

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

FITESA SIMPSONVILLE, INC.,
Petitioners

v.

THE PROCTER & GAMBLE COMPANY,
Patent Owner.

U.S. Patent No. 10,513,801

Inter Partes Review No.:

DECLARATION OF GAJANAN S. BHAT, Ph.D.

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I Gajanan S. Bhat, declare:

I. Retention as an expert witness

1. I have been retained by Petitioner Fitesa Simpsonville, Inc. to provide opinions on certain issues relating to a Petition for *inter partes* review of the '801 Patent, which I understand Fitesa is filing with the Patent Trial and Appeal Board ("PTAB"). My declaration provides analysis and expert opinions on the state of the art related to the subject matter disclosed in U.S. Patent No. 10,513,801 ("the '801 Patent"), as well as the invalidity of Claims 1-25 of the '801 Patent ("the challenged claims"). My invalidity analysis addresses both "anticipation" and "obviousness," including the factors that would have motivated a person of ordinary skill in the art to develop a product like that claimed in the challenged claims, and the combinations of prior art references that a person of ordinary skill would have been motivated to use in designing such a product.

II. Compensation

2. I am being compensated as follows: \$375 per hour for analysis, review, preparation of reports/declaration, and testimony.

III. Experience and Qualifications

3. I received my Bachelor of Technology in Textile Sciences from Bangalore University (India) in 1981. I received my Master of Technology in Fiber Science & Technology from the Indian Institutes of Technology, Delhi in

1984. I received my Master of Science in Textile Engineering from the Georgia Institute of Technology in 1987, and my Doctor of Philosophy (Ph.D.) in Textile Engineering from the Georgia Institute of Technology in 1990.

4. I am currently the Department Head for Textiles Merchandising & Interiors at the University of Georgia in Athens. My research endeavors at the University of Georgia include fiber and nonwoven technologies including meltblown fibers, meltblown nonwovens, and associated meltblown processes.

5. Prior to joining the University of Georgia, I was associated with the University of Tennessee in Knoxville (UTK) from 1990 to 2016 in various professorship, research, and leadership positions. From 1990 to 1996, I served as an Assistant Professor in the Department of Textile, Retailing, and Interior Design. In 1996, I was promoted to Associate Professor, and subsequently to a full Professor in 2001. During this time, my duties included teaching and research.

6. From 2002 to 2016, I was a Professor of Material Science and Engineering at UTK. I also served as the Associate Director of the Textiles and Nonwovens Development Center (TANDEC) at UTK (2006-2007), and in 2008, I was promoted to the position of Director of the University of Tennessee Nonwovens Materials Research Laboratory (UTNRL) where I remained until leaving for my current position at the University of Georgia.

7. During my association with UTK, my research included polymer processing, nonwoven technologies including meltblown and spunbond related processes, biodegradable nonwovens including cellulosic fibers, nanofibers, high performance fibers, and various applications of the foregoing mentioned fibers. In particular, as Director of UTNRL, my research included the production of nanofibers from thermoplastic polymers by meltblowing.

8. I have received numerous awards for accomplishments in these roles, including: the Distinguish Achievement Award from the Fiber Society; being named a Fellow of the Textile Institute; the Best Paper Award from the Association of the Nonwovens Fabric Industry; the TechniTex India Research Achievement Award; and the Technical Association of the Pulp and Paper Industry-Nonwovens, Engineers, and Technologist (TAPPI-NET) division Technical Achievement Award. I previously served as the President of the Fiber Society, and currently serve as an Editorial Board Member for the International Journal of Textile Engineering and Processes; the Journal of Nanomaterials and Molecular Nanotechnology; and Journal of Materials Science and Chemical Engineering.

9. My work in the classroom consists of both teaching and mentoring. I teach (and have taught) classes relating to the following subjects: nonwovens science and technology, high performance fibers, polymer processing and plastics

recycling. I have also overseen, supervised, and mentored students in multiple senior and graduate projects.

10. Additionally, I am named inventor on four issued U.S. patents, have authored and co-authored numerous publications in the field of fibers, textiles and nonwovens, and have worked, consulted, and testified in several patent cases.

Attached as Appendix A (Ex. 1021) is a copy of my curriculum vitae, which lists all publications I have authored within the preceding ten years and the cases in which I testified in the last four years as an expert at trial or by deposition. I reviewed the following materials in providing the opinions in this declaration and the other materials referenced in this Declaration and the Petition.

Exhibit Number	Document
1001	U.S. Patent No. 10,513,801
1002	U.S. Patent No. 6,013,223 – Schwarz
1003	PCT Application Publication No. WO 00/29658 – McDowall
1004	U.S. Patent Application Publication No. 2003/0211802 – Keck
1005	U.S. Patent No. 5,476,616 – Schwarz
1006	U.S. Patent No. 6,783,854 – Bond
1007	U.S. Patent No. 4,100,324 – Anderson
1008	U.S. Patent No. 4,923,454 – Seymour
1009	U.S. Patent No. 5,508,102 – Georger
1010	<i>The History of the Development of Melt Blowing Technology</i> , INJ 1999 – McCulloch
1011	<i>Melt Blown Dies: A Hot Innovation Spot</i> , INJ Winter 2002, 37-38 – Zhao
1012	File History U.S. Patent No. 10,513,801
1013	File History U.S. Patent No. 8,852,474
1014	File History U.S. Patent No. 9,926,648
1015	Intentionally left blank

1016	U.S. Patent No. 3,825,379 – Lohkamp
1017	U.S. Patent No. 4,380,570 – Schwarz
1018	U.S. Patent No. 6,114,017 – Fabbicante
1019	U.S. Patent No. 6,200,120 – Fish
1020	Assignment Record for U.S. Patent No. 5,476,616
1021	CV of Dr. Gajanan S. Bhat
1022	<i>Handbook of Nonwovens</i> , edited by S.J. Russel, Woodhead Publishing Limited, (2007), 149-150
1023	U.S. Patent No. 7,947,359 – Suzuka
1024	<i>ITMA 2007 Review: Implications for the Nonwovens Industry,” J. of Engineered Fibers and Fabrics</i> , Vol. 3, Issue 1 (2008), 38-47, 46 – Pourdeyhimi
1025	<i>Influence of Processing Conditions on Melt Blown Web Structure: Part 1 – DCD</i> , INJ Spring 2004, 49-55 - Bresee et al.
1026	<i>Influence of Processing Conditions on Melt Blown Web Structure: Part 2 – Primary Airflow Rate</i> , INJ Summer 2005, 11-18 - Bresee et al.
1027	<i>Effects of Melt-Blowing Process Conditions on Morphological and Mechanical Properties of Polypropylene Webs</i> , POLYMER 1992, Vol. 3, No. 6, 1200-1209 - Lee et al.
1028	Intentionally Left Blank
1029	U.S. Patent Application Publication No. 2007/0202766-Ouellette

IV. Level of Ordinary Skill in the Art

11. In determining the characteristics of a person of ordinary skill in the art of the '801 Patent at the time of the claimed invention, I considered several things, including the prior art and the type of problems encountered in the art. I also considered the sophistication of the technology involved, and the educational background and experience of those actively working in the field. Finally, I placed myself back in 2007 and considered the engineers/scientists whom I had worked with in the nonwovens industry. I conclude that a person of ordinary skill in the art

at the time of the effective filing date of the application that led to the '801 Patent would have been a person with a Bachelor of Science degree in Engineering (or a substantively related engineering or science degree) or equivalent work experience, and/or at least 3 to 5 years of experience in the field of nonwovens. Such experience could include, but is not necessarily required to include, knowledge about the design and operation of meltspun systems, such as meltblown and spunbond systems. Extraordinary training or experience in one aspect of the definition above may make up for an apparent deficiency in training or experience in another aspect. In forming the opinions discussed herein, I have applied the perspective of a person of ordinary skill in the art at the time of the effective filing date of the application that lead to the '801 Patent.

12. In preparing this Declaration, I have consulted the '801 Patent and its prosecution history as well as each of the documents cited herein in light of the general knowledge in the state of the art as of July 2007. In arriving at my opinions, I have relied on my experience in the relevant art and have considered the point of view of a person of ordinary skill in the art ("POSA").

V. Statement of Controlling Law

13. I have been instructed by Petitioner's attorneys and, as a result, understand that 35 U.S.C. § 102 ("§ 102") provides the standards for determining whether a claim in a patent is invalid as anticipated by prior art. I also understand

that, for purposes of my declaration here, “prior art” consists of patents or other types of printed publications that were publicly available before the ’801 Patent’s priority date. I have been informed that ’801 Patent’s earliest possible priority date is July 17, 2007. I understand that a claim in a patent is invalid as anticipated under §102 if each and every element of the claim is found expressly or inherently in a single prior art reference.

14. I understand that, when determining whether the single item of prior art anticipates the claims, one must consider not only what is expressly disclosed in that prior art, but also what is inherently present in that prior art. I understand that claim limitations that are not expressly found in a prior art reference are inherent if the prior art necessarily functions in accordance with, or includes, the claim limitations, or if the missing element or feature would be the natural result of following what the prior art teaches to persons of ordinary skill in the art. I also understand that it is acceptable to examine evidence outside the prior art reference, often referred to as extrinsic evidence, in determining whether a feature, while not expressly discussed in the reference, is necessarily present in the reference. I understand, however, that mere probabilities that an element is present are not enough, but it is not required that persons of ordinary skill actually recognized the inherent disclosure at the time the prior art was first known or used.

15. I understand that 35 U.S.C. § 103 (“§ 103”) provides the standard for determining whether a claim in a patent is invalid as “obvious.” I understand that a claim in a patent is invalid as obvious under § 103 when the differences between the claimed subject matter and the prior art are such that the claimed subject matter as a whole would have been obvious to a person of ordinary skill in the art at the time the invention was made. I understand that, similar to anticipation, the only grounds for obviousness that may be presented in a petition for IPR are those based on patents and/or printed publications. I understand that the relevant inquiry for assessing obviousness consists of the following four factors: (a) the scope and content of the prior art; (b) the differences between the prior art and the claims at issue; (c) the level of ordinary skill in the pertinent art at the time of the invention; and (d) objective factors indicating obviousness or non-obviousness – sometimes referred to as secondary considerations or indicia.

16. I understand that a prior art reference may be considered in assessing a patent claim’s obviousness if the reference discloses solving any problem or addressing any need addressed by the patent, or if the reference discloses information having obvious uses beyond its primary purpose that a person of ordinary skill in the art would reasonably examine to solve a problem or address a need addressed by the patent. I understand that a claimed combination of familiar elements according to known methods is likely obvious when it does no more than

yield predictable results. I understand that when a work is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in the same field or a different one. I understand that if a person of ordinary skill in the art can implement a predictable variation of claimed subject matter and have a reasonable expectation of success in doing so, § 103 likely renders the claim invalid.

17. I understand that an obviousness analysis need not seek out precise teachings directed to the specific subject matter of the challenged claim, and the PTAB can take account of the inferences and creative steps, or even the routine steps, that a person of ordinary skill in the art would have employed at the time of the alleged invention. I understand that it is often necessary to look to interrelated teachings of multiple prior art references; the effects of demands known to the design community or present in the marketplace; and the background knowledge possessed by a person of ordinary skill in the art, all to determine whether there was an apparent reason for the person of ordinary skill in the art to have combined elements in the manner claimed. I understand that any need or problem known in the field of endeavor at the time of the alleged invention or addressed by the '801 Patent can provide a reason for the person of ordinary skill in the art to have combined elements in the manner claimed. I understand that one way in which a patent's subject matter can be proved obvious is by showing that there existed at

the time of invention a known problem for which there was an obvious solution encompassed by the patent's claims. I understand that a person of ordinary skill attempting to solve a problem will not be led only to those elements of prior art designed to solve the same problem, but also apply common sense teachings. I understand that common sense teaches that familiar items may have obvious uses beyond their primary purposes, and in many cases a person of ordinary skill in the art will be able to fit the teachings of multiple prior references together like pieces of a puzzle. I understand that when there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill in the art has good reason to pursue the known options within his or her technical grasp. I further understand that, if this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense and, as such, likely is obvious.

18. I understand that for a reference to be used in an obviousness combination, it must be analogous art to the claimed invention. There are two ways to determine whether prior art is analogous. First, the art can be from the same field of endeavor as the claimed invention. Second, if the reference is not within the same field of endeavor, the reference can still be analogous if it is reasonably pertinent to the particular problem faced by the inventor of the claimed invention such that a person of ordinary skill would reasonably have sought a

solution to the problem in that outside field. This problem is not limited to the specific problem the patentee was trying to solve. Instead, any need or problem known in the field and addressed by the patent can provide a reason for combining the elements in the manner claimed.

19. I understand that someone assessing obviousness should be aware of and avoid the potential for distortion caused by hindsight bias and must be cautious of arguments reliant upon *ex post* reasoning. I understand that, before assessing the issue of obviousness, one must also consider certain objective factors – sometimes referred to as secondary considerations or indicia – that, if established, may indicate that the claimed invention may not have been obvious. Such secondary considerations include: (a) Were products covered by the claim commercially successful due to the merits of the claimed invention rather than due to other, unrelated factors, such as, for example, advertising, promotion or marketing, salesmanship, or unclaimed features of the product?; (b) Was there a long-felt but unresolved need for a solution to the problem facing the inventors, which was resolved by the claimed invention?; (c) Did others try, but fail, to solve the problem solved by the claimed invention?; (d) Did others copy the claimed invention?; (e) Did the claimed invention achieve unexpectedly superior results over the closest prior art?; (f) Did others in the field praise the claimed invention or express surprise at the making of the claimed invention?; and (g) Did others accept

licenses under the patent-at-issue because of the merits of the claimed invention? I understand that these factors are only relevant to obviousness if there is a connection, or nexus, between each of them and the claimed subject matter. I understand that, even if one could conclude that some of the above factors have been established, those factors should be considered along with all other available evidence when determining whether the claimed invention would have been obvious to the person of ordinary skill in the art at the time of the alleged invention.

20. As of the date of this declaration, I am not aware of any documents or information that relate to the “secondary consideration” factors I outlined above.

21. I also understand that, in an IPR, the PTAB will construe a claim using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b), including construing the claim in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent. 37 C.F.R. § 42.100(b).

22. I also understand, however, that the PTAB could find that the inventor specifically defined a particular claim term (which I understand is referred to as “lexicography”), in which case that definition would control. Finally, I understand that the PTAB could find that an inventor gave up (*i.e.*, “disavowed” or

“disclaimed”) the scope that a claim term would otherwise have had if there are specific statements made in the patent or depending on what happened when the application was being prosecuted before it became an issued patent.

VI. Summary of the '801 Patent

23. I have reviewed and considered the '801 Patent in view of general knowledge in the relevant field measured from the time of the earliest possible priority date for the '801 Patent, which I understand to be July 17, 2007.

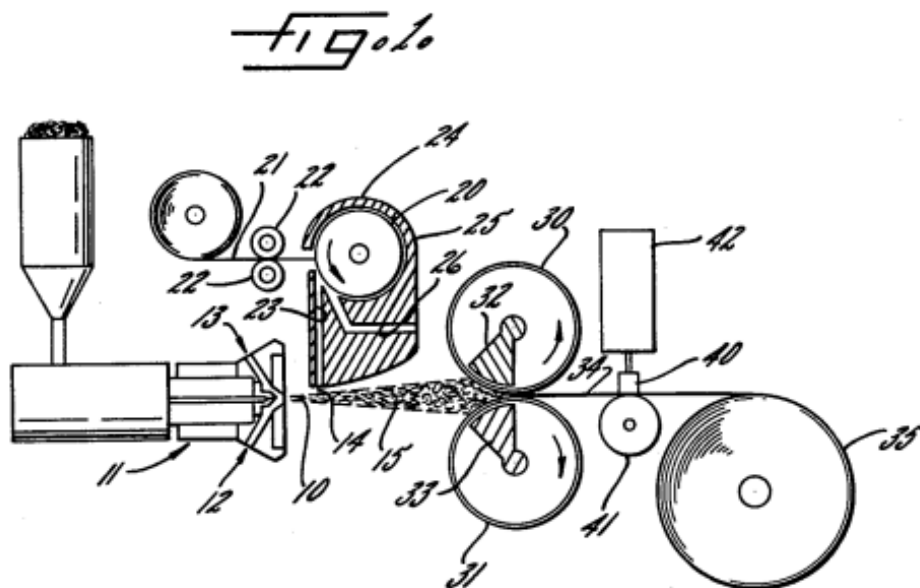
24. The challenged claims of the '801 Patent are directed to methods for preparing a fibrous structure that comprises a blend of polymeric filaments and solid additives (commonly referred to as a coform nonwoven). More specifically, in the coform process filaments are extruded from a die to form a filament stream to which a solid additive containing stream (for example, comprising a mixture of a gas, such as air, and wood pulp), is comingled with the filament stream prior to being deposited on a collection surface.

A. Background of Technology of the '801 Patent

25. A coform nonwoven is a fibrous structure comprising a blend of filaments and a solid additive, such as pulp. The '801 Patent defines a coform fibrous structure as “compris[ing] a mixture of at least two different materials wherein at least one of the materials comprises a filament ...and at least one other material, different from the first material, comprises a solid additive, such as a

fiber and/or particulate. Ex. 1001, column 3, lines 41-47. Wood pulp fibers are an example of a solid additive provided in the '801 Patent. Ex. 1001, column 3, lines 62-64.

26. U.S. Patent No. 4,100,324 to Anderson et al. (Ex. 1007) is one of the earliest patents to describe a process of preparing a coform nonwoven. As described in Anderson and with reference to figure 1, below, a primary gas stream 10 of meltblown fibers is prepared from a die head 11 having at least one row of extrusion apertures *Id.*, column 2, lines 44-45; figure 1. The primary gas stream comprising the meltblown fibers is merged with a secondary gas stream 14 containing wood pulp fibers. *Id.*, column 2, lines 55-58.



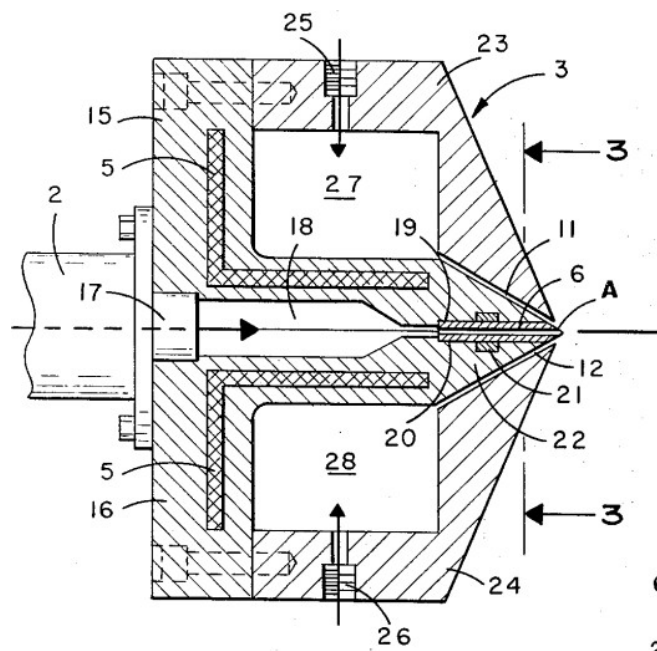
In the figure, die head 11 provides the primary gas stream 10 comprising a mixture of air and fibers. The secondary gas stream 14 comprising wood pulp fibers and

air is provided by picker roll 20, which removes individual fibers from pulp sheet 21. *Id.*, column 3, lines 1-8. The removed wood pulp fibers and a stream of air are introduced into a forming duct 23 that maintains fiber separation and is maintained to avoid fiber flocking. *Id.*, column 3, lines 10-22. The primary and secondary gas streams are merged to produce an integrated stream 15, which is introduced in between cooperating vacuum rolls 30, 31, and then subsequently wound on roll 35. *Id.*, column 6, lines 29-42.

27. The process described in Anderson uses meltblown fibers as the fibers of the primary gas stream. In a meltblown process, polymers (typically thermoplastics), are heated and extruded through die openings into thin, fine fibers and are attenuated by a fluid (air) to produce fibers having diameters typically ranging from 1 to 10 microns. *Id.*, column 2, lines 44-52; *see also* Ex. 1004 ¶ 35. Meltblown processes and meltblown nonwoven webs were first developed in the 1950s. Ex. 1007, column 2, lines 28-38.

28. While Anderson states that the meltblown fibers used in his coform process were discontinuous (*Id.*, column 2, lines 1-4), it is well known that meltblown fibers can be discontinuous or continuous. For example, U.S. Patent Publication No. 2003/0211802 to Keck et al. (Ex. 1004) describes a process of preparing a coform in which the meltblown fibers may be continuous or discontinuous. Ex. 1004, ¶ 35. PCT Application Publication No. WO 00/29658 to

McDowall (Ex. 1003) describes an absorbent article prepared with the coform process in which continuous meltblown filaments or continuous spunbond filaments are comingled with pulp fibers. Ex. 1003, page 8, lines 1-2.



and forced through a plurality of capillary tubes 6 (die openings) having outlets at the apex A of the die tip. *Id.* A pair of gas cover plates 23, 24 are disposed on opposite sides of the die nose and collectively define a pair of converging gas slots 11, 12, which extend along the length of the die tip. *Id.* The pair of gas slots 11, 12 provide a pair of converging gas streams that attenuates the individual streams of polymer as they are extruded from the die openings to form microfibers. *Id.*

31. The requirement to have gas streams that converge to attenuate the filaments as they exit the die openings has generally limited knife-edge meltblown dies to a single row of die openings. As a consequence, polymer throughput, and hence, production capacity, of knife-edge die heads has been limited.

32. Coform nonwovens have been used for decades in single-use, disposable consumer products, including and most prevalently in baby wipes. A single-use article, such as a paper towel or a baby wipe, must be relatively low-cost. For example, a typical baby wipe price point is 2 to 3-cents per unit (wipe) on the consumer retail shelf. In the nonwoven industry, the importance of reducing cost per unit, and hence, providing a competitive product, cannot be overstated.

33. An important factor to reaching a tolerable consumer price point for a wipe substrate is manufacturing cost. Total manufacturing cost is the sum of three categories: material (feedstock), direct labor, and manufacturing overhead. All of

these three cost factors are directly or indirectly affected by the productivity of the process.

34. In general, productivity is a measurement of product output over time. Process throughput is an important element of productivity; simply stated, a process that produces more output over a given time is more efficient and thereby more productive. Productive processes provide more output over time while consuming less resources which directly reduce manufacturing costs, such as, associated labor, energy requirements, associated manufacturing space, and asset depreciation. Higher productivity reduces all these cost factors directly improving the ROI (Return of Investment) on capital of a given manufacturing process.

35. Accordingly, it is desirable to optimize these factors to improve the manufacturing process and thereby reduce associated costs.

36. One method of reducing costs, is to improve the product throughput of the product being manufactured. That is, increasing productivity will result in decreased costs per unit for a given period of time. Decreasing the costs associated with manufacturing a coform nonwoven per unit will improve the manufacturer's competitiveness in the market and potentially provide a greater return on investment.

37. In general, the throughput of the meltblown fibers with a knife-edge die has been a limiting factor in process in the production of coform nonwovens.

More specifically, the use of the knife-edge meltblown die having a single row of die openings has inherently limited productivity rate.

38. In the 1990s, the capacity limitation of knife-edge meltblown dies was solved by the arrival of multirow meltblown dies.

39. U.S. Patent No. 4,380,570 to Schwarz (hereinafter “Schwarz ’570”) (Ex. 1017), which issued in 1993, is one of the earliest patents directed to a multirow meltblown die. Schwarz ’570 describes a multirow meltblown die in which the meltblown die has multiple rows of filament nozzles, and in which each row comprises a plurality of filament nozzles (resin orifice). Schwarz ’570 states that an object of the invention is to “provide a novel apparatus and process for melt-blowing fiberforming thermoplastic polymers to form fine fibers with improved economics.” Ex. 1017, column 1, lines 56-60.

40. As can best be seen with reference to figure 1, below, the multirow meltblown die head includes a pair of spaced apart plates 2, 5, which collectively define an air manifold 4 between the plates. *Id.*, column 3, lines 29-58. Both plates 2, 5 include corresponding holes through which an individual filament nozzle 3 is inserted. *Id.* As shown in figures 2 and 3, the holes in the plate 5 define the air orifices 6, and may be square or triangular. *Id.* The filament nozzles 3 are centered in the holes.

