UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

EPL LIMITED,
Petitioner

v.

COLGATE-PALMOLIVE COMPANY,
Patent Owner

Case PGR2022-00001
U.S. Patent No. 10,889,093 B2

DECLARATION OF STEPHEN MCCARTHY, PH.D., IN SUPPORT OF PETITION FOR POST-GRANT REVIEW OF U.S. PATENT NO. 10,889,093

Mail Stop "PATENT BOARD"
Patent Trial and Appeal Board
U.S. Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

Huhtamaki EX1029
U.S. Patent No. 11,260,624

EPL LIMITED EX1003
U.S. Patent No. 10,889,093

TABLE OF CONTENTS

I. INTRODUCTION 1
II. QUALIFICATIONS 3
III. My Understanding of Legal Principles 5
A. Patent Eligibility 5
B. Analogous Art 6
C. Obviousness Law 6
D. Indefiniteness Law 11
E. Enablement Law 11
F. Pre- or Post-AIA eligibility of a patent or patent application 12
IV. LEVEL OF ORDINARY SKILL IN THE ART 13
V. OVERVIEW OF THE '093 PATENT 13
A. Alleged Problem of Recycling Multilayer Plastics 20
B. Overview of the '093 Patent Claims 20
C. Summary of the '093 Patent's Prosecution History 22
D. PGR Eligibility of the '093 Patent 23
E. Claim Construction 23
VI. OVERVIEW OF THE DECLARATION 24
A. Citation of Prior Art 24
1. Morris 24
2. Haley 25
3. Borse 26
4. Guo 27
B. Grounds for the Challenge 27
VII. GROUND 1: MORRIS RENDERS OBVIOUS CLAIMS 1–4 and 7–10. ... 27
A. Morris renders obvious claim 1 27
1. Preamble: "A sheet comprising:" 29
2. [1.1] "a polymeric multi-layer structure comprising:" 30

3. [1.1a] “a plurality of layers including an uppermost layer and a lowermost layer, each of the plurality of layers having a stress value”.....31

4. [1.1b] “wherein the stress value of at least two of the plurality of layers are non-zero and different from one another”.....33

a) It would have been obvious that the multilayer material of Morris would have had two layers with non-zero, different stress values.....33

b) Claiming a highly probable result of a well-known technique is not patentable.....34

c) Two layers with non-zero, different stress values is obvious as being part of a finite number of predictable solutions.....37

5. [1.1c] “wherein the multi-layer structure has a net stress value that is less than the greater stress value of the plurality of layers.”.....38

B. Morris renders obvious claim 2.....39

C. Morris renders obvious claim 3.....40

D. Morris renders obvious claim 4.....40

E. Morris renders obvious claim 7.....41

F. Morris renders obvious claim 8.....42

G. Morris renders obvious claim 9.....43

H. Morris renders obvious claim 10.....44

VIII. GROUND 2: MORRIS AND HALEY RENDERS OBVIOUS CLAIMS 5-6.....46

A. Morris and Haley render obvious claim 5.....46

1. Element [5.1].....49

2. Element [5.2].....50

3. Element [5.3].....51

B. Morris and Haley render obvious claim 6.....52

IX. GROUND 3: HALEY, BORSE, AND GUO RENDER OBVIOUS CLAIMS 1–10. 54
A. Haley, Borse, and Guo render obvious claim 1. 54
1. Preamble: "A sheet comprising:" 54
2. [1.1] "a polymeric multi-layer structure comprising:" 54
3. [1.1a] "a plurality of layers including an uppermost layer and a lowermost layer, each of the plurality of layers having a stress value"....55
4. [1.1b] "wherein the stress value of at least two of the plurality of layers are non-zero and different from one another"....57
a. A POSA would have been motivated to modify Haley in view of Borse, the combination of which renders element [1.1b] obvious. 57
b. A POSA would have further been motivated to apply the teachings of Guo to the combination of Haley and Borse. 59
5. [1.1c] "wherein the multi-layer structure has a net stress value that is less than the greater stress value of the plurality of layers" 63
B. Haley, Borse, and Guo render obvious claim 2. 64
C. Haley, Borse, and Guo render obvious claim 3. 65
D. Haley, Borse, and Guo render obvious claim 4. 66
E. Haley, Borse, and Guo render obvious claim 5. 66
1. Element [5.1]....69
2. Element [5.2]....70
3. Element [5.3]....71
F. Haley, Borse, and Guo render obvious claim 6. 72
G. Haley, Borse, and Guo render obvious claim 7. 73
H. Haley, Borse, and Guo render obvious claim 8. 74
I. Haley, Borse, and Guo render obvious claim 9. 75
J. Haley, Borse, and Guo render obvious claim 10. 76

X. CLAIMS 1–10 ARE NOT ENABLED. 78
XI. CLAIMS 1–10 DO NOT RECITE PATENTABLE SUBJECT MATTER..81
A. The claims recite well-known structure in combination with certain material properties. 81
B. The claims are directed towards a natural law and meet step one. 83
C. The claims fail to add an inventive concept and thus meet step two. .83
XII. CONCLUSION.....85

I. INTRODUCTION

I, Stephen McCarthy, declare as follows:

1. I have been retained by Sterne, Kessler, Goldstein & Fox on behalf of EPL Limited ("EPL") for a post grant review ("PGR", number PGR2022-00001) to provide my expert opinions and expert knowledge. I understand that this proceeding involves U.S. Patent No. 10,889,093 ("the '093 patent") titled "Dimensionally Stable Recyclable Package," and that the face of the '093 patent indicates that it is currently assigned to Colgate-Palmolive Company ("Colgate").

2. The '093 patent describes multilayer structures comprising plastic materials. I am familiar with the technology described in the '093 patent as of its earliest possible priority date, May 6, 2019.

3. I have been asked to provide my independent technical review, analysis, insights, and opinions regarding the '093 patent and the references that form the basis for the grounds of unpatentability set forth in the petition for PGR of the '093 patent.

4. In preparing this declaration, I have reviewed and am familiar with all the documents cited herein. For reference, I include the following exhibit list detailing the exhibits I reference in this declaration.

Exhibit No.	Description
1001	U.S. Patent No. 10,899,093 B2 to Wang ("the '093 Patent")
1002	Prosecution File History of U.S. Patent No. 10,889,093 B2 ("'093 File History")

Exhibit No.	Description
1004	*Curriculum Vitae* of Stephen McCarthy, Ph.D.
1005	Barry A. Morris, *The Science and Technology of Flexible Packaging: Multilayer Films from Resin and Process to End Use*, Elsevier Inc., 2007 ("Morris")
1006	U.S. Patent No. 8,709,611 B2 to Haley ("Haley")
1007	International Patent Application Publication No. WO 2014/005214 A1 to Borse ("Borse")
1008	Guo, et al., "Predicting multilayer film's residual stress from its monolayers," *Materials and Design* 110 (2016) 858-864
1009	*Multilayer Flexible Packaging*, 2nd Ed., edited by John R. Wagner, Jr., Elsevier Inc., 2016 ("Wagner")
1010	Declaration of Sylvia Hall-Ellis, Ph.D.
1011	High Density Polyethylene TIPELIN, MOL Group Product Catalogue, April 2018
1012	"SoarnoL," Soarus L.L.C. website, captured by the Web Archive on January 6, 2019 (accessed October 8, 2021 at https://web.archive.org/web/20190106165900/https://soarus.com/product/soarnol-evoh/)
1013	Polyethylene Technical Guide Series, "01 General Properties – Technical Guide," Qenos Pty Ltd.
1014	"HDPE Bottle Application Test, HDPE-A-01," The Association of Postconsumer Plastic Recyclers
1015	U.S. Patent No. 3,655,503 to Stanley et al. ("Stanley")
1016	"Newest APR Recycling Demand Champion Companies Announced at the 2019 Plastics Recycling Conference," The Association of Plastic Recyclers Press Release, March 13, 2019
1017	U.S. Patent No. 7,802,685 B2 to Allen et al. ("Allen")
1018	"The APR Design Guide for Plastics Recyclability," The Association of Plastic Recyclers, October 26, 2018
1019	"Applications Guidance for Innovations 'HDPE Bottles Applications Guidance Document,'" Association of Postconsumer Plastic Recyclers, May 13, 2019
1020	"SMARTFLEX -- The New Series of Packaging Film Extrusion Lines," Bandera, YouTube video, June 10, 2012 (accessed October 11, 2021 at https://www.youtube.com/watch?v=WdHTLiC5jUk)

I have reviewed and am familiar with the ’093 patent and its file history. I confirm that to the best of my knowledge the accompanying exhibits are true and accurate copies of what they purport to be, and that an expert in the field would reasonably rely on them to formulate opinions such as those set forth in this declaration.

5. I am being compensated at my customary rate of $465.00 per hour for my work on this case. My compensation is not dependent upon my opinions, my testimony, or the outcome of this case.

II. QUALIFICATIONS

6. I received a B.S. degree in Textile Chemistry from Southeastern Massachusetts University in 1978. I then studied Chemical Engineering at Princeton University, where I received my Master’s Degree in 1980. I continued on to study Macromolecular Science at Case Western Reserve University, where I received my Ph.D. in 1984.

7. I have worked as a professor in the field of polymer science since graduating with my Ph.D. in 1984. I have held various positions at the University of Massachusetts Lowell, where I am currently an Emeritus Professor in the Department of Plastics Engineering and the Department of Biomedical Engineering. I have over 35 years of directly relevant academic experience in the field of polymers.

8. My research focuses on polymer material design and manufacture, and I have had numerous publications that are relevant to multilayer polymer structures, a sampling of which are listed in my *curriculum vitae*. EX1004. Examples include (1) "Effect of Blends and Fillers on the Permeability of Linear Low Density Polyethylene", (2) "Rheological and Mechanical Properties of Immiscible Blends of EVOH and Styrene-Based Polymers", (3) "Interfacial Agents for Blends of Polystyrene and Ethylene-Vinyl Alcohol Copolymers", (4) "Analysis of the Mechanical Properties of Biodegradable Films Made from Blends of Polylactic Acid (PLA) and Polyesters by Blown Film Extrusion", (5) Advances in Properties and Biodegradability of Co-continuous, Immiscible, Biodegradable, Polymer Blends" Degradability, Renewability and Recycling – Key Functions for Future Materials, (6) "Analysis of Adhesive Properties of Different Engineering Thermoplastics to Elastomers by a Two-Shot Injection Molding Process" and (7) "Thermoplastic Paint (A.K.A. Film Finish, Paint Film, Dry Paint) A Complementary Technology for Exterior Automotive Plastic" .I have also supervised 34 Ph. D. Dissertations and 126 Masters Theses in the polymer field. EX1004.

9. I also served as an editor for the Journal of Polymers and the Environment from 1991-2016, and I served on the Editorial Board of the Journal of Applied Polymer Science from 1995-2003. EX1004.

10. I am an inventor on fifteen patents or patent applications that are all related to polymer science. EX1004. Some examples of relevant patents that I am an inventor on include U.S. Patent No. 6,670,028 ("Molded Article and Process for Preparing the Same") and U.S. Patent No. 6,770,230 ("Surface Finishing Compression Molding with Multi-Layer Extrusion").

11. My *curriculum vitae* has further details on my education, experience, publications, and other qualifications. EX1004.

III. MY UNDERSTANDING OF LEGAL PRINCIPLES

A. Patent Eligibility

12. I understand that utility patents like the '093 patent must claim patent-eligible subject matter to be issued as a patent. I further understand that the general concepts that have been found not to be patent-eligible subject matter are natural laws, natural phenomena, and abstract ideas. I further understand that there is a two-step test for determine whether a claim is directed towards patent-ineligible subject matter. First, it is determined whether the claim recites an ineligible concept. If the answer to this step is yes, then it is determined if the claim as a whole recites an inventive concept that is significantly more than just the recited ineligible concept. Put otherwise, the remainder of the claim must recite some structures, steps, or processes that transform the ineligible concept recited in the claim into a patent-eligible invention.

B. Analogous Art

13. It is my understanding that a prerequisite to determining whether a combination of references renders a claimed invention obvious is determining the scope and content of the prior art and determining whether a given reference properly falls within that scope. Further, it is my understanding that a reference qualifies as prior art for an obviousness determination only when it is analogous to the claimed invention. It is my understanding that a reference is analogous art to the claimed invention only if: (1) the reference is from the same field of endeavor as the claimed invention; or (2) the reference is reasonably pertinent to the particular problem solved by the inventor. I understand that the field of endeavor of a patent is determined by looking to the patent itself—including the written description and claims, including the structure and function of the invention. I further understand that a reference is "reasonably pertinent" if it would logically commend itself to the inventor's attention in considering the problem solved by the claimed invention.

C. Obviousness Law

14. I understand that my analysis requires an understanding of the scope of the '093 patent claims and that the disclosures of the '093 patent and the prior art are judged from the perspective of a person of ordinary skill in the art ("POSA") at the time of the purported invention. For the purposes of this declaration, I have

been instructed to consider the time of the purported invention of the ’093 patent to be May 16, 2019, the earliest alleged priority date for the ’093 patent even though that date is challenged in this proceeding. However, my opinions would not change even if all the relevant disclosures were judged from a later time period.

15. I understand that during a post grant review, the claims of a patent are to be given their ordinary and customary meaning as understood by a person of ordinary skill in the art at the time of the alleged invention in light of the claims, the specification of the patent, the prosecution history, and other relevant extrinsic information.

16. I understand that a patent claim is invalid if the claims would have been obvious to a person of ordinary skill in the art at the time of the purported invention. This means that even if all of the requirements of the claim cannot be found in a single prior art reference that would anticipate the claim, the claim can still be invalid.

