM.
15. *Generating Perchlorate and N-Nitrosodimethylamine Isotherms Using Pecan Shell Activated Carbons*; J. Freeh, J. Rodriguez, D. A. Rockstraw, C. E. Brewer, American Institute of Chemical Engineers National Meeting, Salt Lake City, UT, November, 11, 2015.
16. *Generating Perchlorate and N-Nitrosodimethylamine Isotherms Using Pecan Shell Activated Carbons*; J. Freeh, D. Amidei, D. A. Rockstraw, C. E. Brewer, 13th Annual International Workshop on Environment and Alternative Energy, European Space Agency, Madrid, Spain, Nov. 11, 2015.
17. *Remediating Salt Attack in Adobe and Earthen Structures*; E. Liefeld, D. A. Rockstraw, G. Henry, Earth USA 2015 Conference, Santa Fe, NM Oct. 2-4, 2015.
18. *Understanding, Detecting, Measuring, and Remediating Salt Attack (Salt Weathering) in Adobe and Earthen Structures*; D. A. Rockstraw, S. Cooper, E. Liefeld, G. Henry, Earth USA 2013 Conference, Santa Fe, NM, Oct. 4-5, 2013.
19. Teach Your Students the Power of Aspen Plus® and Aspen HYSYS® with University Teaching Modules; D. A. Rockstraw, C. Yip, and B. Gochenour, AspenTech Webinar series, Oct 2 2013.
20. Incorporating Process Simulation Across the Chemical Engineering Curriculum to Improve Student Performance On the Capstone Design Project, American Institute of Chemical Engineers Conference, Pittsburgh, PA Oct. 28 - Nov 2, 2012.
21. Continuing Our Journey to Bridge the Process Safety Gaps Between Academia and Industry (Paper 232e), Bruce K. Vaughen, Thomas O. Spicer, D. Morrison, James A. Klein, and David A. Rockstraw, Am. Institute of Chemical Engineers, Minneapolis, MN, Oct. 16-21, 2011.
22. Recruiting & Interacting with Students; Erin Reyes (NSPE), David Rockstraw (NMSU), and Terrance Glunt (FDOT), NSPE Leadership Webinar Series, Nov. 11, 2010.
23. Photocatalytic Activity of TiO₂ and TiO₂-xCxNy Thin Films From Polymer Assisted Deposition, S. Baber, Q. Lin, V. Daram, D. A. Rockstraw, S. Deng, H. Luo, American Institute of Chemical Engineers Conference, Salt Lake City, UT, Nov. 7-12, 2010.
24. Workshop: How to Make Meetings Worthwhile and Entertaining, Michelle Wilson, Alicia Aguirre, David Rockstraw, Jessica Houston, American Institute of Chemical Engineers Conference, Salt Lake City, UT, November 6, 2010.
25. Deposition Of Ru-Ni-S Nanoparticles On Carbon By Spray-Pyrolysis: Effects Of Solvent And Other Processing Parameters, K. C. Pingali, S. Deng, D. A. Rockstraw, American Institute of Chemical Engineers Conference, Salt Lake City, UT, Nov. 4-9, 2007.
26. Synthesis of Ru-Ni Core-Shell Nanoparticles for Sensor Applications, S. Deng, K. C. Pingali, D. A. Rockstraw, Nanoelectronic Devices for Defense and Security conference, organized by

