

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

PROAMPAC HOLDINGS INC.,

Petitioner

v.

SIGMA TECHNOLOGIES INTERNATIONAL, LLC,

Patent Owner

Case IPR2025-01143
U.S. Patent No. 11,072,148

**DECLARATION OF RUOXI MA, PH.D. IN SUPPORT OF PATENT
OWNER'S RESPONSE**

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EXHIBITS CITED

Exhibit No.	Description
2021	Curriculum vitae of Dr. Ruoxi (Rachel) Ma
2022	“ <i>Biopolymer Films from Glucomannan: The effects of Citric Acid Crosslinking on Barrier Properties</i> ,” in Journal of Print and Media Research Technology, Research 7(2018)1, 19-25.
2023	“ <i>Screen Printed Moisture Sensor and Its Application on Smart Packaging</i> ,” in The Technical Association of Graphic Arts Proceedings 2021, pgs. 191-203 (focusing on material-layer substrates and substrates/coating surface interactions)
2024	<i>Method for Formulating Silver-Doped Lanthanum Titanate Photochromic Ink</i> (CN103804986A), issued May 21, 2014.
2025	Friel, John M., and Edwin Nungesser. “ <i>Acrylic Polymers as Coatings Binders</i> .” Paint and Coating Testing Manual - Fifteenth Edition of the Gardner-Sward Handbook: (MNL 17-2nd), edited by JV Koleske, no. MNL17, ASTM International, 2012, pp. 49–64, https://doi.org/10.1520/MNL12186M .
2026	Gündüz, Güngör. <i>Chemistry Materials and Properties of Surface Coatings: Traditional and Evolving Technologies</i> . DEStech Publications, 2015
2027	<i>Pigment Coating and Surface Sizing of Paper</i> . Vol. bk. 11., Fapet Oy, 2000. Chapter 6: Binders, section Coating binders, @ page 191. This reference covers binders, including latex and acrylic, their functions, properties, and implications for coating formation.
2028	<i>Recycled Fiber and Deinking</i> . Vol. bk. 7, Fapet Oy, 2000. Chapter 11, page 441-504.

I, Dr. Ruoxi (Rachel) Ma, make this declaration in connection with the Case IPR2025-01143, ProAmpac Holdings Inc. ("Petitioner") v. Sigma Technologies International LLC ("Patent Holder"):

INTRODUCTION

1. I am over 18 years of age and, if I am called upon to do so, I would be competent to testify as to the matters set forth in this Declaration.

2. I have been retained on behalf of Pratt Retail Specialties, LLC ("Pratt"), which I understand to be the exclusive licensee of U.S. Patent No. 11,072,148 ("the '148 Patent"). I understand that Patent Holder will submit this declaration as part of its Preliminary Response.

3. Pratt has asked me to respond to the Declaration of Glenn May (EX1003), submitted in connection with the Petition. I understand that Petitioner challenges the patentability of Claims 1-15 of the '148 Patent (the "Challenged Claims"). I have reviewed and analyzed Mr. May's Declaration in this regard, including the list of materials he listed as having been reviewed and considered. I have not been asked and have not analyzed the Petition outside of the May Declaration. My analysis is technical and not legal.

4. In summary, as set forth in greater detail below, I conclude that Mr. May has not shown Claims 1-15 to be unpatentable pursuant to the legal standards that I have been asked to apply.

5. I am being compensated for my services in connection with the above-identified proceeding at my standard rate of \$375 per hour. My compensation is not dependent in any way upon the substance of my testimony or the outcome of Petitioner's Petition.

BACKGROUND INFORMATION

6. All of my opinions stated in this Declaration are based on my own personal knowledge, professional experience and judgement, and analysis of the materials presented by Mr. May. Based on my understanding of a person of ordinary skill in the art as set forth below, I believe I have at least that level of skill regarding the '148 Patent and the materials addressed by Mr. May.

7. I attach a copy of my current curriculum vitae, EX2021, which details my education and professional and academic experience. I summarize below my experiences that are most pertinent to my opinions in this declaration.

8. I am an Associate Professor of Graphic Communication at California Polytechnic State University, where I specialize in packaging materials, barrier coatings, and sustainable design for thermal and food-related applications. My research and teaching span over 14 years.