17. I understand that an obviousness analysis involves comparing a claim to the prior art to determine whether the claim would have been obvious to a person of ordinary skill in the art at the time of the purported invention in view of the prior art and in light of the general knowledge in the art as a whole. I also understand that obviousness is ultimately a legal conclusion based on underlying facts of four general types, all of which must be considered: (1) the scope and

content of the prior art; (2) the level of ordinary skill in the art; (3) the differences between the claims and the prior art; and (4) any objective indicia of non-obviousness.

18. I also understand that obviousness may be established by combining or modifying the teachings of the prior art. Specific teachings, suggestions, or motivations to combine any first prior art reference with a second prior art reference can be explicit or implicit, but they must have existed before the date of the purported invention. I understand that prior art references themselves may be one source of a specific teaching or suggestion to combine features of the prior art, but that such suggestions or motivations to combine art may come from the knowledge of a person of ordinary skill in the art. Specifically, a rationale to combine the teachings of references may include logic or common sense available to a person of ordinary skill in the art.

19. I understand that a reference may be relied upon for all that it discloses, including uses beyond its primary purpose. I understand that though a reference may be said to teach away, when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, the mere disclosure of alternative designs does not teach away.

20. I further understand that whether there is a reasonable expectation of success for combining references in a particular way is also relevant to the

analysis. I understand there may be a number of rationales that may support a conclusion of obviousness, including:

- Combining prior art elements according to known methods to yield predictable results;
- Substitution of one known element for another to obtain predictable results;
- Use of a known technique to improve similar devices (methods, or products) in the same way;
- Applying a known technique to a known device (method, or product) ready for improvement to yield predictable results;
- Choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success, or in other words, "obvious to try";
- Known work in one field of endeavor prompting variations of it for use in either the same field or a different one based on design incentives or other market forces, if the variations are predictable to one of ordinary skill in the art; and
- Some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art teachings to arrive at the claimed invention.

21. I understand that it is not proper to use hindsight to combine references or elements of references to reconstruct the invention using the claims as a guide. I understand that hindsight means the use of the current patent claims to guide the selection and combination of prior art references. My analysis of the prior art in this declaration is made from the perspective of a person of ordinary skill in the art at the time of the purported invention.

22. I understand that so-called objective indicia may be relevant to the determination of whether a claim is obvious should the Patent Owner allege such evidence. Such objective indicia can include evidence of commercial success caused by an invention, evidence of a long-felt need that was solved by an invention, evidence that others copied an invention, or evidence that an invention achieved a surprising result. I understand that such evidence must have a nexus, or causal relationship to the elements of a claim, in order to be relevant to the obviousness or non-obviousness of the claim.

23. I understand that for a reference to be used to show that a claim is obvious, the reference must be analogous art to the claims. I understand that a reference is analogous to the claims if the reference is from the same field of endeavor as the claims, even if it addresses a different problem, or if the reference is reasonably pertinent to the problem faced by the inventor, even if it is not in the same field of endeavor as the claims. I understand that a reference is reasonably

pertinent if it would logically commend itself to the attention of the inventor at the time of invention based on the problem faced by the inventor as reflected in the specification, either explicitly or implicitly.

D. Indefiniteness Law

24. I understand that a claim is indefinite if it fails to inform, with reasonable certainty, those skilled in the art about the scope of the invention. Moreover, I also understand that claims must particularly and distinctly set out what is claimed so that the public has fair notice of the claimed invention. For example, if the language of a claim may be read and understood in more than one way by a POSA, then that claim is indefinite. I understand that the claim must be read in light of the disclosure of the application, the teachings of the prior art, and the knowledge of a POSA at the time of the invention of the claim. Further, I understand that each term in a claim must find clear support or antecedent basis in the specification.

E. Enablement Law

25. I understand that a claim must be enabled by the as-filed disclosure accompanying the claim. I have been informed that a claim is enabled if the as-filed disclosure accompanying the claim enables a POSA to practice the invention of the claim without undue or unreasonable experimentation. I understand that

analyzing whether a disclosure enables a claim may include examination of many factors, including:

- Breadth of the claims;
- Nature of the invention;
- State of the prior art;
- Level of one of ordinary skill;
- Level of predictability in the art;
- Amount of direction provided by the inventor;
- Existence of working examples; and
- Quantity of experimentation needed to make or use the invention based on the content of the disclosure.

F. Pre- or Post-AIA eligibility of a patent or patent application

26. I understand that a patent or patent application can be classified as either pre- or post-America Invents Act ("AIA"). Effective March 16, 2013, all applications that included claims only supported by subject matter filed before March 16, 2013 are classified as pre-AIA applications and must be analyzed under the laws in effect before the AIA was enacted. All applications that currently include or, at any time during prosecution, included a claim only supported by subject matter filed on or after March 16, 2013 must be analyzed under the AIA statute and are eligible for post grant review challenges.

IV. LEVEL OF ORDINARY SKILL IN THE ART

27. A person of ordinary skill in the art ("POSA") at the time of the alleged invention would have had a Bachelor of Science degree in Chemical Engineering, Material Science, or Mechanical Engineering (or equivalent), as well as at least 2-4 years of academic or industry experience with multilayer polymer material production or research. Less work experience may be compensated by a higher level of relevant education, such as a Master of Science Degree, and vice versa.

V. OVERVIEW OF THE '093 PATENT

28. The '093 patent discloses methods and systems for manufacturing multilayer structures made from various types of plastic materials. EX1001, 1:9-22. These structures (called "sheets" in the '093 patent) are commonly used as flexible packaging for products like toothpaste. EX1001, 1:9-22, 1:35-43. Examples of materials used in the layers of these sheets include High Density Polyethylene ("HDPE"), Low Density Polyethylene ("LDPE"), and ethylene-vinyl-alcohol ("EVOH"). EX1001, 14:31-34, 15:40-43, 16:46-48. These sheets can be either formed as single, combined structure, or they can be formed by combining multiple existing layers in a process called lamination. EX1008, 7-8. Forming the sheets as a single structure with multiple layers can be accomplished, for example, in two processes. In a blown film process molten material is extruded through a

ring-shaped die that has air being blown through the center of the ring. *Id.*; EX1001, 23:2-24:27; EX1005, 29-35. The molten material is blown into a cylindrical film in a process somewhat analogous to blowing a continuous soap bubble. Additional layers can be added to a blown film by adding additional dies nested next to each other, with each die corresponding to a single layer. EX1001, 23:2-24:27; EX1005, 29-35. Figure 12 from the '093 patent shows a nine-layer blown film machine, with extruders 921-929 visible.

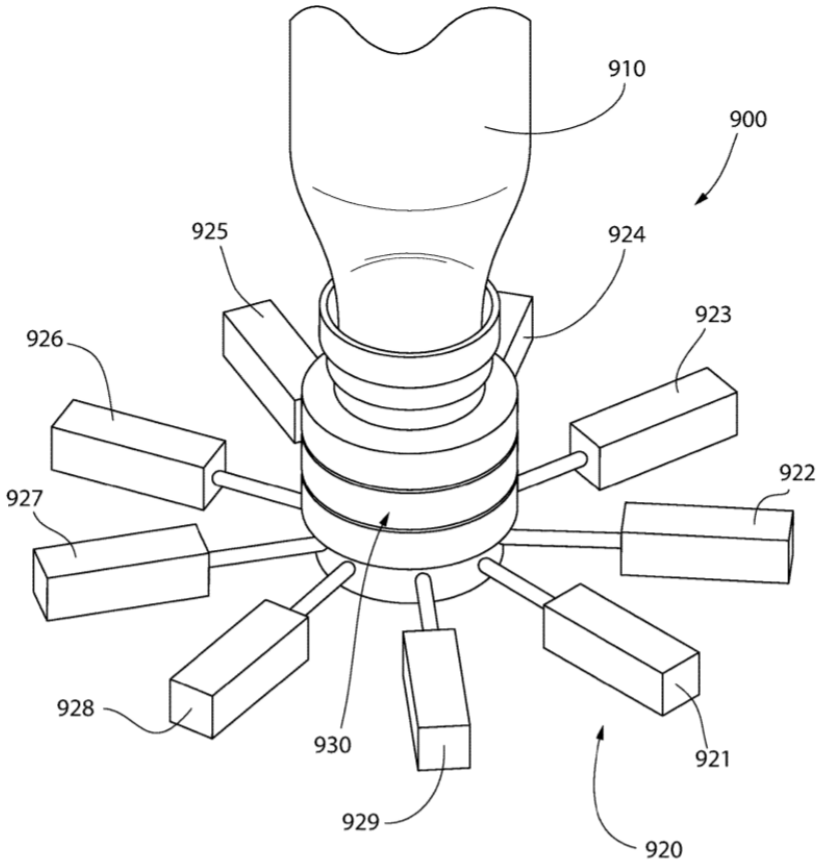


FIG. 12

EX1001, FIG. 12.

29. Another process that can form a single multi-layer structure is a casting process. EX1001, 25:27-26:39; EX1005, 36-39; EX1008, 139-142. In this process, the molten film material is extruded out of a die onto a series of cooling rollers, as shown below.

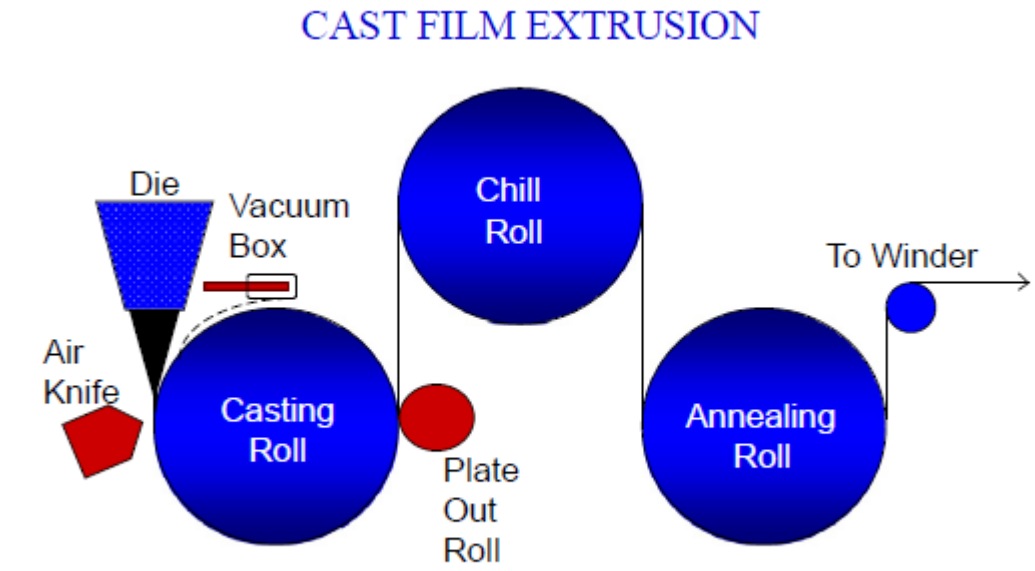


Figure 2.15 Cast film process.

EX1005, FIG. 2.15.

30. Multilayer sheets can also be formed by laminating together existing plastic layers. EX1001, 26:1-21; EX1005, 42-45; EX1008, 142-145. Lamination occurs by bonding together the existing layers into multilayer structure. EX1001, 26:1-21; EX1005, 42-45. This can be accomplished using adhesives, for example. EX1001, 26:1-21; EX1005, 42-45. It is also possible to laminate multilayer structures together to form a single, combined multilayer structures. For example,

the ’093 patent teaches forming a first web 100 and a second web 200 that are each themselves multilayer structures, and then laminating them together with an intermediate adhesive sheet layer 300 to create the final multilayer structure. EX1001, 26:21-30. A cross-section of one of the multilayer sheets discussed in the ’093 patent is shown below.

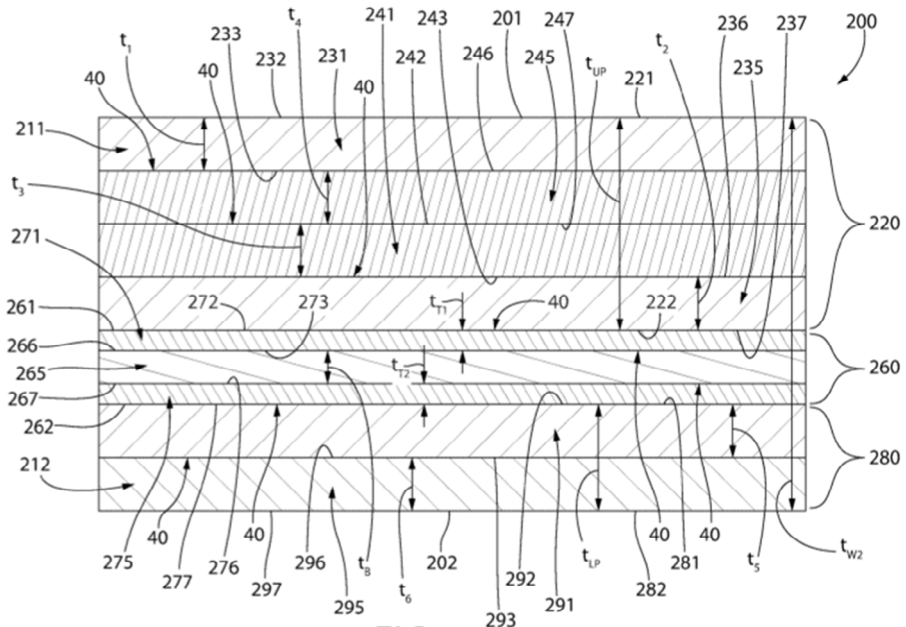


FIG. 4

EX1001, FIG. 4.