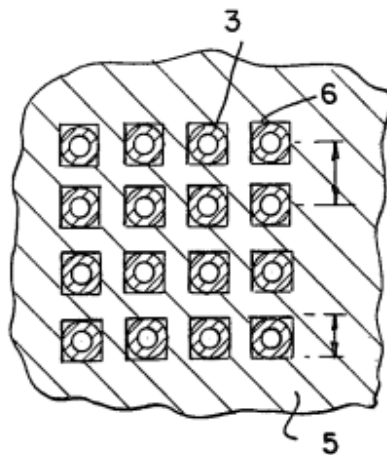
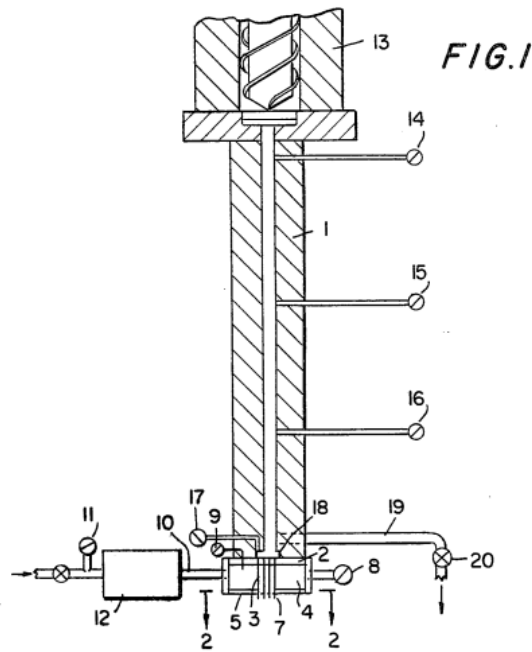


FIG. 2

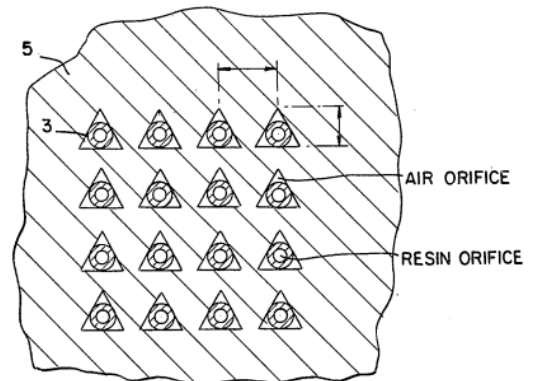


FIG. 3

41. Pressurized air is introduced into the air manifold 4 via air supply line 10. *Id.* The air then flows parallel to the main axis of the filament nozzles and exits the air manifold through the air orifices in plate 5. In discussing figure 2, Schwarz

'570 states that the "four corners of the square 6 around the tubes 3 [filament nozzles] are the orifices through which air is blown approximately parallel to the fibers exiting tubes 3. *Id.*, column 3, lines 35-38.

42. In contrast to knife-edge dies that use converging gas streams, the multirow meltblown dies use streams of attenuating gas in which each gas stream flows parallel to the main axis of a corresponding filament nozzle. Each filament nozzle is associated with a stream of parallel flowing attenuating gas, which, consequently, removes the limitation of requiring each row of filament nozzles to be disposed between the pair of converging gas streams.

43. The multirow meltblown dies developed by Schwarz significantly improved productivity of meltblown nonwovens.

44. The innovation of multirow meltblown dies has been recognized in the nonwoven field as breaking the limitation of requiring air from each side of the tapered die tip, which allows the number of rows of filament nozzles present on the die head to be increased without a tremendous capital expense. *See Zhao, Melt Blown Dies: A Hot Innovation Spot*, INJ Winter (2002) (Ex. 1011).

45. In addition to Schwarz '570, additional patents were filed in the 1990s directed to multirow meltblown dies including U.S. Patent No. 5,476,616 to Schwarz (hereinafter "Schwarz '616") (Ex. 1005) (which is described as an improvement of the multirow meltblown die of Schwarz '570); U.S. Patent No.

6,013,223 to Schwarz (hereinafter “Schwarz ’223”)(Ex. 1002) (described as further improvement on the meltblown apparatus described in Schwarz ’616); U.S. Patent No. 6,114,017 to Fabbicante et al. (hereinafter “Fabbicante”)(Ex. 1018) (describing a modular multirow meltblown die providing parallel air flow for preparing continuous filaments having improved strength and also providing improved meltblown production capacity); and U.S. Patent No. 6,200,120 to Fish et al. (hereinafter “Fish”)(Ex. 1019) (describing a meltblown die having greater throughput and production rate).

46. There are a wide variety of different types of filaments that can be used to prepare a coform nonwoven including meltblown and spunbond filaments. For example, PCT Application Publication No. WO 00/29658 to McDowall (Ex. 1003) describes a coform comprising a blend of thermoplastic filaments and pulp fibers prepared from continuous spunbond filaments or continuous meltblown filaments. Ex. 1003, page 8, lines 1-2 and page 10, lines 1-2.

47. The concept of spunbond fabric production developed in the late 1950s, but it was not until the mid-1960s to the early 1970s that the full commercial potential of the spunbond technology was fully recognized. *See* G S Bhat et al., Polymer-laid web Formation, *Handbook of Nonwovens*, edited by S.J. Russel, Woodhead Publishing Limited, (2007), 149-150 (Ex. 1022). In the spunbond process, a molten thermoplastic material is extruded as filaments from a

plurality of fine, usually circular, capillaries (filament forming holes) of a spinneret, with the filaments then being attenuated and drawn mechanically or pneumatically. The filaments are deposited on a collecting surface to form a web of randomly arranged substantially continuous filaments which can thereafter be bonded together to form a coherent nonwoven fabric. Generally, the spunbond spinneret die includes a plurality of rows of spinning capillaries with each row typically comprising from 50 to 500 spinning capillaries. Spunbond filaments typically have diameters ranging from 15 to 35 μm .

48. In general, spunbond webs are recognized as having greater strength than meltblown webs. One reason for this difference in strength results from the meltblown webs comprising microfibers having average filament diameters less than 10 μm , whereas spunbond webs comprise filaments having diameters greater than 10 μm . As noted in U.S. Patent No. to 7,947,359 to Suzuka et al. (Ex. 1023), fabrics prepared from melt blow spinning exhibit poor mechanical tenacity, such as tensile strength, because the meltblown microfibers have diameters of 5 μm or less. *See* Ex. 1023, column 1, line 65-column 2, line 9.

49. In view of the differences in strength between meltblown webs and spunbond webs, there was a desire to provide stronger meltblown webs. In the case of a wipe prepared from a coform nonwoven, having higher strength filaments is particularly desirable. Higher strength filaments reduce the possibility of “poke-

through,” which refers to the tendency of the users finger to poke through the wipe during use. In addition, higher strength filaments allow the basis weight of the nonwoven to be reduced, which provides further cost savings.

B. Claims of the '801 Patent

50. The '801 Patent has two independent claims (Claims 1 and 25). Independent Claim 1 is directed to a process of making a fibrous structure. Claim 1 includes 6 steps (steps a.-f.). Step a. requires providing a die having one or more filament-forming holes, wherein one or more fluid-releasing holes are associated with one filament-forming holes, and wherein a fluid exiting the fluid-releasing hole contacts an exterior surface of a filament exiting the filament-forming hole at an angle of less than 10°. Step b. recites supplying a first polymer to the die, and step c. recites producing a plurality of filaments comprising the first polymer from the die. Step d. requires supplying a fluid to the die such that the fluid exits the one or more fluid-releasing holes parallel or substantially parallel to the exterior surface of at least one of the filaments, In step e., the filaments are combined with a solid additive to form a mixture, and in step f., the mixture is collected on a collection device to produce a fibrous structure.

51. Claim 25 is substantially identical to Claim 1, with the exception that the first polymer is specified to be a polyolefin, and the solid additive is specified to be wood pulp fibers. Ex. 1001, column 22, lines 46–61.

52. The dependent claims add elements such as reciting that the die comprises two or more rows of filament-forming holes (*Id.*, Claim 2, column 21, lines 44-45); at least one of the rows includes two or more filament-forming holes; (*Id.*, Claim 3, column 21, lines 47-49); types of polymers (*Id.*, Claims 6-13, column 21, line 55-column 22, line 15); types of solid additives (*Id.*, Claims 14-15, column 22, lines 16-19); and additional processing steps (*Id.*, Claims 16-19 and 22-24, column 22, lines 20-45).

VII. Claim Construction

53. I understand that, for purposes of my analysis in this *inter partes* review proceeding, the terms appearing in the patent claims should be interpreted using the same claim construction standard that would be used to construe the claim in the federal courts (as set out in *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312 (Fed. Cir. 2005)), including construing the claim terms in accordance with the ordinary and customary meaning of such claim terms as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent. 37 C.F.R. § 42.100(b). The following terms should be construed:

A. Substantially Parallel

54. Step a. of both independent Claims 1 and 25 require that a fluid exiting the fluid-releasing hole contacts an exterior surface of a filament exiting the filament-forming hole at an angle of less than 10°, while step d. requires supplying

a fluid to the die such that the fluid exits the one or more fluid-releasing holes parallel or substantially parallel to the exterior surface of at least one of the filaments.

55. It is understood that the fluid in step. a. and d. are the same fluid, as step d. provides a fluid to the die, which was defined in step a. Therefore, the angles in step a. and d. are the same angles. As such, for the purposes of interpreting the claims, “substantially parallel” means an angle of less than 10°. Since the fluid referenced in steps a. and d. is the same fluid, the angle at which the fluid contacts the exterior surface of the filaments in steps a. and d. is the same angle. Step d. requires that angle to be “substantially parallel” while step a. requires it to be less than 10°. Ex. 1001, Claims 1 and 25. Since the same angle must be both “substantially parallel” and less than 10°, for the purposes of interpreting the claims, “substantially parallel” must mean an angle of less than 10°.

B. Polypropylene

56. The term “polypropylene” as used in the ’801 Patent, must be a polyolefin because Claim 9 of the ’801 Patent claims a polyolefin that comprises polypropylene. Ex. 1001, Claim 9. Moreover, polypropylene is a particular type of polyolefin.

C. Synthetic Polymer

57. The term “synthetic polymer” as used in the ’801 Patent must include polyolefins, polyesters, and polylactic acids because Claim 7 of the ’801 Patent claims a synthetic polymer selected from the group including polyolefins, polyesters, and polylactic acids. Ex. 1001, Claim 7. Moreover, polyolefins, such as polypropylene, are considered to be a synthetic polymer.

D. Natural Polymer

58. The term “natural polymer” as used in the ’801 Patent (Claims 10-11) must include starch, starch derivatives, cellulose, cellulose derivatives, hemicellulose, hemicellulose derivatives, and mixtures thereof because Claim 11 of the ’801 Patent claims a natural polymer selected from the group consisting of starch, starch derivatives, cellulose, cellulose derivatives, hemicellulose, hemicellulose derivatives, and mixtures thereof. Ex. 1001, Claim 11. Moreover, starches and cellulose are natural polymers.

E. Compostable Polymer

59. The term “compostable polymer” as used in the ’801 Patent must include polylactic acids, polyhydroxyalkanoates, polycaprolactones and mixtures thereof because Claim 13 of the ’801 Patent claims a compostable polymer selected from the group including polylactic acids, polyhydroxyalkanoates, polycaprolactones and mixtures thereof because. Ex. 1001, Claim 13.

F. Post Processing Operation

60. Claims 23 and 24 include a “post processing operation.” The specification of the ’801 Patent does not define “post processing operation,” but gives examples:

The fibrous structures of the present invention and/or any sanitary tissue products comprising such fibrous structures may be subjected to any post-processing operations such as embossing operations, printing operations, tuft-generating operations, thermal bonding operations, ultrasonic bonding operations, perforating operations, surface treatment operations such as application of lotions, silicones and/or other materials and mixtures thereof.

Ex. 1001, column 9, lines 31-38. “Post processing operation” must, therefore, be defined to include tuft-generating, thermal bonding operations, and the application of lotions and other materials or mixtures.

G. Second Polymer

61. The definition of “second polymer” must include the second polymer being the same as the first polymer because Claim 19 of the ’801 Patent, which depends on Claim 17, recites that the first and second polymer are the same. Ex. 1001, Claim 19.

H. Solid Additive Spreader

62. The ’801 Patent defines the term “solid additive spreader” as a device that comingles air with pulp or other solid additives and injects the mixture into the stream of meltblown filaments. Ex. 1001, column 16, lines 9-60.

VIII. Introduction to the Prior Art

63. In this section, I will provide an introduction to each prior art reference.

A. U.S. Patent No. 5,476,616 (“Schwarz ’616”) (Ex. 1005)

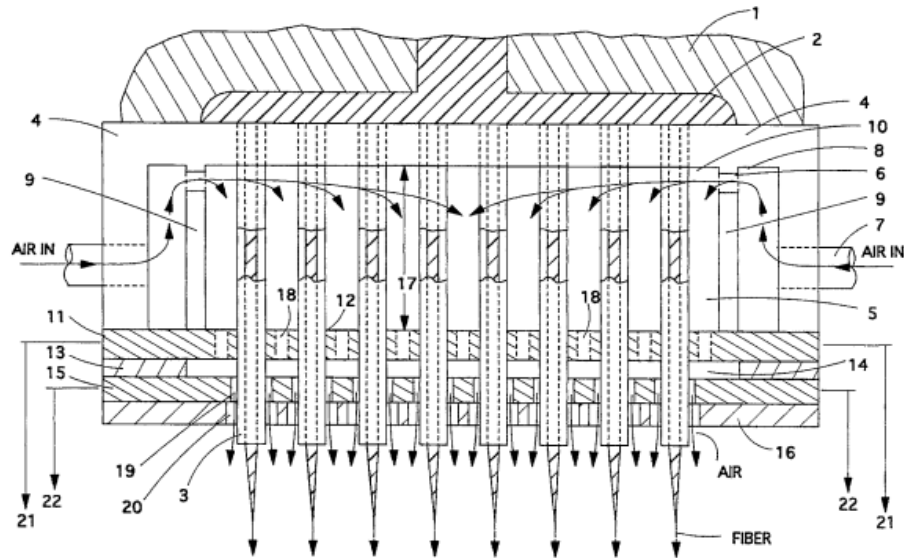
64. United States Patent No. 5,476,616 to Schwarz (“Schwarz ’616”) (Ex. 1005), entitled “Apparatus and Process for Uniformly Melt-Blowing a Fiberforming Thermoplastic Polymer in a Spinnerette Assembly of Multiple Rows of Spinning Orifices,” Schwarz ’616 issued on December 19, 1995.

65. Schwarz ’616 is directed to an apparatus and method for preparing meltblown fibers and nonwovens comprising meltblown fibers. As such, Schwarz ’616 is in the same field of the endeavor or the ’801 Patent.

66. Schwarz ’616 is directed to an improvement of the meltblown die head and the process described in Schwarz ’570. *Id.*, column 1, lines 9-12.

67. Schwarz ’616 describes a multirow meltblown die in which each filament nozzle is concentrically surround by an air orifice. Ex. 1005, abstract.

68. The meltblown die of Schwarz ’616 includes one or more gas cover plates having round holes in which a corresponding filament nozzle is centered. This arrangement can best be seen in Figure 1 of Schwarz ’616, below.

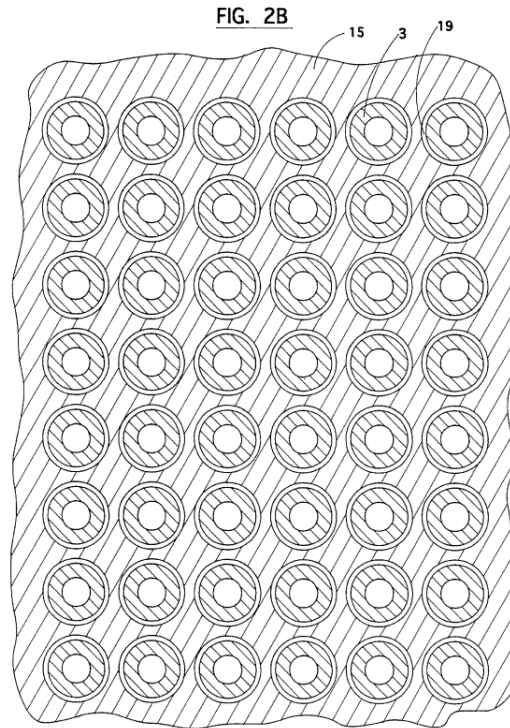


Id., figure 1.

69. In figure 1, the filament nozzles 3 extend through a gas cavity 5, and then through a series of gas cover plates (e.g., plate 11, plate 15, and optional plate 16). *Id.*, column 2, lines 15-52. Each cover plate includes a plurality round holes that are aligned with a corresponding hole in the other cover plates. *Id.* In figure 1, the round holes in gas plate 15 are identified by reference character 19, and the round holes in gas plate 16 are identified by reference character 20. The round holes in gas plate 15 define the air orifices through which air flows parallel to the main axis of the filament nozzles. *Id.*, abstract and column 2, lines 41-46.

70. Figure 2B shows a bottom view of gas cover plate 15 in which each individual filament nozzle 3 is positioned in a round hole 19. An annular space is present between the outer surface of the filament nozzle and the inner surface of

the round hole 19. This space defines an annular shaped gas outlet concentrically surrounding each filament nozzle. *Id.*,



71. During fiber extrusion, a molten polymeric resin is fed via an extruder to supply cavity 2, which in turns supplies the molten polymeric resin to the plurality of filament nozzles 3. *Id.*, column 2, lines 15-19. Gas enters the gas cavity 5 via the air inlet 7 and then flows through gas holes 18 in plate 11 into a second gas cavity 14 and then around the nozzles 3 through holes 19 and 20 in which the nozzles are centered. *Id.*, column 2, lines 41-46. As the gas exits holes 19 and 20, it is flowing parallel to the main axis of the filament nozzles. That is, as the gas exits the holes in the cover plates, the gas is flowing parallel to the filaments as they are extruded from filament nozzles 3. Consequently, the gas

(e.g., air) contacts the surfaces of the filaments as they exit the filament nozzles at an angle that is less than 10°.

72. In the examples disclosed in Schwarz '616, meltblown fibers were prepared comprising polypropylene. *Id.*, column 2, lines 63-67. Polypropylene is a polyolefin and is also considered to be a synthetic polymer.

73. Schwarz '616 states that an object of the invention is to increase productivity and also provide a uniform stream of attenuating gas around each spinning nozzle. *Id.*, column 1, lines 20-28. As discussed previously with respect to Schwarz '570, the multirow meltblown dies have been recognized as breaking the limitation of requiring air from each side of the tapered die tip, and as such, providing increased polymer throughput and productivity without a tremendous capital expense. *See also* Ex. 1011, Zhao.

74. Advantageously, the multirow meltblown die of Schwarz '616 promises higher productivity in comparison to knife-edge meltblown dies having a single row of die openings.

75. Table 1 of Schwarz '616 highlights the improvements obtained with the multirow meltblown die of Schwarz '616. More specifically, the examples of Schwarz '616 shows that higher throughput is achieved by increasing the number of filament nozzles in a given spinneret die by increasing the number of rows of filament nozzles. *Id.*, Table 1.

76. Using the multirow meltblown die parameters set forth in example 3 of Table 1, the production capacity of the meltblown die of Schwarz '616 can be extrapolated to provide an estimated meltblown production capacity of 189 Kg/M_{width}/Hour. In addition, the multirow meltblown die of Schwarz '616 having 8 rows of filament nozzles would have approximately 3,937 filament nozzles per meter width.

77. These values for the multirow meltblown die of Schwarz '616 can be compared to a typical single row meltblown die available in 2007. In 2007, the typical single row meltblown die had 30 Holes Per Inch (HPI), which is equivalent to approximately 1,181 filament nozzles for a die with a width of one meter. (See Ex. 1024, *ITMA 2007 Review: Implications for the Nonwovens Industry*," J. of Engineered Fibers and Fabrics, Vol. 3, Issue 1 (2008), 38-47, 46 – Pourdeyhimi). This would provide an estimated meltblown production capacity of approximately 57 Kg/M_{width}/Hour (based on a polymer throughput of 0.8 grams per hole (gph) per minute as specified in Table 1 of Schwarz '616).

78. Based on these values, the multirow meltblown die of Schwarz '616 is expected to provide more than a 233 percent increase in the number of filament nozzles for the same cross directional die width, and to produce nearly three times the polymer throughput per die in comparison to a single row meltblown die having a filament nozzle density of 30 HPI.

79. Such increases in productivity with a single row meltblown die would have been unachievable given the requirement of converging gas streams for each row of filament nozzles. However, Schwarz '616 solves this problem by providing individual parallel streams of blown air to each filament nozzle. Consequently, the increased number of nozzle filaments per die significantly increases production capacity of the multirow meltblown die of Schwarz '616 in comparison to a typical single row meltblown die.

B. PCT Published Application No. WO 00/29658 (“McDowall”) (Ex. 1003)

80. Entitled “Pulp-Modified Bicomponent Continuous Filament Nonwoven Webs,” McDowall was published May 25, 2000. Ex. 1003, page 1.

81. McDowall is directed to a coform nonwoven and processes of preparing the same. Accordingly, McDowall is in the same field of the endeavor or the '801 Patent.

82. McDowall describes a process of preparing an absorbent nonwoven web comprising a combination of substantially continuous bicomponent thermoplastic filaments and pulp fibers. Ex. 1003, abstract. McDowall states that the continuous filaments may be combined with pulp fibers using a coform process. *Id.*, page 10, lines 1-6. As discussed previously, in the coform process, a solid additive, such as pulp fibers, are comingled with a stream of thermoplastic filaments prior to the mixture of filaments and pulp fibers being deposited on a

collection surface. More specifically, a plurality of filaments are extruded from a die head having multiple die openings (e.g., filament nozzles) to form a filament stream. A stream comprising a gas and a solid additive, such as wood pulp, is introduced into the filament stream at which point the solid additives come in and merge with the filaments in the filament stream. The resulting integrated stream is then deposited onto a collection surface. McDowall describes that the integrated stream of continuous filaments and pulp fibers were deposited onto a web forming conveyor and then subsequently subjected to a step of through-air bonding. *Id.*, page 16, lines 2-6.

83. As described in Anderson, the coform process typically includes entailing the individual pulp fibers in a stream of air which travels through a duct that maintains separation of the individual wood pulp fibers prior to merger of the continuous filaments and pulp fibers. *See*. Ex. 1007, column 3, lines 18-33.

84. In addition, McDowall discloses “thermal point bonding” and teaches that it means passing a fabric or web of fibers to be bonded between a heated calender roll and an anvil roll in order to hold the laminate layers together and impart integrity to each individual layer by bonding filaments and/or fibers within each layer. Ex. 1003, pages 6-7. McDowall further teaches thermal bonding the absorbent nonwoven web using through-air bonding. *Id.*, lines 4-6. Such bonding

typically occurs during manufacture of the absorbent nonwoven composite and is therefore considered a “directly coupled” post processing operation.

85. Notably, McDowall states that the continuous filaments may be, without limitation, spunbonded or meltblown fibers. *Id.*, page 6, lines 1-3. More specifically, McDowall in defining suitable continuous filaments includes the following definition:

The term “substantially continuous filaments of fibers” refers to filaments or fibers prepared by extrusion from a spinnerette, including without limitation spunbonded and meltblown fibers, which are not cut from their original length prior to being formed into a nonwoven web or fabric. Substantially continuous filaments or fibers may have average lengths ranging from greater than about 15 cm to more than one meter, and up to the length of the nonwoven web or fabric being formed. The definition of "substantially continuous filaments or fibers" includes those which are not cut prior to being formed into a nonwoven web or fabric, but which are later cut when the nonwoven web or fabric is cut.

Id., page 6, lines 1-8. In addition, McDowall states that “meltblown fibers used in the present invention are substantially continuous in length. *Id.*, page 4 lines 19-20.

86. Accordingly, McDowall teaches that both meltblown continuous filaments and spunbond continuous filaments may be used interchangeably to prepare McDowall’s absorbent nonwoven. In addition, it is clear that McDowall is not limited to only using spunbond or meltblown filaments, but rather embraces other methods of preparing filaments by extrusion from a spinnerette.

87. McDowall further describes that the thermoplastic continuous filaments may include a wide variety of polymers including polypropylene, such as polypropylene homopolymers and polypropylene copolymers. *Id.*, page 8, lines 20-23; page 18, Claim 4. Polypropylene is a polyolefin and is also considered a synthetic polymer.

88. McDowall further defines pulp fibers to include fibers from natural sources such as woody and non-woody plants. *Id.*, page 4, lines 21-24. McDowall also describes that the pulp fibers may be of high average fiber length (e.g., lengths greater than 1.5 mm), low average fiber length (e.g., lengths less than about 1.5 mm), and mixtures thereof. *Id.*, page 10, lines 10-21.

89. McDowall further describes that the absorbent nonwoven composites can be used in various medical products, which contain alcohol or other disinfectants. *Id.*, page 15, lines 16-18. The conversion of the absorbent nonwoven composite of McDowall into such medical products is normally completed at a separate facility from the manufacturing site and is therefore considered a “closely coupled” post processing operation.

C. U.S. Patent App. Publication No. 2003/0211802 A1 (“Keck”) (Ex. 1004)

90. Entitled Three-Dimensional Coform Nonwoven Web,” Keck was published November 13, 2003. Ex. 1003, page 1.

91. Keck is directed to a coform nonwoven and processes of preparing the same. Accordingly, Keck is in the same field of the endeavor or the '801 Patent.

92. Keck describes a process of preparing a coform nonwoven (a “fibrous structure”) prepared from meltblown filaments and a secondary additive. *Id.*, abstract. Keck describes that the coform nonwoven may be used to form “a presaturated or absorbent cleaning sheet used as a wiper,...” *Id.*, ¶ 0135. More specifically, Keck states that “[c]oform nonwoven webs have been used in applications such as disposable absorbent articles, absorbent dry wipes, wet wipes, wet mops and absorbent dry mops.” *Id.*, ¶ 0006.

93. At paragraph 0036, Keck defines a coform nonwoven as follows:

The term “coform nonwoven web” or “coform material” means composite materials comprising a mixture or stabilized matrix of thermoplastic filaments and at least one additional material, usually called the “second material” or the “secondary material”. As an example, coform materials may be made by a process in which at least one meltblown die head is arranged near a chute through which the second material is added to the web while it is forming. The second material may be, for example, an absorbent material such as fibrous organic materials such as woody and non-wood pulp such as cotton, rayon, recycled paper, pulp fluff; superabsorbent materials such as superabsorbent particles and fibers; inorganic absorbent materials and treated polymeric staple fibers and the like; or a non-absorbent material, such as non-absorbent staple fibers or non-absorbent particles. Exemplary coform materials are disclosed in commonly assigned U.S. Pat. No. 5,350,624 to Georger et al.; U.S. Pat. No. 4,100,324 to Anderson et al.; and U.S. Pat. No. 4,818,464 to Lau et al.; the entire contents of each is hereby incorporated by reference.