9. I earned a Ph.D. in Paper and Printing Science from Western Michigan University with a strong research background in barrier materials and sustainable packaging solutions. My dissertation was titled *Screen Printed*

Moisture Sensor on Barrier Coated SBS Board: The Characterizations of the Hemicellulose-Based Biofilms and Their Applications for Smart Packaging.

Before that I earned my masters in Paper and Printing Engineering from Xi'an University of Technology, Xi'an China, and my undergraduate Bachelor of Science degree in Printing Science from Qingdao University of Science and Technology, Qingdao, China.

10. I currently teach "Packaging Materials for Medical Applications" and "Digital Printing and Emerging Technologies." I have taught a number of other courses that have touched on the issues relating to the issues raised by Mr. May and the '148 Patent including "Stock Preparation and Papermaking", "Pulping and Paper Coating", and "Emerging Technologies in Graphic Communication".

11. I have published several peer reviewed articles relevant to multilayer recyclable substrates including "*Biopolymer Films from Glucomannan: The effects of Citric Acid Crosslinking on Barrier Properties*," in Journal of Print and Media Research Technology, Research 7(2018)1, 19-25. EX2022. I am also the co-author of "*Screen Printed Moisture Sensor and Its Application on Smart Packaging*," in The Technical Association of Graphic Arts Proceedings 2021, pgs. 191-203 (focusing on material-layer substrates and substrates/coating surface interactions). EX2023.

12. I have presented at numerous conferences and industry meetings.

For example, in May 2023, I was invited to speak at the PACKout Conference, presenting on digital print in healthcare packaging, which is a sector analogous to thermal insulated bags. PACKout is a leading annual forum that brings together global packaging professionals to showcase innovations, regulatory trends, and disruptive technologies shaping the future of healthcare and consumer packaging.

13. I was invited to speak at TAGA Conference in 2021, presenting hemicellulose-based barrier coatings and their sustainability impact for smart packaging. TAGA (Technical Association of the Graphic Arts) is a premier international conference that bridges academic research and industry application in printing and packaging sciences, influencing technical standards and advancing best practices across the field.

14. I was the lead researcher on digital printing and functional materials for food and medical packaging (2022-2025). I also served as an external advisor for Duo He's Ph.D. dissertation "The Fractionation of Woody Biomass with Bifunctional Aryl Sulfonic Acids at Mild Conditions" (Western Michigan University, 2022). The work explored bio-based chemistries for coatings and binders that enhance functionality while remaining compatible with recycling streams, aligning with industry efforts to develop fiber-based packaging systems

that maintain repulpability and avoid mill contamination.

15. I was awarded a grant by the German Academic Exchange Service (DAAD) for a project on sustainable medical packaging across the EU and North America. For this project, I served as a visiting researcher at Hochschule München University of Applied Sciences teaching and conducting research on Innovative Packaging Solutions for Medical Applications in Spring 2025.

16. I was Co-PI (co-principle investigator) for a study on carbon footprint estimation and material compatibility of materials used in various mailing solutions in Winter 2025. The study involved lifecycle analysis of multi-layer laminates and was a sponsored project awarded by Quad Graphics Co.

17. I served as co-principal investigator on a study sponsored by Quad Graphics Co. (Quad), one of the world's largest printing and packaging providers, examining the carbon footprint of printing and packaging materials in mailing solutions. The project focused on sustainability and recycling regulations, evaluating the environmental impact and repulpability of common substrates and laminates. Its findings provided actionable guidance on material selection and laminate design, directly informing industry best practices and advancing packaging sustainability.

18. I hold a patent for *A Method for Formulating Silver-Doped*

EX2024.

RELEVANT LEGAL STANDARDS

19. I am not an attorney. My understanding of the law is based on information provided by counsel for Pratt, which I assume to be true.

20. **Anticipation.** I understand that for a claim to be anticipated: (1) each and every claim element must be identically disclosed, either explicitly or inherently, in a single prior art reference; (2) the claim elements disclosed in the single prior art reference must be arranged in the same way as in the claim; and (3) the identical invention must be disclosed in the single prior art reference. Where even one element is not disclosed in a reference, there is no anticipation.