31. While the ’093 patent describes in detail embodiments that are laminations of multiple layers wherein the layers are themselves multilayer structures made through blown film and cast film techniques, in my opinion it is clear that alleged invention of the ’093 patent includes even a simple three layer

sheet made using conventional blown and cast film techniques. *See, e.g.*, EX1001, 28:3-13.

32. The ’093 patent states that flexible multilayer materials can exhibit “poor dimensional stability.” EX1001, 1:15-22. The ’093 patent further explains that flexible material that exhibits poor dimensional stability tends to curl onto itself making it unsuitable as a packaging material. EX1001, 1:15-22. However, this problem was well-known in the art long before the ’093 patent was filed. *See, e.g.*, EX1015, 3:50-54 (discussing the need to minimize curl in a patent filed in 1969). In my opinion, the ’093 patent does not identify any new facets or features of this well-known issue. The ’093 patent explains that the polymeric material is comprised of macromolecule chains. Within each layer of the multi-layer structure that is formed from a polymeric material, the corresponding macromolecule chains (i.e., polymer chains) may exhibit a specific molecular orientation. The ’093 patent further explains that each layer of the multilayer sheet exhibits a particular molecular orientation of the polymeric chains contained within the layer. EX1001, 5:14-6:46. Depending on the molecular orientation for a given layer, the counterbalancing forces of the polymer chains within that given layer may not be at equilibrium, thereby causing that layer to be in a state of internal stress. EX1001, 5:14-17. The internal stress of the given layer may manifest in the given layer

deforming (e.g., curling) from a substantially flat state to a non-flat state even when no external forces are applied to that given layer. EX1001, 5:18-28.

33. It is important to recognize that the stress value in the ’093 patent depends on the stress derived from internal stress patterns overcoming equilibrium and causing the layer to have a tendency to deform. As the ’093 patent explains “[d]epending on the molecular orientation for a given layer, the counterbalancing forces of the polymer chains within that given layer may not be at equilibrium, thereby causing that layer to be in a state of internal stress.” EX1001, 5:14-17. Morris expands on this, explaining “the residual stress is countered by a resisting force related to the stiffness and thickness of the layers in the structure.” EX1005, 495. For example, if a material is very stiff (i.e., has a high Young’s modulus), it may have quite high internal stresses, but it may not deform because the stress cannot overcome the stiffness of the material.

34. A simple example of how curl forms in a material is when a molten plastic material is poured onto a very cold surface and allowed to solidify. The plastic in contact with the cold surface will cool and solidify rapidly and at least partially adhere to the cold surface. The opposite surface of the molten plastic layer that is exposed only to ambient atmosphere will cool and solidify much more slowly. Because most plastic materials contract when they solidify, the portion of plastic in contact with the ambient atmosphere will contract more than the surface

exposed to the cold surface. This would result in stresses that tend to curl the resulting solid plastic away from the side that was in contact with the cold surface.

35. The ’093 patent states that “it has been discovered that the resulting multi-layer structure 50 may comprise such layers having such non-zero stress values that are different from one another, yet the overall multi-layer structure 50 has a net stress value that is less than the greater stress value for the individual layers.” EX1001, 6:7-12. This alleged discovery is restated as “the multi-layer structure 50 may exhibit a non-zero stress value, yet the net stress value of the multi-layer structure 50 will still be less than the greatest stress value for an individual layer within that multi-layer structure 50—thereby resulting in the multi-layer structure 50 exhibiting less curl as compared [to] the layer having the greatest individual stress value.” EX1001, 6:14-20. Thus, according to the ’093 patent, while the stress patterns of each individual layer may be a non-zero value and are different from each other—the summation of all stress patterns may at least partially counterbalance each other, thereby putting the multi-layer structure 50 closer to equilibrium and reducing the amount of deformation (e.g., curling) within the multi-layer structure 50. As explained in detail below, the ’093 patent does not explain exactly how this counterbalancing of stress layers is accomplished. Section X. Regardless, the alleged discovery of the ’093 patent is nothing more than a well-known natural phenomenon: that layers with different stress values can be

arranged to balance each other in a multi-layer film. EX1005, 499-502. The claims of the ’093 add nothing to this alleged issue beyond well-known structures and material properties.

A. Alleged Problem of Recycling Multilayer Plastics

36. The ’093 patent is titled “Dimensionally Stable Recyclable Plastic Package” and states that “[r]ecycling is a way to prevent waste material from being deposited in a landfill.” EX1001, (54), 1:6-7. But beyond the general statements found in the background section, I find that the ’093 patent only links recyclability to a single concept: the overall melt flow index of the multilayer structure. EX1001, 27:21-33. However, the recited melt flow index range was known to be desirable for recycling in existing HDPE recycling streams. *See* EX1014, 8; EX1019, 6. Indeed, Exhibit 1014 is a guidance document from the Association of Postconsumer Plastic Recyclers (“APR”) that discusses the various properties (and their ranges) that are required for a material to be compatible with existing HDPE recycling streams. *See generally* EX1014. And in my opinion, the ’093 patent does not add any more detail regarding recyclability of these multilayer structures beyond the known compatibility issues.

B. Overview of the ’093 Patent Claims

37. The above manufacturing processes are well-known and are not elements recited in the claims of the ’093 patent. Instead, the sole independent

claim of the ’093 patent focus specifically on multilayer sheets in which the “net stress value” of the sheet is less than the greatest stress value of an individual layer:

> 1. A sheet comprising:
> a polymeric multi-layer structure comprising:
> a plurality of layers including an uppermost layer and a lowermost layer, each of the plurality of layers having a stress value;
> wherein the stress value of at least two of the plurality of layers are non-zero and different from one another; and
> wherein the multi-layer structure has a net stress value that is less than the greater stress value of the plurality of layers.

EX1001, Claim 1.

38. The remaining nine dependent claims can be split into three general categories:

1. Claim 2 is the sole additional claim that involves stress values. It includes the same stress value concept found in claim 1 because it only adds that the stress value of a third layer must be non-zero and different from the stress values of the two layers recited in claim 1.

2. Claims 3-6 recite adding additional layers to the multilayer structure.

3. Claims 7-10 recite properties of the multilayer structure, such as thickness or overall density.

C. Summary of the '093 Patent's Prosecution History

39. The application that became the '093 patent received a single substantive Office Action. EX1002, 0112-21. The Examiner issued Section 112 rejections for lack of clarity. EX1002, 0112-21. In response, Applicant amended the claims to remove certain claim elements that were subject to the Section 112 rejection. EX1002, 0134-49.

40. The Examiner also rejected all claims as obvious over U.S. Patent Application Publication 2016/0339663 to Clare, finding that Clare disclosed a multi-layer flexible sheet with layers formed of different materials. EX1002, 0114-20. The Examiner further found that the layers of differing materials would "inherently" possess differing, non-zero stress values as claimed. EX1002, 0114-20. In response, Applicant argued that claim 1's recitation of "wherein the stress value of at least two of the plurality of layers are non-zero and different from one another" and "wherein the multi-layer structure has a net stress value that is less than the greater stress value of the plurality of layers" distinguished the claims from Clare. EX1002, 0134-49. Specifically, Applicant argued that "there is no teaching or suggestion in Clare that would lead a skilled person to believe that the plurality of layers of Clare necessarily have different stress values." EX1002, 0134-49. Applicant continued on to explain that a POSA would not have been

motivated to modify Clare to match the claims because there was no teaching or suggestion to do so. EX1002, 0134-49.

D. PGR Eligibility of the '093 Patent

41. I understand that the earliest possible priority date that the '093 patent claims is May 16, 2019, which is after the critical AIA date of March 16, 2013. Thus, I understand that the '093 patent is eligible for post grant review.

E. Claim Construction

42. I understand that words in a claim are given their plain meaning, which is the meaning understood by a person of ordinary skill in the art at the time of the alleged invention after reading the entire patent.

43. The only term of the '093 patent claims that I believe warrants discussion is the "stress value" term recited in claims 1 and 2. As I discussed above, internal stresses and the deformation that can be induced by these stresses is well-known in the art. Section III.A. But instead of the more common internal stress or residual stress terms, the '093 patent uses a slightly different term in its claims: "stress value." The '093 patent specification discloses that "stress value is a measure of magnitude of stress—therefore, the stress value is an absolute value (i.e., a positive value)." EX1001, 5:35-40. "As an example, a first layer hav[ing] a first stress value that is zero refers to the internal stress caused by the molecular orientation of the polymer chains within that first layer being at equilibrium; a

second layer having a non-zero stress value refers to the internal stress caused by the molecular orientation of the polymer chains within that second layer not being at equilibrium." EX1001, 5:40-46. The '093 patent goes on to explain that a non-zero stress value "mean[s] that the given layer may deform from a flat state to a non-flat state when no external force is applied to that given layer." *Id.*, 5:55-58. The opposite holds true for a zero stress value: "a substantially zero stress value refers to that given layer not deforming from a flat state to a non-flat state in the absence of an external force." *Id.*, 5:60-63. In view of this discussion in the specification, in my opinion a POSA would have given the term "stress value" it's plain and ordinary meaning under the *Philips* standard. No other claim terms require specific construction and the remaining terms should receive their plain and ordinary meaning under the *Philips* standard.

VI. OVERVIEW OF THE DECLARATION

A. Citation of Prior Art

44. All of the references disclose multilayer structures and methods of addressing deformation (i.e., curl) during manufacture of the multilayer structures and are therefore from the same field as the '093 patent or, at least, are reasonably pertinent to the alleged problem of the '093 patent.

1. Morris

45. Morris is a textbook dedicated to multilayer plastic structures. Indeed, Morris is titled "The Science and Technology of Flexible Packaging: Multilayer

Films from Resin and Process to End Use." EX1005, Title. Morris is a 709-page text that covers a wide range of topics related to multilayer structures, including their designs, selection of their materials, and their methods of manufacturing. *See generally* EX1005. Of specific interest here is Section 13.5 of Morris, titled "Curl." EX1005, 494-513. This section provides an in-depth explanation of the factors that cause the internal stresses that lead to curl or deformation. EX1005, 494-496. Morris continues on to provide a range of strategies to reduce the resulting curl, including, for example "[m]atch[ing] the shrinkage of the layers so that they cancel out," "[r]educ[ing] the crystallinity of the polymers in the film structure," and "[m]atch[ing] the freezing points or crystallization rates of the layers so that shrinkage occurs at the same time*."* EX1005, 494-499. Morris goes on to explore these curl-reduction strategies with a specific multilayer film having a structure of "HDPE-tie-EVOH-sealant." EX1005, 502-507. Morris presents a sensitivity analysis that shows the effects of different strategies (e.g., changing a layer's thickness) on the resulting curl in the finished multilayer structure. EX1005, 502-507. Morris concludes that adjusting different layers enables balancing the stresses that develop due to material differences in the layers. EX1005, 502-507.

2. Haley

46. Haley discloses a "multilayer film that possesses good water vapor barrier property and reduced curling." EX1006, 1:6-8. Haley's "invention includes

a method for reducing or eliminating the curling of a multilayer film having the general structure of A/B/C… [by] adding a layer to the multilayer film." EX1006, 5:16-21. As Haley explains, "[t]he invention includes a method for reducing or eliminating the curling of a multilayer film having the general structure of A/B/C. The method comprises adding a layer to the multilayer film to form a new film structure of A/B/NC [A/B/A/C] or B/A/B/C."[1] EX1006, 5:17-21. Haley also defines layers A, B, and C as will be discussed below, and gives multiple enabling examples of these multilayer structures in its specification. EX1006, 5:30-8:20.

3. Borse

47. Borse discloses "new designs for multilayer films having high barrier properties." EX1007, 1:5-6. Borse explains that "curl" is a well-known problem and seeks to minimize or eliminate curl by "utiliz[ing] a blend of HDPE and LDPE in the core of a multilayer film." EX1007, 2:31-32. As Borse explains, "the addition of some LDPE to the core layer was observed to produce multilayer films with little or no curl." EX1007, 8:20-24.

[1] Haley contains a printing error in this sentence. The first multilayer material cited was originally presented as "A/B/A/C" in Haley's as-filed specification, but it was printed as "A/B/NC" in the issued patent.

4. Guo

48. Guo is a journal article that develops a theoretical model for predicting net stress values of a multilayer structure based on stress values of individual layers. EX1008, 858-860. After developing the model, Guo verifies the accuracy of the model using experimental trials on actual materials. EX1008, 860-862. Guo provides experimental data that shows stress values for individual layers, as well as net stress values of the resulting multilayer structures. EX1008, 860-862.

B. Grounds for the Challenge

Ground	References	Basis	Claims Challenged
1	Morris	§103	1-4, 7-10
2	Morris, Haley	§103	5-6
3	Haley, Borse, Guo	§103	1-10
4	None	§112	1-10
5	None	§101	1-10

VII. GROUND 1: MORRIS RENDERS OBVIOUS CLAIMS 1–4 AND 7–10.

A. Morris renders obvious claim 1.

49. As discussed above, the Morris text is a textbook dedicated to multilayer materials, which are the subject of the claims. EX1005, Title; Section VI.A.1. Indeed, I note that Morris includes an entire appendix that discloses numerous examples of multilayer structures—a single page in the appendix contains nearly two dozen different multilayer structures, for example. EX1005,

698-709. And Morris also includes an entire section (13.5) directed at the alleged point of novelty of the ’093 patent: stress values in multilayer structures and the resulting deformation or curl. EX1005, 498-507. As I discuss below the language used in the ’093 patent specification to discuss the stress value concept is often very similar to language found in Morris in the relevant section. For example, the ’093 patent states that “[t]he internal stress of the given layer may manifest in the given layer deforming (e.g., curling) from a substantially flat state…to a non-flat state.” EX1001, 5:18-23. Morris teaches that “[t]he actual mechanism for curl is residual stress caused by differential shrinkage, and in some cases orientation from the film blowing process.” EX1005, 495. “When the residual stress is strong enough to overcome the resisting force, the film bends or curls.” EX1005, 495.