Id., ¶ 0036.

94. With reference to Figure 3 of Keck, a pair of extruders 14, 14' feed molten polymer into a pair of corresponding meltblowing dies 16, 18, respectively. *Id.*, ¶ 0084. Each meltblowing die produces a stream of gas that attenuates the filaments as they exit small holes or orifices of the meltblowing die to form a filament containing stream. *Id.*, ¶ 0085. Keck discloses that the stream of gas may comprise air ¶ 0035.

95. The pair of meltblowing dies are configured so that their respective filament streams 26, 28 merge to form a single filament stream at an impingement zone 30. *Id.*, ¶ 0085. A secondary gas stream containing secondary fibers, such as pulp fibers, is directed between the two filament streams at the impingement zone 30. *Id.*, ¶ 0093. The resulting composite stream 56 comprising the merged filament streams and gas stream containing secondary fibers is deposited on a collecting device, such as an endless forming surface 58. *Id.*, ¶ 0097.

96. Keck further discloses that the secondary fibers (solid additives) are conveyed toward the stream of thermoplastic polymer fibers through a nozzle, with a housing that encloses the picker roll and provides a passageway or gap between the housing and the picker roll and that a gas (i.e., air) is supplied to the passageway or gap between the surface of the picker roll and the housing by way of a gas duct. *Id.*, ¶ 0088. The gas is supplied by any conventional arrangement including a blower and is supplied in sufficient quantity to serve as a medium for

conveying the secondary fibers through the nozzle. *Id.* Keck further discloses that it is contemplated that additives and/or other materials may be added to or entrained in the gas stream to treat secondary fibers. *Id.* Keck further discloses a “conventional particulate injection system” (solid additive spreader). *Id.*, ¶¶ 0092, 0108.

97. In addition, Keck defines terms “fibers” to include fibers that are not continuous as well as continuous fibers. *Id.*, ¶ 0033. Keck defines the term “filaments” to be synonymous with the term “substantially continuous filaments.” *Id.*

98. Keck defines the term “meltblown fibers” to mean the following:

fibers formed by extruding a molten thermoplastic material through a plurality of fine, usually circular, die capillaries as molten threads or filaments into converging high velocity, usually hot, gas (e.g. air) streams which attenuate the filaments of molten thermoplastic material to reduce their diameter, which may be to microfiber diameter. Thereafter, the meltblown fibers are carried by the high velocity gas stream and are deposited on a collecting surface to form a web of randomly dispersed meltblown fibers.

Id., ¶ 0034. Notably, Keck further states that “[t]he term “meltblown” is also intended to cover other processes in which a high velocity gas (generally air) is used to aid in the formation of the filaments, such as melt spraying or centrifugal spinning.” *Id.* (emphasis added).

99. Accordingly, Keck teaches a process of preparing a coform nonwoven comprising continuous thermoplastic filaments, and that such filaments

can be prepared with any process that uses high velocity gas to attenuate the continuous filaments.

100. Keck discloses that thermoplastic meltblown filaments comprise a polymer selected from the group consisting of polyolefins, polyesters, polyamides, polycarbonates, polyurethanes, polyvinylchloride, polytetrafluoroethylene, polystyrene, polyethylene terephthalate, polylactic acid and copolymers and blends thereof. *Id.*, ¶ 0052, Claim 8. More specifically, Keck teaches that the meltblown filaments may comprise polyolefins, such as polypropylene. *Id.*, ¶ 0052. Polypropylene is considered a synthetic polymer.

101. In addition to polyolefins, Keck teaches that the meltblown filaments may comprise biodegradable filaments, such as polylactic acids. *Id.*, ¶ 0052.

102. Keck discloses that the secondary material (solid additives) includes fibrous organic materials (fibers) and superabsorbent particles and fibers. *Id.*, ¶ 0003. In particular, Keck teaches that the secondary material (i.e., secondary fibers) of the coform nonwoven may be an absorbent material, such as absorbent fibers. *Id.*, ¶ 0056. Examples of such secondary fibers include cellulosic derived fibers, such as wood pulp fibers. *Id.*

103. Keck also teaches that the meltblown filaments may be monocomponent or multicomponent. *Id.*, ¶ 0055. In particular, Keck discloses “multicomponent fibers” which have been formed from at least two polymers and

that the “polymers are usually different from each other, although conjugate fibers may be prepared from the same polymer.” *Id.*, ¶ 0039.

104. Keck teaches that the coform nonwoven may be subject to a post-processing operation directly following formation of the coform nonwoven. More particularly, Keck discloses that the coform nonwoven may be “pattern bonded,” which is a process of bonding a nonwoven web in a pattern by the application of heat and pressure or other methods, such as ultrasonic bonding. Keck discloses that thermal pattern bonding typically is carried out at a temperature in a range of from about 80 C. to about 180° C. *Id.*, ¶ 0047. Thermal bonding of the coform nonwoven typically occurs during manufacture of the coform nonwoven and is therefore considered a “directly coupled” post processing operation.

105. Keck also describes additional steps (post-processing operations) of depositing the second composite stream onto the deposited layer as a matrix of meltblown filaments and a secondary material to form a two-layer tufted coform nonwoven web. *Id.*, ¶¶ 0015-0018. For example, figure 4 of Keck provides a schematic of an apparatus a system in which a first coform layer is formed on a collection surface from a first composite stream 156, and then a second coform layer formed from a second composite stream 156' is deposited onto the first coform layer. *Id.*, ¶¶ 0100-0110, FIG. 4. In Example 5 of Keck, a two-layer coform nonwoven (fibrous structure) is described in which the meltblown

filaments of both coform nonwoven layers comprise the same polymer. *Id.*, ¶ 0150. In the example, the first coform nonwoven layer was formed and then the second coform nonwoven layer was formed on the first coform nonwoven layer. *Id.* As a consequence, the meltblown filaments of the second coform layer contacted the surface of the first coform layer.

106. The first coform nonwoven layer is formed of meltblown filaments comprising polypropylene resin grade PF-015 available from Basell. *Id.* The second coform nonwoven layer, which was directly deposited on the surface of the first coform layer, was formed of meltblown filaments comprising the same polypropylene grade resin as the meltblown filaments in the first coform layer. *Id.*

107. Keck further describes that the coform nonwoven can be used in the preparation of cleaning sheets, and that the cleaning sheets can be provided in a pre-moistened condition. *Id.*, ¶ 0138. In other words, the cleaning sheets are treated by the application of a liquid or other materials. The conversion of the coform nonwoven of Keck into such cleaning sheets is normally completed at a separate facility from the manufacturing site and is therefore considered a “closely coupled” post processing operation.

D. United States Patent No. 6,013,223 to Schwarz (“Schwarz ’223”) (Ex. 1002)

108. United States Patent No. 6,013,223 to Schwarz (“Schwarz ’223”) (Ex. 1002), entitled “Process and Apparatus For Producing Non-Woven Webs of Strong Filaments,” issued on January 11, 2000.

109. Schwarz ’223 is directed to an apparatus and method for preparing meltblown fibers and meltblown nonwoven webs. Accordingly, Schwarz ’223 is in the same field of the endeavor or the ’801 Patent.

110. Schwarz ’223 patent describes itself as an improvement of the meltblown die system described in Schwarz ’616. Ex. 1002, column 1, lines 7-10.

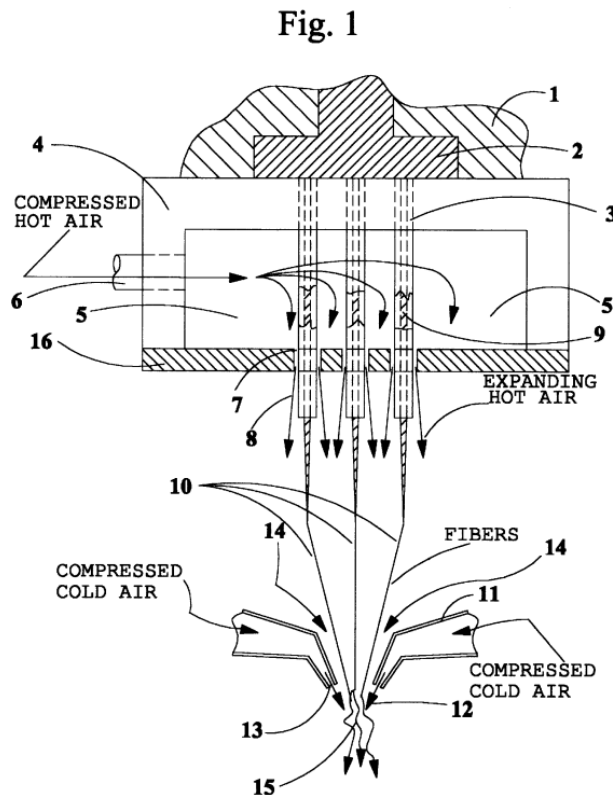
111. Schwarz ’223 further states that objects of the invention provide fibers of high tenacity and to also to provide “unusually high production capacities.” *Id.*, column 1, lines 19-24. As the meltblown die of Schwarz ’223 is similar to that of Schwarz ’616, it would be expected that the meltblown die would have equivalent meltblown filament throughput as taught in Schwarz ’616.

112. Schwarz ’223 teaches an apparatus and method for preparing filaments in which the spinning nozzles are arranged in a plurality of rows with each row containing multiple filament nozzles per row. *Id.*, figure 2, column 2, lines 29-35, 52-54; Claim 1, lines 39-45.

113. Schwarz ’223 includes a multirow meltblown die similar to what is described in Schwarz ’616, and further includes a draw jet positioned below the

filament nozzles. The draw jet, which provides quenching air, is described as being more similar to the spunbond process. *Id.*, column 1, lines 7-12.

114. With reference to figure 1 of Schwarz '223, below, the meltblown die and spinnerette assembly is illustrated.



115. The spinnerette assembly is mounted on die body 1 and includes a polymer supply cavity 2, which feeds molten polymer to a plurality of filament nozzles 3 that are arranged in rows. *Id.*, column 2, lines 29-51. The filament nozzles extend from the die body through gas cavity 5 and protrude through circular holes 7 in which a corresponding filament nozzle is associated. This spinnerette assembly is similar to the meltblown die described in Schwarz '616.

116. Figure 2, which is a partial bottom view of the cover plate 16, shows that the meltblown die includes three or more rows of filament nozzles in which each row includes three or more filament nozzles. Figure 2, column 2, lines 29-35, 52-54; Claim 1, lines 39-45. Indeed, figure 2 of Schwarz '223 explicitly shows multiple rows of filament nozzles with each row containing multiple filament nozzles per row. *Id.*, figure 2.

117. As the filaments are extruded from the filament nozzles, heated gas introduced into gas cavity 5 concentrically surrounds the nozzles and expands outwardly at a high velocity parallel to the nozzles and fiber stream. *Id.*, column 2, lines 39-44. The filaments 10 are then drawn into the draw jet 11 where they are subjected to a high degree of molecular orientation resulting in filaments of high tenacity *Id.*, column 2, lines 45-46; column 1, lines 19-21. The resulting fibers are deposited on a receiver surface to form a nonwoven mat. *Id.*, Claim 5, column 5, lines 34-36.

118. In the Examples of Schwarz '223, meltblown fibers were prepared comprising polypropylene. *Id.*, column 2, lines 65-68. Polypropylene is a polyolefin and is also considered to be a synthetic polymer. Notably, the polypropylene resin used in the examples, had a melt flow rate (MFR) of 400 g/ 10 minutes, which is typical of a meltblown grade polypropylene resin. *Id.*, Table II.

119. The resulting fibers evaluated in Table III exhibited diameters ranging from 5 to 9 micrometers, which is within the typical range of meltblown fiber diameters. *Id.*, Table III.

120. Notably, Schwarz '223 emphasizes that an object of the invention is to provide fibers of high tenacity in addition to the object of achieving high production capacities. *Id.*, column 1, lines 16-21. As discussed previously, fine fibers, such as meltblown fibers, are recognized as having poor strength. *See*, Ex. 1023, column 1, line 65 through column 2, line 9.

E. United States Patent No. 6,783,854 to Bond (“Bond”) (Ex. 1006)

121. United States Patent No. 6,738,854 to Bond (“Bond”) (Ex. 1006), entitled “Bicomponent Fibers Comprising A Thermoplastic Polymer Surrounding a Starch Rich Core” issued on August 31, 2004.

122. Bond is directed to continuous bicomponent fibers that may be used in the preparation of meltblown and spunbond nonwoven fabrics. Accordingly, Bond is in the same field of the endeavor or the '801 Patent.

123. Bond describes bicomponent fibers having a sheath/core configuration in which a non-starch thermoplastic polymer (defining the sheath) surrounds a thermoplastic starch (defining the core). *Id.*, abstract.

124. Bond teaches that the non-starch thermoplastic polymer may be a polyolefin, such as polyethylene or polypropylene. *Id.*, column 3, lines 39-45.

125. Bond states that the thermoplastic starch is a naturally occurring biopolymer. *Id.*, column 4, lines 58-60.

126. Bond provides the following statement with respect to suitable starches:

Suitable naturally occurring starches can include, but are not limited to, corn starch (including, for example, waxy maize starch), potato starch, sweet potato starch, wheat starch, sago palm starch, tapioca starch, rice starch, soybean starch, arrow root starch, bracken starch, lotus starch, cassava starch, high amylose corn starch, and commercial amylose powder. Blends of starch may also be used. Though all starches are useful herein, the present invention is most commonly practiced with natural starches derived from agricultural sources, which offer the advantages of being abundant in supply, easily replenishable and inexpensive in price. Naturally occurring starches, particularly corn starch (including, for example, waxy maize starch), and wheat starch, are starch polymers of choice due to their economy and availability. Modified starch may also be used. Modified starch is defined as non-substituted, or substituted, starch that has had its native molecular weight characteristics changed (i.e. the molecular weight is changed but no other changes are necessarily made to the starch). Molecular weight can be modified, preferably reduced, by any technique numerous of which are well known in the art. These include, for example, chemical modifications of starch by, for example, acid or alkali hydrolysis, acid reduction, oxidative reduction, enzymatic reduction, physical/mechanical degradation (e.g., via the thermomechanical energy input of the processing equipment), or combinations thereof. The thermomechanical method and the oxidation method offer an additional advantage when carried out in situ. The exact chemical nature of the starch and molecular weight reduction method is not critical as long as the average molecular weight is provided at the desired level or range. Such techniques can also reduce molecular weight distribution.

Id., column 5, line 51-column 6, line 15.

127. Bond teaches that the bicomponent filaments may be made with melt spinning processes, and may be used to produce continuous filaments through spunbond methods or meltblowing processes. *Id.*, column 12, line 61-column 13, line 4.

128. Bond further teaches that the nonwovens prepared from the bicomponent fibers may be used in hygiene applications, which includes wipes and diapers. *Id.*, column 14, lines 30-45. In addition, Bond teaches that the nonwovens comprising the thermoplastic starch may be environmentally degradable, and thus flushable. *Id.*, column 10, lines 23-42.

F. United States Patent No. 6,114,017 to Fabbriante (“Fabbriante”) (Ex. 1018)

129. United States Patent No. 6,114,017 to Fabbriante (“Fabbriante”) (Ex. 1018), entitled “Micro-Denier Nonwoven Materials Made Using Modular Die Units” issued on September 5, 2000.

130. Fabbriante is directed to nonwoven webs and processes for their production. Accordingly, Fabbriante is in the same field of the endeavor or the ’801 Patent.

131. Fabbriante describes a modular multirow meltblown die for preparing continuous meltblown filaments. Ex.1018, abstract. Fabbriante teaches that the modular multirow meltblown die produces meltblown webs having equal or superior strength properties to nonwoven fabrics prepared with spunbond

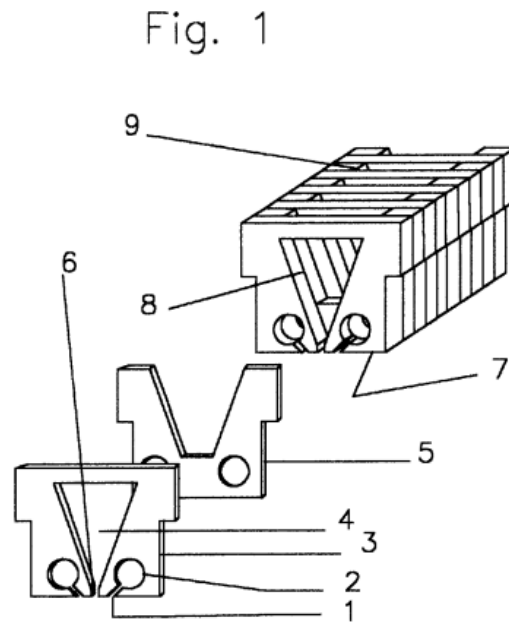
processes. *Id.*, abstract, column 2, lines 7-10. Fabbicante further teaches that the meltblown webs prepared with the modular multirow die also exhibit significantly higher unbonded strength than a typical meltblown web. *Id.*, column 4, lines 1-10.

132. Fabbicante also discloses that the modular multirow meltblown die provides economic advantages. Fabbicante teaches that it is well known in the nonwoven industry that in order to be competitive in meltblowing polymers, a minimum polymer flow rate per die hole must be maintained. *Id.*, column 1, lines 63-67. To meet this minimum polymer flow rate requirement, it may be necessary to use additional dies or beam to produce the nonwovens at a commercially acceptable rate. *Id.*, column 2, lines 1-2. However, traditional meltblown beams are very expensive to produce. *Id.*, column 2, lines 2-7.

133. The multirow meltblown die of Fabbicante provides a solution to this problem. In particular, Fabbicante teaches that because of the “inherent economies of manufacture,” the modular meltblown die allows multiple rows of die holes without high capital costs. *Id.*, column 3, lines 11-14. Notably, Fabbicante discloses that the cost of manufacture of the modular meltblown die is about 10 to 20% of the cost of an equivalent die, in which the die block is traditionally machined. *Id.*, column 3, lines 6-9.

134. In other words, Fabbriante's modular meltblown die provides for higher polymer throughputs without the significant capital expense typically associated with machining a traditional meltblown die.

135. As shown in figure 1, below, the modular meltblown die comprises a series of alternating primary plates 3 and secondary plates 5. *Id.*



Id., figure. 1. Both the primary plates 3 and secondary plates 5 include a central cut-out portion 4 that, when the modular meltblown die is assembled, defines a central cavity 8 that extends laterally along the length of the meltblown die. *Id.* In addition, both the primary and secondary plates also include a pair of circular gas cut-outs 2 formed on opposite sides of the plates. When assembled, the cut-outs 2 are in fluid communication with the cut-outs of adjacent plates and thereby define a pair of gas cavities that extend laterally along the length of the die. *Id.*

136. The primary plate 3 further includes a polymer orifice 6 (filament die holes) on the bottom of the primary plate that is in fluid communication with the central cut-out portion 4 of the plate. A pair of air nozzles 1 are disposed in a flanking position on opposite sides of each of the polymer orifices 6 and extend from the gas cut-outs to the bottom of the primary plate 3. *Id.*, column 5, lines 24-48.

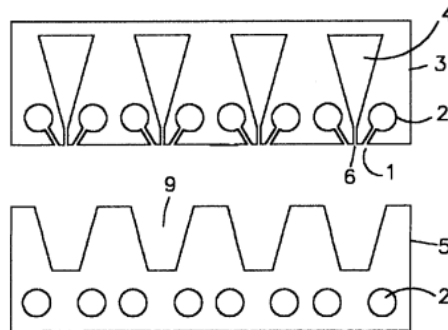
137. The air nozzles are capable of producing a stream of high velocity air. The angle formed between the axis of the polymer orifices and the air nozzles varies between 0° and 60°. *Id.*, column 3, lines 58-62. When the angle is 0°, the air flows parallel to the filaments as they are extruded from the polymer orifices. The resulting filaments are continuous and have diameters ranging in the 0.6 to 8 micron range. *Id.*, column 3, lines 36-42.

138. In operation, molten polymeric resin is forced into central cavity 8 from which it flows outwardly from polymer orifices 6 to form fibers. Pressurized air is fed into the pair of gas cavities and then exits the air nozzles at which point the air, which is travelling at high velocities, attenuates the polymer streams exiting from the polymer orifices 6 to form continuous filaments. *Id.*, column 5, lines 24-48.

139. The modular die of figure 1 includes a single row of polymer orifices (filament-forming holes). However, figure 2 shows a primary plate 3 and

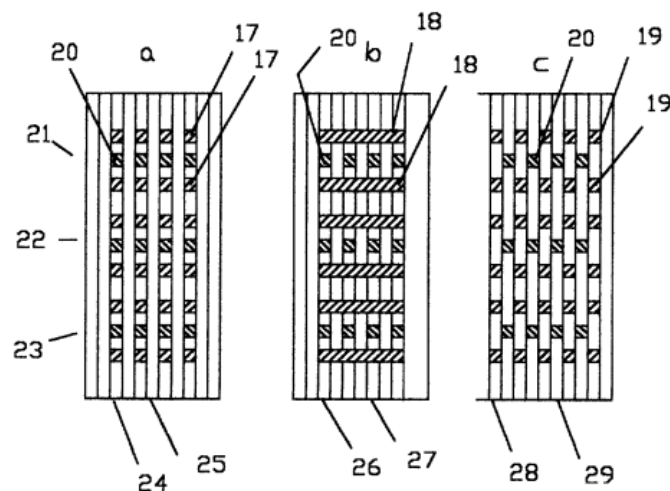
secondary plate 5 that when assembled provides a modular multirow meltblown die having at least four rows of polymer orifices 6. *Id.*, figure 2, column 5, lines 49-51.

Fig. 2



Id., figure 2. Figure 3, below, is a plan view that depicts three different assembled die bodies comprising a plurality of primary plates and secondary plates in an assembled state.

Fig. 3



Id., figure 3. In the assembled die body a, the assembled die includes 3 rows of polymer orifices 20 in which each row includes at least 4 polymer orifices, and in which each individual polymer orifice is flanked on opposing sides by a pair of the air nozzles 17. *Id.*, figure 3, column 5, lines 53-65.

140. Fabbriante further describes an embodiment in which the air nozzles are positioned adjacent to the polymer orifices and that the air nozzles produce a curtain of air on both sides of, and parallel, to the polymer fibers as they are extruded from the polymer orifices. *Id.*, Claim 15. In addition, Fabbriante teaches that the high-speed air curtains attenuate the fibers to form a plurality of continuous filaments from each row on the die. *Id.* The resulting filaments are deposited on a collecting means. *Id.* For example, Fabbriante describes that the filaments may be collected on a collection device, such as a porous cylinder or a continuous screen. *Id.*, column 7, lines 10-12.

141. Fabbriante also teaches that the high-speed air curtains may be separated from high-speed curtains of adjacent polymer orifices by plates positioned perpendicular to the surface of the die and parallel to the rows of fiber outlets. *Id.*, Claim 16, column 12, lines 19-24. In other words, the plates isolate individual polymer orifices from high-speed air curtains created by the air nozzles on adjacent plates. In this way, each individual fiber outlet is associated with only a single pair of air nozzles.

142. Fabbriante further teaches that the web of meltblown filaments may be thermally bonded, such as with hot calendaring techniques. *Id.*, column 3, lines 20-24.

143. In the examples, Fabbriante prepared meltblown nonwoven webs using polypropylene resin. *Id.*, column 8, lines 12-14. Polypropylene is a polyolefin and is also considered a synthetic polymer.

144. Fabbriante does describe that liquid barrier properties are an important feature of the web produced using the modular meltblown dies as evidenced by the hydrohead values provided in the examples. *Id.*, column 4, lines 13-17, tables 1 and 2. It should be recognized that a nonwoven web comprising polypropylene meltblown fibers would be inherently hydrophobic and exhibit water barrier properties as polypropylene is hydrophobic. However, Fabbriante further teaches that the meltblown webs prepared with the modular meltblown die may also be used in products, such as diapers, feminine hygiene products, wipers, and other related products that are considered absorbent in nature. *Id.*, abstract.

145. Fabbriante further teaches that the meltblown web may be used in combination with cellulose fibers. *Id.*, column 7, lines 60-66. In particular, Fabbriante teaches that the meltblown layer may be a single layer or may be combined with other layers to form:

a multi-layer laminate wherein the layers are composed of any combination of the instant invention plus films, woven fabrics, metallic

foils, unbonded webs, cellulose fibers, paper webs both bonded and debonded, various other nonwovens, and similar suitable webs suitable for laminating.

Id., column 7, lines 60-66. Fabbicante further teaches that the layers of the multi-layer laminate may include cellulose fibers, which means that the cellulose fibers may be mixed with the meltblown filaments of Fabbicante's meltblown web, in the layers that are in addition to Fabbicante's meltblown web, or in both.

146. As Fabbicante describes that the meltblown web may be used in wiper applications, and that it may be used in combination with cellulose fibers, it would be desirable to use cellulose fibers in combination with Fabbicante's meltblown filaments in order for the resulting article to function effectively as a wiper.

G. United States Patent Application Publication No. 2007/0202766 to Ouellette et al. ("Ouellette") (Ex. 1029)

147. United States Patent Application Publication No. 2007/0202766 to Ouellette et al. ("Ouellette") (Ex. 1029), entitled "Low Density Cleaning Substrate" published on August 30, 2007, and was filed on February 24, 2006. Ouellette qualifies as pre-AIA prior art to the '801 Patent under 35 U.S.C. § 102(e)(1).

148. Ouellette is directed to a cleaning substrate comprising a nonwoven material, such as a meltblown or coform. Accordingly, Ouellette is in the same field of the endeavor or the '801 Patent.