21. I understand that to serve as an anticipatory reference, the reference itself must provide enough information so that a person of ordinary skill in the art can practice the subject matter of the reference without undue experimentation.

22. I further understand that where a prior art reference fails to explicitly disclose a claim element, the prior art reference inherently discloses the claim element only if the prior art reference must necessarily include the undisclosed claim element. Inherency may not be established by probabilities or possibilities. The fact that an element may result from a given set of circumstances is not sufficient to prove inherency.

23. **Obviousness.** I understand that the test for obviousness is whether the claimed invention would have been obvious to one of ordinary skill in the art at the time of the invention, considering the scope and content of the prior art, the differences between the prior art and the invention, the level of skill of the person of ordinary skill in the art and secondary considerations of non-obviousness.

24. I understand that a claim can be obvious in view of a single prior art reference (through modification of that reference) or multiple prior art references (through a combination of two or more prior art references). The single art reference or combination of prior art must teach each and every limitation of the patent claim at issue.

25. I understand that to establish a finding of obviousness, one must show that a person of ordinary skill in the art (“POSITA”) would have had a motivation to combine the prior art references to produce the claimed invention and have a reasonable expectation that the combination would be successful.

26. I understand that a prior art reference is proper to use in an obviousness determination if the prior art reference is analogous art to the claimed invention. I understand that a prior art reference is analogous art if at least one of the following two considerations is met. First, a prior art reference is analogous art if it is from the same field of endeavor as the claimed invention, even if the prior art reference addresses a different problem and/or arrives at a different solution.

Second, a prior art reference is analogous art if the prior art reference is reasonably pertinent to the problem faced by the inventor, even if it is not in the same field of endeavor as the claimed invention.

27. I understand that each alleged prior art reference in a proposed obviousness combination must be evaluated in its entirety, i.e., including those portions that would argue against obviousness, and must be considered for everything that it teaches, not simply the described invention or a preferred embodiment.

28. I understand that it is inappropriate to resolve obviousness issues by a retrospective analysis or hindsight reconstruction of the prior art and that the use of “hindsight reconstruction” is improper in analyzing the obviousness of a patent claim.

29. **POSITA.** I understand that a POSITA is a hypothetical person presumed to have known the relevant art at the time of the invention. I understand that date here is January 8, 2018. I also understand that the factors considered in determining the level of ordinary skill in the relevant art include: (1) the problems encountered in the art; (2) the prior art solutions to the problems encountered in the art; (3) the rapidity of innovation; (4) the sophistication of the technology; and (5) the education level of active workers in the field. I understand that not all of these factors need to be considered for analysis and that equivalent work or experience

may be substituted for education.

30. I have considered Mr. May's description of POSITA for this case. EX1003, ¶ 24. While I agree on certain aspects of Mr. May's description, I believe it is incomplete. This difference, however, does not impact my bottom-line conclusions.

31. In my view, as of January 8, 2018, a person of ordinary skill in the art ("POSITA") would have had at least a bachelor's degree in packaging, chemical engineering, materials science, or paper engineering, or an equivalent field, and at least 5 years of experience in developing or evaluating packaging materials. Relevant experience could include repulpability and recyclability of barrier films, laminates, coatings, recyclability assessments, or thermal management in packaging applications. Additional academic training (e.g., a master's degree) could compensate for less work experience, and conversely, more extensive work experience could compensate for formal education. Such a person would have been familiar with commonly used packaging materials (paper, polymers, thin films, metalized layers), as well as with standard testing methods used in the field (e.g., recyclability, repulpability, and barrier performance).

32. **Claim construction.** I understand that in certain instances there is the need to engage in a process called claim construction to provide meaning to claim terms that are important to the dispute. Here, I am able to base my analysis on the

plain and ordinary meaning of the claim terms based on my technical understandings. This includes the ‘148 patents consistent use of terms such as recyclable packaging and emissivity. Accordingly, I have not engaged in any claim construction analysis. I note that Mr. May too said it was not necessary to engage in claim construction. EX1003, ¶ 61.