50. Another example of similarities between the ’093 patent and Morris is the ’093 patent’s statement that “the summation of all stress patterns may at least partially counterbalance each other, thereby putting the multi-layer structure 50 closer to equilibrium and reducing the amount of deformation (e.g., curling).” EX1001, 6:21-27. Morris teaches that “[i]t explains why symmetric structures have little or no curl. For example, the structure (LLDPE-tie-EVOH-tie-LLDPE) where the layers on each side of the EVOH are the same should have no curl. As the film is quenched, the EVOH freezes first, followed by the LLDPE and tie resins on each side. Both sides shrink, but by the same amount so that the stress balances

out." EX1005, 499. Further, "[w]ith a nine-layer line, one has the flexibility to build in the other layers on the sealant side to balance out the shrinkage and curl." EX1005, 499. And, Morris has a section header titled "Balance the Modulus, Thickness, Location, and Shrinkage of the Layers." EX1005, 501-502 (Section 13.5.2.6).

1. Preamble: "A sheet comprising:"[2]

51. Morris is a textbook that teaches many different types of multilayer structures or "sheets," as they are called in the '093 patent. EX1005, Title, 697-709; *see* EX1001, 4:53-5:5. The term films and sheets are often used together in the art to refer to multilayer structures, with sheets generally, but not necessarily, referring to thicker structures. EX1006, 1:40-44; EX1009, 8. Morris refers to both sheets and films together throughout its text. *See, e.g.,* EX1005, 74 ("when making film and sheet"), 93 ("PHAs can be processed into films and sheet"), 129 ("patterns may develop in the film or sheet"). Morris refers to multilayer structures using the term film in the curl section, for example, where it discusses that "[c]url is particularly problematic in coextruded blown ***films*** when the layers are not

[2] The Morris text discloses numerous examples of multilayer sheets (to use the terms of the preamble and 1.1) throughout its text, but the discussion regarding stress values is focused on chapter 13.5.

symmetrically balanced."[3] EX1005, 494 (emphasis added). In my opinion, a POSA would have been familiar with both films and sheets referring to multilayer structure, and further would have understood that the fundamental issues relevant here—namely curl issues—are shared between films and sheets. Thus, a POSA would have understood that, or at least found obvious that, absent further definition, the term "sheet," as used in claim 1, encompasses both sheet and film multilayer structures. Thus, Morris discloses or renders obvious the preamble.

2. [1.1] "a polymeric multi-layer structure comprising:"

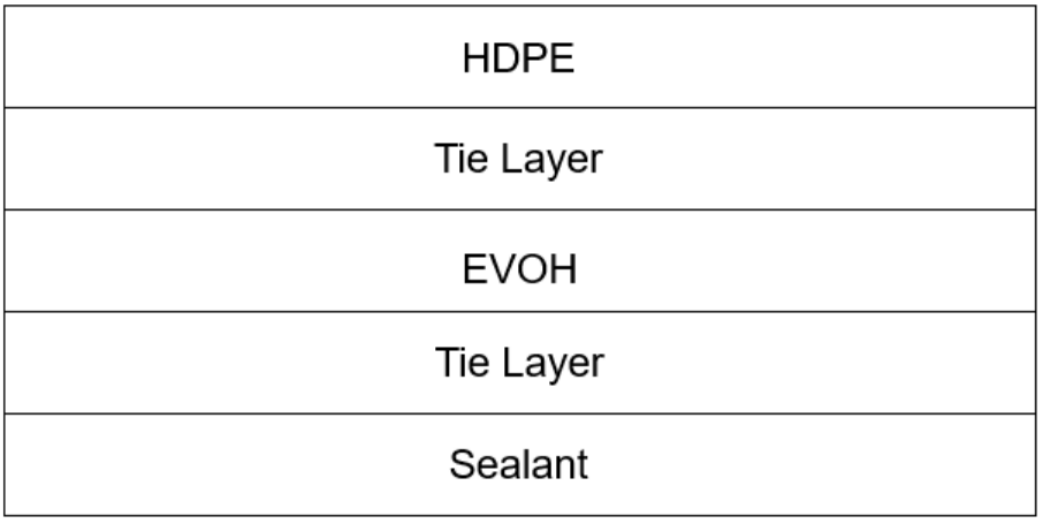
52. As noted above, Morris discloses a "coextruded blown film," which is a "polymeric multi-layer structure" as claimed. For example, Morris discloses that "[i]n ***coextrusion blown film***, the primary cause of curl is the stress created when the layers shrink as the film is quenched or afterward during post-quench crystallization." EX1005, 494 (emphasis added). Morris further discloses that "[f]or barrier applications, a layer of EVOH (and tie layers) can be added to a typical snack structure: (HDPE–tie–EVOH–tie–sealant)." EX1005, 494. This structure comprises at least two layers that include polymeric materials: namely, HDPE (high density polyethylene) and EVOH (ethyl-vinyl alcohol). EX1005, 6-7. In fact, the '093 patent states that "the polymeric material may be high-density

[3] Emphasis added throughout unless otherwise noted.

polyethylene" and that the "polymeric barrier material may consist of EVOH polymer." EX1001, 16:48-49, 18:41-42. Thus, Morris discloses [1.1].

3. [1.1a] "a plurality of layers including an uppermost layer and a lowermost layer, each of the plurality of layers having a stress value"

53. Morris discloses the following multilayer structure: "(HDPE–tie–EVOH–tie–sealant)." EX1005, 494. This five-layer structure is schematically depicted below. As can be seen, this structure has a plurality of layers. EX1005, 494. Morris also discloses that "the inner layer provides sealability." EX1005, 16. A POSA would have understood that the "sealant" layer is the lowermost layer because it is the layer that seals the interior contents from the exterior environment. The uppermost layer is therefore the layer opposite the lowermost layer, which as shown below means that the uppermost layer here is HDPE, as represented below.



54. The ’093 patent states that “stress value is a measure of magnitude of stress,” where “zero [stress value] refers to the internal stress caused by the molecular orientation of the polymer chains within that first layer being at equilibrium.” EX1001, 5:35-46. A positive stress value refers to the internal stress “not being at equilibrium.” EX1001, 5:35-46. Specifically, zero stress value “refers to that given layer not deforming from a flat state” while a non-zero stress value means that the layer will “deform from a flat state to a non-flat state when no external force is applied to that given layer.” EX1001, 5:55-63 Thus, the claimed “stress value” is a measurement of the tendency of a layer to deform or curl, with zero associated with no tendency, and increasing positive values associated with an increasing tendency to curl.

55. Morris includes very similar disclosure. For example, Morris states that “[c]url is a term used to describe the tendency of a packaging film to roll up and not lay flat.” EX1005, 494. Further, “the primary cause of curl is the stress created when the layers shrink as the film is quenched or afterward during post-quench crystallization.” EX1005, 494. With respect to the specific structure discussed above, “[t]his structure has a strong tendency to curl towards the HDPE layer…[because] the EVOH freezes first so that as the HDPE freezes, its shrinkage gives rise to stresses.” EX1005, 494-495. Thus, the layers of different material in Morris have varying tendencies to curl, and thus varying stress values, caused by

the formation of the multilayer structure. Indeed, as will be explained in Section VII.A.4, Morris uses this material as the focus of an experiment that varies material and process elements to determine the effectiveness of various curl-reduction strategies. While Morris does not use the explicit terminology found in the ’093 claims here, in my opinion a POSA would have at least found it obvious that the layers have stress values because of the material differences discussed above. Thus, Morris discloses or at least renders obvious element [1.1a].

4. [1.1b] “wherein the stress value of at least two of the plurality of layers are non-zero and different from one another”

56. Two layers having different, non-zero stress values is obvious for at least three reasons. First, in my opinion it would have been obvious that the example multilayer structure from Morris would have had two layers with different, non-zero stress values. Second, this variable configuration (i.e., non-zero and different stress values) is the most likely result of optimizing the multilayer structure using well-known techniques. Third, this configuration is obvious because it is one of a finite number of predictable solutions.

a) It would have been obvious that the multilayer material of Morris would have had two layers with non-zero, different stress values.

57. As discussed above, Morris discloses that the HDPE-tie-EVOH-tie-sealant structure “has a strong tendency to curl towards the HDPE

layer…[because] the EVOH freezes first so that as the HDPE freezes, its shrinkage gives rise to stresses." EX1005, 494-495. Thus, a POSA would have understood that two of the layers in this multilayer structure (the HDPE and the EVOH) have non-zero stress values as a result of their material differences (i.e., the different freezing points/shrinkage rates) and the resulting material interactions during processing. EX1005, 494-495. A POSA would have also understood, or at least found it obvious, that these two materials have *different* non-zero stress values because, as Morris explains, the overall multilayer structure "has a strong tendency to curl." EX1005, 494-495. The most likely explanation for this curl is, as Morris points out, the different stresses induced in the HDPE and EVOH layers. EX1005, 494-495. Thus, in my opinion a POSA would have understood, or at least found it obvious, that at least two of the layers would have had different, non-zero stress values. Thus, Morris renders this element obvious.

b) Claiming a highly probable result of a well-known technique is not patentable.

58. As I explain above with reference to Morris, internal stresses in multilayer structures can result from contact between different layers in a multilayer structure. Section VII.A.4.a. Specifically, material differences between the layers cause stresses that may result in deformation or curl of the layers. In fact, when the layers are formed from different materials in a typical multilayer structure, it is far more likely that the resulting stress values in the layers will be

both non-zero and different. As I explained above, adjusting any two layers that are in contact to have exactly the same stress value is extremely difficult in practice, and not a technique that a POSA would knowingly pursue absent some specific need to do so. Section VII.A.4.a. In the case of pursuing the well-known goal of reducing the overall curl of the multilayer structure to zero, there would have been little reason to adjust two layers to have the same stress value without some unique insights into the behavior of the multilayer structure—insights that are not the norm. Thus, it is far more common for stress values of different layers to be different, and non-zero, than it is for them to be the same, in multilayer structures that have been optimized to have minimal or no curl. Indeed, I analogizes this situation to the creation of snowflakes: the probability of having the exact same stress value in two layers is vanishingly small. Indeed, I note that it was well-known that stress values of the layers affect the net stress value. In fact, the combination of the individual stress values is what is responsible for the net stress value of the multilayer structure. I understand that this type of situation (i.e., claiming a well-known variable configuration for a known problem) is not patentable because it is obvious. Therefore, this claim element is obvious for this additional reason.

i. Patent Owner's arguments during prosecution support the unpatentability of this claim element.

59. During prosecution of the '093 patent, the Examiner rejected this claim element as being inherent over a prior art reference that disclosed a structure identical to the claimed multilayer structure. EX1002, 0117-118. Patent Owner overcame this rejection by arguing that there are numerous factors that affect that stress values of different layers, and that the prior art did not show or teach that the materials would have different stress values. EX1002, 0143-145. In my opinion, Patent Owner was arguing that it would theoretically be possible to form layers with the same stress value, and thus the stress value claim element was not inherent in the art cited during Examination because I understand that inherency requires that a property be present 100% of the time. But this argument only supports the unpatentability of this claim element because it is far more likely for the stress values to be different from each other in a process that depends on so many factors. Changing just one of the factors Patent Owner listed during prosecution a small amount will result in different stress values. EX1002, 0143-145. Moreover, different layers comprising different materials in different thicknesses will react to this change in different ways, which further multiplies the effect on the stress values from any small change in the design or production of a multilayer structure. EX1002, 0143-145. Thus, Patent Owner's argument against inherency supports the unpatentability of this claim element, which is nothing more than a common result

of optimizing a multilayer structure to a desired state (i.e., zero overall curl) is not patentable.

c) Two layers with non-zero, different stress values is obvious as being part of a finite number of predictable solutions.

60. I understand that a problem with a finite number of predictable solutions is obvious. Here, the well-known problem is curl in multilayer structures. EX1005, 494-506. Various solutions to this problem are known in the art (e.g., adjusting layer thickness or composition; adding additional layers to the structure). EX1005, 494-506; EX1006, 5:19-21; EX1007, 8:20-23. But, all of these solutions are effectively accomplishing the same thing: they are changing the stress values of one or more of the layers in the multilayer structure. This adjusting of individual layer stress values, in turn, affects the overall balance of the stress values in the entire multilayer structure and, ultimately, results in a multilayer structure with little or no curl (and, thus, little or no net stress value). While searching for the optimum solution (of stress values of the layers) to this problem, there are only three possible configurations of the stress values of the layers per the way stress value is claimed in the ’093 patent. First, the layers can all have zero stress (and thus all have the same stress value). Second, the layers can all have the same, non-zero stress value. Third, the layers can all have different, non-zero stress values. I understand that given the limited number of possible solutions (i.e., three possible

solutions) for the claimed stress value configuration, this claim element would have been obvious as one of a set of predictable solutions to a known problem. Thus, this claim element is obvious for this additional reason.

5. [1.1c] "wherein the multi-layer structure has a net stress value that is less than the greater stress value of the plurality of layers."

61. Morris discloses the results of experimental trials that made various adjustments to the HDPE-tie-EVOH-tie-Sealant material that, ultimately, "yields essentially flat film." EX1005, 504-506. This means that the net stress value of the multilayer structure is at or near zero.