149. Ouellette is directed towards a nonwoven substrate that is particularly useful as a cleaning wipe. Ex. 1029, ¶¶ 0017, 0020. The nonwoven substrate has an optimized pore volume distribution in which at least 50 percent of the cumulative volume within the pores have a radius size of about 110 to 250 microns. *Id.*, abstract. Ouelette teaches that the optimized pore volume distribution of the substrate enables it to controllably release a fluid composition effectively onto a surface. *Id.*

150. Ouellette teaches that the substrate is a nonwoven material which may comprise a spunbond, meltblown, or coform nonwoven among others. *Id.*, ¶ 0019. Ouellette further teaches that the meltblown fibers may be continuous or discontinuous. *Id.*, ¶ 0041. Ouelette teaches that “the fibrous web or substrate may comprise natural fibers, synthetic fibers, polypropylene, polyethylene, polyester, PET, wood pulp, regenerated cellulose nylon, cotton, bicomponent fibers, continuous fibers, and combinations thereof...”. *Id.*, ¶ 0058.

IX. Elements of the '801 Patent in the Prior Art

151. In this section, I will discuss each ground of invalidity and how each of the prior art references that I introduced above exemplifies elements of the '801 Patent claims.

Ground 1: Claims 1-3, 5-9, and 12-25 are obvious under 35 U.S.C. §103 based on the teachings of U.S. Patent No. 6,013,223 to Schwarz ("Schwarz '223") (Ex. 1002) and U.S. Patent App. Publication No. 2003/0211802 A1 to Keck ("Keck") (Ex. 1004).

Independent claims 1 and 25

152. Schwarz '223 explicitly discloses all but one element of independent Claims 1 and 25 of the '801 Patent. The remaining element – combining the filaments with solid additives (wood pulp) to form a mixture – was well known in the art and would have been obvious to a POSA based on Schwarz's disclosures in light of the teachings of Keck. An element-by-element analysis follows:

Preamble: A process for making a fibrous structure, the process comprising the steps of:

153. Schwarz '223 teaches a process for making a fibrous structure. Ex. 1002, abstract, Claim 1.

Element 1a: providing a die comprising one or more filament-forming holes, wherein one or more fluid-releasing holes are associated with one filament-forming hole such that a fluid exiting the fluid-releasing hole contacts an exterior surface of a filament exiting the filament-forming hole at an angle of less than 10°

154. Schwarz '223 discloses a die body (Ex. 1002, column 2, line 31) through which pressurized hot air is blown out of holes (fluid releasing holes)

around each spinning nozzle (filament-forming hole) at a high velocity parallel (angle of less than 10°) to the fibers. Ex. 1002, column 1, lines 58-60; column 2, lines 30-35; figures 1, 2. As the hot air is blown parallel to the spinning nozzles, and hence, parallel to the filaments as they are extruded from the spinning nozzles, the hot air necessarily contacts an exterior surface of the filament as it exits the spinning nozzles at an angle of less than 10°.

155. Thus, Schwarz '223 discloses contacting the surface of the filament as it exits the spinning nozzle at an angle of less than 10° and therefore discloses this element.

Element 1b (Claim 1): supplying at least a first polymer to the die

Element 1b (Claim 25): supplying a polyolefin polymer to the die

156. Schwarz '223 discloses both these elements of Claims 1 and 25. Schwarz '223 discloses supplying thermoplastic fiber-forming polymer melt (first polymer) to a supply cavity in a die body (die). Ex. 1002, column 2, lines 30-32. More particularly, Schwarz '223 discloses supplying polypropylene (first polymer) to the die body (die). Ex. 1002, column 2, line 65. Polypropylene is a particular type of polyolefin. This must be true because dependent Claim 9 of the '801 Patent claims a polyolefin that comprises polypropylene.

157. Accordingly, Schwarz '223 teaches both these elements of Claims 1 and 25.

Element 1c: producing a plurality of filaments comprising the first polymer from the die

158. Schwarz '223 discloses producing strong filaments (Ex. 1002, column 1, lines 10-12) by supplying thermoplastic fiber-forming polymer (first polymer) to a supply cavity on a die body (die). Ex. 1002, column 2, lines 30-39.

159. Thus, Schwarz' 223 also teaches this element of Claims 1 and 25.

Element 1d: supplying a fluid to the die such that the fluid exits the one or more fluid-releasing holes parallel or substantially parallel to the exterior surface of at least one of the filaments

160. Schwarz '223 discloses a die body (Ex. 1002, column 2, line 31) through which pressurized hot air (fluid) is blown out of holes (fluid releasing holes) around each spinning nozzle (filament-forming hole) at a high velocity parallel to the fibers (filaments). Ex. 1002, column 1, lines 58-60; column 2, lines 30-35; figures 1, 2. As discussed previously, the hot air is blown through the holes (fluid-releasing holes) parallel to the spinning nozzles, and therefore the air (i.e., fluid) exits the holes parallel to the surface of the filaments as they are extruded from the spinning nozzles.

161. Accordingly, Schwarz '223 discloses this element of Claim 1.

Element 1f: collecting the mixture on a collection device to produce a fibrous structure.

Schwarz '223 discloses collecting said fibers on a receiver surface (collection device) to form a nonwoven mat (fibrous structure). Ex. 1002, Claim 1, column 5, lines 34-36.

162. Thus, Schwarz '223 teaches the step of collecting the mixture on a collection device, and therefore discloses this element.

Element 1e (Claim 1): combining the filaments with solid additives to form a mixture

Element 1e (Claim 25): combining the filaments with wood pulp fibers to form a mixture

163. This is the only element of independent claims 1 and 25 that is not explicitly disclosed in Schwarz '223. But adding solid additives, or specifically wood pulp fibers, to polymer filaments to form a mixture has been long known in the art (referred to as coform), and is explicitly disclosed in Keck (and many other prior art references known at the time).

a. Motivation to Combine

164. Prior to the patent owner's earliest possible priority date (July 17, 2007), a POSA would have been motivated to modify Schwarz '223 in view of Keck in order to provide a coform nonwoven having lower costs and exhibiting improved strength.

165. More specifically, a POSA would have known that the multirow meltblown die taught in Schwarz '223 provides significant improvements with

respect to throughput, and hence, productivity. As a consequence, the costs associated with manufacturing the coform nonwoven per unit would be decreased, which would improve the manufacturer competitiveness in the market and potentially provide a greater return on investment.

166. In addition, a POSA would be motivated to modify Schwarz '223 in view of Keck in order to improve the strength of the coform nonwoven. Schwarz '223 explicitly states that the fibers prepared therein have improved tenacity. As such, a POSA would have been motivated to modify Schwarz '223 in view of Keck to provide a coform nonwoven having improved strength.

167. Accordingly, the combination of Schwarz '223 and Keck teaches each and every element of independent Claims 1 and 25.

b. Reasonable Expectation of Success

168. A POSA would have had a reasonable expectation of success in modifying Schwarz '223 in use in a coform process as described in Keck. The simple substitution of a multirow meltblown die in lieu of a knife-edge meltblown die in the coform process would be within the routine skill of the POSA and such a substitution would not result in the coform process of Keck being inoperable.

Claim 2

The process according to Claim 1, wherein the die comprises two or more rows of filament-forming holes

169. Beyond the elements of Claim 1, Claim 2 adds an element that the die comprises two or more rows of filament-forming holes. As can explicitly be seen in figure 2 of Schwarz '223, the die body includes multiple rows of nozzle (filament-forming holes) in which each row comprises a plurality of nozzles. Ex. 1002, column 2, lines 29-35 52-54; figure 2; Claim 1 (column 5, lines 39-45)(“multiplicity of nozzles arranged in at least two rows”).

170. Thus, Schwarz '223 in combination with Keck discloses each and every element of Claim 2.

Claim 3

The process according to Claim 2 wherein at least one row of filament-forming holes comprises two or more filament-forming holes

171. Beyond the elements of Claim 2, Claim 3 adds an element that at least one row of filament forming holes comprise two or more filament-forming holes. Again, figure 2 of Schwarz '223 shows that the die body includes multiple rows of nozzle (filament-forming holes) in which each row comprises a plurality of nozzles. Ex. 1002, column 2, lines 29-35,52-54; figure 2; Claim 1 (column 5, lines 39-45)(“multiplicity of nozzles arranged in at least two rows”).

172. Thus, Schwarz '223 in combination with Keck discloses each and every element of Claim 3.

Claim 5

The process according to Claim 1 wherein one fluid-releasing hole is concentrically positioned around one filament-forming hole

173. Schwarz '223 discloses multiple rows of nozzles (filament-forming holes) sticking through the round holes (which are concentrically positioned around fluid-releasing holes). Ex 1002, column 2, lines 51-54. Further, figure 2 of Schwarz '223 shows that the filament nozzle is centered in the round holes, which means that the round hole concentrically surrounds the filament nozzle.

174. Thus, Schwarz '223 in combination with Keck discloses each and every element of Claim 5.

Claim 6

The process according to Claim 1 wherein the first polymer comprises a synthetic polymer

175. Schwarz '223 explicitly discloses using polypropylene. Ex. 1002, column 2, line 65. Polypropylene is a synthetic polymer.

176. Accordingly, Schwarz '223 in combination with Keck discloses each and every element of Claim 6.

Claim 7

The process according to claim 6 wherein the synthetic polymer is selected from the group consisting of: polyvinyl alcohol, polyvinyl alcohol derivatives, polyesters, nylons, polyolefins, polylactic acids, polyhydroxyalkanoates, polycaprolactones and mixtures thereof

177. Schwarz '223 explicitly discloses using polypropylene. Ex. 1002, column 2, line 65. Polypropylene is a polyolefin. Further, Keck also discloses

that the continuous filaments may comprise a polyolefin, such as polypropylene, Ex. 1004, ¶ 0052.

178. Accordingly, Schwarz '223 in combination with Keck discloses each and every element of Claim 7.

Claim 8

The process according to claim 7 wherein the synthetic polymer comprises a polyolefin

179. Schwarz '223 explicitly discloses using polypropylene. Ex. 1002, column 2, lines 65. Polypropylene is a polyolefin.

180. Thus, combination of Schwarz '223 and Keck discloses each and every element of Claim 8.

Claim 9

The process according to claim 8 wherein the polyolefin comprises polypropylene

181. Schwarz '223 explicitly discloses using polypropylene. Ex. 1002, column 2, lines 65. Polypropylene is a polyolefin.

182. Accordingly, the combination of Schwarz '223 and Keck discloses each and every element of Claim 9.

Claim 12

The process according to Claim 1 wherein the first polymer comprises a compostable polymer

183. The term “compostable polymer” as used in Claim 12 of the ’801 Patent must include polylactic acids, polyhydroxyalkanoates, polycaprolactones and mixtures thereof because Claim 13 claims a compostable polymer selected from the group including polylactic acids, polyhydroxyalkanoates, polycaprolactones and mixtures thereof because. Ex. 1001, Claim 13 (emphasis added).

184. Keck discloses that thermoplastic meltblown filaments comprise a polymer selected from the group consisting of polyolefins, polyesters, polyamides, polycarbonates, polyurethanes, polyvinylchloride, polytetrafluoroethylene, polystyrene, polyethylene terephthalate, polylactic acid and copolymers and blends thereof. Ex. 1004, Claim 8 (emphasis added).

185. Since Keck discloses filaments (first polymer) made from polylactic acid, and the ’801 Patent teaches that polymers made from polylactic acids are compostable, Keck explicitly discloses a first polymer comprising a compostable polymer as claimed in Claim 12 of the ’801 Patent.

186. Accordingly, Schwarz ’223 in combination with Keck teaches every element of Claim 12.

Claim 13

The process according to claim 12 wherein the compostable polymer is selected from the group consisting of: polylactic acids, polyhydroxyalkanoates, polycaprolactones and mixtures thereof

187. Again, Keck discloses that thermoplastic meltblown filaments comprise a polymer selected from the group consisting of polyolefins, polyesters, polyamides, polycarbonates, polyurethanes, polyvinylchloride, polytetrafluoroethylene, polystyrene, polyethylene terephthalate, polylactic acid and copolymers and blends thereof. Ex. 1004, Claim 8.

188. Accordingly, the combination of Schwarz '223 and Keck teaches each and every element of Claim 13.

Claim 14

The process according to claim 1 wherein the solid additives comprise fibers

189. Keck discloses that the secondary material (solid additives) includes fibrous organic materials (fibers) and superabsorbent particles and fibers. Ex. 1004, ¶ 0003.

190. Accordingly, the combination of Schwarz '223 and Keck teaches every element of Claim 14.

Claim 15

The process according to claim 14 wherein the fibers comprise wood pulp fibers

191. Keck discloses that the secondary material (solid additives) includes fibrous organic materials such as woody and non-wood pulp. Ex. 1004, ¶ 0003.

192. Accordingly, the combination of Schwarz '223 and Keck teaches every element of Claim 15.

Claim 16

The process according to claim 1 wherein the solid additives are combined with the plurality of filaments by a solid additive spreader

193. Keck teaches that the secondary fibers (solid additives) are introduced into a secondary gas stream via an apparatus having a housing that encloses a picker roll and is in communication with a nozzle, in which the stream of secondary fibers are entrained and subsequently introduced into the filament containing streams. Ex. 1004, ¶¶ 0088-0089. More specifically, Keck discloses that the secondary fibers (solid additives) are conveyed toward the stream of thermoplastic polymer fibers through a nozzle, with a housing that encloses the picker roll and provides a passageway or gap between the housing and the picker roll and that a gas (i.e. air) is supplied to the passage way or gap between the surface of the picker roll and the housing by way of a gas duct. Ex. 1004, ¶ 0088. The gas is supplied by any conventional arrangement including a blower and is supplied in sufficient quantity to serve as a medium for conveying the secondary fibers through the nozzle. *Id.* Keck further discloses that it is contemplated that additives and/or other materials may be added to or entrained in the gas stream to treat secondary fibers. *Id.* Keck further discloses a “conventional particulate injection system” (solid additive spreader). Ex. 1004, ¶¶ 0092, 0108.

194. Accordingly, the combination of Schwarz '223 and Keck teaches every element of Claim 16.

Claim 17

The process according to claim 1 wherein the process further comprises the step of: [17g] contacting a surface of the fibrous structure with a plurality of filaments comprising a second polymer

195. Keck discloses preparing a two layer coform structure (two layered fibrous structure) in which a second coform layer is formed directly on the first coform layer. Ex. 1004, ¶ 0150. This would necessarily result in the filaments of the second coform layer contacting a surface of the first coform layer (fibrous structure). Keck further describes that the meltblown filaments of both coform layers comprise the same polypropylene resin. *Id.* The definition of “second polymer” must include the second polymer being the same as the first polymer because Claim 19 of the '801 Patent, which depends on Claim 17, recites that the first and second polymer are the same. Ex. 1001, Claim 19.

196. Accordingly, the combination of Schwarz '223 and Keck teaches every element of Claim 17.

Claim 18

The process according to claim 17 wherein the plurality of filaments comprising the second polymer are in the form of a fibrous structure

197. Keck discloses that the second layer is a coform nonwoven (fibrous structure) comprised a mixture of thermoplastic filaments and wood pulp fibers (solid additive). Ex. 1004, ¶ 0150.

198. Accordingly, the combination of Schwarz '223 and Keck teaches every element of Claim 18.

Claim 19

The process according to claim 17 wherein the second polymer is the same as the first polymer

199. Keck discloses in example 5 that the filaments of the first coform layer and the filaments of the second coform layer both comprise the same grade polypropylene resin.

200. Accordingly, the combination of Schwarz '223 and Keck teaches every element of Claim 19.

Claim 20

The process according to claim 1 wherein the fluid released by the fluid-releasing holes comprises air

201. Schwarz '223 discloses that the gas released through the holes (fluid releasing holes) in the cover plate is air. Ex. 1002, column 2, lines 29-51. Keck further discloses “fibers formed by extruding a molten thermoplastic material through a plurality of fine, usually circular, die capillaries as molten threads or filaments into converging high velocity, usually hot, gas (e.g. air) streams which

attenuate the filaments of molten thermoplastic material to reduce their diameter, which may be to microfiber diameter.” Ex. 1004, ¶ 0035.

202. Accordingly, the combination of Schwarz ’223 and Keck teaches every element of Claim 20.

Claim 21

The process according to claim 1 wherein the fibrous structure exhibits a pore volume distribution such that greater than about 40% of the total pore volume present in the fibrous structure exists in pores of radii of from about 121 um to about 200 um

203. The ’801 Patent discloses that the spinnerette used in the examples of preparing the claimed fibrous structure was obtained from Biax-Fiberfilm Corporation (“Biax”). Ex. 1001, column 15, lines 60-63. Notably, Schwarz ’223 was assigned to Biax-Fiberfilm Corporation. Ex. 1002, page 1.

204. Thus, it appears that the examples in the ’801 Patent were prepared with the same or similar meltblown die described in Schwarz ’223. Given the similarities between the Biax meltblown die described in the ’801 Patent and that of Schwarz ’223, it is reasonable to expect that a coform nonwoven prepared based on the combination of Schwarz ’223 and Keck would have the same properties. That is, it would be expected that a process of preparing a coform nonwoven using the meltblown die of Schwarz ’223 in combination with the solid additive process of Keck would produce a coform nonwoven having a pore volume distribution

such that greater than about 40% of the total pore volume present in the fibrous structure exists in pores of radii of from about 121 um to about 200 um.

205. Moreover, it is well known that pore size, and hence pore size distribution, in meltblown webs varies depending on process conditions, such as processing temperatures, increasing air flow rate at the die, and decreasing the distance between the filament nozzles and the collection surface, and the speed of the collection surface. See, Bresee et al., *Influence of Processing Conditions on Melt blown Web Structure: Part 1 – DCD*, INJ Spring 2004, 49-55 (Ex. 1025); Bresee et al., *Influence of Processing Conditions on Melt Blown Web Structure: Part 2 – Primary Airflow Rate*, INJ Summer 2005, 11-18 (Ex. 1026); and Lee et al. *Effects of Melt-Blowing Process Conditions on Morphological and Mechanical Properties of Polypropylene Webs*, POLYMER 1992, Vol. 3, No. 6, 1200-1209 (Ex. 1027). For example, changing one or more of the process parameters by increasing the air flow rate, decreasing the distance between the collection surface and filament nozzles, or increasing the speed of the collection surface is well known to decrease pore size in the meltblown web. Similarly, decreasing air flow rate, increasing the distance between the collection surface and filament nozzles, or decreasing the speed of the collection surface is well known to increase pore size in the meltblown web. As such, it is reasonable to expect that obtaining a coform nonwoven having the recited pore distribution is well within the routine skill of a

POSA, and that doing such is merely an optimization of known parameters that affect pore size distribution.

206. Accordingly, the combination of Schwarz '223 and Keck teaches every element of Claim 21.

Claim 22

The process according to claim 1 wherein the process further comprises the step of subjecting the fibrous structure to a thermal bonding operation

207. Keck discloses “pattern bonded” which is a process of thermal bonding a nonwoven web in a pattern by the application of heat and pressure or other methods, such as ultrasonic bonding. Keck discloses that thermal pattern bonding typically is carried out at a temperature in a range of from about 80 C. to about 180° C. Ex. 1004, ¶ 0047. Keck also discloses that due to the fact that thermoplastic polymer fibers are usually semi-molten and tacky at the time of incorporation of the secondary fibers, the secondary fibers are thermally bonded or joined to the thermoplastic polymer fibers. Ex. 1004, ¶ 0109.

208. Accordingly, the combination of Schwarz '223 and Keck teaches every element of Claim 22.

Claim 23

The process according to claim 1 wherein the process is directly coupled to a post-processing operation

209. Keck discloses “pattern bonded” which is a process of bonding a nonwoven web in a pattern by the application of heat and pressure or other methods, such as ultrasonic bonding. Keck discloses that thermal pattern bonding typically is carried out at a temperature in a range of from about 80 C. to about 180° C. Ex. 1004, ¶ 0047. The ’801 Patent expressly discloses that post-processing operations as that term is used in the ’801 Patent includes thermal bonding operations. Ex. 1001, column 9, lines 31-38. Keck also describes additional steps (post-processing operations) of depositing the second composite stream onto the deposited layer as a matrix of meltblown filaments and a secondary material to form a two layer tufted coform nonwoven web. Ex. 1004, ¶ 0015-0018. The ’801 Patent expressly discloses that post-processing operations as that term is used in the ’801 Patent includes tuft-generating operations. Ex. 1001, column 9, lines 31-38.

210. Thermal bonding, such as the “pattern bonded” process described in Keck and the tufting-generating step are typically performed during the manufacturing process of the nonwoven web, and are therefore considered as being “directly coupled to a post-processing operation.”

211. Accordingly, the combination of Schwarz ’223 and Keck teaches every element of Claim 23.

Claim 24

The process according to claim 1 wherein the process is closely coupled to a post-processing operation

212. Keck discloses “pattern bonded” which is a process of bonding a nonwoven web in a pattern by the application of heat and pressure or other methods, such as ultrasonic bonding. Keck discloses that thermal pattern bonding typically is carried out at a temperature in a range of from about 80 C. to about 180° C. Ex. 1004, ¶ 0047. The ’801 Patent expressly discloses that post-processing operations as that term is used in the ’801 Patent includes thermal bonding operations. Ex. 1001, column 9, lines 31-38. Keck also describes additional steps (post-processing operations) of depositing the second composite stream onto the deposited layer as a matrix of meltblown filaments and a secondary material to form a two layer tufted coform nonwoven web. Ex. 1004, ¶¶ 0015-0018. The ’801 Patent expressly discloses that post-processing operations as that term is used in the ’801 Patent includes the application of lotions and mixtures. Ex. 1001, column 9, lines 31-38.

213. In addition, Keck describes preparation of cleaning sheets using the nonwoven web. Such cleaning sheets may include treatment with a liquid or other materials Ex. 1004, ¶¶ 0137-0140. The conversion of Keck’s nonwoven web into such treated cleaning sheets typically occurs at a separate facility from that of manufacture of the nonwoven web and is therefore considered a “closely coupled” post processing operation.

214. Accordingly, the combination of Schwarz '223 and Keck teaches every element of Claim 24.

Ground 2: Claims 1-3, 5-9, and 12-25 are obvious under 35 U.S.C. §103 based on the teachings of U.S. Patent No. 5,476,616 to Schwarz ("Schwarz '616") (Ex. 1002) and U.S. Patent App. Publication No. 2003/0211802 A1 to Keck ("Keck") (Ex. 1004).

Independent claims 1 and 25

215. Schwarz '616 teaches an apparatus and process for meltblowing fiberforming thermoplastic polymers to form fine fibers by extruding through spinning nozzles arranged in four or more rows. Ex. 1005, abstract. The molten fibers are accelerated to high velocity by gas being blown in parallel flow through small circular gas orifices surrounding each nozzle. *Id.* The air orifices are formed by a family of plates which affect the perfect centering of each nozzle in each of the circular air orifices. *Id.*

216. Schwarz '616 explicitly discloses all but one element of independent claims 1 and 25 of the '801 Patent. The remaining element – combining the filaments with solid additives (wood pulp) to form a mixture – would have been obvious to a POSA based on Schwarz '616's disclosures in light of the teachings of Keck. An element-by-element analysis follows:

Preamble: A process for making a fibrous structure, the process comprising the steps of:

217. Schwarz '616 teaches a process for making a fibrous structure. Ex. 1005, abstract, Claim 5.

Element 1a: providing a die comprising one or more filament-forming holes, wherein one or more fluid-releasing holes are associated with one filament-forming hole such that a fluid exiting the fluid-releasing hole contacts an exterior surface of a filament exiting the filament-forming hole at an angle of less than 10°

218. Schwarz '616 discloses this element, providing a die body 1 (die) comprising spinning nozzles 3 (filament-forming holes), wherein gas cavity 5 (fluid-releasing holes) are associated with spinning nozzles 3 (filament-forming holes) such that a fluid exiting the gas cavity 5 (fluid-releasing holes) is parallel or substantially parallel to an exterior surface of a filament exiting the spinning nozzles 3 (filament-forming holes). Ex. 1005, column 2, lines 15-52, Claim 5, figure 1, figure 2A, figure 2B. As the hot air is blown parallel to the spinning nozzles, and hence, parallel to the filaments as they are extruded from the spinning nozzles, the hot air necessarily contacts an exterior surface of the filament as it exits the spinning nozzles at an angle of less than 10°.

219. Thus, Schwarz '616 discloses contacting the surface of the filament as it exits the spinning nozzle at an angle of less than 10° and therefore discloses this element.

Element 1b (Claim 1): supplying at least a first polymer to the die

Element 1b (Claim 25): supplying a polyolefin polymer to the die

220. Schwarz '616 discloses both these elements of Claims 1 and 25.

Schwarz '616 discloses supplying thermoplastic fiber-forming polymer melt (first polymer) to a supply cavity in a die body (die). Ex. 1005, column 2, lines 30-32, 63-66. More particularly, Schwarz '616 discloses supplying polypropylene (first polymer) to the die body (die). Ex. 1005, column 2, lines 63-66. Polypropylene is a particular type of polyolefin.

221. Accordingly, Schwarz '616 teaches both these elements of Claims 1 and 25.

Element 1c: producing a plurality of filaments comprising the first polymer from the die

222. Schwarz '616 discloses producing a plurality of filaments comprising the polypropylene (first polymer) from the die body 1 (die). Ex. 1005, Claim 5, figure 1, figure 2A, figure 2B.

223. Thus, Schwarz '616 also teaches this element of Claims 1 and 25.

Element 1d: supplying a fluid to the die such that the fluid exits the one or more fluid-releasing holes parallel or substantially parallel to the exterior surface of at least one of the filaments

224. Schwarz '616 discloses supplying air (a fluid) to the die body 1 (die) such that the air (fluid) exits the gas cavity 5 (fluid-releasing holes) parallel or substantially parallel to the exterior surface of at least one of the filaments. Ex. 1005, column 2, lines 15-52, Claim 5, figure 1, figure 2A, figure 2B.