SUMMARY OF THE ‘148 PATENT

33. The ‘148 Patent is entitled “Recyclable Paper-Coating Packaging With Radiant Barrier Insulation.” EX1001. The problem the ‘148 Patent addresses is how to make a recyclable paper-containing packaging to preserve temperature sensitive foods or pharmaceutical goods. *Id.*, 1:15-22. The ‘148 Patent observed that “practically all perishable or temperature sensitive goods shipped in small volumes are shipped with the use of corrugated cardboard boxes, which are easily and commonly recycled.” *Id.*, 6:10-13. The prior art, however, was not able to provide a fully recyclable, low-emissivity packaging material. *Id.*, 4:39-41.

34. The Abstract summarizes the solution: “Material for packaging – and package or receptacle made of such material – that contains a particular aluminized polymeric film with emissivity of equal to, or less than 0.10 and yet sufficiently thin to withstand and satisfy industrial requirements of the recycling process due to substantially complete oxidation of aluminum during recycling.” *Id.*, Abstract.

35. The ‘148 Patent describes and claims various “stacks” that meet the

goals of the invention, which include multiple layers of paper (which includes corrugated fiberboard), polymer and aluminum, and sometimes also a coating.

Figure 4 illustrates such a stack.

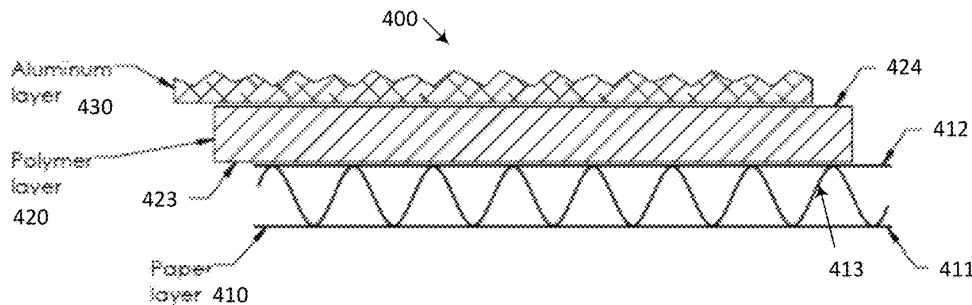


Fig. 4

36. To be recyclable, packaging must first be repulpable. The ‘148 Patent lays out the industry standard for repulpability and recyclability in great detail underscoring the importance of repulpability and recyclability to the invention. EX1001, 4:64 – 6:9. In this regard, the ‘148 Patent refers to and incorporates “The Voluntary Standard for Repulping and Recycling Corrugated Fiberboard Treated to Improve its Importance in the presence of Water and Water Vapor” (“Voluntary Standard”). *Id.* I agree that the Voluntary Standard was and is a commonly used test.

37. The first portion of the Voluntary Standard addresses repulpability. The ‘148 Patent sets forth the Voluntary Standard’s test method in this regard. *Id.*, 5:11-24. This test is included in each claim as the “treatment.” *Id.*, 19:1 – 22:36.

The material is disintegrated into water which is passed over a screen. The material that passes through the screen is called the “accepts” and the material that does not pass through the screen is called the “rejects.” The dried weight of the materials are measured and if the “accepts” weigh at least 85 weight-% of the total material, the material itself is classified as repulpable. That is, if 85% or more of the total material, by oven dry weight, passes through the screen during testing, the material is repulpable.

38. The second step of the Voluntary Standard test involves the potential use of the recyclable material in paper making. EX1001, 5:31-32. The accepts are pressed together to form sheets. *Id.*, 5:32-35. These sheets are then inspected for defects, “spots” or other visual blemishes according to industry test methods. *Id.*, 5:35-53. For example, if a small amount of dirt or aluminum makes its way into the pulp, it could result in visual blemishes and could be a cause for rejection of the paper product. Further, if polymeric material makes its way into the pulp, the polymer material could be re-softened or re-melted and cause undesirable “stickies” because they negatively affect the physical properties of the paper. *Id.*, 5:54-66. To pass this second step of the Voluntary Standard test, and for the paper to be considered recyclable, there can be no more than 15 visually observable spots in a 0.4 square millimeter area of the sheet. *Id.*, 6:1-4.

39. The low emissivity (i.e., reflectivity) and related low optical density

lead to transparency of the aluminum rendering the pulp recyclable.