62. As I explained above, it would have been obvious that the stress values of the layers are non-zero (i.e., positive) values. Section VII.A.4. In fact, Morris discusses numerous strategies for achieving a flat (zero net stress value) multilayer structure. EX1005, 494-506; Section III. For example, a POSA could have "[m]atch[ed] the shrinkage of the layers so that they cancel out," which Morris notes is the reason "why symmetric structures have little or no curl" because "the [symmetrical] layers on each side…are the same [and] should have no curl." EX1005, 499. This is precisely the same concept as the "counterbalance[ing]" that the '093 patent discusses in the specification when it says "the summation of all stress patterns may at least partially counterbalance each other… [t]he result is a multi-layer structure 50 that will deform less." EX1001, 6:21-34.

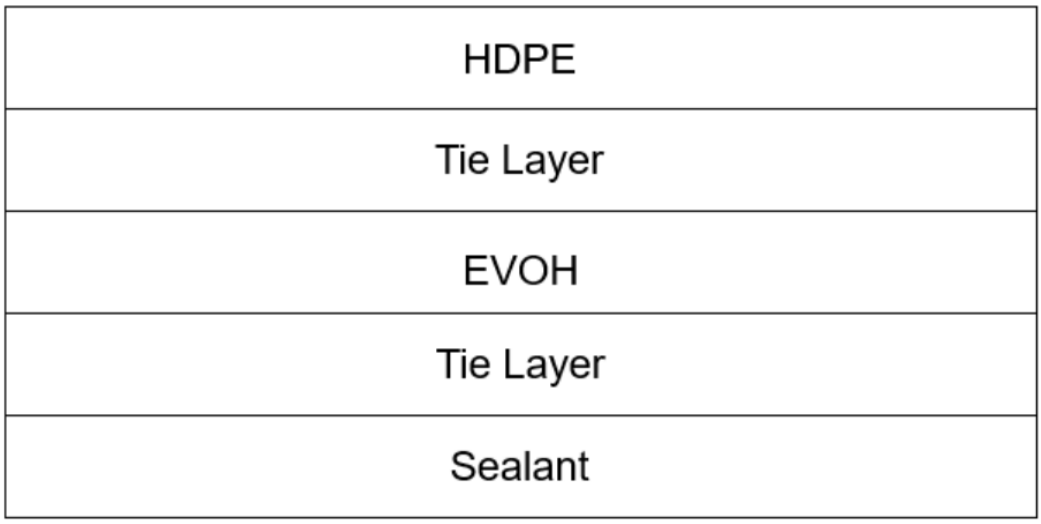
63. Thus, it also would have been obvious that the zero net stress value of the multilayer structure is less than the stress values of the layers because a value that is zero or near-zero (i.e., equivalent to zero) is less than a positive value. Thus, Morris renders this element obvious. EX1001, 6:21-34.

B. Morris renders obvious claim 2.

64. Claim 2 depends from claim 1 and recites "wherein the stress value of at least three of the plurality of layers are different from one another." This element is obvious for the same reasons as element [1.1b], which recites "wherein the stress value of at least two of the plurality of layers are non-zero and different from one another." Section VII.A.4. The relevant multilayer structure of Morris is a five-layer structure: HDPE-tie-EVOH-tie-Sealant. EX1005, 494-495. Morris discloses that "[c]ommon sealant layers include EVA, LDPE, LLDPE, polyethylene plastomers and ionomers." EX1005, 16. Thus, it would have been obvious to use LDPE as the Sealant layer. This means that there are three different materials in contact with each other in this structure: HDPE, EVOH, and LDPE. The material differences that result in curl and stress values discussed above apply equally well to three different layers as they do to two different layers. Section VII.A.4.a. Moreover, adding an additional layer does not change the analysis regarding this element being one of a finite number of predictable solutions that were obvious to try. Section VII.A.4.b. Thus, Morris renders claim 2 obvious.

C. Morris renders obvious claim 3.

65. Claim 3 depends from claim 1 and recites "wherein the uppermost layer is formed of high density polyethylene and the lowermost layer is formed of one of linear low density polyethylene and low-density polyethylene." As discussed in [1.1a], the uppermost layer of the multilayer structure shown below is HDPE. EX1005, 494; Section VII.A.3. Morris discloses that "[c]ommon sealant layers include EVA, LDPE, LLDPE, polyethylene plastomers and ionomers." EX1005, 16. Therefore, the lowermost or sealant layer can comprise, for example, LDPE, as shown below. Thus, Morris renders claim 3 obvious.



D. Morris renders obvious claim 4.

66. Claim 4 depends from claim 3 and recites "wherein [multi-layer structure comprises a barrier layer located between the uppermost layer and the lowermost layer, wherein the barrier layer is formed of ethylene vinyl alcohol." Morris disclose that "[f]or barrier applications, a layer of EVOH (and tie layers)

can be added to a typical snack structure: (HDPE–tie–EVOH–tie–sealant)." EX1005, 494. "EVOH" is an acronym for ethylene vinyl alcohol. EX1005, 690. Morris discloses using the EVOH, "[f]or barrier applications," which makes the EVOH a "barrier layer" as claimed. EX1005, 494. Thus, Morris renders obvious claim 4.

E. Morris renders obvious claim 7.

67. Claim 7 depends from claim 1 and recites "wherein the sheet has a thickness ranging from about 150 μm to about 450 μm." Morris discloses numerous examples of films with thicknesses that fall into this range. EX1005, 698-704. Specifically, for example, various meat packaging structures fall into this thickness range. EX1005, 701 (disclosing various multilayer structures with thicknesses ranging from "150-200" μm.) A POSA would have been motivated to modify the multilayer structure discussed in claim 1 as needed to fall within the appropriate thickness range to create a usable film for a particular purpose, like meat packing. A POSA would have had a reasonable expectation of success making this modification because adjusting manufacturing processes to create thicker films was well within the skill of a POSA at the critical date.

68. This claim would also have been obvious as a matter of design choice. I understand that absent any criticality, specific dimensions or dimensional ranges are obvious as a matter of design choice, especially when these ranges were known

in the art (as is the case with the claimed thickness range). Here, there is no criticality discussed with respect to this known thickness range. In fact, the ’093 patent discusses thickness ranges without tying the thickness to any functionality, much less a patentable feature. EX1001, 4:53-64. Thus, this claim is also obvious as matter of design choice.

F. Morris renders obvious claim 8.

69. Claim 8 depends from claim 1 and recites “wherein the multi-layer structure is substantially free of a metal-containing layer and a cellulosic-containing layer.” The multilayer structure is “HDPE–tie–EVOH–tie–sealant” with the sealant being LDPE. EX1005, 16, 494; Sections VII.A.2-3. None of these layers contain metals or cellulose because they are all polymer resin-type plastics. This claim is also obvious in view of the need to ensure compatibility with existing recycling streams. EX1014, 1. Including metal and cellulose materials in a polymer recycling stream (e.g., and HDPE recycling stream) would cause compatibility issues because the metal and cellulose cannot be processed in the same way as the polymer material. EX1017, 15:29-34 (listing contaminants to be separated form a plastic recycling stream including metal screws and paper); EX1018, 11. For example, metal scraps can cause damage to plastic processing equipment. EX1017, 14:13-22. Thus, a POSA would have been well aware that metal and cellulose

materials would not generally be compatible with a polymer recycling stream. Thus, Morris renders obvious claim 8.

G. Morris renders obvious claim 9.

70. Claim 9 depends from claim 1 and recites "wherein the multi-layer structure has a density ranging from about 0.950 g/cm^3 to about 0.965 g/cm^3." The materials in the multilayer structure HDPE–tie–EVOH–tie–sealant have the following densities: 0.96 g/cm^3 (HDPE); 0.92-.93 g/cm^3 (LDPE); and 1.18 g/cm^3 (EVOH). EX1005, 73. Morris also discloses the following thicknesses for these materials: 40 μm HDPE, 4 μm EVOH, and 19 μm LDPE. EX1005, 504. A POSA would have known that the average density of a multilayer structure can be calculated by taking a weighted average of the individual layers' densities. Taking the weighted average of the densities of these three layers using these thicknesses results in a density of 0.964 g/cm^3.

71. Accounting for the tie layers will only change this value by a small amount because the tie layers are thin relative to the overall material. Moreover, tie layers for EVOH and HDPE are known to be either LDPE or LLDPE. EX1005, 73, 595. These materials have a *lower* density than the average density above (0.964 g/cm^3), and thus would only lower the net density further into the claimed range. For example, if the tie layers are assumed to be 5 μm thick and comprise LLDPE, which has a density of 0.91-0.93 g/cm^3, the net density for multilayer structure

results in a density of 0.96 g/cm^3, which also falls within the claimed range. Thus, Morris renders this claim obvious.

72. This claim would also have been obvious because the claimed density range is a requirement for compatibility with HDPE recycling streams. EX1014, 7. Thus, a POSA would have been motivated to ensure that a multilayer structure has the claimed density range to improve recyclability of the multilayer structure.

73. This claim would also have been obvious as a matter of design choice for the same reasons discussed with respect to the thickness in claim 7: there is no criticality to the claimed density range. Section VII.H. Like the thicknesses of claim 7, the ’093 patent discusses the density ranges without tying the density to any functionality, much less a patentable improvement. EX1001, 8:22-25. Thus, this claim is also obvious as matter of design choice.

H. Morris renders obvious claim 10.

74. Claim 10 depends from claim 1 and recites “wherein the multi-layer structure has a melt flow index ranging from about 0.7 g/10 min to about 1.1 g/10 min.” Melt flow index is a known material property that “is a measure of how much polymer melt flows through a standard orifice using a standard weight, time, and temperature. It is inversely related to viscosity, but the relationship is not exact.” EX1005, 108. In my experience, the melt flow index of a multilayer structure can be calculated using a weighted average of the melt flow index of each

layer if the multilayer structure melts into a compatible mixture. Here, the materials in Morris' multilayer structure are identical to the materials of the multilayer structure that is allegedly recyclable in the '093 patent. EX1001, 27:21-33. It is fair to assume that this means that the materials in Morris' multilayer structure will melt into a compatible mixture because otherwise they would not be easily recyclable. *See* EX1017, 2:12-18 (discussing the desirability of using melt-compatible plastics together with respect to recycling). Incompatible mixtures are not easily recyclable because it is difficult to process the melt without clogging caused by the non-homogenous nature of the melt. Using a weighted average with the thickness values discussed above in claim 9 and the following Melt Flow Indices (HDPE: 0.68 g/10min; EVOH: 3.2 g/10min; LDPE: 0.25 g/10min) results in an overall melt flow index of 0.71g/10 minutes. EX1011; EX1012; EX1013.

75. This claim would also have been obvious because the claimed melt flow is a requirement for compatibility with HDPE recycling streams. EX1014, 7; EX1019, 6. Thus, a POSA would have been motivated to ensure that a multilayer structure has the claimed melt-flow range to improve recyclability of the multilayer structure.

76. This claim would also have been obvious as a matter of design choice for the same reasons discussed with respect to the thickness in claim 7: there is no criticality to the claimed melt flow index ("MFI") range. Section VII.H. Like the

thicknesses of claim 7, the '093 patent discusses the MFI range without tying the MFI to any functionality, much less a patentable improvement. EX1001, 2:55-60. Thus, this claim is obvious as a matter of design choice.

VIII. GROUND 2: MORRIS AND HALEY RENDERS OBVIOUS CLAIMS 5-6.

A. Morris and Haley render obvious claim 5.

77. Claim 5 depends from claim 4 and recites "wherein the multi-layer structure further comprises: [5.1] a first intermediate layer located between the uppermost layer and the barrier layer, the first intermediate layer formed of high density polyethylene; [5.2] a second intermediate layer located between the lowermost layer and the barrier layer, the second intermediate layer formed of high density polyethylene; and [5.3] a third intermediate layer located between the uppermost layer and the first intermediate layer, the third intermediate layer comprising high density polyethylene."

78. The "HDPE—tie—EVOH—tie—Sealant" material discussed in claim does not disclose three additional intermediate layers. But, Morris discloses:

> Adding an additional layer gains some functionality, often in a way that reduces overall cost (even after including the additional processing cost of making a more complex structure) over what would be needed to make a single layer perform the same function. Or more often, the multilayer structure allows the package to perform a combination of functions not possible with a single layer.

EX1005, 15. Morris specifically discloses several advantages gained by adding additional layers, including improved physical attributes, sealing, and enhanced process performance. EX1005, 15-17. Thus, a POSA would have looked to improve performance of the multilayer structure of Morris discussed with respect to claim 1 by adding additional layers.

79. This would have led a POSA to Haley, which discloses "multilayer film that possesses good vapor barrier propert[ies] and reduced curling." EX1006, 1:6-8. Haley discloses a film with layers "B/A/B/C." EX1006, 5:19-21. "[Layer] A is a nucleated high density polyethylene (HDPE) layer, [layer] B is a single or multilayer structure, and [layer] C is a seal layer. Preferably the seal layer C is selected from the group consisting of linear low density polyethylenes (LLDPE), low density polyethylenes (LDPE), ethylene-vinyl acetate copolymers (EVA), polyolefin ionomers, the like, and mixtures thereof." EX1006, 1:44-51. "When B layer is a multilayer structure, B preferably has a structure of tie layer/barrier layer/tie layer . . . . Preferably the tie layer resin comprises a maleated polyolefin. . . . Preferably, the maleated polyolefin is a maleated HDPE." EX1006, 4:4-19. "Suitable barrier layer includes any polymers which provide water vapor or oxygen barrier properties. Suitable barrier layer is preferably selected from the group consisting of ethylene-vinyl alcohol copolymers (EVOH), polyamides (nylons), the

like, and mixture thereof." EX1006, 4:63-67. The end result of the B/A/B/C structure is shown below.