225. As discussed previously, the hot air is blown through the holes (fluid-releasing holes) parallel to the spinning nozzles, and therefore the air (i.e., fluid) exits the holes parallel to the surface of the filaments as they are extruded from the spinning nozzles.

226. Accordingly, Schwarz '616 discloses this element of Claims 1 and 25.

Element 1f: collecting the mixture on a collection device to produce a fibrous structure.

227. Schwarz '616 discloses collecting the mixture on a receiver (collection device) to produce a fibrous structure. Ex. 1005, Claim 5.

228. Thus, Schwarz '616 teaches the step of collecting the mixture on a collection device, and therefore discloses this element.

Element 1e (Claim 1): combining the filaments with solid additives to form a mixture

Element 1e (Claim 25): combining the filaments with wood pulp fibers to form a mixture

229. This is the only element of independent claims 1 and 25 that is not explicitly disclosed in Schwarz '616. But adding solid additives, or specifically wood pulp fibers, to polymer filaments to form a mixture has been long known in the art (referred to as coform), and is explicitly disclosed in Keck (and many other prior art references known at the time).

a. Motivation to Combine

230. Prior to the patent owner's earliest possible priority date (July 17, 2007), a POSA would have been motivated to modify Schwarz '616 in view of Keck in order to provide a coform nonwoven having lower manufacturing costs.

231. More specifically, a POSA would have known that the multirow meltblown die taught in Schwarz '616 provides significant improvements with respect to throughput, and hence, productivity. As a consequence, the costs associated with manufacturing the coform nonwoven per unit would be decreased, which would improve the manufacturer's competitiveness in the market and potentially provide a greater return on investment.

232. Accordingly, the combination of Schwarz '616 and Keck teaches each and every element of independent Claims 1 and 25.

b. Reasonable Expectation of Success

233. A POSA would have had a reasonable expectation of success in modifying Schwarz '616 in use in a coform process as described in Keck. The relatively simple substitution of a multirow meltblown die of Schwarz '616 in lieu of a knife-edge meltblown die in the coform process is well within the routine skill of the POSA and such a substitution would not result in either the coform process of Keck or the meltblown process of Schwarz '616 being inoperable.

Claim 2

The process according to Claim 1, wherein the die comprises two or more rows of filament-forming holes

234. Schwarz '616 in combination with Keck discloses the elements of Claim 2.

235. Schwarz '616 discloses a die comprised of multiple rows of spinning orifices or nozzles (filament-forming holes). Ex. 1005, column 1, lines 20-28; 49-51; figure 2A; Claim 1 (“a multiplicity of nozzles arranged in at least four rows”). As can explicitly be seen in figure 2B of Schwarz '616, the die body includes multiple rows of nozzle (filament-forming holes) in which each row comprises a plurality of nozzles.

236. Thus, Schwarz '616 in combination with Keck discloses each and every element of Claim 2.

Claim 3

The process according to Claim 2 wherein at least one row of filament-forming holes comprises two or more filament-forming holes

237. Schwarz '616 discloses the elements of Claim 3.

238. Beyond the elements of claim 2, Claim 3 adds an element that at least one row of filament forming holes comprise two or more filament-forming holes. Again, figure 2B of Schwarz '616 shows that the die body includes multiple rows of nozzle (filament-forming holes) in which each row comprises a plurality of nozzles. Ex. 1005, column 2, lines 29-35, 52-54; figure. 2; Claim 1 (column 5, lines 39-45)(“multiplicity of nozzles arranged in at least two rows”).

239. Thus, Schwarz '616 in combination with Keck discloses each and every element of Claim 3.

Claim 5

The process according to Claim 1 wherein one fluid-releasing hole is concentrically positioned around one filament-forming hole

240. Schwarz '616 discloses multiple rows of nozzles (filament-forming holes) sticking through the round holes (which are concentrically positioned around fluid-releasing holes). Ex 1005, column 2, lines 51-54. Further, figure 2B of Schwarz '616 shows that each individual filament nozzle is centered in the round holes, which means that the round hole concentrically surrounds the filament nozzle.

241. Thus, Schwarz '616 in combination with Keck discloses each and every element of Claim 5.

Claim 6

The process according to Claim 1 wherein the first polymer comprises a synthetic polymer

242. Schwarz '616 explicitly discloses using polypropylene. Ex. 1005, column 2, lines 63-65. Polypropylene is a synthetic polymer.

243. Accordingly, Schwarz '616 in combination with Keck discloses each and every element of claim 6.

Claim 7

The process according to claim 6 wherein the synthetic polymer is selected from the group consisting of: polyvinyl alcohol, polyvinyl alcohol derivatives, polyesters, nylons, polyolefins, polylactic acids, polyhydroxyalkanoates, polycaprolactones and mixtures thereof

244. Schwarz '616 explicitly discloses using polypropylene. Ex. 1005, column 2, lines 63-65. Polypropylene is a polyolefin. Further, Keck also discloses that the continuous filaments may comprise a polyolefin, such as polypropylene, Ex. 1004, ¶ 0052.

245. Accordingly, Schwarz '616 in combination with Keck discloses each and every element of Claim 7.

Claim 8

The process according to claim 7 wherein the synthetic polymer comprises a polyolefin

246. Schwarz '616 explicitly discloses using polypropylene. Ex. 1005, column 2, lines 63-65. Polypropylene is a polyolefin.

247. Thus, combination of Schwarz '616 and Keck discloses each and every element of Claim 8.

Claim 9

The process according to claim 8 wherein the polyolefin comprises polypropylene

248. Schwarz '616 explicitly discloses using polypropylene. Ex. 1005, column 2, lines 63-65. Polypropylene is a polyolefin.

249. Accordingly, the combination of Schwarz '616 and Keck discloses each and every element of Claim 9.

Claim 12

The process according to Claim 1 wherein the first polymer comprises a compostable polymer

250. The term “compostable polymer” as used in Claim 12 of the '801 Patent must include polylactic acids, polyhydroxyalkanoates, polycaprolactones and mixtures thereof because Claim 13 claims a compostable polymer selected from the group including polylactic acids, polyhydroxyalkanoates, polycaprolactones and mixtures thereof because. Ex. 1001, Claim 13 (emphasis added).

251. Keck discloses that thermoplastic meltblown filaments comprise a polymer selected from the group consisting of polyolefins, polyesters, polyamides, polycarbonates, polyurethanes, polyvinylchloride, polytetrafluoroethylene, polystyrene, polyethylene terephthalate, polylactic acid and copolymers and blends thereof. Ex. 1004, Claim 8 (emphasis added).

252. Since Keck discloses filaments (first polymer) made from polylactic acid, and the '801 Patent teaches that polymers made from polylactic acids are compostable, Keck explicitly discloses a first polymer comprising a compostable polymer as claimed in Claim 12 of the '801 Patent.

253. Accordingly, Schwarz '616 in combination with Keck teaches every element of Claim 12.

Claim 13

The process according to claim 12 wherein the compostable polymer is selected from the group consisting of: polylactic acids, polyhydroxyalkanoates, polycaprolactones and mixtures thereof

254. Again, Keck discloses that thermoplastic meltblown filaments comprise a polymer selected from the group consisting of polyolefins, polyesters, polyamides, polycarbonates, polyurethanes, polyvinylchloride, polytetrafluoroethylene, polystyrene, polyethylene terephthalate, polylactic acid and copolymers and blends thereof. Ex. 1004, Claim 8.

255. Accordingly, the combination of Schwarz '616 and Keck teaches each and every element of Claim 13.

Claim 14

The process according to claim 1 wherein the solid additives comprise fibers

256. Keck discloses that the secondary material (solid additives) includes fibrous organic materials (fibers) and superabsorbent particles and fibers. Ex. 1004, ¶ 0003.

257. Accordingly, the combination of Schwarz '616 and Keck teaches every element of Claim 14.

Claim 15

The process according to claim 14 wherein the fibers comprise wood pulp fibers

258. Keck discloses that the secondary material (solid additives) includes fibrous organic materials such as woody and non-wood pulp. Ex. 1004, ¶ 0003.

259. Accordingly, the combination of Schwarz '616 and Keck teaches every element of Claim 15.

Claim 16

The process according to claim 1 wherein the solid additives are combined with the plurality of filaments by a solid additive spreader

260. Keck teaches that the secondary fibers (solid additives) are introduced into a secondary gas stream via an apparatus having a housing that encloses a picker roll and is in communication with a nozzle, in which the stream of secondary fibers are entrained and subsequently introduced into the filament containing streams. Ex. 1004, ¶¶ 0088-0089. More specifically, Keck discloses that the secondary fibers (solid additives) are conveyed toward the stream of thermoplastic polymer fibers through a nozzle, with a housing that encloses the picker roll and provides a passageway or gap between the housing and the picker roll and that a gas (i.e. air) is supplied to the passage way or gap between the surface of the picker roll and the housing by way of a gas duct. Ex. 1004, ¶ 0088. The gas is supplied by any conventional arrangement including a blower and is

supplied in sufficient quantity to serve as a medium for conveying the secondary fibers through the nozzle. *Id.* Keck further discloses that it is contemplated that additives and/or other materials may be added to or entrained in the gas stream to treat secondary fibers. *Id.* Keck further discloses a “conventional particulate injection system” (solid additive spreader). Ex. 1004, ¶¶ 0092, 0108.

261. Accordingly, the combination of Schwarz ’616 and Keck teaches every element of Claim 16.

Claim 17

The process according to claim 1 wherein the process further comprises the step of: [17g] contacting a surface of the fibrous structure with a plurality of filaments comprising a second polymer

262. Keck discloses preparing a two layer coform structure (two layered fibrous structure) in which a second coform layer is formed directly on the first coform layer. Ex. 1004, ¶ 0150. This would necessarily result in the filaments of the second coform layer contacting a surface of the first coform layer (fibrous structure). Keck further describes that the meltblown filaments of both coform layers comprise the same polypropylene resin. *Id.* The definition of “second polymer” must include the second polymer being the same as the first polymer because Claim 19 of the ’801 Patent, which depends on Claim 17, recites that the first and second polymer are the same. Ex. 1001, Claim 19.

263. Accordingly, the combination of Schwarz '616 and Keck teaches every element of Claim 17.

Claim 18

The process according to claim 17 wherein the plurality of filaments comprising the second polymer are in the form of a fibrous structure

264. Keck discloses that the second layer is also a coform nonwoven (fibrous structure) comprised a mixture of thermoplastic filaments and wood pulp fibers (solid additive). Ex. 1004, ¶ 150.

265. Accordingly, the combination of Schwarz '616 and Keck teaches every element of Claim 18.

Claim 19

The process according to claim 17 wherein the second polymer is the same as the first polymer

266. Keck discloses in example 5 that the filaments of the first coform layer and the filaments of the second coform layer both comprise the same grade polypropylene resin. As such, the first polymer and the second polymer are the same.

267. Accordingly, the combination of Schwarz '616 and Keck teaches every element of Claim 19.

Claim 20

The process according to claim 1 wherein the fluid released by the fluid-releasing holes comprises air

268. Schwarz '616 discloses that the gas released through the holes (fluid releasing holes) in the cover plate is air. Ex. 1005, column 2, lines 21-23. Keck further discloses “fibers formed by extruding a molten thermoplastic material through a plurality of fine, usually circular, die capillaries as molten threads or filaments into converging high velocity, usually hot, gas (e.g. air) Streams which attenuate the filaments of molten thermoplastic material to reduce their diameter, which may be to microfiber diameter.” Ex. 1004, ¶ 0035.

269. Accordingly, the combination of Schwarz '616 and Keck teaches every element of Claim 20.

Claim 21

The process according to claim 1 wherein the fibrous structure exhibits a pore volume distribution such that greater than about 40% of the total pore volume present in the fibrous structure exists in pores of radii of from about 121 um to about 200 um

270. The '801 Patent discloses that the spinnerette used in the examples of preparing the claimed fibrous structure was obtained from Biax-Fiberfilm Corporation (“Biax”). Ex. 1001, column 15, lines 60-63. Notably, the Schwarz '616 was assigned to Biax-Fiberfilm Corporation between July 23, 2001 and January 28, 2010. Ex. 1020, page 1.

271. Thus, it appears that the examples in the '801 Patent were prepared with the same or similar meltblown die described in Schwarz '616. Given the similarities between the Biax meltblown die described in the '801 Patent and that

of Schwarz '616, it is reasonable to expect that a coform nonwoven prepared based on the combination of Schwarz '616 and Keck would have the same pore volume distribution properties as recited in Claim 21. That is, it would be expected that a process of preparing a coform nonwoven using the meltblown die of Schwarz '616 as modified with the solid additive process of Keck would produce a coform nonwoven having a pore volume distribution such that greater than about 40% of the total pore volume present in the fibrous structure exists in pores of radii of from about 121 um to about 200 um.

272. Moreover, it is well known that pore size, and hence pore size distribution, in meltblown webs varies depending on process conditions, such as processing temperatures, increasing air flow rate at the die, and decreasing the distance between the filament nozzles and the collection surface, and the speed of the collection surface. See, Bresee et al., *Influence of Processing Conditions on Melt blown Web Structure: Part 1 – DCD*, INJ Spring 2004, 49-55 (Ex. 1025); Bresee et al., *Influence of Processing Conditions on Melt Blown Web Structure: Part 2 – Primary Airflow Rate*, INJ Summer 2005, 11-18 (Ex. 1026); and Lee et al. *Effects of Melt-Blowing Process Conditions on Morphological and Mechanical Properties of Polypropylene Webs*, POLYMER 1992, Vol. 3, No. 6, 1200-1209 (Ex. 1027). For example, changing one or more of the process parameters by increasing the air flow rate, decreasing the distance between the collection surface

and filament nozzles, or increasing the speed of the collection surface is well known to decrease pore size in the meltblown web. Similarly, decreasing air flow rate, increasing the distance between the collection surface and filament nozzles, or decreasing the speed of the collection surface is well known to increase pore size in the meltblown web. As such, it is reasonable to expect that obtaining a coform nonwoven having the recited pore distribution is well within the routine skill of a POSA, and that doing such is merely an optimization of known parameters that affect pore size distribution.

273. Accordingly, the combination of Schwarz '616 and Keck teaches every element of Claim 21.

Claim 22

The process according to claim 1 wherein the process further comprises the step of subjecting the fibrous structure to a thermal bonding operation

274. Keck discloses that the coform (fibrous structure) may be “pattern bonded,” which is a process of thermal bonding a nonwoven web in a pattern by the application of heat and pressure or other methods, such as ultrasonic bonding. Keck discloses that thermal pattern bonding typically is carried out at a temperature in a range of from about 80 C. to about 180° C. Ex. 1004, ¶ 0047. Keck also discloses that due to the fact that thermoplastic polymer fibers are usually semi-molten and tacky at the time of incorporation of the secondary fibers,

the secondary fibers are thermally bonded or joined to the thermoplastic polymer fibers. Ex. 1004, ¶ 0109.

275. Accordingly, the combination of Schwarz '616 and Keck teaches every element of Claim 22.

Claim 23

The process according to claim 1 wherein the process is directly coupled to a post-processing operation

276. Keck discloses “pattern bonded” which is a process of bonding a nonwoven web in a pattern by the application of heat and pressure or other methods, such as ultrasonic bonding. Keck discloses that thermal pattern bonding typically is carried out at a temperature in a range of from about 80 C. to about 180° C. Ex. 1004, ¶ 0047. The '801 Patent expressly discloses that post-processing operations as that term is used in the '801 Patent includes thermal bonding operations. Ex. 1001, column 9, line 31-38. Keck also describes additional steps (post-processing operations) of depositing the second composite stream onto the deposited layer as a matrix of meltblown filaments and a secondary material to form a two layer tufted coform nonwoven web. Ex. 1004, ¶ 0015-0018. The '801 Patent expressly discloses that post-processing operations as that term is used in the '801 Patent includes tuft-generating operations. Ex. 1001, column 9, lines 31-38.

277. Thermal bonding, such as the “pattern bonded” process described in Keck, and the tufting-generating operations are typically performed during the manufacturing process of the nonwoven web, and are therefore considered as being “directly coupled to a post-processing operation.”

278. Accordingly, the combination of Schwarz '616 and Keck teaches every element of Claim 23.

Claim 24

The process according to claim 1 wherein the process is closely coupled to a post-processing operation

279. Again, Keck discloses “pattern bonded” which is a process of bonding a nonwoven web in a pattern by the application of heat and pressure or other methods, such as ultrasonic bonding. Keck discloses that thermal pattern bonding typically is carried out at a temperature in a range of from about 80 C. to about 180° C. Ex. 1004, ¶ 0047. The '801 Patent expressly discloses that post-processing operations as that term is used in the '801 Patent includes thermal bonding operations. Ex. 1001, column 9, lines 31-38. Keck also describes additional steps (post-processing operations) of depositing the second composite stream onto the deposited layer as a matrix of meltblown filaments and a secondary material to form a two layer tufted coform nonwoven web. Ex. 1004, ¶ 0015-0018. The '801 Patent expressly discloses that post-processing operations as that term is used in the '801

Patent includes application of lotions and mixtures. Ex. 1001, column 9, lines 31-38.

280. In addition, Keck describes preparation of cleaning sheets using the nonwoven web. Such cleaning sheets may include treatment with a liquid or other materials Ex. 1004, ¶¶ 0137-0140. The conversion of Keck's nonwoven web into such treated cleaning sheets typically occurs at a separate facility from that of manufacture of the nonwoven web and is therefore considered a "closely coupled" post processing operation.

281. Accordingly, the combination of Schwarz '616 and Keck teaches every element of Claim 24.

Ground 3: Claims 1-3, 5-9, 14-15, and 20-25 are obvious under 35 U.S.C. §103 based on the teachings of U.S. Patent No. 6,013,223 to Schwarz ("Schwarz '223") (Ex. 1002) and PCT Published Application No. WO 00/29658 ("McDowall") (Ex. 1003)

Independent Claims 1 and 25

As discussed above, Schwarz '223 explicitly discloses all but one element of independent claims 1 and 25 of the '801 Patent. The remaining element – combining the filaments with solid additives (wood pulp) to form a mixture – would have been obvious to a POSA based on Schwarz's disclosures in light of the teachings of McDowall.

Element 1e (Claim 1): combining the filaments with solid additives to form a mixture

Element 1e (Claim 25): combining the filaments with wood pulp fibers to form a mixture

This is the only element of independent claims 1 and 25 that is not explicitly disclosed in Schwarz '223. But adding solid additives, or specifically wood pulp fibers, to polymer filaments to form a mixture has been long known in the art (referred to as coform), and is explicitly disclosed in McDowall (and many other prior art references known at the time). Ex. 1003, Claim 1; page 4.

a. Motivation to Combine

282. Prior to the patent owner's earliest possible priority date (July 17, 2007), a POSA would have been motivated to modify Schwarz '223 in view of McDowall in order to provide a coform nonwoven having lower manufacturing costs and exhibiting improved strength.

283. More specifically, a POSA would have known that the multirow meltblown die taught in Schwarz '223 provides significant improvements with respect to throughput, and hence, productivity. As a consequence, the costs associated with manufacturing the coform nonwoven per unit would be decreased, which would improve the manufacturer competitiveness in the market and potentially provide a greater return on investment.

284. In addition, a POSA would be motivated to modify Schwarz '223 in view of McDowall in order to improve the strength of the coform nonwoven.

Schwarz '223 explicitly states that the fibers prepared therein have improved tenacity. As such, a POSA would have been motivated to modify Schwarz '223 in view of McDowall to provide a coform nonwoven having improved strength.

285. Accordingly, the combination of Schwarz '223 and McDowall teaches each and every element of independent Claims 1 and 25.

b. Reasonable Expectation of Success

286. A POSA would have had a reasonable expectation of success in modifying Schwarz '223 in use in a coform process as described in McDowall. The relatively simple substitution of a multirow meltblown die of Schwarz '223 in lieu of a knife-edge meltblown die in the coform process is well within the routine skill of the POSA and such a substitution would not result in either the coform process of McDowall or the meltblown process of Schwarz '223 being inoperable.

Claim 2

The process according to Claim 1, wherein the die comprises two or more rows of filament-forming holes

287. Beyond the elements of Claim 1, Claim 2 adds an element that the die comprises two or more rows of filament-forming holes. As can explicitly be seen in figure 2 of Schwarz '223, the die body includes multiple rows of nozzle (filament-forming holes) in which each row comprises a plurality of nozzles. Ex. 1002, column 2, lines 29-35, 52-54; figure 2; Claim 1 (column 5, lines 39-45)(“multiplicity of nozzles arranged in at least two rows”).

288. Thus, Schwarz '223 in combination with McDowall discloses each and every element of Claim 2.

Claim 3

The process according to Claim 2 wherein at least one row of filament-forming holes comprises two or more filament-forming holes

289. Beyond the elements of Claim 2, Claim 3 adds an element that at least one row of filament forming holes comprise two or more filament-forming holes. Again, figure 2 of Schwarz '223 shows that the die body includes multiple rows of nozzle (filament-forming holes) in which each row comprises a plurality of nozzles. Ex. 1002, column 2, lines 29-35, 52-54; figure 2; Claim 1 (column 5, lines 39-45)(“multiplicity of nozzles arranged in at least two rows”).

290. Thus, Schwarz '223 in combination with McDowall discloses each and every element of Claim 3.

Claim 5

The process according to Claim 1 wherein one fluid-releasing hole is concentrically positioned around one filament-forming hole

291. Schwarz '223 discloses multiple rows of nozzles (filament-forming holes) sticking through the round holes (which are concentrically positioned around fluid-releasing holes). Ex 1002, column 2, lines 51-54. Further, figure 2 of Schwarz '223 shows that the filament nozzle is centered in the round holes, which

means that the round hole concentrically surrounds the filament nozzle. *Id.*, figure 2.

292. Thus, Schwarz '223 in combination with McDowall discloses each and every element of Claim 5.

Claim 6

The process according to Claim 1 wherein the first polymer comprises a synthetic polymer

293. Schwarz '223 explicitly discloses using polypropylene. Ex. 1002, column 2, line 65. Polypropylene is a synthetic polymer.

294. Accordingly, Schwarz '223 in combination with McDowall discloses each and every element of Claim 6.

Claim 7

The process according to claim 6 wherein the synthetic polymer is selected from the group consisting of: polyvinyl alcohol, polyvinyl alcohol derivatives, polyesters, nylons, polyolefins, polylactic acids, polyhydroxyalkanoates, polycaprolactones and mixtures thereof

295. Schwarz '223 explicitly discloses using polypropylene. Ex. 1002, column 2, line 65. Polypropylene is a polyolefin.

296. McDowall also explicitly discloses synthetic polymers including polypropylene, polyesters, and other high tensile materials. Ex. 1003, page 8.

297. Accordingly, Schwarz '223 in combination with McDowall discloses each and every element of Claim 7.

Claim 8

The process according to claim 7 wherein the synthetic polymer comprises a polyolefin

298. Schwarz '223 explicitly discloses using polypropylene. Ex. 1002, column 2, lines 65. Polypropylene is a polyolefin.

299. McDowall also explicitly discloses synthetic polymers including polypropylene (Ex. 1003, page 8), which is a polyolefin by definition because Claim 9 of the '801 Patent claims a synthetic polymer that is a polyolefin comprised of polypropylene. Ex. 1001, Claim 9.

300. Thus, combination of Schwarz '223 and McDowall discloses each and every element of Claim 8.

Claim 9

The process according to claim 8 wherein the polyolefin comprises polypropylene

301. Schwarz '223 explicitly discloses using polypropylene. Ex. 1002, column 2, lines 65. Polypropylene is a polyolefin. McDowall also explicitly discloses synthetic polymers including polypropylene. Ex. 1003, page 8.

302. Accordingly, the combination of Schwarz '223 and McDowall discloses each and every element of Claim 9.

Claim 14

The process according to claim 1 wherein the solid additives comprise fibers

303. McDowall discloses that pulp fibers (solid additives) refers to fibers from natural sources such as woody and non-woody plants. Ex. 1003, page 4.

304. Accordingly, the combination of Schwarz '223 and McDowall teaches every element of Claim 14.

Claim 15

The process according to claim 14 wherein the fibers comprise wood pulp fibers

305. McDowall discloses that pulp fibers (solid additives) refers to fibers from natural sources such as woody and non-woody plants. Ex. 1003, page 4.

306. Accordingly, the combination of Schwarz '223 and McDowall teaches every element of Claim 15.

Claim 20

The process according to claim 1 wherein the fluid released by the fluid-releasing holes comprises air

307. Schwarz '223 discloses that the gas released through the holes (fluid releasing holes) in the cover plate is air. Ex. 1002, column 2, lines 29-51.

308. McDowall also discloses extruding filaments from die capillaries (fluid-releasing holes) with “converging high velocity heated gas (e.g., air)” streams. Ex. 1003, page 4.

309. Further, Schwarz '223 explicitly discloses that the gas is air. Ex. 1002, column 2, lines 37-39.

310. Accordingly, the combination of Schwarz '223 and McDowall teaches every element of Claim 20.

Claim 21

The process according to claim 1 wherein the fibrous structure exhibits a pore volume distribution such that greater than about 40% of the total pore volume present in the fibrous structure exists in pores of radii of from about 121 um to about 200 um

311. The '801 Patent discloses that a the spinnerette used in the examples of preparing the claimed fibrous structure was obtained from Biax-Fiberfilm Corporation ("Biax"). Ex. 1001, column 15, lines 60-63. Notably, Schwarz '223 is assigned to Biax-Fiberfilm Corporation. Ex. 1002, page 1.