ANALYSIS OF MR. MAY'S PRIOR ART

40. Mr. May bases his invalidity analysis on four primary references, which I have reviewed in detail: (1) U.S. Patent Publication No. 2014/0044903 (“Gundlach”) (EX1005); (2) S. Yializis, *Multi-Layer, Low Emissivity, Metallized Materials for Replacing Aluminum Foils in Heat Reflection and Energy Management Applications*, Society of Vacuum Coaters, 52nd Annual Technical Conference Proceedings, 755-759 (May 2009) (“Yializis”) (EX1006); (3) *The Voluntary Standard for Repulping and Recycling Corrugated Fiberboard Treated to Improve its Performance in the Presence of Water and Water Vapor*, Fibre Box Association (August 16, 2013) (“Voluntary Standard Reference”) (EX1007); and (4) U.S. Patent Publication No. 2015/0053086 (“Rebouillat”) (EX1008). I also have reviewed the other materials cited in Mr. May’s list of materials reviewed and considered, but my focus has been on these four items.

41. Applying the legal standards set forth above, I conclude that Mr. May fails to show the invalidity of the ‘148 Patent. I address each of the above four references below individually, and then address them in the context of each of the six grounds in the final section of this declaration.

42. I have not been asked to identify every way in which I disagree (or agree) with Mr. May’s discussion. Instead, I have been asked to identify the key

areas in which I disagree with Mr. May's analysis of each of the four references - that is, the reference does not satisfy one or more requirements or limitations of the claims of the '148 Patent. I reserve the right to address additional aspects of Mr. May's Declaration if asked to do so.

43. The following is a general discussion of Mr. May's four main references:

Gundlach's Failure to Disclosure Each Element of the Claims of the '148 Patent

44. Gundlach generally addresses a film for use with packaging for foodstuffs having different layers on top of the paperboard "base material." EX1005, Abstract. Gundlach states in the Summary of the Disclosure, "The disclosure is directed to a film for use in association with packaging useable with foodstuffs having product contact." *Id.*, [0008].

45. Gundlach does note in the Background of the Disclosure that the prior art packaging materials were "not well suited for recycling or composting." *Id.*, [0005]. While this might suggest Gundlach intended to solve this problem, Gundlach did not. Nowhere in the rest of Gundlach is there any discussion regarding how and why the packaging of Gundlach solves this problem. Indeed, the packaging of Gundlach does not.

46. I am of the opinion that one of the key aspects of Gundlach is the base coat structure (something different than the base material), which can be made up

of an inner base layer and an outer base layer. *Id.*, [0037-0042]. The importance of the base coat structure to Gundlach is underscored by the fact that the metallic layer is optional. EX1005, [0023; 0051].

47. Of particular interest in Gundlach's discussion of the base coat structure is the disclosure of high molecular weight acrylic polymer resins. *Id.*, [0042]. For instance, Gundlach discloses BMA acrylic copolymer -- a synthetic resin based on butyl methacrylate + ("BMA") other acrylic monomers. *Id.*, [0040]. In packaging, BMA polymer serves as a flexible, adhesive base coat to support metallization and prevent aluminum flaking.

48. Gundlach discloses that these high molecular weight polymer resins "repress[] the propensity for metal flaking upon sheet folding (gusset folds)." *Id.*, [0041]. Put another way, the high-molecular weight polymers help anchor the metallized layer so it doesn't crack or shed upon repeated folding. The literature supports the conclusion that the acrylic copolymer's function is to increase adhesion and flexibility of the metallized layer and reduce flaking: (1) Friel, John M., and Edwin Nungesser. "*Acrylic Polymers as Coatings Binders.*" Paint and Coating Testing Manual - Fifteenth Edition of the Gardner-Sward Handbook: (MNL 17-2nd), edited by JV Koleske, no. MNL17, ASTM International, 2012, pp. 49–64, <https://doi.org/10.1520/MNL12186M>. EX2025. And (2) Gündüz, Güngör. *Chemistry Materials and Properties of Surface Coatings: Traditional and*

Evolving Technologies. DEStech Publications, 2015. EX2026.