HDPE
EVOH
HDPE
HDPE
HDPE
EVOH
HDPE
LDPE

80. A POSA would have been motivated to modify the multilayer film of Morris (HDPE—tie—EVOH—tie—LDPE) to improve material performance, and in particular water barrier performance, by adding the necessary layers to improve the performance of the resulting multilayer structure per Haley's disclosure. This modification per Haley's disclosure would improve film performance, particularly by having a high water vapor barrier, while still reducing or eliminating curl. EX1006, 1:56-58. Indeed, Haley specifically identifies curl as an issue to be

addressed in multilayer films. Moreover, this modification would have been the simple combination of known elements of the prior art (Morris' and Haley's film structures) to achieve a predictable result (improved film performance). Thus, a POSA would have been motivated to combine Morris and Haley.

81. A POSA would have had a reasonable expectation of success making this modification because the modification only requires adding layers to the existing Morris film, which was well within the skills of a POSA. In fact, Haley itself starts with simpler films and adds layers to create the film disclosed here: "The invention includes a method for reducing or eliminating the curling of a multilayer film having the general structure of A/B/C. The method comprises adding a layer to the multilayer film to form a new film structure of [A/B/A/C] or B/A/B/C." EX1006, 5:17-21. This is further evidence that this modification would have been accomplished by a POSA.

1. Element [5.1]

82. A mapping of the various claimed layers of claim 5 is shown below on the combined Morris-Haley multilayer structure. As can be seen, the third HDPE layer from the top discloses the claimed "first intermediate layer" of element [5.1]. Thus, Morris and Haley render obvious element [5.1].

HDPE	"uppermost layer"
EVOH (barrier)	
HDPE	"third intermediate layer"
HDPE	"first intermediate layer"
HDPE	"tie layer"
EVOH (barrier)	"barrier layer"
HDPE	"second intermediate layer"
LDPE	"lowermost layer"

2. Element [5.2]

83. A mapping of the various claimed layers of claim 5 is shown below on the combined Morris-Haley multilayer structure. As shown, the lowest HDPE layer discloses the claimed "second intermediate layer" of element [5.2]. Thus, Morris and Haley render obvious element [5.2].

HDPE	"uppermost layer"
EVOH (barrier)	
HDPE	"third intermediate layer"
HDPE	"first intermediate layer"
HDPE	"tie layer"
EVOH (barrier)	"barrier layer"
HDPE	"second intermediate layer"
LDPE	"lowermost layer"

3. Element [5.3]

84. A mapping of the various claimed layers of claim 5 is shown below on the combined Morris-Haley multilayer structure. As shown, the second HDPE layer from the top discloses the claimed "third intermediate layer" of element [5.3]. Thus, Morris and Haley render obvious element [5.3].

HDPE	"uppermost layer"
EVOH (barrier)	
HDPE	"third intermediate layer"
HDPE	"first intermediate layer"
HDPE	"tie layer"
EVOH (barrier)	"barrier layer"
HDPE	"second intermediate layer"
LDPE	"lowermost layer"

B. Morris and Haley render obvious claim 6.

85. Claim 6 depends from claim 5 and recites "wherein the multi-layer structure comprises a first barrier tie layer located between the barrier layer and the first intermediate layer and a second barrier tie layer located between the barrier layer and the second intermediate layer." As shown below, a first barrier tie layer is located above the barrier layer.

HDPE	"uppermost layer"
EVOH (barrier)	
HDPE	"third intermediate layer"
HDPE	"first intermediate layer"
HDPE	"tie layer"
EVOH (barrier)	"barrier layer"
HDPE	"second intermediate layer"
LDPE	"lowermost layer"

86. This structure does not disclose a second tie layer between the second intermediate layer and the barrier (EVOH) layer. It would have been obvious to add a second barrier tie layer between the final HDPE layer and the final EVOH layer to ensure proper adhesion between those two layers. This modification would also have been obvious because it gives a POSA more flexibility to design the final two HDPE layers without needing to ensure that a single HDPE layer (as shown above) can act as a tie layer to link the EVOH and the LDPE. A POSA would have had a reasonable expectation of success making this modification because adding a tie layer was well within the skill of a POSA. Thus, Morris and Haley render claim 6 obvious.

IX. GROUND 3: HALEY, BORSE, AND GUO RENDER OBVIOUS CLAIMS 1–10.

A. Haley, Borse, and Guo render obvious claim 1.

1. Preamble: "A sheet comprising:"

87. Haley is a patent titled "Multilayer Films Having Reduced Curling." EX1006, Title. Haley discloses that "[t]he invention relates to a multilayer film." EX1006, 1:7. Haley goes on to note that "[b]y 'film,' I mean to include both films (which are normally referred to those having a thickness less than or equal to 10 mils) and sheets (which are normally referred to those having a thickness greater than 10 mils)." EX1006, 1:40-44. Thus, Haley discloses or at least renders obvious the preamble.

2. [1.1] "a polymeric multi-layer structure comprising:"

88. Haley discloses that "[t]he invention includes a method for reducing or eliminating the curling of a multilayer film having the general structure of A/B/C. The method comprises adding a layer to the multilayer film to form a new film structure of [A/B/A/C] or B/A/B/C." EX1006, 5:17-21. As explained in detail in the next section, these layers are formed from HDPE, EVOH, and LDPE, which are all polymer materials. EX1006, 1:62-5:27; EX1005, 6-7; Section IX.A.3. Thus, Haley discloses element [1.1].

3. [1.1a] "a plurality of layers including an uppermost layer and a lowermost layer, each of the plurality of layers having a stress value"

89. In the B/A/B/C structure in Haley, "[layer] A is a nucleated high density polyethylene (HDPE) layer, [layer] B is a single or multilayer structure, and [layer] C is a seal layer. Preferably the seal layer C is selected from the group consisting of linear low density polyethylenes (LLDPE), low density polyethylenes (LDPE), ethylene-vinyl acetate copolymers (EVA), polyolefin ionomers, the like, and mixtures thereof." EX1006, 1:44-51. "When B layer is a multilayer structure, B preferably has a structure of tie layer/barrier layer/tie layer . . . . Preferably the tie layer resin comprises a maleated polyolefin. . . . Preferably, the maleated polyolefin is a maleated HDPE." EX1006, 4:4-19. "Suitable barrier layer includes any polymers which provide water vapor or oxygen barrier properties. Suitable barrier layer is preferably selected from the group consisting of ethylene-vinyl alcohol copolymers (EVOH), polyamides (nylons), the like, and mixture thereof." EX1006, 4:63-67. The end result of the B/A/B/C structure is shown below. As can be seen below, this structure includes a "plurality of layers" as claimed.

HDPE
EVOH
HDPE
HDPE
HDPE
EVOH
HDPE
LDPE

90. The "C" layer, or LDPE layer above, is a lowermost layer because this is a "seal layer," which a POSA would have understood is the lowermost (or inner) layer of a multilayer structure. EX1006, 1:44-51. Thus, the layer on the opposite end of the multilayer structure (the HDPE layer) is an uppermost layer.

91. As discussed above, claimed "stress value" is a measurement of the tendency of a layer to deform or curl, with zero associated with no tendency, and increasingly positive values associated with an increasing tendency to curl. Section VII.A.3. Haley discloses that some of the materials above "cause[] the multilayer films to curl to a greater extent. . . . Therefore, there is a need to reduce or eliminate the curling of multilayer film." EX1006, 1:30-36. Indeed, as I explained

above with respect to Morris, when different materials are placed together in a multilayer structure, stresses are often the result. EX1005, 494-495. In fact, Morris notes that two of the materials in Haley's multilayer structure (HDPE and EVOH) differ enough to induce internal stresses when placed together in a multilayer structure like Haley's. Thus, a POSA would have understood, or at least found it obvious, that the layers each have a stress value.

4. [1.1b] "wherein the stress value of at least two of the plurality of layers are non-zero and different from one another"

a. A POSA would have been motivated to modify Haley in view of Borse, the combination of which renders element [1.1b] obvious.

92. Haley discloses reducing curl by "adding a layer to the multilayer film to form a new film structure of [A/B/A/C] or B/A/B/C." EX1006, 5:19-21. However, Haley also discloses that the B/A/B/C structure discussed above retains some curl, as shown by "Example 5" and the results in Table 1 (shown below). EX1006, 7:30-8:19. This would have motivated a POSA to search for additional techniques to reduce curl (and thus, stress value) of the multilayer structure.

TABLE 1

RESULTS SUMMARY

Ex. No.	MD Curvature Radius, mm	TD Curvature Radius, mm	WVTR $g/m^2/day$	1% Secant Modulus, kpsi
C1	3	5	2.0	114
2	10	12	2.0	114
3	14	34	2.1	116
C4	7	20	2.0	117
5	9	25	2.0	117
6	No Curl	No Curl	2.0	119

EX1006, 8:8-19 (Table 1).

93. This would have led a POSA to Borse. Borse also discloses "multilayer plastic films." EX1007, 1:5-6. Borse discloses techniques to reduce curl, and specifically techniques applicable to multi-layer films, which include modifying material composition of the layers. For example, Borse teaches that "the use of a core layer that consisted of a blend of nucleated HDPE with LDPE was observed to produce 'flat' film." EX1007, 8:20-23.

94. It would have been obvious to a POSA to implement Borse's techniques in the material from Haley to reduce or eliminate curl to improve material performance and properties. Specifically, adding Borse's core layer to the structurally similar film of Haley would have been the use of a known technique (Borse's core layer addition) to a similar product (Haley's multilayer structure).

Doing so would result in the predictable improvement of minimizing or eliminating overall curl (or net stress value per the '093 patent).

95. A POSA would have had a reasonable expectation of success modifying the materials because Borse discloses the specific material details needed to make the modification. EX1007, 8:1-10:35. And the manufacturing techniques needed to make this modification are well known in the art. EX1005, 29-39. Further, modifying layer properties like thicknesses and composition were well within the skill of a POSA at the critical date.

96. As explained above, the process of optimizing a multilayer structure like the Haley-Borse structure would have rendered obvious the claimed configuration of the stress values (i.e., non-zero, different stress values) of the individual layers for at least three reasons: (1) the material differences between the layers would have resulted in different, non-zero stress values; (2) this configuration of the layers' stress values is the most likely result of this process; and (3) the configuration is one of a predictable number of finite solutions. Section VII.A.4. The reasoning above applies equally here, and Haley and Borse render element [1.1b] obvious.

b. A POSA would have further been motivated to apply the teachings of Guo to the combination of Haley and Borse.

97. This claim element is also obvious for an additional reason. As explained above, a POSA would have been motivated to modify Haley's

multilayer structure by adding the core layer to reduce or eliminate curl. However, Borse and Haley do not explicitly teach how to arrange the stress values to achieve the desired reduction in stress values. This is why a POSA would have looked for examples of multilayer materials with stress values that result in a lower (or zero) net stress value.

98. This would have led a POSA to Guo, which is a journal article titled "Predicting multilayer film's residual stress from its monolayers." EX1008, Title. Guo discusses the need to accurately predict residual stresses in materials, which are the stresses that lead to curl. EX1008, 858-859. Guo then develops a theoretical model that can be used to predict the overall residual stress (that corresponds to the '093 patents net stress value) based on the stress of the layers. EX1008, 859-860. Guo then verifies the theoretical results by measuring stress in actual multilayer structures and comparing those results to output from the model. EX1008, 860-862. The relevant results table is shown below, with the "σ_i" rows representing the stress of an individual layer, and the "$\sigma_{1,2...n}$" rows representing the net stress through each of the layers (annotated as A, B, C, D at the top of the chart). EX1008, 860-862. The asterisked ("*") values are the theoretical values produced by the model.

Table 2
Residual stresses of monolayers (σ_i, σ_i^*) and gradient DLC multilayers ($\sigma_{1,2,\ldots n}$, $\sigma_{1,2,\ldots n}^*$).

Monolayer	A	B	C	D
σ_i (−GPa)	1.555	1.959	3.455	4.322
σ_i^* (−GPa)	1.555	1.863	2.937	4.141
Multilayer	–	AB	ABC	ABCD
$\sigma_{1,2,\ldots n}$ (−GPa)	–	1.729	2.010	2.361
$\sigma_{1,2,\ldots n}^*$ (−GPa)	–	1.688	1.891	2.233
δ	–	2.4%	5.9%	5.4%

EX1008, 861 (Table 2).

99. The layers are cumulative going from left to right, and thus column A has no net stress value because it is only a single layer. Columns B, C, and D, detail the individual stress values of the additional layer, and the resulting net stress value. EX1008, 861. In every case, the individual stress values are both non-zero and different (i.e., 1.555, 1.959, 3.455, and 4.322). EX1008, 861-862. And in each of these cases, the overall or net stress of the multilayer structure is lower than at least one of the individual stresses (i.e., 1.729, 2.010, and 2.361). A POSA would have therefore been motivated to arrange the individual stress values to be non-zero and different as shown in Guo because Guo is a real-world example of achieving the desired goal of stress reduction made obvious by Haley and Borse. A POSA would have had a reasonable expectation of success making this modification for the same reasons discussed above with respect to the combination

of Haley and Borse, including that it was well within the skill of a POSA to modify the materials of the layers as needed. Section IX.A.4.a.

i. Guo is analogous art.

100. I understand that Patent Owner may argue that Guo is directed at non-plastic materials (e.g., CrN and DLC layers), and that it is therefore not analogous art. I further understand that whether a reference is analogous art is determined based on: 1) whether the art is from the same field of endeavor as the claimed invention, regardless of the problem addressed and, (2) if the reference is not within the field of the inventor's endeavor, whether the reference still is reasonably pertinent to the particular problem with which the inventor is involved. Here, Guo is analogous art because it meets both prongs of this test.