312. Thus, it appears that the examples in the '801 Patent were prepared with the same or similar meltblown die described in Schwarz '223. Given the similarities between the Biax meltblown die described in the '801 Patent and that of Schwarz '223, it is reasonable to expect that a coform nonwoven prepared based on the combination of Schwarz '223 and McDowall would have the same properties. That is, it would be expected that a process of preparing a coform nonwoven using the meltblown die of Schwarz '223 in combination with the coform process of McDowall would produce a coform nonwoven having a pore volume distribution such that greater than about 40% of the total pore volume present in the fibrous structure exists in pores of radii of from about 121 um to about 200 um.

313. Moreover, it is well known that pore size, and hence pore size distribution, in meltblown webs varies depending on process conditions, such as processing temperatures, increasing air flow rate at the die, and decreasing the distance between the filament nozzles and the collection surface, and the speed of the collection surface. See, Bresee et al., *Influence of Processing Conditions on Melt Blown Web Structure: Part 1 – DCD*, INJ Spring 2004, 49-55 (Ex. 1025); Bresee et al., *Influence of Processing Conditions on Melt Blown Web Structure: Part 2 – Primary Airflow Rate*, INJ Summer 2005, 11-18 (Ex. 1026); and Lee et al. *Effects of Melt-Blowing Process Conditions on Morphological and Mechanical Properties of Polypropylene Webs*, POLYMER 1992, Vol. 3, No. 6, 1200-1209 (Ex. 1027). For example, changing one or more of the process parameters by increasing the air flow rate, decreasing the distance between the collection surface and filament nozzles, or increasing the speed of the collection surface is well known to decrease pore size in the meltblown web. Similarly, decreasing air flow rate, increasing the distance between the collection surface and filament nozzles, or decreasing the speed of the collection surface is well known to increase pore size in the meltblown web. As such, it is reasonable to expect that obtaining a coform nonwoven having the recited pore distribution is well within the routine skill of a POSA, and that doing such is merely an optimization of known parameters that affect pore size distribution.

314. Accordingly, the combination of Schwarz '223 and McDowall teaches every element of Claim 21.

Claim 22

The process according to claim 1 wherein the process further comprises the step of subjecting the fibrous structure to a thermal bonding operation

315. McDowall discloses “thermal point bonding” and teaches that it means passing a fabric or web of fibers to be bonded between a heated calender roll and an anvil roll in order to hold the laminate layers together and impart integrity to each individual layer by bonding filaments and/or fibers within each layer. Ex. 1003, pages, 6-7.

316. Accordingly, the combination of Schwarz '223 and McDowall teaches every element of Claim 22.

Claim 23

The process according to claim 1 wherein the process is directly coupled to a post-processing operation

317. McDowall discloses “thermal point bonding” and teaches that it means passing a fabric or web of fibers to be bonded between a heated calender roll and an anvil roll in order to hold the laminate layers together and impart integrity to each individual layer by bonding filaments and/or fibers within each layer. Ex. 1003, pages, 6-7. Further, McDowall describes depositing the nonwoven web on a conveyor and then subjecting the composite to through-air-

bonding. *Id.*, page 10, lines 4-6. Such a bonding step immediately following deposition on the conveyor is considered as being “directly coupled to a post-processing operation” as recited in Claim 23 of the ’801 Patent.

318. Accordingly, the combination of Schwarz ’223 and McDowall teaches every element of Claim 23.

Claim 24

The process according to claim 1 wherein the process is closely coupled to a post-processing operation

319. McDowall discloses “thermal point bonding” and teaches that it means passing a fabric or web of fibers to be bonded between a heated calender roll and an anvil roll in order to hold the laminate layers together and impart integrity to each individual layer by bonding filaments and/or fibers within each layer. Ex. 1003, pages, 6-7.

320. McDowall further describes that the absorbent nonwoven composites can be used in various medical products, which contain alcohol or other disinfectants. *Id.*, page 15, lines 16-18. The conversion of the absorbent nonwoven composite of McDowall into such medical products is normally completed at a separate facility from the manufacturing site and is therefore considered a “closely coupled” post processing operation.

321. Accordingly, the combination of Schwarz ’223 and McDowall teaches every element of Claim 24.

Ground 4: Claims 10-11 are obvious under 35 U.S.C. §103 based on the teachings of U.S. Patent No. 6,013,223 to Schwarz (“Schwarz ’223”) in view of U.S. Patent App. Publication No. 2003/0211802 A1 to Keck (“Keck”) (Ex. 1004) (or PCT Published Application No. WO 00/29658 (“McDowall”) (Ex. 1003)), and in further view of United States Patent No. 6,783,854 to Bond (“Bond”) (Ex. 1006)

322. As discussed previously, Schwarz ’223 discloses each element of Claim 1 except the step of combining the filaments with solid additives to form a mixture, which is disclosed by both Keck and McDowall.

323. Dependent Claim 10 of the ’801 Patent, further claims where the polymer disclosed in Claim 1 is a natural polymer, and Claim 11 claims a specific type of natural polymer. U.S. Patent No. 6,783,854 to Bond explicitly discloses such natural polymers, and it would have been obvious to a POSA to combine the teachings of Schwarz ’223 with Keck (or McDowall) and Bond.

324. Bond is directed to continuous bicomponent fibers that may be used in the preparation of meltblown and spunbond nonwoven fabrics. Bond teaches that the bicomponent filaments may be made with melt spinning processes, and may be used to produce continuous filaments through spunbond methods or meltblowing processes. *Id.*, column 12, line 61-column 13, line 4. Bond further teaches that the nonwovens prepared from the bicomponent fibers may be used in hygiene applications, which includes wipes and diapers. *Id.*, column 14, lines 30-45. Accordingly, Bond is in the same field of the endeavor or the ’801 Patent.

325. Prior to the patent owner's earliest possible priority date (July 17, 2007), a POSA would have been motivated to modify the process of Schwarz '223 as modified by Keck or McDowall to include a thermoplastic starch (natural polymer) as taught by Bond in order to provide a coform nonwoven that is environmentally degradable and thus flushable. Combining Schwarz '223 with Keck or McDowall along with Bond would not make any of them inoperable.

Claim 10

The process according to claim 1 wherein the first polymer comprises a natural polymer

326. Bond describes bicomponent fibers having a sheath/core configuration in which a non-starch thermoplastic polymer (defining the sheath) surrounds a thermoplastic starch (defining the core). *Id.*, Abstract. Bond teaches that the non-starch thermoplastic polymer may be a polyolefin, such as polyethylene or polypropylene. *Id.*, column 3, lines 39-45. Bond states that the thermoplastic starch is a naturally occurring biopolymer. *Id.*, column 4, lines 58-60.

327. Accordingly, Bond teaches a process of preparing filaments in which the filaments comprises a natural polymer, and therefore the combination of Schwarz '223, one of Keck or McDowall, and in further view of Bond teaches the elements of Claim 10.

Claim 11

The process according to claim 10 wherein the natural polymer is selected from the group consisting of: starch, starch derivatives, cellulose, cellulose derivatives, hemicellulose, hemicellulose derivatives, and mixtures thereof

328. Bond provides the following statement with respect to suitable starches:

Suitable naturally occurring starches can include, but are not limited to, corn starch (including, for example, waxy maize starch), potato starch, sweet potato starch, wheat starch, sago palm starch, tapioca starch, rice starch, soybean starch, arrow root starch, bracken starch, lotus starch, cassava starch, high amylose corn starch, and commercial amylose powder. Blends of starch may also be used. Though all starches are useful herein, the present invention is most commonly practiced with natural starches derived from agricultural sources, which offer the advantages of being abundant in supply, easily replenishable and inexpensive in price. Naturally occurring starches, particularly corn starch (including, for example, waxy maize starch), and wheat starch, are starch polymers of choice due to their economy and availability. Modified starch may also be used. Modified starch is defined as non-substituted, or substituted, starch that has had its native molecular weight characteristics changed (i.e. the molecular weight is changed but no other changes are necessarily made to the starch). Molecular weight can be modified, preferably reduced, by any technique numerous of which are well known in the art. These include, for example, chemical modifications of starch by, for example, acid or alkali hydrolysis, acid reduction, oxidative reduction, enzymatic reduction, physical/mechanical degradation (e.g., via the thermomechanical energy input of the processing equipment), or combinations thereof. The thermomechanical method and the oxidation method offer an additional advantage when carried out in situ. The exact chemical nature of the starch and molecular weight reduction method is not critical as long as the average molecular weight is provided at the desired level or range. Such techniques can also reduce molecular weight distribution.

Id., column 5, line 51-column 6, line 15.

329. Prior to the patent owner's earliest possible priority date (July 17, 2007), a POSA would have been motivated to modify the process of Schwarz '223 as modified by Keck or McDowall to include a thermoplastic starch (natural polymer) as taught by Bond in order to provide a coform nonwoven that is environmentally degradable and thus flushable.

330. Accordingly, Bond teaches that the natural polymer is a starch, which is recited in Claim 11. Therefore, the combination of Schwarz '223 with one of Keck or McDowall, and in further view of Bond teaches the elements of Claim 11.

Ground 5: Claims 1-4, 6-9, and 12-25 are obvious under 35 U.S.C. §103 based on the teachings of U.S. Patent No. 6,114,017 to Fabbriante ("Fabbriante") (Ex. 1018) and U.S. Patent App. Publication No. 2003/0211802 A1 to Keck ("Keck") (Ex. 1004)

Independent claims 1 and 25

331. Keck is directed to a coform nonwoven and processes of preparing the same. Ex. 1004, abstract, Claims 1, 34. Keck describes a process of preparing a coform nonwoven (a "fibrous structure") prepared from meltblown filaments and a secondary additive. *Id.*, abstract. Keck describes that the coform nonwoven may be used to form "a presaturated or absorbent cleaning sheet used as a wiper,..." *Id.*, ¶ 0135. More specifically, Keck states that "[c]oform nonwoven webs have been used in applications such as disposable absorbent articles, absorbent dry wipes, wet wipes, wet mops and absorbent dry mops." *Id.*, ¶ 0006.

332. Keck explicitly discloses all but one element of independent Claims 1 and 25 of the '801 Patent. The remaining element – supplying fluid (air) at an angle less than 10° (or substantially parallel) – was well known in the art and would have been obvious to a POSA based on Keck's disclosures in light of the teachings of Fabbicante. An element-by-element analysis follows:

Preamble: A process for making a fibrous structure, the process comprising the steps of:

333. Keck teaches a process for making a fibrous structure. Ex. 1004, abstract, Claim 34.

Element 1a: providing a die comprising one or more filament-forming holes, wherein one or more fluid-releasing holes are associated with one filament-forming hole such that a fluid exiting the fluid-releasing hole contacts an exterior surface of a filament exiting the filament-forming hole at an angle of less than 10°

334. As shown in figure 3, Keck discloses a pair of extruders 14, 14' that feed molten polymer into a pair of corresponding meltblowing dies 16, 18, respectively, that contain "small holes or orifices 24 and 24'" (filament forming holes). Ex. 1004, ¶¶ 0084, 0085. Each meltblowing die produces a stream of gas (from one or more fluid releasing holes) that contacts and attenuates the filaments as they exit small holes or orifices of the meltblowing die to form a filament containing stream. *Id.*, ¶ 0085.

335. Keck does not explicitly disclose the angle of the fluid with respect to the surface of the filament, but Fabbicante teaches providing the fluid

substantially parallel to the filament and it would be obvious to combine the teachings of Keck and Fabbriante. Fabbriante discloses that the air nozzles are capable of producing high velocities with the angle formed between the axis of the filament die holes and the air nozzles varied between 0° and 60°. Ex. 1018, column 3, lines 58-62. When the angle is 0°, the air flows parallel to the filaments as they are extruded from the die holes. Fabbriante further includes an example in which the axis of the air nozzles and the axis of the die holes are parallel. *Id.*, column 8, lines 65-67.

336. Moreover, Keck further states that “[t]he term “meltblown” is also intended to cover other processes in which a high velocity gas (generally air) is used to aid in the formation of the filaments, such as melt spraying or centrifugal spinning.” *Id.* ¶ 0034. Such “other processes” would include the meltblown process described in Fabbriante, which uses a multirow meltblown die.

337. In addition, Fabbriante discloses a multirow meltblown die having a primary plate that includes a polymer orifice (filament-forming hole) in which the polymer orifice is flanked on opposing sides by a pair of air nozzles (fluid-releasing holes). Ex. 1018, column 5, lines 24-48. Accordingly, Fabbriante discloses a die comprising one or more filament-forming holes, wherein one or more fluid-releasing holes are associated with one filament-forming hole.

338. Therefore, the combination of Keck and Fabbriante teaches this element of Claims 1 and 25.

Element 1b (Claim 1): supplying at least a first polymer to the die

Element 1b (Claim 25): supplying a polyolefin polymer to the die

339. Keck discloses that thermoplastic meltblown filaments comprise a polymer selected from the group consisting of polyolefins, polyesters, polyamides, polycarbonates, polyurethanes, polyvinylchloride, polytetrafluoroethylene, polystyrene, polyethylene terephthalate, polylactic acid and copolymers and blends thereof. *Id.*, ¶ 0052, Claim 8. More specifically, Keck teaches that the meltblown filaments may comprise polyolefins, such as polypropylene. *Id.*, ¶ 0052. In addition to polyolefins, Keck teaches that the meltblown filaments may comprise biodegradable filaments, such as polylactic acids. *Id.*

340. Thus, the combination of Keck and Fabbriante teaches these elements of Claim 1 and Claim 25.

Element 1c: producing a plurality of filaments comprising the first polymer from the die

341. Keck discloses that thermoplastic meltblown filaments comprise a polymer. *Id.*, ¶ 0052, Claim 8.

342. Accordingly, the combination of Keck and Fabbriante teaches this element of Claims 1 and 25.

Element 1d: supplying a fluid to the die such that the fluid exits the one or more fluid-releasing holes parallel or substantially parallel to the exterior surface of at least one of the filaments

343. Keck does not explicitly disclose the angle of the fluid with respect to the surface of the filament, but Fabbicante teaches providing the fluid substantially parallel to the filament and it would be obvious to combine the teachings of Keck and Fabbicante. Fabbicante discloses that the air nozzles are capable of producing high velocities with the angle formed between the axis of the filament die holes and the air nozzles varied between 0° and 60°. Ex. 1018, column 3, lines 58-62. When the angle is 0°, the air flows parallel to the filaments as they are extruded from the die holes.

344. Accordingly, the combination of Keck and Fabbicante teaches this element of Claims 1 and 25.

Element 1e (Claim 1): combining the filaments with solid additives to form a mixture

Element 1e (Claim 25): combining the filaments with wood pulp fibers to form a mixture

345. Keck discloses that a secondary gas stream containing secondary fibers (solid additives), such as pulp fibers, is directed between the two filament streams at the impingement zone 30. *Id.*, ¶ 0093. The resulting composite stream 56 comprising the merged filament streams and gas stream containing secondary fibers is deposited on a collecting device, such as an endless forming surface 58. *Id.*, ¶ 0097.

346. Keck discloses that the secondary material (solid additives) includes fibrous organic materials (fibers) and superabsorbent particles and fibers. Ex. 1004, ¶ 0003. In particular, Keck teaches that the secondary material (i.e., secondary fibers) of the coform nonwoven may be an absorbent material, such as absorbent fibers. *Id.*, ¶ 0056. Examples of such secondary fibers include cellulosic derived fibers, such as wood pulp fibers. *Id.*

347. In addition, Fabbriante contemplates use of the meltblown web in combination with cellulose fibers. Ex. 1018, column 7, lines 60-66. In particular, Fabbriante teaches that the meltblown layer may be a single layer or may be combined with other layers to form:

a multi-layer laminate wherein the layers are composed of any combination of the instant invention plus films, woven fabrics, metallic foils, unbonded webs, cellulose fibers, paper webs both bonded and debonded, various other nonwovens, and similar suitable webs suitable for laminating.

Id., column 7, lines 60-66. Fabbriante further teaches that the layers of the multi-layer laminate may include cellulose fibers, which means that the cellulose fibers may be mixed with the meltblown filaments of Fabbriante's meltblown web, in the layers that are in addition to Fabbriante's meltblown web, or in both.

348. As Fabbriante describes that the meltblown web may be used in wiper applications, and that it may be used in combination with cellulose fibers, it

would be desirable to use cellulose fibers in combination with Fabbriante's meltblown web in order for the resulting article to function effectively as a wiper.

Element 1f: collecting the mixture on a collection device to produce a fibrous structure.

349. Keck discloses that the resulting composite stream 56 comprising the merged filament streams and gas stream containing secondary fibers is deposited on a collecting device, such as an endless forming surface 58. *Id.*, ¶ 0097.

350. Therefore, the combination of Keck and Fabbriante teaches this element of Claims 1 and 25.

a. Motivation to Combine

351. Prior to the patent owner's earliest possible priority date (July 17, 2007), a POSA would have been motivated to modify Keck in view of Fabbriante in order to provide a coform nonwoven exhibiting significantly improved strength.

352. More specifically, a POSA would have known that the modular multirow meltblown die taught in Fabbriante provides significant improvements with respect to strength in comparison to typical meltblown webs (prepared with a single row knife edge meltblown die). As noted in Fabbriante,

[t]he instant invention is based on the discovery that using the modular die design, in a melt blowing configuration at low pressure and low polymer flows per hole, continuous fibers of extremely uniform size distribution are created, which fibers and their resultant unbonded webs exhibit significant strength compared to typical unbonded melt blown or spunbond webs.

Ex. 1018, column 2, lines 41-48.

353. Accordingly, a POSA would have been motivated to modify Keck in view of Fabbriante to provide a process of preparing a fibrous structure (e.g., coform) that exhibits significant improvements in strength. As discussed previously, Fabbriante teaches that the modular meltblown die described therein produces a meltblown web having “higher unbonded strength than a typical meltblown web.” Ex, 1018, column 4, lines 7-8. In view of the known desire to improve the strength of meltblown webs, a POSA would have been motivated to use the multirow meltblown die of Fabbriante in the coform process of Keck in order to provide a higher strength coform nonwoven.

354. In addition, the POSA would be motivated to combine Keck with Fabbriante to provide higher polymer throughputs without the significant capital expense typically associated with machining a traditional meltblown die.

355. Finally, Fabbriante contemplates that the meltblown web may be used in combination with cellulose fibers, and also contemplates use of the meltblown web in a wiper application. In view of this suggestion, a POSA would be motivated to use Fabbriante’s multirow meltblown die in a process to prepare a coform nonwoven, such as the coform process disclosed in Keck.

356. Therefore, the combination of Keck and Fabbriante teaches each and every element of independent Claims 1 and 25.

b. Reasonable Expectation of Success

357. A POSA would have had a reasonable expectation of success in modifying the coform process in Keck with the multrow meltblown die of Fabbicante. The relatively simple substitution of a multirow meltblown die of Fabbicante in lieu of a knife-edge meltblown die in the coform process is well within the routine skill of the POSA and such a substitution would not result in either the coform process of Keck or the meltblown process of Fabbicante being inoperable.

358. In addition, Fabbicante contemplates the use of cellulose fibers in combination with a meltblown web prepared with Fabbicante's multirow meltblown die.

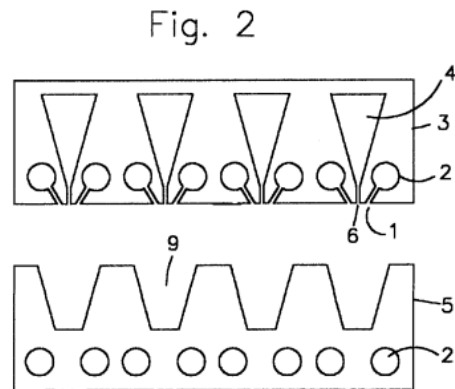
359. Accordingly, modifying Keck to include the multirow meltblown die of Fabbicante is well within the routine skill of a POSA, and therefore, a POSA would have a reasonable expectation of success in making the modification.

360. Accordingly, the combination of Fabbicante and Keck teaches each and every element of independent Claims 1 and 25.

Claim 2

The process according to Claim 1, wherein the die comprises two or more rows of filament-forming holes

361. Fabbicante discloses in figure 2 a primary plate 3 and secondary plate 5 when assembled provides a modular multirow meltblown die having at least four rows of polymer orifices 6. Ex. 1018, figure 2, column 5, lines 49-51.



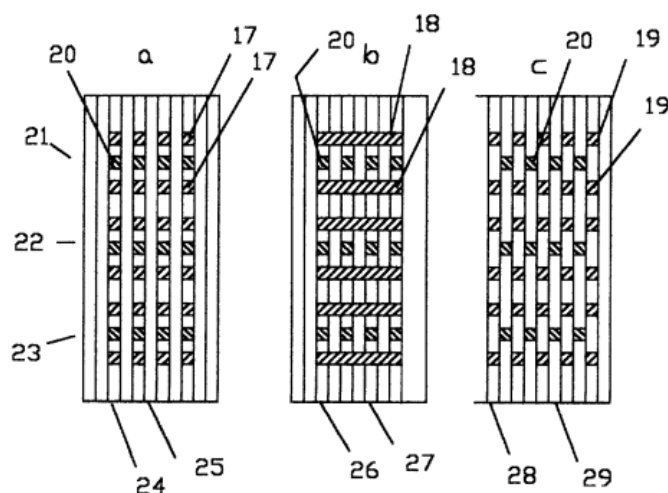
Id., figure 2.

Claim 3

The process according to Claim 2 wherein at least one row of filament-forming holes comprises two or more filament-forming holes

362. Fabbicante discloses in figure 3, below, a plan view that depicts three different assembled die bodies comprising a plurality of primary plates and secondary plates in an assembled state.

Fig. 3



Id., figure 3. In the assembled die body a, the assembled die includes 3 rows of polymer orifices 20 in which each row includes at least 4 polymer orifices, and in which each individual polymer orifice is flanked on opposing sides by a pair of air nozzles 17. *Id.*, figure 3, column 5, lines 53-65.

363. Accordingly, the combination of Keck and Fabbriante teaches each and every element of Claim 3.

Claim 4

The process according to claim 1 wherein more than one fluid-releasing hole are associated with a filament-forming hole

364. Fabbriante discloses in figure 3, the assembled die includes 3 rows of polymer orifices 20 in which each row includes at least 4 polymer orifices, and in which each individual polymer orifice is flanked on opposing sides by a pair of air nozzles 17. *Id.*, figure 3, column 5, lines 53-65.

365. Thus, the combination of Keck and Fabbricante teaches the elements of Claim 4.

Claim 6

The process according to claim 1 wherein the first polymer comprises a synthetic polymer

366. Keck discloses that thermoplastic meltblown filaments comprise a polymer selected from the group consisting of polyolefins, polyesters, polyamides, polycarbonates, polyurethanes, polyvinylchloride, polytetrafluoroethylene, polystyrene, polyethylene terephthalate, polylactic acid and copolymers and blends thereof. *Id.*, ¶ 0052, Claim 8. More specifically, Keck teaches that the meltblown filaments may comprise polyolefins, such as polypropylene. *Id.*, ¶ 0052. Polypropylene is considered a synthetic polymer.

367. Thus, the combination of Keck and Fabbricante teaches the elements of Claim 6.

Claim 7

The process according to claim 6 wherein the synthetic polymer is selected from the group consisting of: polyvinyl alcohol, polyvinyl alcohol derivatives, polyesters, nylons, polyolefins, polylactic acids, polyhydroxyalkanoates, polycaprolactones and mixtures thereof

368. Keck discloses that thermoplastic meltblown filaments comprise a polymer selected from the group consisting of polyolefins, polyesters, polyamides, polycarbonates, polyurethanes, polyvinylchloride, polytetrafluoroethylene,

polystyrene, polyethylene terephthalate, polylactic acid and copolymers and blends thereof. *Id.*, ¶ 0052, Claim 8.

369. Therefore, the combination of Keck and Fabbriante teaches the elements of Claim 7.

Claim 8

The process according to claim 7 wherein the synthetic polymer comprises a polyolefin

370. Keck discloses that thermoplastic meltblown filaments comprise a polymer selected from the group consisting of polyolefins, polyesters, polyamides, polycarbonates, polyurethanes, polyvinylchloride, polytetrafluoroethylene, polystyrene, polyethylene terephthalate, polylactic acid and copolymers and blends thereof. *Id.*, ¶ 0052, Claim 8.

371. Therefore, the combination of Keck and Fabbriante teaches the elements of Claim 8.

Claim 9

The process according to claim 8 wherein the polyolefin comprises polypropylene

372. More specifically, Keck teaches that the meltblown filaments may comprise polyolefins, such as polypropylene. *Id.*, ¶ 0052.

373. Accordingly, the combination of Keck and Fabbriante teaches the elements of Claim 9.

Claim 12

The process according to claim 1 wherein the first polymer comprises a compostable polymer

374. The term “compostable polymer” as used in Claim 12 of the ’801 Patent must include polylactic acids, polyhydroxyalkanoates, polycaprolactones and mixtures thereof because Claim 13 claims a compostable polymer selected from the group including polylactic acids, polyhydroxyalkanoates, polycaprolactones and mixtures thereof because. Ex. 1001, Claim 13 (emphasis added). Keck discloses that thermoplastic meltblown filaments comprise a polymer selected from the group consisting of polyolefins, polyesters, polyamides, polycarbonates, polyurethanes, polyvinylchloride, polytetrafluoroethylene, polystyrene, polyethylene terephthalate, polylactic acid and copolymers and blends thereof. Ex. 1004, Claim 8 (emphasis added). Since Keck discloses filaments (first polymer) made from polylactic acid, and the ’801 Patent teaches that polymers made from polylactic acids are compostable, Keck explicitly discloses a first polymer comprising a compostable polymer as claimed in Claim 12 of the ’801 Patent.