49. These high molecular weight polymers, however, do not repulp with the fibers. They remain intact and can form stickies – stickies, as mentioned above regarding the disclosures of the ‘148 Patent, are tacky contaminants that can agglomerate in screens and can cause defects in recycled paper such as spots and blemishes. The literature also supports this observation: (1) *Pigment Coating and Surface Sizing of Paper*. Vol. bk. 11., Fapet Oy, 2000. Chapter 6: Binders, section Coating binders, @ page 191. This reference covers binders, including latex and acrylic, their functions, properties, and implications for coating formation. EX2027. And (2) *Recycled Fiber and Deinking*. Vol. bk. 7, Fapet Oy, 2000. Chapter 11, page 441-504. EX2028. This reference deals with the sources and behavior of stickies in pulp, including adhesives, ink, coating binders/latexes as sources.

50. Gundlach does not reference the Voluntary Standard - it references no standard or test regarding repulpability or recyclability. Instead, Gundlach references leaching tests using peanut oil and pickle juice. EX1005, [0052].

51. The Gundlach packaging material thus does not meet all of the requirements of the claims of the ‘148 Patent. As discussed above, the ‘148 Patent generally discloses that the thin, low emissivity aluminum layer will oxidize and disappear during the repulping process as per the Voluntary Standard and the

treatment in the claims, resulting in pulpable material that meets the “industrial requirements of the recycling process.” EX1001, Abstract. Gundlach, in contrast, not only fails to disclose the Voluntary Standard and specific treatment claimed in the ‘148 Patent, but, as discussed above, it also discloses material for packaging that has significant recycling problems, not advantages. And the claims of the ‘148 Patent require a recyclable packaging material.

52. Finally, certain of the claims of the ‘148 Patent require an optical density (OD) of less than 0.09. EX1001 (e.g., Claim 7). This low OD means that oxidized aluminum layer has disappeared during the repulping test. While Gundlach does mention ODs, they are much higher (e.g., 4.0) and the discussion is not in the context of a measurement taken in connection with repulpability and recyclability tests. EX1005, [0044]. There is no discussion regarding the treatment or recyclability of the Gundlach packaging.

The Yializis Article Fails to Disclose Each Element of the Claims of the ‘148 Patent

53. The problem addressed in the Yializis article is the degradation of metallized aluminum films in the presence of heat and moisture. EX1006, Abstract. “Unlike oxide layers grown in air, in dry conditions, aluminum hydroxides formed from a water reactions lack the ability to protect the aluminum from further corrosion. . . .” *Id.*, p. 755, right col.. The Yializis article further observes, “Extreme environments consisting of high heat and moisture can result in

propagation of oxidation and corrosion sites to the degree that a vapor deposited, low-e surface is entirely consumed.” EX1006, p. 755, right col..

54. The Yializis article then goes on to report on the investigation into the solution to this problem – a “novel, multi-layer, low emissivity materials incorporating one or more vacuum deposited layers designed to protect vacuum deposited aluminum layers from oxidization and corrosion.” *Id.*, Abstract. “[V]apor deposited polymer coatings [are] designed to protect thin films from the effects of corrosion and oxidization. *Id.*, p. 755, right col..

55. The Yializis article goes on to discuss an “In-Line Plasma Passivation” that results in the “formation of an aluminum oxide layer that is guaranteed not to contain damaging hydroxides.” *Id.*, p. 757, left col.. The article further discusses “Flash Evaporation and Curing,” the result of which “is a protective layer capable of preventing ingress of moisture in quantities sufficient to facilitate formation of aluminum hydrozides. *Id.*, p.757, right col..

56. The Yializis article does mention the use of metallized films for use in packaging for foodstuffs and pharmaceutical products (*Id.*, p. 757, left col.), but this is not the focus of the investigation.

57. The Yializis article does not address the repulpability and recyclability issues relating to the low emissivity, thin aluminum layered packaging material addressed in the ‘148 Patent. Indeed, while the ‘148 Patent seeks full oxidization

during the pulping test, the Yializis article describes a protective layer to prevent the oxidization and corrosion of the aluminum layer.