101. First, Guo is a reference that discusses the problem of curl in multilayer structures, which is the "field of endeavor" of the claimed invention at least because the alleged point of novelty of the claims was the stress value elements. Second, Guo is also analogous art because it is reasonably pertinent to the particular problem addressed by the claimed invention: curl of multilayer structures. The materials in Guo suffer from curl for the same underlying technical reasons as do the materials discussed in the '093 patent: material incompatibilities between layers and asymmetric production-induced stress formation in the layers. Guo's teachings help directly address this problem because they provide examples

of stress patterns and net stress values in multilayer structures that a POSA would have been able to analogize to other materials that suffer from the same issues (like the materials used in the '093 patent). Thus, Guo is analogous art.

ii. Guo's teachings are applicable to Haley and Borse.

102. I also understand that Patent Owner may argue that Guo's teachings are incompatible with Haley and Borse because Guo is directed at non-plastic materials (e.g., CrN and DLC layers), and that it is therefore incompatible with Haley and Borse. But this is not the case because the underlying phenomenon causing the residual stress in Guo is the same as the one causing the stresses and curl in Haley and Borse. Namely, material and process differences result in the stresses in all three of these references. Thus, the teachings of Guo are applicable to the materials of Haley and Borse. And, this combination is not proposing adding any of the layers of Guo to the Haley-Borse combination so there can be no issue created by the physical compatibility of the materials in Guo and the materials of Haley and Borse. Thus, Haley, Borse, and Guo render obvious element [1.1b].

5. [1.1c] "wherein the multi-layer structure has a net stress value that is less than the greater stress value of the plurality of layers"

103. Borse discloses that adding "a core layer that consisted of a blend of nucleated HDPE with LDPE was observed to produce 'flat' film." EX1007, 8:20-23. This means that the net stress value of the multilayer structure is at or near

zero. As discussed above, it would have been obvious that the stress values of the layers are non-zero (i.e., positive) values. Section VIII.A.4. Thus, it also would have been obvious that the zero net stress value of the multilayer structure is less than the stress values of the layers. Moreover, as discussed above, Guo shows that the net stress values in multilayer materials can, and are, lower than at least the highest stress value of one of the layers. EX1008, 862. Thus, Haley, Borse, and Guo render element [1.1c] obvious.

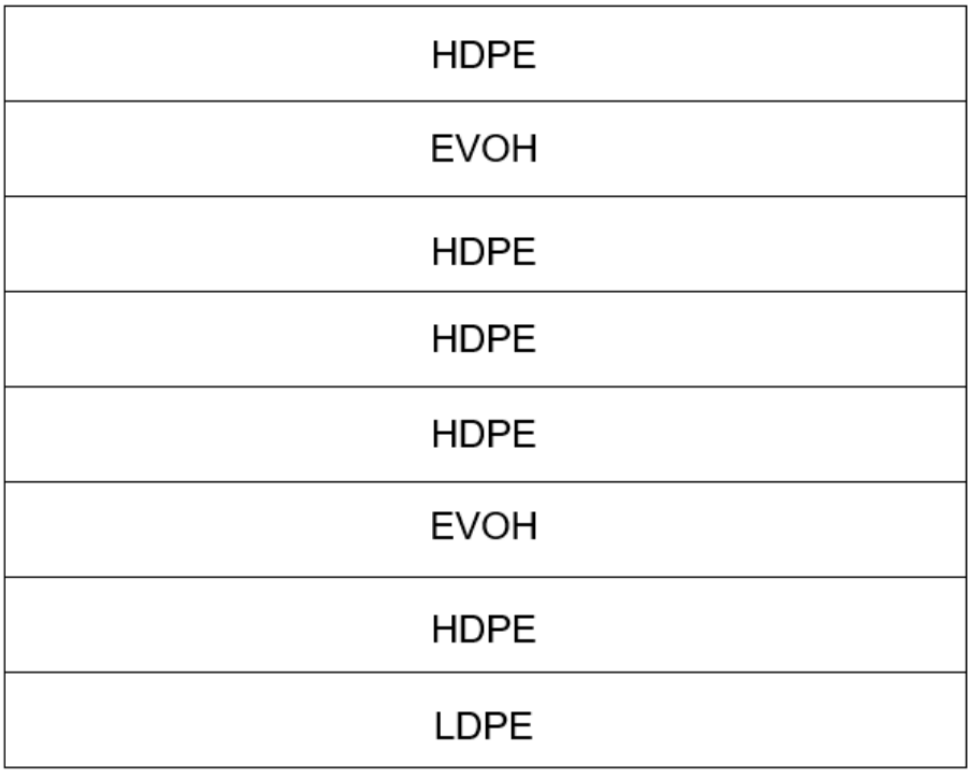
B. Haley, Borse, and Guo render obvious claim 2.

104. Claim 2 depends from claim 1 and recites "wherein the stress value of at least three of the plurality of layers are different from one another." This element is obvious for the same reasons as element [1.1b], which recites "wherein the stress value of at least two of the plurality of layers are non-zero and different from one another." Section VIII.A.4. The Haley-Borse multilayer structure includes eight layers, including HDPE, EVOH, and LDPE. The material differences that result in the curl and stress values discussed above apply equally well to these three different layers as they do to the two layers discussed above. Section VII.A.4.a. In particular, the LDPE and EVOH will interact and induce stresses in each other in a manner that is different from the interaction between the EVOH and the HDPE because LDPE has different properties than EVOH. Section IX.A.4.a. Further, Guo shows three layers with different, non-zero stresses. EX1008, 862. Finally, adding

an additional layer does not change the analysis regarding this element being one of a finite number of predictable solutions that were obvious to try. Section VIII.A.4.b. Thus, Haley, Borse, and Guo render claim 2 obvious.

C. Haley, Borse, and Guo render obvious claim 3.

105. Claim 3 depends from claim 1 and recites "wherein the uppermost layer is formed of high density polyethylene and the lowermost layer is formed of one of linear low density polyethylene and low-density polyethylene." As discussed in Section IX.A.3, the uppermost layer of the multilayer structure from Haley, shown below, is HDPE; the lowermost layer is LDPE. EX1006, 1:44-53, 4:4-67.



106. As explained in further detail below, the modification of adding a core layer from Borse only affects the interior layers, not the skin layers (i.e., the uppermost and lowermost layers). Section IX.D. Thus, Haley, Borse, and Guo render claim 3 obvious.

D. Haley, Borse, and Guo render obvious claim 4.

107. Claim 4 depends from claim 3 and recites "wherein multi-layer structure comprises a barrier layer located between the uppermost layer and the lowermost layer, wherein the barrier layer is formed of ethylene vinyl alcohol." The "B" layers of Haley "ha[ve] a structure of tie layer/barrier layer/tie layer." EX1006, 4:4-6. Specifically, a "[s]uitable barrier layer is preferably selected from the group consisting of ethylene-vinyl alcohol copolymers (EVOH), polyamides (nylons), the like, and mixture thereof." EX1006, 4:63-67. Thus, in the Haley-Borse structure shown below, the second EVOH layer is a "barrier layer" as claimed. As explained in further detail below, the modification of adding a core layer from Borse does not remove or otherwise replace this barrier layer. Section IX.E. Thus, Haley, Borse, and Guo render obvious claim 4.

E. Haley, Borse, and Guo render obvious claim 5.

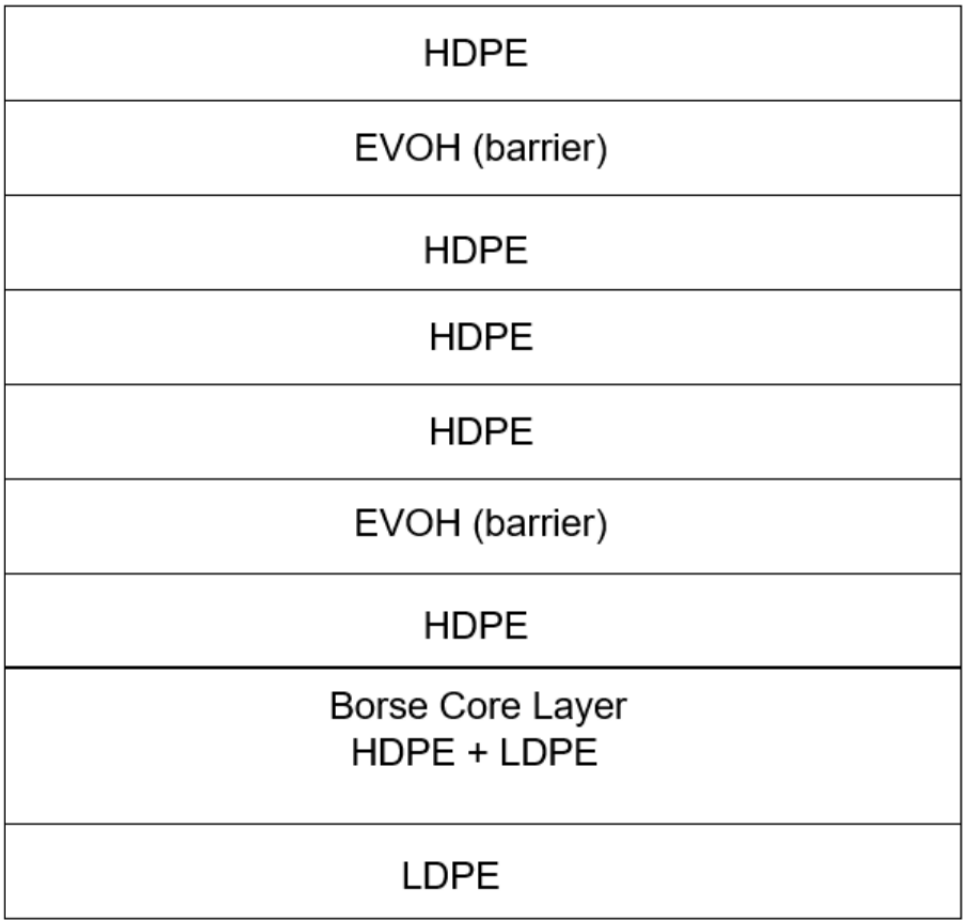
108. Claim 5 depends from claim 4 and recites ""wherein the multi-layer structure further comprises: [5.1] a first intermediate layer located between the uppermost layer and the barrier layer, the first intermediate layer formed of high

density polyethylene; [5.2] a second intermediate layer located between the lowermost layer and the barrier layer, the second intermediate layer formed of high density polyethylene; and [5.3] a third intermediate layer located between the uppermost layer and the first intermediate layer, the third intermediate layer comprising high density polyethylene."

109. As explained above, it would have been obvious to add Borse's core layer to Haley's multilayer structure to reduce curl. Section IX.A.4. Because this is a core layer, a POSA would have been motivated to add the core layer in a position between the uppermost and lowermost layers. Given the existing structure of Haley (shown below), there are only seven possible locations to place the core layer (i.e., one location between each of the existing layers).

HDPE
EVOH
HDPE
HDPE
HDPE
EVOH
HDPE
LDPE

110. It therefore would have at least been obvious to try adding the core layer in the position shown below because that position is one of a finite number of predictable options for the core layer. As explained above, a POSA would have had a reasonable expectation of success adding the core layer to Haley's multilayer structure because: (1) Borse provides the necessary material details, and (2) a POSA would have been aware of the manufacturing processes needed to add a layer to Haley's structure. Section IX.A.4.a. This modification would result in the following structure:



1. Element [5.1]

111. A mapping of the various claimed layers of claim 5 is shown below on the combined Haley-Borse multilayer structure. As can be seen, the third HDPE layer from the top discloses the claimed "first intermediate layer" of element [5.1]. Thus, Haley, Borse, and Guo render obvious element [5.1].

HDPE	"uppermost layer"
EVOH (barrier)	
HDPE	"third intermediate layer"
HDPE	"first intermediate layer"
HDPE	"tie layer"
EVOH (barrier)	"barrier layer"
HDPE	"tie layer"
Borse Core Layer HDPE + LDPE	"second intermediate layer"
LDPE	"lowermost layer"

2. Element [5.2]

112. A mapping of the various claimed layers of claim 5 is shown below on the combined Haley-Borse multilayer structure. As can be seen, the Borse core layer discloses the claimed "second intermediate layer" of element [5.2]. As disclosed in Borse, this core layer comprises HDPE. EX1008, 8:14-23. Thus, Haley, Borse, and Guo render obvious element [5.2].

HDPE	"uppermost layer"
EVOH (barrier)	
HDPE	"third intermediate layer"
HDPE	"first intermediate layer"
HDPE	"tie layer"
EVOH (barrier)	"barrier layer"
HDPE	"tie layer"
Borse Core Layer HDPE + LDPE	"second intermediate layer"
LDPE	"lowermost layer"

3. Element [5.3]

113. A mapping of the various claimed layers of claim 5 is shown below on the combined Haley-Borse multilayer structure. As can be seen, the second HDPE layer from the top discloses the claimed "third intermediate layer" of [5.3]. Thus, Haley, Borse, and Guo render obvious element [5.3].

HDPE	"uppermost layer"
EVOH (barrier)	
HDPE	"third intermediate layer"
HDPE	"first intermediate layer"
HDPE	"tie layer"
EVOH (barrier)	"barrier layer"
HDPE	"tie layer"
Borse Core Layer HDPE + LDPE	"second intermediate layer"
LDPE	"lowermost layer"

F. Haley, Borse, and Guo render obvious claim 6.

114. Claim 6 depends from claim 5 and recites "wherein the multi-layer structure comprises a first barrier tie layer located between the barrier layer and the first intermediate layer and a second barrier tie layer located between the barrier layer and the second intermediate layer." As shown below, a first barrier tie layer is located above the barrier layer, and a second barrier tie layer is located between the barrier layer and the second intermediate layer. Thus, Haley, Borse, and Guo render obvious claim 6.