- the U. S Army Edgewood Chemical Biological Center (ECBC) & U.S. Army Research Office (ARO) in Washington DC, June 18-21, 2007.
27. Water Distillation in a Solar Still, E. Sandoval, A. De La O, D.A. Rockstraw; American Institute of Chemical Engineers Conference, San Francisco, CA; Nov. 12-17, 2006.
 28. Synthesis of core-shell nanoparticles and mathematical modeling of exponential relation of particle size variation with precursor concentration, K.C. Pingali, S. Deng, D.A. Rockstraw; Am. Institute of Chemical Engineers Conference, San Francisco, CA; November 12-17, 2006.
 29. Formation of Ru-Ni core-and-shell nanoparticles by spray pyrolysis and effect of temperature and precursor constituent ratio on particle size; K. C. Pingali, S. Deng, D. A. Rockstraw; The 14th International Conference on Composites/NANO Engineering Conference, Boulder, CO; July 2-7, 2006.
 30. Synthesis of binary metal nanoparticles of Ru-Ni with core and shell structure; K. C. Pingali, S.Deng, D. A. Rockstraw, Particle Technology Forum, American Institute of Chemical Engineers Conference, Cincinnati, OH; October 30-November 4, 2005.
 31. Effect of Ammonium Nitrate on Average Size Reduction of Nanoparticles of Silver and Nickel; K. C. Pingali, S.Deng, D. A. Rockstraw, Nanoscale Sci and Engr Forum, American Institute of Chemical Engineers Conference, Cincinnati, OH; October 30-November 4, 2005.
 32. Suitable Course Content and Pedagogy for use of the Aspen Plus® Simulator in the Chemical Engineering Curriculum, D.A. Rockstraw, 2004 American Society of Engineering Education National Meeting, Salt Lake City, UT, June 20-23, 2004.
 33. Rapid oxidation of sulfide mine tailings by reaction with potassium ferrate, D.A. Rockstraw, M. Murshed, A.T. Hanson, M.J. Johnson, International Symposium on Chemical Reaction Engineering, Chicago, IL, June 6-9, 2004.
 34. Synthesis and characterization of TiO₂ aerogel photocatalysts for environmental remediation technologies, D.A. Rockstraw, G.K. Newman, M. Dreyer, S. J. Kersey, II Encuentro Científico Internacional de Invierno - ECI2003i, Lima Peru Jan 2-5, 2003.
 35. Adsorption of 2,4-dinitrophenol and 2,4-dinitrotoluene from aqueous system using surfactant-modified, lignocellulosic-based activated carbon, A. D. Cota-Espericueta, D. Rockstraw, 224th ACS National Meeting, Boston, MA, August 18-22, 2002.
 36. A Generating equation for Mixing Rules for the Interatomic Potential Parameters and a New Mixing Rule for the Noble Gases, American Institute of Chemical Engineers National Meeting, Poster Session: Applying Molecular Simulations and Computational Chemistry, Ali K Al-Matar, David A Rockstraw, Reno, NV, November 2001.
 37. Adsorption of metal ions onto oxidized, activated carbon produced from pecan shells, in single and multicomponent systems, S.A. Dastgheib, D. A. Rockstraw, 219th American Chemical Society National Meeting, San Francisco, CA, March 27, 2000
 38. Adsorption of aromatics on pecan-shell-based carbon, D.A. Rockstraw and L.A. Roybal, 219th American Chemical Society National Meeting, San Francisco, CA, March 27, 2000
 39. Solution to the 1999 AIChE National Student Design Contest, D.A. Rockstraw, S.P. Bellner, American Institute of Chemical Engineers National Meeting, Dallas, TX, November 1, 1999.

40. Vitrified Magnesia Dissolution and its Impact on Plutonium Residue Processing, K.W. Fife, J.L. Alwin, D.A. Rockstraw, 129th Minerals, Metals, and Materials Society, Nashville, TN, March 12-16, 2000.
41. Real-Time Densitometer for Implementation in Hanford Tanks, M Corpening, K Anderson, DA Rockstraw, Waste Management '99; Tucson, AZ, February 28 - March 4, 1999.
42. Enhanced Pyrite Destruction and Copper Recovery with Fe(VI), A. Al-Matar, J. Alwin, J. Kearns, D. A. Rockstraw, Waste Management '99, Tucson, AZ, Feb. 28 – Mar. 4, 1999.
43. A Novel Lignocellulosic-Based Carbon Material for Separation of Ionic Species from Aqueous Solutions, D. A. Rockstraw, R. Shawabkeh, R. K. Bhada, TechnoVentions '98, Orlando, FL, December 9-12, 1998.
44. Synthesis & Characterization of Phosphate-Based Zirconium/Titanium Mixed Oxide Catalysts, D. K. Kambhampati, D. A. Rockstraw, N. Jackson, S. Thoma, poster presentation at the 2nd World Congress on Environmental Catalysis Conference, Miami, FL, November 1998.
45. One-Step Sol-Gel Synthesis of Sulfated Zirconium/Titanium Phosphate Solid Acid Catalysts, D. K. Kambhampati, D. A. Rockstraw, N. Jackson, S. Thoma, American Institute of Chemical Engineers National Meeting Proceedings, Miami, FL, November 15-19, 1998.
46. Treatment of Copper Mine Tailings by Slurry Approach: A Case Study, D.K. Kambhampati, R. Mallapragada, K.G. Ragunathan, R.K. Bhada, D.A. Rockstraw, Environmental Engineering & Management Proceedings, Barcelona, Spain, September 30 – Oct. 2, 1998,
47. Synthesis & Characterization of Carbon from Pecan Shells, D. Rockstraw, Center for Applied Energy Res., Univ of Kentucky, Lexington, KY, April 23, 1998 (invited).
48. Use of Pecan Shells in the Chemical Industry, DA Rockstraw, R Shawabkeh, RK Bhada, D Binkley, XXXII Annual Western Pecan Conference, Las Cruces, NM, March 9, 1998 (invited).
49. Groundwater Remediation with Pecan Shell-Based Activated Carbon and Montmorillonite Clay, J. Alwin, D. Rockstraw, Waste Management '98, Tucson, AZ, Feb 28 - March 4, 1998.
50. Interaction of Micelles with Ion-Exchange Membranes, M. Nelson, D.A. Rockstraw, M. Montoya, J.F. Scamehorn, Am. Inst. Chem. Engrs, Los Angeles, CA, Nov. 16-21, 1997.
51. An Interdisciplinary Course in Design, D.A. Rockstraw, American Chemical Society, Emerging Technologies in Hazardous Waste Management, Special Session WERC: Bringing Environmental Excellence into the 21st Century, Pittsburgh, PA, September 15-17, 1997.
52. Reduction of BOD in Pecan Process Water using Foam Flotation, D.A. Rockstraw, National Pecan Sheller's Association Annual Meeting, Charleston, SC, September 12, 1997 (invited).
53. Removal of Reactive Dyes from Water, D.A. Rockstraw, El Paso Water Users Consortium Meeting, El Paso, TX, July 16, 1997 (invited).
54. Synthesis & Characterization of Phosphate-Based Solid Acid Catalysts, N. Jackson, D.A. Rockstraw, D.K. Kambhampati, S. Thoma, N. A. Catalysis Soc., Chicago, IL, May 19-23, 1997.
55. An Activated Carbon Manufactured by Novel Techniques, R. Shawabkeh, D. A. Rockstraw, R. K. Bhada, NMSU Graduate Student Symposium, Las Cruces, NM, May 2, 1997 (First Place).