375. Thus, the combination of Keck and Fabbriante teaches the elements of Claim 12.

Claim 13

The process according to claim 12 wherein the compostable polymer is selected from the group consisting of: polylactic acids, polyhydroxyalkanoates, polycaprolactones and mixtures thereof

376. Keck discloses that thermoplastic meltblown filaments comprise a polymer selected from the group consisting of polyolefins, polyesters, polyamides, polycarbonates, polyurethanes, polyvinylchloride, polytetrafluoroethylene, polystyrene, polyethylene terephthalate, polylactic acid and copolymers and blends thereof. Ex. 1004, Claim 8 (emphasis added).

377. Accordingly, the combination of Keck and Fabbriante teaches the elements of Claim 13.

Claim 14

The process according to claim 1 wherein the solid additives comprise fibers

378. Keck discloses that the secondary material (solid additives) includes fibrous organic materials (fibers) and superabsorbent particles and fibers. Ex. 1004, ¶ 0003.

379. Thus, the combination of Keck and Fabbriante teaches the elements of Claim 14.

Claim 15

The process according to claim 14 wherein the fibers comprise wood pulp fibers

380. Keck discloses that the secondary material (solid additives) includes fibrous organic materials such as woody and non-wood pulp. Ex. 1004, ¶ 0003.

381. Therefore, the combination of Keck and Fabbriante teaches the elements of Claim 15.

Claim 16

The process according to claim 1 wherein the solid additives are combined with the plurality of filaments by a solid additive spreader

382. Keck discloses that the secondary fibers (solid additives) are conveyed toward the stream of thermoplastic polymer fibers through a nozzle, with a housing that encloses the picker roll and provides a passageway or gap between the housing and the picker roll and that a gas (i.e. air) is supplied to the passage way or gap between the surface of the picker roll and the housing by way of a gas duct. Ex. 1004, ¶ 0088. The gas is supplied by any conventional arrangement including a blower and is supplied in sufficient quantity to serve as a medium for conveying the secondary fibers through the nozzle. *Id.* Keck further discloses that it is contemplated that additives and/or other materials may be added to or entrained in the gas stream to treat secondary fibers. *Id.* Keck further discloses a “conventional particulate injection system” (solid additive spreader). Ex. 1004, ¶¶ 0092, 0108.

383. Accordingly, the combination of Keck and Fabbriante discloses the elements of Claim 16.

Claim 17

The process according to claim 1 wherein the process further comprises the step of: [17g] contacting a surface of the fibrous structure with a plurality of filaments comprising a second polymer

384. Keck discloses preparing a two-layer coform structure in which a second coform layer is formed directly on the first coform layer. Ex. 1004, ¶ 0150. This would necessarily result in the filaments of the second coform layer contacting a surface of the first coform layer (fibrous structure). Keck further describes that the meltblown filaments of both coform layers comprise the same polypropylene resin. *Id.* The definition of “second polymer” must include the second polymer being the same as the first polymer because Claim 19 of the ’801 Patent, which depends on Claim 17, recites that the first and second polymer are the same. Ex. 1001, Claim 19.

385. Thus, the combination of Keck and Fabbicante discloses the elements of Claim 17.

Claim 18

The process according to claim 17 wherein the plurality of filaments comprising the second polymer are in the form of a fibrous structure

386. Keck discloses that the second layer is a coform nonwoven (fibrous structure) comprised a mixture of thermoplastic filaments and wood pulp fibers (solid additive). Ex. 1004, ¶ 0150.

387. Thus, the combination of Keck and Fabbriante discloses the elements of Claim 18.

Claim 19

The process according to claim 17 wherein the second polymer is the same as the first polymer

388. In example 5 of Keck, the filaments of the first coform layer and the filaments of the second coform layer both comprise the same grade polypropylene resin. Ex. 1004, ¶0150.

389. Thus, the combination of Keck and Fabbriante discloses the elements of Claim 19.

Claim 20

The process according to claim 1 wherein the fluid released by the fluid-releasing holes comprises air

390. Keck discloses “fibers formed by extruding a molten thermoplastic material through a plurality of fine, usually circular, die capillaries as molten threads or filaments into converging high velocity, usually hot, gas (e.g. air) streams which attenuate the filaments of molten thermoplastic material to reduce their diameter, which may be to microfiber diameter.” Ex. 1004, ¶ 0035.

391. In addition, Fabbriante teaches that the meltblown die uses high velocity air to attenuate the filaments. Ex. 1018, column 5, lines 24-48.

392. Thus, the combination of Keck and Fabbicante discloses the elements of Claim 20.

Claim 21

The process according to claim 1 wherein the fibrous structure exhibits a pore volume distribution such that greater than about 40% of the total pore volume present in the fibrous structure exists in pores of radii of from about 121 μm to about 200 μm

393. Preparing a meltblown web having a pore volume distribution such that greater than about 40% of the total pore volume present in the fibrous structure exists in pores of radii of from about 121 μm to about 200 μm as recited in Claim 21 is within the routine skill of a POSA. Accordingly, Claim 21 is obvious in view of the combination of Keck and Fabbicante.

394. More specifically, it is well known that pore size, and hence pore size distribution, in meltblown webs varies depending on process conditions, such as processing temperatures, increasing air flow rate at the die, and decreasing the distance between the filament nozzles and the collection surface, and the speed of the collection surface. See, Bresee et al., *Influence of Processing Conditions on Melt Blown Web Structure: Part 1 – DCD*, INJ Spring 2004, 49-55 (Ex. 1025); Bresee et al., *Influence of Processing Conditions on Melt Blown Web Structure: Part 2 – Primary Airflow Rate*, INJ Summer 2005, 11-18 (Ex. 1026); and Lee et al. *Effects of Melt-Blowing Process Conditions on Morphological and Mechanical Properties of Polypropylene Webs*, POLYMER 1992, Vol. 3, No. 6, 1200-1209

(Ex. 1027). For example, it is known that changing one or more of the process parameters by increasing the air flow rate, decreasing the distance between the collection surface and filament nozzles, or increasing the speed of the collection surface is well known to decrease pore size in the meltblown web. Similarly, decreasing air flow rate, increasing the distance between the collection surface and filament nozzles, or decreasing the speed of the collection surface is also well known to increase pore size in the meltblown web. As such, it is reasonable to expect that obtaining a coform nonwoven having the recited pore size distribution is well within the routine skill of a POSA, and that doing such is merely an optimization of known parameters that affect pore size distribution.

395. Accordingly, the combination of Keck and Fabbriante discloses the elements of Claim 21.

Claim 22

The process according to claim 1 wherein the process further comprises the step of subjecting the fibrous structure to a thermal bonding operation

396. Keck discloses “pattern bonded” which is a process of bonding a nonwoven web in a pattern by the application of heat and pressure or other methods, such as ultrasonic bonding. Keck discloses that thermal pattern bonding typically is carried out at a temperature in a range of from about 80 C. to about 180° C. Ex. 1004, ¶ 0047. Keck also discloses that due to the fact that thermoplastic polymer fibers are usually semi-molten and tacky at the time of

incorporation of the secondary fibers, the secondary fibers are thermally bonded or joined to the thermoplastic polymer fibers. Ex. 1004, ¶ 0109.

397. Accordingly, the combination of Keck and Fabbriante discloses the elements of Claim 22.

Claim 23

The process according to claim 1 wherein the process is directly coupled to a post-processing operation

398. Keck discloses “pattern bonded” which is a process of bonding a nonwoven web in a pattern by the application of heat and pressure or other methods, such as ultrasonic bonding. Keck discloses that thermal pattern bonding typically is carried out at a temperature in a range of from about 80 C. to about 180° C. Ex. 1004, ¶ 0047. The ’801 Patent expressly discloses that post-processing operations as that term is used in the ’801 Patent includes thermal bonding operations. Ex. 1001, column 9, line 31-38. Keck also describes additional steps (post-processing operations) of depositing the second composite stream onto the deposited layer as a matrix of meltblown filaments and a secondary material to form a twolayer tufted coform nonwoven web. Ex. 1004, ¶ 0015-0018. The ’801 Patent expressly discloses that post-processing operations as that term is used in the ’801 Patent includes tuft-generating operations. Ex. 1001, column 9, lines 31-38.

399. Thermal bonding, such as the “pattern bonded” process described in Keck and the tufting-generation operations are typically performed during the manufacturing process of the nonwoven web. In fact, Keck describes that the tufting takes place immediately after the filaments are deposited on a collection surface. Accordingly, these steps are considered as being “directly coupled to a post-processing operation.”

400. Accordingly, the combination of Keck and Fabbriante discloses the elements of Claim 23.

Claim 24

The process according to claim 1 wherein the process is closely coupled to a post-processing operation

401. Keck discloses “pattern bonded” which is a process of bonding a nonwoven web in a pattern by the application of heat and pressure or other methods, such as ultrasonic bonding. Keck discloses that thermal pattern bonding typically is carried out at a temperature in a range of from about 80 C. to about 180° C. Ex. 1004, ¶ 0047. The ’801 Patent expressly discloses that post-processing operations as that term is used in the ’801 Patent includes thermal bonding operations. Ex. 1001, column 9, lines 31-38. Keck also describes additional steps (post-processing operations) of depositing the second composite stream onto the deposited layer as a matrix of meltblown filaments and a secondary material to form a two layer tufted coform nonwoven web. Ex. 1004, ¶ 0015-0018. The ’801 Patent

expressly discloses that post-processing operations as that term is used in the '801 Patent includes the application of lotions and mixtures. Ex. 1001, column 9, lines 31-38.

402. In addition, Keck describes preparation of cleaning sheets using the nonwoven web. Such cleaning sheets may include treatment with a liquid or other materials Ex. 1004, ¶¶ 0137-0140. The conversion of Keck's nonwoven web into such treated cleaning sheets typically occurs at a separate facility from that of manufacture of the nonwoven web and is therefore considered a "closely coupled" post processing operation.

403. Accordingly, the combination of Keck and Fabbriante teaches every element of Claim 24.

Ground 6: Claim 21 is obvious under 35 U.S.C. §103 based on the teachings of U.S. Patent No. 6,013,223 to Schwarz ("Schwarz '223") in view of U.S. Patent App. Publication No. 2003/0211802 A1 to Keck ("Keck") (Ex. 1004) or PCT Published Application No. WO 00/29658 ("McDowall") (Ex. 1003)), and in further view of United States Patent Application Publication No. 2007/0202766 to Ouellette et al. ("Ouellette") (Ex. 1028)

Claim 21

The process according to claim 1 wherein the fibrous structure exhibits a pore volume distribution such that greater than about 40% of the total pore volume present in the fibrous structure exists in pores of radii of from about 121 um to about 200 um

404. As discussed previously, it is well known that pore size, and hence pore size distribution, in meltblown webs varies depending on process conditions,

such as processing temperatures, increasing air flow rate at the die, and decreasing the distance between the filament nozzles and the collection surface, and the speed of the collection surface. Accordingly, providing a coform nonwoven having the recited pore size distribution is well within the routine skill of a POSA.

405. In addition, Ouellette explicitly discloses a nonwoven material for use as a wipe having a pore size distribution that overlaps with that recited in Claim 21 of the '801 Patent. Ex. 1029, abstract. More specifically, Ouellette teaches a nonwoven material having an optimized pore volume distribution in which at least 50 percent of its cumulative volume within pores as a radius size of about 110 to 250 microns. *Id.* Ouellette further teaches that the nonwoven material may be a meltblown or coform, and may include polypropylene and wood pulp fibers. *Id.*, ¶¶ 0019, 0058.

406. Ouellette explains that the “optimized pore volume distribution of the substrate enables it to controllably release a fluid composition effectively onto a surface.” *Id.*, Abstract.

407. Accordingly, the combination of Schwarz '223 with Keck or McDowall, and in further view of Ouellette teaches each and every element of Claim 21.

408. In addition, it is also clear that the combinations of 1) Schwarz '616 with either Keck or McDowall and in further view of Ouellette, and 2) Keck and

Fabbricante in further view of Ouellette teaches each and every element of Claim 21. As such, Claim 21 is also obvious in view of these additional grounds of invalidity.

409. A POSA would be motivated to modify any one of Schwarz '223, Schwarz '616, and Fabbricante in view of Keck or McDowall and in further view of Ouellette to have the recited pore volume distribution in order to provide a wipe that controllably releases a fluid composition onto a surface. That is, a POSA would be motivated to modify the combination of references in order to provide a more effective wipe.

X. Motivations to Combine the Prior Art

a. Motivations to Combine Schwarz '223 or Schwarz '616 with Keck or McDowall

410. A POSA would have been motivated to combine Schwarz '223 or Schwarz '616 (collectively “the Schwarz patents”) with Keck or McDowall because the Schwarz patents teaches that the meltblown die provides “unusually high production capacities.” Ex. 1002, column 1, lines 20-21. As discussed previously, the use of single row knife-edge dies has been a limiting factor in the production of meltblown nonwovens. This limitation has necessarily resulted in increased productions costs in terms of labor, energy, manufacturing space, and asset depreciation.

411. The advantages obtained with a multirow meltblown die of the Schwarz patents in comparison to a single row meltblown die were well known to the POSA prior to the earliest priority date of the '801 Patent. Indeed, these advantages are explicitly recognized by others in the nonwovens field. More specifically, in the Zhao publication the author recognized that the Schwarz multirow meltblown die breaks the limitation of requiring air from each side of the tapered die tip, which allows the number of rows of filament nozzles present on the die head to be increased without a tremendous capital expense. Ex. 1011.

412. In view of the obvious advantages of multitrow meltblown dies of the Schwarz patents, the POSA would be motivated to modify the meltblown systems described therein in view of Keck or McDowall to provide a coform nonwoven having significantly improved throughput. The POSA would be additionally be motivated by the potential reduction in costs associated with increases in productivity, which consequently would deliver superior economics in the production of a coform nowoven in comparison to a coform process using a single row meltblown die. The costs associated with manufacturing the coform nonwoven per unit would be decreased, which would consequently improve the manufacturer's competitiveness in the market and potentially provide a greater return on investment. For these reasons alone, the POSA would be motivated to combine the Schwarz patents with either Keck or McDowall.

413. Accordingly, there were strong economic motivations to further increase the productivity of prior art meltblown dies for use in the preparation of coform nonwovens.

414. Moreover, Schwarz '223 also teaches that the multirow meltblown die described therein provides improvements in fiber tenacity. The POSA would be motivated to modify Schwarz '223 in view of Keck or McDowall to provide a coform nonwoven having improved strength.

b. Motivations to Combine Keck and Fabbicante

415. A POSA would have been motivated to modify Keck in view of Fabbicante in order to provide a coform nonwoven exhibiting significantly improved strength.

416. More specifically, a POSA would have known that the multirow meltblown die taught in Fabbicante provides significant improvements with respect to strength in comparison to typical meltblown webs (prepared with a single row knife edge meltblown die). As noted in Fabbicante,

[t]he instant invention is based on the discovery that using the modular die design, in a melt blowing configuration at low pressure and low polymer flows per hole, continuous fibers of extremely uniform size distribution are created, which fibers and their resultant unbonded webs exhibit significant strength compared to typical unbonded melt blown or spunbond webs.

Ex. 1018, column 2, lines 41-48.

417. Accordingly, a POSA would have been motivated to modify Keck in view of Fabbicante to provide a process of preparing a fibrous structure (e.g., coform) that exhibits significant improvements in strength.

418. In addition, the POSA would be motivated to combine Keck with Fabbicante to provide higher polymer throughputs without the significant capital expense typically associated with machining a traditional meltblown die.

419. Finally, Fabbicante contemplates that the meltblown web may be used in combination with cellulose fibers, and also contemplates use of the meltblown web in a wiper application. In view of this suggestion, a POSA would be motivated to use Fabbicante's multirow meltblown die in a process to prepare a coform nonwoven, such as the coform process disclosed in Keck.

XI. Secondary Considerations of Non-Obviousness

420. The '801 Patent does not claim any unexpected results, because the results of combining a known process of preparing meltblown filaments using a multirow die with the well known coform process of adding wood pulp fibers to continuous meltblown or spunbond filaments was well known in the prior art prior to the earliest priority date of the '801 Patent.

XII. Conclusion

For foregoing reasons, it is my opinion that the claims of the '801 Patent are invalid for at least the following grounds:

Ground 1: Claims 1-3, 5-9, and 12-25 of the '801 Patent are unpatentable as being obvious over Schwarz '223 in view of Keck;

Ground 2: Claims 1-3, 5-9, and 12-25 of the '801 Patent are unpatentable as being obvious over Schwarz '616 in view of Keck;

Ground 3: Claims 1-3, 5-9, 14-15, and 20-25 of the '801 Patent are unpatentable as being obvious over Schwarz '223 in view of McDowall;

Ground 4: Claims 10-11 of the '801 Patent are unpatentable as being obvious over Schwarz '223 in view of Keck or McDowall and in further view of Bond;

Ground 5: Claims 1-4, 6-9, and 12-25 are unpatentable as being obvious over Keck in view of Fabbriante.

Ground 6: Claim 21 is unpatentable as being obvious in view of any one of Schwarz '223, Schwarz '616, or Fabbriante in combination with Keck or McDowall and in further view of Ouellette.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true.

I further declare that I made these statements 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: 9/15/2023



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EDUCATION

Ph. D. in Textile Engineering, Georgia Institute of Technology, Atlanta, GA	1990
M. S. in Textile Engineering, Georgia Institute of Technology, Atlanta, GA	1987
M. Tech. in Fiber Science & Technology, IIT, Delhi, India	1984
B. Tech. in Textiles, Bangalore University, India	1981

EXPERIENCE

July 2016 – Current, **Department Head, Textiles Merchandising & Interiors and Georgia Athletic Association Professor of Fibers and Textiles**, University of Georgia: Responsibilities include complete academic administration including budget, human resources, space management etc. Increased the department visibility, reputation and ranking by hiring several new faculty and mentoring them. Grew the department enrollment by 30% and increased the budget to improve the infrastructure for department. Faculty productivity increased with research funding, publications and presentations in international conferences, every year since 2016. Also conducting research in various areas of fibers and textiles. Setting up a Protective Fabrics Research Center with pilot lines.

January 2008–June 2016, Director, **Nonwoven Materials Research Laboratory**. As the director of UTNRL, expanded nonwoven materials research at the University of Tennessee, Knoxville (UTK). Established the only pilot line capability in the world to evaluate technologies for meltblown nanofiber nonwovens. Conducted research with many industries and helped them successfully develop new products. Worked with more than 50 corporations on contract research.

August 2006 – December 2007, **Associate Director, Textiles and Nonwovens Development Center**. Was responsible for the management of the nonwovens research center with half a million dollars per year in research expenditure and six employees.

August 2002 – June 2016, **Professor**, Materials Science and Engineering, UTK. Responsibilities included teaching, research, and service. Conducted research in different areas of polymer processing, including melt blown and spun bonded nonwovens, biodegradable nonwovens from cellulosic fibers, nanofibers, protective garments, processing recycled plastics, and high-performance fibers.

August 1990 – July 2002, **Assistant Professor**, 1990-1996, **Associate Professor**, 1996-2001, and **Professor, Department of Textile, Retailing and Interior Design**, UTK. Responsibilities included teaching, research, and service. Conducted research in different areas of polymer and fiber science. Taught textiles for Retailing and Interior Design students and other fiber science course.

Summer 2005, **Visiting Scientist**, NASA, MSFC Huntsville, AL, **Developed nonwoven-based multifunctional composites** for space applications, and CNT reinforced nanofibers.

Summers 1994, 1995, and 1997, **Visiting Scientist**, Air Force Office of Scientific Research, Phillips Laboratory, Edwards AFB, CA. **Produced hollow and solid fibers from Ultem** for micromaterial fabrication.

April 1990 – July 1990, **Research Engineer**, Image Carpets Inc., Rome, GA. Worked in the synthetic fiber plant producing carpet fibers from post-consumer recycled polyester (PET). Responsible for setting up an analytical laboratory to analyze the polymer and the fibers, and suggesting improvements to processing of recycled PET.

September 1984 – March 1990, **Graduate Research Assistant**, School of Textile and Fiber Engineering, Georgia Tech, Atlanta, GA. Conducted dissertation research on stabilization of acrylic precursors for carbon fibers. Completed special projects on structure and properties of high-speed melt-spun polyester/polyamide blends, feasibility of converting polyolefins into carbon fibers, and the degradation behavior of nylon marine ropes. Also worked on a DOE sponsored project dealing with the application of powdered chemicals to textile substrates by powder spraying and electrostatic deposition.

September 1981 – July 1982, **Technical Management Trainee**, J. K. Synthetics Ltd., Kota, India. Worked on all aspects of fiber production involving, nylon, nylon tire-cord, polyester and acrylic fibers.

HONORS AND AWARDS

TAPPI NET division Technical Achievement Award, 2014.

TechniTex India Research Achievement Award, 2008.

Fellow of The Textile Institute, 2005.

Best Paper Award, Association of the Nonwoven Fabrics Industry, 2004.

Distinguished Achievement Award, The Fiber Society, 1999.

Listed as Who's Who in Science and Engineering, Marquis Who's Who, 1997-present.

Nancy Belck Foundation Award, College of Human Ecology, 1997.

Outstanding Young Engineering Alumni from Georgia Tech, 1996.

Coordinating Officer, Graduate Student Senate, Georgia Tech, Atlanta, GA, 1986-1987.

Graduate Student Senate, Georgia Tech, Atlanta, GA, 1985-1986.

National Merit Scholarship Holder, India, 1974-1981.

Gold Medal in B. Tech. Textiles, Bangalore University, 1981.

SOCIETY MEMBERSHIPS

The Fiber Society, 1986-present.
The Textile Institute, 2004-present.
Sigma Xi Honor Society, 1995-2000.
Technical Association of the Paper and Pulp Industry (TAPPI), 2002-present
Phi Kappa Phi Honor Society, 1998-present.
Association of the Nonwoven Fabrics Industry (INDA), 1992-present.

PROFESSIONAL SERVICE

Editorial Board Member, Journal of Textile Science and Engineering (2013-current)
Editorial Board Member, Journal of Materials Science and Chemical Engineering (2013-current)
Editorial Board Member, International Journal of Textile Engineering and Processes (2016-current)
Editorial Board, Journal of Nanomaterials and Molecular Nanotechnology. (2012-current)
Area Editor, Journal of Engineered Fibers and Fabrics (JEFF) (2010-current)
Guest Editor, Journal of Nanomaterials (2011-current)
Editorial board member for the journal *Materials Manufacturing and Processes*. 1995-2003.
Co-Chair of the American Filtration Society Fall Conference (2015)
Member of Finance Committee, Lectureship Committee and the Governing Council of the Fiber Society, 2010-2012
Co-Chairman, American Filtration Society Annual Conference, June 2012.
Member of the scientific organizing committee ICONTEX, Istanbul Turkey October 2011.
Member of the Organizing Committee, Fiber Society Conference, Hong Kong, May 2011.
Member Organizing Committee, The Fiber Society International Conference, Bursa, Turkey May 2010.
Chair of the Technical Information paper (TIP) 1205-01, and Education Coordinator, TAPPI, 2006-2008.
President, The Fiber Society, 2009.
Vice President, The Fiber Society, 2008.
Member of the Governing Council, the Fiber Society, 2006-2007.
Chair of Distinguished Achievement Awards Committee, the Fiber Society (2007).
Departmental Representative, All College Council, UTK , 1993-1995 and 1999.
Organized the Spunbond-Meltblown Tutorial, and co-chaired a session on flame retardancy for INTC 07.
President, All College Council, UTK, 2000-01.
Member, Organizing Committees, INTC 2001-2007.
Member, Scientific Organization Committee, HPTEX (India), 2004.
Member, International Academic Committee, ITCM (Coimbatore, India), 2004.
Chair, Student paper session, INTC 2002.
Member, Organizing Committee, Beltwide Cotton Conference, 2001-**present**.
Session organizer, INDA -TAPPI Conferences, 2001-2002.
Member, Distinguished Awards Committee and the Governing Council, The Fiber Society, 2002-present.

Secretary, Sigma Xi Honor Society, UTK Chapter, 1999-2000.
President Elect, All College Council, UTK , 1999-2000.
General Chairman, Fiber Society General Technical Conference, Knoxville, TN, 1997.
Member, Library Selection Committee for the Department, UTK , 1993-96.
Chair, Faculty Development and Concerns Committee, College of Human Ecology, UTK , 1995.
Member, Adhoc Committee on Teaching Evaluation/Improvement, UTK, 1993.
Member, Adhoc Committee on Library Holdings, UTK, 1992.
Book Reviewer for the journal *Materials and Manufacturing Processes*. 1995-1998.
Symposium Organizer, ASME, Annual Winter Meeting, San Francisco, CA (with T. S. Srivatsan), 1995.
Reviewed research papers for many different journals such as Journal of Applied Polymer Science (1997-current), Journal of Textile Institute (2000-current), Journal of Industrial Textiles (2004-current), Journal of Engineered Fibers and Fabrics (2007-08), Journal of Nanomaterials, Journal of Materials Science (2005-current), Polymer Engineering and Science (2008) and Journal of Engineered Fibers and Fabrics.