HDPE	"uppermost layer"
EVOH (barrier)	
HDPE	"third intermediate layer"
HDPE	"first intermediate layer"
HDPE	"tie layer"
EVOH (barrier)	"barrier layer"
HDPE	"tie layer"
Borse Core Layer HDPE + LDPE	"second intermediate layer"
LDPE	"lowermost layer"

G. Haley, Borse, and Guo render obvious claim 7.

115. Claim 7 depends from claim 1 and recites "wherein the sheet has a thickness ranging from about 150 μm to about 450 μm." Haley discloses that its invention is directed at sheets with thicknesses "greater than 10 mils [254 μm]." EX1006, 1:40-44. Specific examples of multilayer sheets with thicknesses in the claimed range are also generally well known. EX1005, 698-704. Specifically, for example, various meat packaging structures fall into this thickness range. EX1005, 701 (disclosing various multilayer structures with thicknesses ranging from "150-200" μm). It would have been obvious to modify the multilayer structure discussed in claim 1 as needed to fall within the appropriate thickness range. A POSA would

have had a reasonable expectation of success making this modification because adjusting manufacturing processes to create thicker films was well within the skill of a POSA at the critical date.

116. This claim would also have been obvious as a matter of design choice for the same reasons discussed in Ground 1 with respect to this claim. Section VII.H. There is no criticality discussed with respect to this known thickness range, and no functionality tied to the thickness range. Thus, this claim is also obvious as a matter of design choice.

H. Haley, Borse, and Guo render obvious claim 8.

117. Claim 8 depends from claim 1 and recites "wherein the multi-layer structure is substantially free of a metal-containing layer and a cellulosic-containing layer." The Haley-Borse multilayer structure comprises HDPE, LDPE, EVOH, and tie layers. Section IX.A. None of these layers contain metals or cellulose because they are all polymeric resin-type plastics. This claim is also obvious in view of the need to ensure compatibility with existing recycling streams. EX1014, 1. Including metal and cellulose materials in a polymer recycling stream (e.g., an HDPE recycling stream) would cause compatibility issues because the metal and cellulose cannot be processed in the same way as the polymer material. EX1017, 15:29-34 (listing contaminants to be separated form a plastic recycling stream including metal screws and paper); EX1018, 11. For example,

metal scraps can cause damage to plastic processing equipment. EX1017, 14:13-22. Thus, a POSA would have been well aware that metal and cellulose materials would not generally be compatible with a polymer recycling stream. Thus, Haley, Borse, and Guo render obvious claim 8.

I. Haley, Borse, and Guo render obvious claim 9.

118. Claim 9 depends from claim 1 and recites "wherein the multi-layer structure has a density ranging from about 0.950 g/cm^3 to about 0.965 g/cm^3." Regarding Haley's B/A/B/C structure, "the percentage of the total film in each layer was 20%/50%/15%/15%" in a 2 mil total thickness film. EX1006, 7:30-36. This results in layer thicknesses of 10 μm for the first "B" layer, 25 μm for the "A" layer, 7.6 μm for the second "B" layer, and 7.6 μm for the "C" layer. In one of the example three-layer films in Borse, which are all 2 mils total in thickness, the core layer is 50% of the film, by weight percentage, which given the similar density ranges between the LDPE and HDPE materials, can be assumed to correspond approximately to thickness. EX1007, 9 (Table 2). Thus, the core layer is approximately 26 μm thick. Assuming that the "B" layers have a density that is the average of an EVOH and an LLDPE tie layer, *see* EX1005, 73, 595, and that the densities of HDPE and LDPE discussed in Ground 1 from Morris are used, the resulting net density, as calculated using a weighted average, is 0.97 g/cm^3. This value is within 5% of the claimed range and, I understand from counsel, therefore

renders this range obvious absent any criticality or patentable association of the claimed density range. There is no such link here, and thus this range is obvious.

119. This claim would also have been obvious because the claimed density range is a requirement for compatibility with HDPE recycling streams. EX1014, 7. Thus, a POSA would have been motivated to ensure that a multilayer structure has the claimed density range to improve recyclability of the multilayer structure.

120. This claim would also have been obvious as a matter of design choice for the same reasons discussed with respect to the thickness in claim 7: there is no criticality to the claimed density range. Section IX.H. Like the thicknesses of claim 7, the ’093 patent discusses the density ranges without tying the density to any functionality, much less a patentable improvement. EX1001, 8:22-25. Thus, this claim is also obvious as a matter of design choice.

J. Haley, Borse, and Guo render obvious claim 10.

121. Claim 10 depends from claim 1 and recites “wherein the multi-layer structure has a melt flow index ranging from about 0.7 g/10 min to about 1.1 g/10 min.” Melt flow index is a known material property that “is a measure of how much polymer melt flows through a standard orifice using a standard weight, time, and temperature. It is inversely related to viscosity, but the relationship is not exact.” EX1005, 108.

122. In my experience, the melt flow index of a multilayer structure can be calculated using a weighted average of the melt flow index of each layer if the multilayer structure melts into a compatible mixture. Here, the materials in Morris' multilayer structure are identical to the materials of the multilayer structure that is allegedly recyclable in the '093 patent. EX1001, 27:21-33. It is fair to assume that this means that the materials in Morris' multilayer structure will melt into a compatible mixture because otherwise they would not be easily recyclable. Incompatible mixtures are not easily recyclable because it is difficult to process the melt without clogging caused by the non-homogenous nature of the melt. Using a weighted average with the thickness values discussed above in claim 9 and the following Melt Flow Indices (HDPE: 0.68 g/10 min; EVOH: 3.2 g/10 min; LDPE: 0.25 g/10 min), the weighted average results in a melt flow index of 0.93 g/10 min. EX1011; EX1012; EX1013.

123. This claim would also have been obvious because the claimed melt flow is a requirement for compatibility with HDPE recycling streams. EX1014, 7; EX1019, 6. Thus, a POSA would have been motivated to ensure that a multilayer structure has the claimed melt flow range to improve recyclability of the multilayer structure.

124. This claim would also have been obvious as a matter of design choice for the same reasons discussed with respect to the thickness in claim 7: there is no

criticality to the claimed melt flow index ("MFI") range. Section IX.G. Like the thicknesses of claim 7, the '093 patent discusses the MFI range without tying the MFI to any functionality, much less a patentable improvement. EX1001, 2:55-60. Thus, this claim is obvious as matter of design choice.

X. CLAIMS 1–10 ARE NOT ENABLED.

125. The '093 patent fails to enable elements [1.1b] and [1.1c], which are reproduced here: "wherein the stress value of at least two of the plurality of layers are non-zero and different from one another" and "wherein the multi-layer structure has a net stress value that is less than the greater stress value of the plurality of layers." Based on my understanding of claim interpretation, claim 1, therefore, ostensibly covers every single multilayer polymer sheet in which the net stress value of the multilayer sheet is less than the stress value of one of the plurality of layers (regardless of polymeric materials used, dimensions, symmetry, manufacturing process, etc). I would presume that these broad elements would require a broad enabling disclosure. But as explained below, the '093 patent does not include any enabling disclosure for these elements, much less a broad enabling disclosure.

126. I understand that the enablement requirement is met where one skilled in the art, having read the specification, could practice the invention without undue experimentation. I further understand that the so-called *Wands* factors set forth by

the Federal Circuit are an inclusive list of factors to consider when determining whether a claimed feature is enabled:

(1) The quantity of experimentation necessary,

(2) the amount of direction or guidance presented,

(3) the presence or absence of working examples,

(4) the nature of the invention,

(5) the state of the prior art,

(6) the relative skill of those in the art,

(7) the predictability or unpredictability of the art, and

(8) the breadth of the claims.

127. Here, the ’093 patent does not enable elements [1.1b] and [1.1c]. Outside of the claim language, the ’093 patent discusses the stress value feature in a few paragraphs found in columns 5 and 6 of the patent. EX1001, 5:11-6:46. This discussion explains the underlying natural phenomenon related to stress value, but it provides no direction or guidance on how to actually achieve the claimed stress value configuration (i.e., two layers with different, non-zero stress values, with a lower net stress value). There are no working examples, no numerical measurements of the stress value, and no other guidance given in the ’093 patent for achieving this stress value configuration. Thus, *Wands* factors 2 and 3 weigh against finding enablement.

128. The nature of the art of multilayer structures means that, absent specific guidance, a significant amount of experimentation would be needed to modify the various material properties and production process variables to achieve the claimed configuration. The very nature of this invention—namely, stress values in material layers—makes it difficult to reliably predict stress values in advance. Particularly where there are no starting points given that are tied to the claimed stress value configuration, adjusting stress values and optimizing a material to have little or no curl (and thus no stress value) is often a trial and error process that requires multiple attempts. *See* EX1005, 494-506. That is especially the case here, where there are no starting points given that are tied to the claimed stress value configuration. Thus, *Wands* factors 1, 4, and 7 also weigh against finding enablement.

129. The lack of any enabling disclosure is even more surprising in view of the claim terms themselves. These claim terms are very broad because they claim a large range of stress values configurations. In fact, as I explained, it is far more likely that any given multilayer structure would have the claimed stress value configuration than not. Section VII.A.4. Thus, *Wands* factor eight weighs against enablement. I note that during prosecution of the ’093, Patent Owner acknowledged that many variables affect the stress values of the layers and the overall structure—further supporting my opinion here. EX1002, 0141. There is,

simply put, no link between the manufacturing methods discussed in the '093 patent and the stress value concept.

130. I understand that because seven of the eight *Wands* factors support a finding against enablement of these broad claim elements here, the '093 patent does not enable elements [1.1b] and [1.1c].

XI. CLAIMS 1–10 DO NOT RECITE PATENTABLE SUBJECT MATTER.

131. I understand that patentability under Section 101 is governed by a two-step process for determining whether a claim is directed at patentable subject matter. The first step is to determine whether the claims at issue are directed to a patent-ineligible concept. If the answer to this question is yes, then the second step is to determine if the claims recite an inventive concept that is sufficient to ensure that the patent in practice amounts to *significantly more* than a patent upon the ineligible concept.

A. The claims recite well-known structure in combination with certain material properties.

132. Before a Section 101 analysis can begin, I understand that it is important to understand the scope and details of the claims. Claim 1 is recited below for reference:

1. A sheet comprising:

a polymeric multi-layer structure comprising:

a plurality of layers including an uppermost layer and a lowermost layer, each of the plurality of layers having a stress value;

wherein the stress value of at least two of the plurality of layers are non-zero and different from one another; and

wherein the multi-layer structure has a net stress value that is less than the greater stress value of the plurality of layers.

Claim 1, like all of the claims of the ’093 patent, is a product claim that recites a “sheet” that is a “polymeric multi-layer structure” that includes a “plurality of layers.” These layers, and the overall claimed structure are further qualified with a material property the ’093 patent terms “stress value.” Specifically, in claim 1 the stress values of two of the layers must be non-zero and different, and the overalls stress value (the “net stress value”) of the multilayer structure must be less than the stress value of at least one of the layers.

133. The remaining nine claims depend from claim 1 and can be separated into three general categories. First, claim 2 is the sole dependent claim that recites an additional stress value limitation—namely, that a third layer must have a non-zero and different stress value from the two layers recited in claim 1. Second, claims 3–6 recite additional layers in the multilayer structure. Third, claims 7–10 recite material properties (e.g., density, thickness) of the overall multilayer structure.

B. The claims are directed towards a natural law and meet step one.

134. Turning to the first step of the analysis, it is clear that the claims are directed at a natural law or phenomenon, which is one of the prohibited categories. Here, the natural law in question governs the chemical and structural interactions between molten plastic layers as they cool to form a multilayer structure. As explained above, when multilayer structures with different layers are formed together, the different material properties of the layers that are in contact can cause stress to form in the layers. Sections III.A-B. These stress values occur naturally as an inherent result of using different materials in multilayer structures. The stresses can also be caused by processing issues, such as improper cooling rates. Sections III.A-B. Indeed, the '093 patent explains that "[d]epending on the molecular orientation for a given layer, the counterbalancing forces of the polymer chains within that given layer may not be at equilibrium thereby causing that layer to be in a state of internal stress." EX1001, 5:14-17. Thus, the '093 patent claims are directed at the result of a natural law or phenomenon.

C. The claims fail to add an inventive concept and thus meet step two.

135. After satisfying the first step of this analysis, this analysis turns to the second step: determining if the '093 patent claims add *significantly more* to this natural law. As discussed above, there is only a single additional claim—claim 2—that recites any further stress value limitations. Section XI.A. And this claim is

substantively identical to the stress value recital in claim 1 because it only adds a third non-zero, different stress value in a third layer. The remaining eight claims add only well-known structures or material properties. Sections VII-IX. Indeed, claims 3–6 can be summarized as adding an additional layer to a multilayer structure. And claims 7–10 claim basic material properties of the overall multilayer structure. None of these elements are linked at all to the stress value concept, and they are all well known.

XII. CONCLUSION

In signing this declaration, I recognize that this declaration will be filed as evidence in a post grant review before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize 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, I will appear for cross-examination within the United States during the time allotted.

I hereby declare that all statements made herein are made of my own knowledge and 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 on this 12 day of October 2021.

Stephen McCarthy, Ph. D.

17425544_1.docx