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57. Micellar-Enhanced Electrodialysis for Water Treatment, D.A. Rockstraw, J.F. Scamehorn, Waste-management Education and Research Consortium / Hazardous Substances Research Consortium Joint Conference on the Environment, Albuquerque, NM, April 22-24, 1997.
58. A Course in Chemical Process Design, D.A. Rockstraw, J.A. Eakman, S. Bellner, N. Nabours, Am. Soc. of Engineering Educ./Gulf SW Section Proceedings, Houston, TX, Mar. 23-25, 1997.
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60. Activated Carbon From Pecan Shells for Water Treatment, D.A. Rockstraw, R. Shawabkeh, Poster Presentation, XXXI Annual Western Pecan Conf., Las Cruces, NM, Mar. 9-11, 1997.
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66. An Integrated Electrodialysis/Evaporation Process for the Treatment of Aqueous Process Streams Containing Electrolytes, D.A. Rockstraw, J.F. Scamehorn, E.A. O'Rear III, American Institute of Chemical Engineers Fall National Meeting; San Francisco; CA; November 1989.
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68. Removal of Dissolved Metals from Water Using Electrodialysis, D.A. Rockstraw, J.F. Scamehorn, "10th American Electroplaters and Surface Finishers & EPA Conference on Environmental Control for the Metal Finishing Industry," Orlando, FL, January 23-25, 1989.
69. Use of Electrodialysis to Clean Abandoned Zn Mine Water in NE Oklahoma: Characterization of Multi-Component Systems Containing Species of Mixed Valences, D.A. Rockstraw, J.F. Scamehorn, Annual Generic Meeting of the Bureau of Mines; Reno, NV, May 1989.
70. The Use of Electrodialysis to Clean Water from Abandoned Zinc Mines in Northeast Oklahoma: Characterization of Single Component Systems, Annual Bureau of Mines Generic Meeting, Golden, CO, May 1988.

David A. Rockstraw, Ph. D., P. E.

TESTIMONY HISTORY SINCE DECEMBER 2018 ([†]DEPOSITION; [‡]TRIAL/ARBITRATION)