58. Consistent with the above, the Yializis article does not mention the Voluntary Standard or other industry standards (i.e., TAPPI) relating to repulpability and recyclability. There is no discussion regarding recyclable fiber yield, stickies count, optical density in connection with repulping or any other recyclability matrix. The article does mention an “Accelerated Steam Testing” (EX1006, p. 758, right col.), but this test gauges the performance of the protective coating and not to simulate repulping.

59. The Yializis article thus does not meet all of the requirements of the claims of the ‘148 Patent. The article neither discloses a recyclable paper containing package, nor discloses the Voluntary Standard - the specific treatment claimed in the ‘148 Patent. Finally, the Yializis article fails to disclose the optical density requirement of certain of the claims of the ‘148 Patent.

The Voluntary Standard

60. The ‘148 Patent, as noted above, expressly refers to and incorporates the Voluntary Standard. Each claim of the ‘148 Patent incorporates the test of the first step of the Voluntary Standard as the treatment.

61. The Voluntary Standard, however, as discussed in the final section of this declaration, does not support Mr. May’s arguments for rendering the claims of

the '148 Patent obvious.

Rebouillat Fails to Disclose Each Element of the Asserted Claims of the '148 Patent

62. Rebouillat is entitled “Breathable Product for Protective Mass Transportation and Cold Chain Applications.” EX1008. The Background of the Invention describes how “thermal covers may be used to protect a wide variety of cargo, such as flowers, fresh fruits and vegetables, fresh fish, pharmaceuticals and electronic products, from temperature fluctuations experienced during transport.” *Id.*, [0004]. The drawback in the prior art was that the thermal covers were impermeable to gasses and water allowing humidity and heat to build up (i.e., “green house effect”), which is detrimental for humidity and temperature sensitive goods. *Id.*, [0005].

63. The Abstract describes the solution to the problem as “a breathable product for protecting mass transportation and cold chain applications.” *Id.*, Abstract. This includes a reflective sheet having at least a first layer made of a highly reflective moisture vapor permeable substrate. The reflective sheet also contains a metal layer. *Id.*

64. Figures 1a and 1b illustrate embodiments of the reflective sheet. *Id.*, [0032]. The low emissivity, breathable reflective cover reflective has a first layer 1 made of Tyvek®. *Id.* There can be a metal layer 2 and lacquer coating 3. *Id.* (Further embodiments relate to flame retardant covers. *Id.*, [0034].)

65. Tyvek® is 100% high-density polyethylene that does not repulp into fibers under the TAPPI tests. Tyvek® is a #2 plastic that is recyclable in the plastics stream, not the paper stream.

66. Rebouillat does not teach anything regarding the repulpable and recyclable packaging of the '148 Patent. Indeed, Rebouillat only makes minor mention of the possibility of having cellulose as part of the cover sheet. EX1008, [e.g., 0046].

67. Rebouillat also does not disclose the Voluntary Standard or other industry tests or standards relating to the repulpability or recyclability of paper or cardboard packaging. Instead, the tests relate to such things as light reflectivity, moisture barrier transmission, liquid water penetration, emissivity and flammability. *Id.*, [0069].

68. Rebouillat thus does not disclose all of the requirements of the claims of the '148 Patent. Rebouillat neither discloses a recyclable paper containing package, nor does it disclose the Voluntary Standard - the specific treatment claimed in the '148 Patent. Finally, Rebouillat fails to disclose the optical density requirement of certain of the claims of the '148 Patent.

ANALYSIS OF AND CONCLUSIONS REGARDING THE SIX GROUNDS IN LIGHT OF MR. MAY'S PRIOR ART

69. Mr. May addressed the six grounds of the Petition. I now will address each of the six grounds in light of my above examination of the prior art relied

upon by Mr. May. I conclude that Mr. May has failed to establish invalidity based on the arguments in each of the six grounds.

70. I focus my analysis on three key omissions in Mr. May's prior art: (1) the requirement that the packaging or material be recyclable as set forth in each of the independent claims;¹ (2) the packaging is subjected to or exposed to the "treatment" (i.e., first step of the Voluntary Standard test) as set forth in each of the independent claims; and (3) the optical density requirement as set forth in independent claims 7 and 9. My above discussion of the references is incorporated herein and will not be repeated in full.