1. Sterne, Kessler, Goldstein, & Fox, Washington, DC. Plaintiff expert witness on matter involving infringement of US 8,167,141 B2, "Gravity Flow Filter" (Brita v. multiple defendants, International Trade Commission. 2021 - 2022).^{†‡}
2. Robins Kaplan LLP; Minneapolis, MN. Expert witness for the **plaintiff** on wrongful injury and product liability matter involving dust remover product (*Ashen S. Diehl, Plaintiff v. 3M Company, Defendant, Court File No. 69DU-CV-18-2662, in the U.S. District Court State of Minnesota, Sixth Judicial District, County of St. Louis.* 2020 - 2022).[†]
3. Arnold & Itkin LLP; Houston, TX. Expert witness for **plaintiff** on matter involving injury out of negligence at a chemical process facility. (*Jacque Lucas, et al. v. KapStone Paper and Packaging Corp., et al., C/A No: 2017-CP-10-838, In the Court of Common Pleas for the Ninth Judicial Circuit, County of Charleston, SC.* 2020 - 2022).[†]
4. Allen, Dyer, Doppelt + Gilchrist, PA; Orlando, FL. Expert witness for **plaintiff** of patent infringement and validity of U.S. Patent 6,350,453 B1 entitled, "Tocotrienols and Geranylgeraniol From Bixa Orellana Byproducts." (*American River Nutrition, LLC v. Beijing Gingko Group Biological Technology Co., Ltd et al., Case No.: 8:18-cv-02201-JLS-JDE in the United States District Court for the Central District of California.* 2019 - 2021).[†]
5. Finnegan, Henderson, Farabow, Garrett & Dunner, LLP; Reston, VA. Expert witness for **plaintiff** on patent infringement matter involving the infringement and validity of U.S. Patent 7,473,685 B2 (January 6, 2009) entitled, "Process for preparation of chemically stable, dry-flow, low compact, dust free, soluble granules of phosphoroamidothioates" (UPL NA v. Tide International (USA), Inc., Zhejiang Tide CropScience, Co., Ltd., and Ningbo Tide Imp. & Exp. Co., Ltd., Civ. No. 8:19-cv-01201 C.D. Cal. 2019 -).[†]
6. Barnes & Thornburg LLP, Dallas, TX. Expert witness for the **plaintiff** on a matter involving trade secret theft of radiant catalytic ionization technology (DBG Group Investments, LLC, et al. v. Allen M. Johnston, Greentech Environmental, LLC, and Ellen Johnston, in the Arbitration administered by the American Arbitration Association, Case No. 01-19-0001-7169. 2020 – 2021).^{†‡}
7. Gibson, Dunn, & Crutcher, Washington, DC. Expert witness for **counter defendant** of anti-trust claim on topic of properties of activated carbon materials used in fuel vapor canisters (Ingevity Corporation et al v. BASF Corporation, Case # 1:18-cv-01391. 2021).^{†‡}
8. Mangum Ririe LLP, Ladera Ranch, CA. Expert witness for **defendant** of a post grant review of a patent involving activated carbon adsorption of fuel vapors (Case PGR2020-00037, Patent 10,323,553: BASF Corp, Petitioner, v. Ingevity South Carolina, LLC. 2020).[†]
9. Alston & Bird, LLP; Atlanta, GA. Expert witness for **plaintiff** on trade secret theft of manufacture methods of calcium carbonate resins. (*Heritage Plastics, Inc., Plaintiff v. Gaston Construction, Inc., Glenn E. Stockdale, Christopher E. Varnado, and Plastical, LLC., Case 1:20-cv-00374-CLM. , United States District Court for the Northern District of Alabama.* 2020 - 2021).^{†‡}

10. McGlinchey Stafford; Houston, TX. Expert witness for **defendant** in a breach of contract matter based on the design and installation of commercial steam boilers (Civil Action No. 4:18-cv-4349 - *Equistar Chemicals, LLC. v. Indeck Power Equipment Company*, in the United States District Court for the Southern District of Texas Houston Div. 2019).[‡]
11. Gibson Dunn; Irvine, CA. Expert witness for the **plaintiff** in a patent infringement matter based on U.S. Patent Number RE38,844E (No. 18-1391 RGA, U.S. District Court for the District of Delaware, C.A. - *Ingevity Corporation and Ingevity South Carolina, LLC, v. BASF Corporation*. 2018-2020).[‡]
12. Gibson Dunn & Crutcher; Irvine, CA. Expert witness for the **plaintiff** in a patent infringement matter based on U.S. Patent Number RE38,844E (U.S. International Trade Commission, Washington DC, Investigation No. 337-TA-1140 In the Matter of Certain Multi-Stage Fuel Vapor Canister Systems and Activated Carbon Components Thereof. – *Ingevity Corporation and Ingevity South Carolina, LLC, v. Mahle, et al.* 2018-19).[‡]
13. Alston & Bird; Charlotte, NC. Expert witness for the **plaintiff** in lawsuit involving intellectual property of HFC blowing agents and propellants (Civil Action No. 3:17-cv-01390-N in US District Court for Northern District of Texas Dallas Division: *Honeywell International Inc. v. MEK Chemical Corporation*. 2018-2020).[‡]