71. Ground 1. Mr. May asserts that Gundlach anticipates Claims 1, 2, 4, 6-11, and 13-15 of the '148 Patent. EX1003, ¶ 77. While Mr. May concludes that Gundlach "teaches that when the packaging is subjected to the treatment in element 1(g) to form a recyclable material" *Id.*, ¶ 98, I disagree for the reasons set

¹ I note that the "recyclable packaging" of Claim 7 is referenced in what I understand to be the preamble of Claim 7. While I understand that the preamble may not be interpreted as a limitation in certain circumstances, I believe it is here given the following legal rule that I have been provided and assume to be true: the preamble of a claim is read as a limitation when it recites essential structural elements (necessary to give life, meaning, or vitality to the claim), provides antecedent basis for later claim terms, or defines the purpose or context of an invention in a way that is integral to the claim. Mr. May appears to agree as he too addresses recyclability in the context of a preamble. EX1003, ¶. 72.

forth above. Gundlach discloses material for packaging that has significant recycling problems, not advantages. Gundlach also fails to disclose the Voluntary Standard or treatment of the claims.

72. To the extent Mr. May suggests these elements are inherent in Gundlach, I also disagree. A prior art reference noted above, inherently discloses the claim element only if the prior art reference must necessarily include the undisclosed claim element. Gundlach does not necessarily include recyclability and the Voluntary Standard/treatment where Gundlach's base coat structure includes high molecular weight polymers that are not recyclable under industry standards.

73. I also disagree with Mr. May's conclusion that Gundlach teaches the optical density requirement of certain of the claims (e.g., 7) expressly or inherently. EX1003, ¶¶ 119-120. As discussed, the optical density of the '148 Patent is measured in the context of the repulpability treatment. The optical density measurements disclosed in Gundlach are not taken in the context of a repulpability test and are well above the low claimed range of the '148 Patent – below 0.09 in the claims and the lowest disclosed in Gundlach is 2.0. EX1005, [0044].

74. Ground 2. Mr. May argues that Claims 1-15 are obvious over Gundlach and the Yializis article. I again disagree. Mr. May cannot fill the gaps in Gundlach with the Yializis article because, as discussed above, the Yializis article

has the same omissions. Put another way, even assuming Mr. May has proven a motivation to combine, the Gundlach/Yializis article combination still has the three gaps discussed above – no recyclability, no Voluntary Standard and no optical density measure in the context of the repulpability treatment.

75. Ground 3. Mr. May argues that Claims 1, 2 and 4-15 are obvious over Gundlach and Rebouillat. EX1003, ¶180. I disagree. Mr. May cannot fill the gaps in Gundlach with the Rebouillat because, as discussed above, the Rebouillat has the same omissions. Put another way, even assuming Mr. May has proven a motivation to combine, the Gundlach/Rebouillat combination still has the three gaps discussed above – no recyclability, no Voluntary Standard and no optical density measure in the context of the repulpability treatment.

76. Ground 4. Mr. May argues that Claims 1, 2, 4, 6-11 and 13-15 are obvious over Gundlach and the Voluntary Standard. I disagree. Even assuming a motivation to combine Gundlach and the Voluntary Standard, the Gundlach/Voluntary Standard combination still omits the recyclability and optical density requirements.

77. Ground 5. Mr. May argues that Claims 1-15 are obvious over Gundlach, the Yializis article and the Voluntary Standard. I disagree. Even assuming a motivation to combine these three references, the Gundlach/Yializis article/Voluntary Standard combination still omits the recyclability and optical

density requirements.

78. Ground 6. Mr. Argues that Claims 1, 2 and 4-15 are obvious over Gundlach, the Rebouillat and the Voluntary Standard. I disagree. Even assuming a motivation to combine these three references, the Gundlach/Rebouillat/Voluntary Standard combination still omits the recyclability and optical density requirements.

CONCLUSION

In view of the facts above, and in accordance with the legal principles described in paragraphs 19-32, a POSITA would have found that Claims 1-15 neither are anticipated nor obvious before January 8, 2018 (the date used by Glenn May in his analysis).

DECLARATION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further 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 Section 1001 of Title 18 of the United States Code.

Executed this 01 day of October 2025.



Ruoxi (Rachel) Ma, Ph.D.