TEACHING EXPERIENCE

TXMI 8180 – Physics of Polymers and Fibers
TXMI 2100 – Textiles for Consumers
TXMI 3500 - Textiles
MSE 201- Introductions to Materials Science & Engineering
TS 120 – Textiles for Consumers
TS 524 - Advanced Dyeing and Finishing
MSE 220 - Selection of Soft goods
MSE 340 - Principles of Polymeric Materials
MSE 370 - Materials Processing
MSE 552 - Fiber Science (developed the course)
MSE 555 - Nonwovens Processing and Characterization (developed the course)
MSE 652 - High Performance Fibers

FUNDED RESEARCH GRANTS

2022-Current	"Materials for Next Generation PPF," NIST through AFFOA, \$460,000
2020-Current	"Advanced Personal Protective Fabrics," AFFOA/DoD. \$1,100,000
2018-current	"Antimicrobial Coating of Nonwovens for Filter Media and other Applications" Kimmering Associates.
2017-current	"Evaluation of Spa Filters," Pleatco.
2017-19	"Elastomeric Cotton Nonwovens," USDA.
2016-17	"Flame Retardant Cotton Nonwovens," US Army.
2015-16	"Meltblowing studies with Various Lignin Compositions," ORNL
2014-15	"Cotton rich Nonwovens and Composites," Cotton Incorporated.
2014	"Meltblowing Carbon Fiber Precursors," ORNL.
2013-2016	"Improved Carbon Nanotube Fibers through Crosslinking and Densification," NASA.
2008 - 2016	"Nonwovens Research and Service for Industry"- UTNRL through Multiple Corporations (25+ companies).
2012 - 2013	"Meltblown Nanofibers," UFI, Italy.
2011 - 2013	"Monolayer Coating of Inorganic Membranes, ORNL
2010 - 2014	"Nanoparticle Reinforced Nonwoven-Based Composites, ONR.
2009 – 2011	"Nanofiber Nonwovens," Ethicon, J&J
2008 – 2010	"Processing and Evaluation of Meltblown Nonwovens," Lubrizol.
2008 – 2009	"Meltblown Nonwovens from PLA," Natureworks, LLC.
2008 – 2009	SARIF grant, UTK, for the purchase a nanofiber die assembly.
2007 – 2010	"Durable Flame Retardants for Cotton Nonwovens," Cotton, Inc.
2007 – 2009	"Fibers from a High Temperature Polymer," Celanese-Ticona.
2007 – 2008	"Structure and Properties of Biopolymer Nonwovens," Ethicon.
2006 – 2008	"Flame Retardant Cotton-Based Nonwovens," USDA.
2006	"Evaluation of Cotton-Based Wipes," Cotton Inc.
2006 – 2008	"Polyethylene Based Composites for Space Applications," NASA.
2006 – 2008	"Evaluation of Nanoclay Reinforced Films and Fibers" Techmer PM (though the Center for Materials Processing (CMP), UTK.
2005 – 2006	"Evaluation of Degradability of Polymer Films," Cyclotron Systems, Inc (CTI).
2005	SARRIF Equipment Award, UTK (with L.C. Wadsworth).
2004 – 2005	"Material Variables in Thermal Bonding," Nonwovens Cooperative Research Center (NCRC), North Carolina State University.
2002 – 2003	"Evaluation of TiO ₂ and Other Additives," GV PolyTex, Inc.
2003 – 2004	"Cotton Based Composites for Automotive Applications, Cotton, Inc.
2002 – 2003	"Acquisition of a Multi-Stage Tensile Tester," UTK SARIF Award.
2001	"Biodegradable Composites from Cellulosic Fibers," Professional Development Award, UTK.
2000 – 2001	"Biodegradable Nonwovens from Cotton Fibers," Cotton, Inc.
1999 – 2002	"Disposable Nonwovens Incorporating Cotton and Other Natural Fibers," USDA (with K. E. Duckett).
1999 – 2000	"Evaluation of the 3-D Donning Test," Beiersdorf Jobst, Inc.
1999	"Fabrication of Nonwovens from Cotton/Cellulose Acetate Blends," Cotton, Inc.

1998 – 2000 “Role of Fiber Morphology in Thermal Bonding,” NCRC, NCSU, Raleigh (with J. E. Spruiell).

1998 “Filtration of Odors from Poultry Farms,” Agricultural Exptl. Station, UTK.

1997 “Evaluation of Hollow Ultem Fibers Hughes,” Hughes STX Corp.

1997 Nancy Belck Faculty Enrichment Award, College of Human Ecology, UTK.

Summer 1997 “Production of Hollow Polyimide and Carbon Fibers,” for conducting research at Edwards AFB, CA, Air Force Office of Scientific Research.

Summer 1997 “Processing and Characterization of Carbon Fibers from Special Precursors,” Southeastern Universities Research Association, Washington, DC.

1996 – 1997 “Melt Blowing of Metallocene Polypropylene,” Exxon Chemical Company (with S. Malkan).

1995 – 1997 “Fabrication of Nonwovens from Cotton/Cellulose Acetate Blends,” Cotton, Inc. (with K. E. Duckett).

1995 – 1996 “Carbon Fibers from Polyimide Precursors,” Professional Development Research Award from UTK.

1994 – 1995 “Evaluation of the Processability of Polymer Blends,” Techmer PM.

1995 “Investigation of the Spinnability of Specialty Polymers,” Summer Faculty Support to Conduct Research at the Phillips Laboratory, Edwards AFB, CA, Air Force Office of Scientific Research.

1994 – 1995 “Evaluation of the Performance Properties of Composite Nonwoven Fabrics,” PolyBond Inc

1994 – 1995 “Characterization of Polyetherimide Fibers,” Phillips Laboratory, Edwards AFB, CA, Sept. 1995.

1994 “Polyetherimide Fibers: Production, Processing and Characterization,” Summer Faculty Support to Conduct Research at the Phillips Lab., Edwards AFB, CA, Air Force Office of Scientific Research.

1993 “Rheological Behavior of Spunbonded Polypropylene Fibers,” Exxon Chemical Company. (with S. R. Malkan and L. C. Wadsworth)

1992 – 1994 “Biodegradability of Cotton/Cellulose Acetate Nonwoven Fabrics,” Professional Research Award from UTK (with K. E. Duckett).

1992 – 1993 “Thermal Analysis of Polymeric and Textile Materials,” Exxon Education Foundation.

1992, “Evaluation of Experimental Nonwoven Composite Fabrics,” Poly-Bond, Inc.

1991 – 1993 “Recycled Polymers Program,” Consortium Sponsored Research. (with M. Dever and L. C. Wadsworth).

1991, “Investigation of Rapid Stabilization of Acrylic Fibers,” from Southeastern Universities Research Association to conduct research at ORNL, Washington, DC.

1991 – 1992 “Use of Compatibilizers to Process the Post-Consumer Recycled Commingled Plastics to Produce Nonwovens,” Research Award, UTK.

1991, “Processing Studies and Performance Characterization of Melt Blown Nonwoven Fabrics Made from Commingled Recycled Plastics,” from the Center for Plastics Recycling Research, Rutgers, NJ (with M. Dever and L. C. Wadsworth).

PUBLICATIONS

Refereed Journal Articles:

S. Islam and G. Bhat, “A model for predicting thermal conductivity of porous composite materials,” *Heat Mass Transfer* (2023). <https://doi.org/10.1007/s00231-023-03380-w>

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<https://doi.org/10.1016/j.jobbe.2023.105979>

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<https://doi.org/10.1016/j.dt.2022.06.007>

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S Islam, M. El. Messiry, P. P. Sikdar, J. Seylar, and G. Bhat, "Microstructure and Performance Characteristics of Acoustic Insulation Materials from Post-consumer Recycled Denim Fabrics," *Journal of Industrial Textiles*, 1-27 (2020). <https://doi.org/10.1177/1528083720940746>

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<https://doi.org/10.1016/j.sna.2020.112174>

H. G. Atasagun and G.S. Bhat, "Advancement in Flushable Wipes: Modern Technologies and Characterization," *Journal of Industrial Textiles*, 49(6), 722-747 (2020).
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G. Chen, G. S. Bhat, H. Azari, "Electret Characteristics of Meltblown Polylactic Acid Fabrics for Air Filtration Application," *Journal of Applied Polymer Sci.* 1-6 (2020).
DOI:10.1002/app.48309

H. Sun, Y. Xian, Y. Lai, H. Zhang, B. Yu, Y. Liu and G. Bhat, "Evaluation of Mercury Ions Adsorption Capacity of Copper-based Metal organic Frameworks/Poly(lactic acid) Composites," *Polymer plastics Technology and Materials*, (2019) pp 1-12.
<https://doi.org/10.1080/25740881.2019.1669648>

H. G. Atasagun and G. S. Bhat, "Assessing the Structural, Mechanical and Dispersible Characteristic of Flushable Nonwovens," *Textile Research Journal*, 1-12 (2019).
<https://doi.org/10.1177/0040517519873055>

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<https://doi.org/10.1016/j.jenvman.2019.109536>

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G. S. Bhat and M. El-Messiry, "Effect of Microfiber Layers on Acoustical Absorptive Properties of Nonwoven Fabrics," *Journal of Industrial Textiles*, 1-21 (2019).
DOI:10.1177/1528083719830146

M. C. Evora, X. Lu, N. Hiremath, N. G. Kang, K. Hong, R. Uribe, G. Bhat and J. Mays "Single-step Process to Improve the Mechanical Properties of Carbon Nanotube Yarn," *Beilstein journal of Nanotechnology* 9, 545 (2018).

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H. G. Atasagun and G. Bhat, "Evaluation of Mechanical and Dispersible Properties of Flushable Nonwovens," Proceedings of the 7th International Textile Congress, Izmir ,Turkey, October 10-12, 2018.

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G. S. Bhat, "Nonwovens Processes and Products: Recent Advances and Future Trends," International Textile Fair – Preview in Daegu, Daegu, S. Korea, March 8-10, 2017.

G. S. Bhat, "Recent Advances in Nanofiber Technologies and Multifunctionality for Next Generation Fabrics," Proceedings of the TEXFO 2017 – Global Textile and Vision Forum, Daegu, S. Korea, March 8-10, 2017.

G. Bhat, "Meltblown Nanofiber Webs for Filter Media and other Applications: Recent Developments and Future Prospects," International Symposium on High Temperature bag Filter Technology, Shanghai, China, October 11-12, 2016.

G. Bhat, Y. Yesil and V. Shah, "Recent Advances in Polyolefin Meltblown Nonwovens," Proceedings of the SPE Polyolefins Conference, Houston, TX February 20-23, 2016.

G. Bhat, "Meltblown Submicron Fibers: Recent Advances and Future Prospects," Proceedings of the INDA RISE Conference, Miami FL, February 11-14, 2015.

V. K. Srivastava, R. A. Quinlan, A. L. Agapov, K. M. Nelson, A. P. Sokolov, G. S. Bhat, and J. W. Mays. "Simple macroscopic tailoring of 2D layered hexagonal materials using redox-liquid exfoliation." In *Abstracts of Papers of The American Chemical Society*, Vol. 247. 1155 16th St, NW, Washington, Dc 20036 USA: Amer Chemical Soc, 2014.

G. Bhat, "Meltblown Submicron Fiber Nonwovens: Recent Developments and Future Prospects," Proceedings of the Asia-Africa Symposium 9, Hangzhou, China, November 24-26, 2014.

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G. S. Bhat, J. Fogle, J. Mays and V. Srivastava, "Energy Absorbing Nanocomposite Materials and Methods thereof," U.S. Patent No. 11,754,374 (issued September 12, 2023).

R. Vempati and G. S. Bhat, "Nanophase Mn (VII) oxide (NM7O) and Nanophase Mn (III) Oxide (NM3O) Incorporated Nonwovens," U.S. Patent 8,163,036, Issued April 21, 2012.

G. S. Bhat, V. Narayanan and L. C. Wadsworth, "Dimensionally Stable Polyester Films, Fibers, Yarns and Melt Blown Nonwovens," U. S. Patent 5,753,736 (issued May 19, 1998).

K. E. Duckett, G. S. Bhat and Hagen Suh, "Compostable/Biodegradable Nonwovens," U.S. Patent 5,783,505 (issued July 21, 1998).

L. H. Peebles, Jr., A. S. Abhiraman and G. S. Bhat, "Method for Stabilization of PAN-Based Carbon Fibers," *U. S. Statutory Invention Registration* - H1052 (May 5, 1992).

PRESENTATIONS

"Sustainable Fibers and Textile Products: Current Status and Future Potential," International Conference on Sustainable Materials, Management, and Innovative Technologies 2022 (ICSMMIT), Coimbatore, India, June 23-24, 2022. (Invited Talk)

"Surface Modification and Nanocomposite Coating on UHMWPE Fabrics," Techtextile North America, Atlanta, GA, May 17-19, 2022 (poster by Talon Shaw).

"Barrier and Performance Properties of Melt blown Nonwovens," Techtextile North America, Atlanta, GA, May 17-19, 2022 (poster by Partha Sikdar).

"Performance Properties of Water Based Polyurethane Coated Hydroentangled Cotton Nonwovens," Techtextile North America, Atlanta, GA, May 17-19, 2022 (poster by Avik Dhar).

"Effect of Processing Conditions on Wash Durability and Tensile Properties of Nanoparticle Coated UHMWPE Yarns," UGA CURO symposium April 4-5, 2022 (by Aysiah Gibbs).

"The Effect of Surface Modification on UHMWPE Fabrics and Their Polyurethane/Tungsten Disulfide Composites for Ballistic Applications," UGA CURO symposium April 4-5, 2022 (by Talon Shaw)

“Advances in Nonwoven Technical Textiles and Personal Protective Fabrics,” ITS Symposium 22, Alberta, Canada (Virtual), March 8-9 (2022).

“Modernization of PPE Supply Chain: Melt Blown and Mask Production Pilot Lines,” AFFOA Annual Member Event, MIT, Boston, October 20-21 (2021).

“Structure and Properties of Insulation Materials from Recycled Fabrics,” International Webinar on Textile Waste as a Resource for Technical Textile Applications, Coimbatore, India, July 29-30 (2021).

“Structure and Properties of Thermal and Acoustic Insulation Materials from Recycled Fabrics,” Materials Info 2021, Mind Authors Scientific Conference, March 29 (2021).

“Environmentally Friendly Thermal and Acoustic Insulation Materials from Recycled Fabrics, Webinar on Recycling and Waste Management, London – Virtual Conf. Nov.9-10 (2020).

“Processing and Performance of Value-Added Products from Recycled Textiles,” AFFOA Virtual Event, MIT, Boston, Virtual, October 7-8 (2020).

“Sustainable Polymers and Fibers for Nonwovens: Current Status and Future Potential,” INDA RISE Conference, Raleigh, NC, Virtual, September 28-30 (2020).

“Advances in Melt Blown Technology for Submicron Fibers, and its importance in the Covid19 Crisis,” International Conference on Recent Trends in Textile and Fashion, Jalandhar, India Virtual, June 22-25 (2020)

“Recent Developments in Nanofiber Technologies and Multifunctionality for Next-Generation Textile Materials,” G. Bhat, In *The 15th Asian Textile Conference (ATC15)*, Shaoxing/ Hangzhou, China (2019) Keynote Speaker.

“Microstructure And Performance Properties Of Meltblown Nanofiber Nonwovens From A Biodegradable Polymer,” G. Bhat and H. Azari, In *4th International Symposium on Materials from Renewables*, Athens, GA October 2019.

“Development Of Sustainable Building Insulation Materials From Textile Waste,” Islam, S. and Bhat, G., Poster session presented at the meeting of 4th International Symposium on Materials from Renewables (2019) (by S. Islam).

“Mechanical and Dispersible Properties of Some Commercial Flushable Nonwovens,” Atasagun, H., Wu, S., & Bhat, G. Poster session presented at the meeting of 4th International Symposium on Materials from Renewables (2019) (by S. Wu).

“Effect of Processing Conditions on the Structure and Properties of Melt Blown Polylactic Acid (PLS) Nonwovens,” Azari, H., and Bhat, G. Poster session presented at the meeting of AATCC International Conference, Fort Worth, TX (2019) (by H. Azari).

“Barrier and Mechanical Properties of Composite Nonwovens Produced from Hydroentangling Cotton Fibers with Elastomeric Webs,” Sikdar, P., Hinchliff, D., Condon, B., and Bhat, G., Poster session presented at the meeting of AATCC International Conference, Fort Worth, TX (2019) (by P. Sikdar).

“Structure and Properties of Polypropylene Graphene Composite Filaments,” Azari, H., Hiremath, N. S., Bhat, S., and Bhat, G., Poster session presented at the meeting of Techtextil 2019, Raleigh, NC (by H. Azari).

“Barrier and Mechanical Properties of Composite Nonwovens from Cotton Fibers with Elastomeric Webs,” Sikdar, P. P., Hinchliff, D., Condon, B., and Bhat, G., Poster session presented at the meeting of Techtextile 2019, Raleigh, NC (by P. Sikdar).

“Environmentally-Friendly Acoustic Insulation Materials from Post-Consumer Recycled Fabrics,” Islam, S., Sikdar, P. P., El Messiry, M., Seylar, J., and Bhat, G., Poster session presented at the meeting of Techtextile 2019, Raleigh, NC ((by S. Islam).

“Preliminary Studies on Development of Lightweight Ballistic Materials: Effect of Coating Nonwovens,” Wu, S., and Bhat, G., Poster session presented at the meeting of Techtextile 2019, Raleigh, NC (by S. Wu).

“Nanofiber Nonwovens from A Biodegradable Polymer By Meltblowing,” G. Bhat and H. Azari, Nanotech 2018, Valencia, Spain, December 3-5, 2018.

“Effect of Process Parameters On Air Permeability And Hydrostatic Pressure Of Polypropylene Nonwovens Produced By Melt Blowing,” N. Hoda, P. Sikdar, G. Bhat, 7th International Technical Textiles Congress, Izmir, Turkey, October 10-12, 2018 (by N. Hoda).

“Evaluation Of Mechanical And Dispersible Properties Of Flushable Nonwovens,” H. Atasagun and G. Bhat, 7th International Technical Textiles Congress, Izmir, Turkey, October 10-12, 2018 (by H. Atasagun).

“Influence of Chemical Pretreatments on Processing, Structure and Properties of Rayon-Based Carbon Fibers,” Fiber Society Conference, Tokyo, Japan, June 2018.

“Recent Advances in Meltblown Nanofiber Nonwovens,” Nanofiber Symposium 2018, Tokyo, Japan June 2018.

“Processing, Structure and Properties of Melt Blown Nonwovens from a Sustainable Polymer,” Techtextile Symposium, Atlanta, GA, May 2018. (by Homeira Azari)

“Mechanical and Dispersible Properties of Some Commercial Flushable Nonwovens,” Techtextile Symposium, Atlanta, GA, May 2018. (by Shuangyan Wu)

“Elastic Nonwovens Containing Cotton Fibers,” Techtextile Symposium, Atlanta, GA, May 2018. (by Partha Sikdar)

“Nanoparticle Reinforced Elastomeric Nonwoven-based Composites for Ballistic Protection,” Techtextile Symposium, Atlanta, GA, May 2018.

“Structure and Properties of Nanoparticle Reinforced Elastomeric Nonwoven-based Composites,” TAPPI NET Conference, Charlotte, NC April 2018.

“Raising the Bar: Can IoT improve Fitness and Performance,” In *IoT Tech Expo North America*. Santa Clara, CA, November 2017.

“Nanophase Manganese Oxide-Violet and Nanophase Carbonate Coated Fabrics for Chem-Bio Suits and other Military Applications,” In *CBD S&T Conference*, Anaheim, CA, November 2017.

“Structure and Properties of Inorganic Fullerene Reinforced Elastomeric Nonwoven-based Composites,” In *the Fiber Society Fall Technical Conference*, Athens, GA November 2017

“Effect of Process Parameters on Fiber Diameters of Polypropylene Microfibers Produced by Melt Blowing in a Biax Line,” In *the Fiber Society Fall Technical Conference*, Athens, GA, November 2017.

“Structural and Mechanical Properties of Commercially Available Flushable Nonwovens,” Poster presented at *The Fiber Society Fall Technical Conference*, Athens, GA, November 2017. (*presented by H. Atasgun*)

“Sustainability in Carpet Industry: Challenges and Recent Developments,” Poster presented *The Fiber Society Fall Technical Conference*, Athens, GA, November 2017. (*presented by V. Caldwell*)

“Structure and Properties of Polypropylene Graphene Composite Filaments,” Poster at *The Fiber Society Fall Technical Conference*, Athens, GA, November 2017. (*Presented by H. Azari*)

“Structure and Properties of Melt Blown Polyetherimide as High Temperature Filter Media,” in *ICTEYM Conference*. Stockholm, Sweden, July 2017

“Jute Fiber Nonwovens and Composites for Waste,” In *TEX India 2017*, Ahmedabad, India, June 2017.

“Sustainability in Electronic Textiles,” In *WEAR Conference*. San Francisco, CA, June 2017.

“Nonwovens Processes and Products: Recent Advances and Future Tends,” International Textile Fair – Preview in Daegu, Daegu, S. Korea, March 8-10, 2017.

“Recent Advances in Nanofiber Technologies and Multifunctionality for Next Generation Fabrics,” *TEXFO 2017 – Global Textile and Vision Forum*, Daegu, S. Korea, March 8-10, 2017.

“Nanofibers from the Meltblowing Process: Recent Developments and Future Opportunities,” Seoul National University, Seoul, S. Korea, March 7, 2017.

“Meltblown Nanofiber Webs for Filter Media and other Applications: Recent Developments and Future Prospects,” International Symposium on High Temperature bag Filter Technology, Shanghai, China, October 11-12, 2016.

“Development of Structure and Morphology in Meltblown Nanofiber Nonwovens,” NART2016 – Nanofiber Applications and Related Technologies, Raleigh, NC, Sept. 13-15, 2016.

“Compositional Analysis of Polymer Blends Using Differential Scanning Calorimetry and Thermogravimetric Analysis,” J. Seylar and G. Bhat, National Council for Undergraduate Research, Asheville, NC, April 7-9 2016 (presented by J. Seylar)

“Submicron Fiber Nonwovens from Ingeo® a Sustainable Polymer,” American Filtration Society Fall Conference, Franklin, TN, October 5-8, 2015. (presented by K. Akato)

“Activated Carbon from Recycled-Cotton Fibers for Filter Media Applications,” American Filtration Society Fall Conference, Franklin, TN, October 5-8, 2015. (presented by N. Hiremath)

“Structure and Properties of Nanoparticle Reinforced Nonwoven-based Composites,” Advanced Nano,” International Conference on Advanced Nanomaterials, Ottawa, Canada, August 10-12, 2015

“Commercially Feasible Production of Nanofiber Webs by Meltblowing,” Chemical and Biological Defense Science and Technology (CBD S&T) Conference, St. Louis, MO, May 12-14, 2015.

“Processing and Characterization of Nonwoven-Based Composites from Recycled Denim Fiber for Automotive Applications,” TAPPI NET Conference, Atlanta, GA, April 20-22, 2015.

“Effect of Processing Conditions on the Structure and Properties of Cellulosic Precursor-Based Carbon Fibers,” Carbon Fibers and Composites Workshop, Oak Ridge, TN April 16-17, 2015

“Structure and Properties of CNT Yarns,” Carbon Fibers and Composites Workshop, Oak Ridge, TN April 16-17, 2015 (by Nitilaksha Hiremath).

“Meltblown Submicron Fibers: Recent Advances and Future Prospects,” Proceedings of the INDA RISE Conference, Miami FL, February 11-14, 2015.

“Structure and Properties of Multifunctional Nanoparticle Reinforced Textile Materials and Composites,” Naval Future Conference, Washington, DC, January 4-5, 2015

“Meltblown Submicron Fiber Nonwovens: Recent Developments and Future Prospects,” Asia Africa Symposium 9, Hangzhou, China, November 24-26, 2014.

“Recent Developments in the Processing Melt Blown Nanofibers for Filter Media,” AFS Fall Conference, Chicago, IL, October 13-15, 2014.

“Meltblown Nanofiber Webs: Recent Developments and Future Prospects,” COST workshop on Electrospinning, Bilkent University, Ankara, Turkey, June 11-13, 2014.

“Coating of Membranes for Biomass Separation,” North American Membrane Society, Spring Meeting, Houston, TX, May 31- June 4, 2014. (by V. Kandagor)

“Nonwovens Process Tutorial,” TAPPI NET Conference, Nashville, TN, April 28-30, 2014.

"Antibacterial Nonwovens using Nanophase MN Oxide ," TAPPI NET Conference, Nashville, TN, April 28-30, 2014.

“Structure & Properties of Melt Blown Submicron Fiber Nonwovens from Polypropylene,” TAPPI NET Conference, Nashville, TN, April 28-30, 2014.

“Filtration Efficiency of Submicron Filters,” TAPPI NET Conference, Nashville, TN, April 28-30, 2014. (by S. Ramkumar).

“Processing Structure and Properties of Melt Blown Polyetherimide” TAPPI NET Conference, Nashville, TN, April 28-30, 2014. (by V. Kandagor)

"Effect of Quenching on the Structure and Properties of Melt Blown Polyurethane Nonwovens” TAPPI NET Conference, Nashville, TN, April 28-30, 2014. (by Yalcin Yesil).

“Meltblowing A Novel Approach to Produce Nanofibers,” TTRI Conference, Taipei, Taiwan, October 2013.

“Polymeric Coatings of Inorganic Membranes ,” North American Membrane Society Conference, Boise, ID, June 2013 (by V. Kandagor).

“Monolayer Polymeric Coatings to Enhance the Performance of Inorganic Membranes for Biomass Filtration,” AFS Conference Minneapolis, (MN) May 2013 (by V. Kandagor).

“Structure and Properties of Melt Blown Submicron Fiber Nonwovens,” the Fiber Society Conference, Geelong, Australia (May 2013).

“Submicron Fiber Nonwovens from a Sustainable Polymer for Filter Media,” AATCC Conference, Greenville, SC (April 2013).

Other Invited Presentations:

“Recent Advances in Melt Blown Nonwovens and Personal Protective Fabrics,” Department of Textile and Fiber Engineering, IIT Delhi, Dec 14, 2022

“Advances in Melt Blown Nonwovens and PPF,” Department of Textile Technology, NIT, Jalandhar, Nov. 30, 2022

“Advances in Meltblown Nonwoven and Personal Protective Fabrics: Learnings from the Pandemic,” College of Engineering, UGA, March 14 (2022).

“Advances in Melt Blown Nonwovens and Personal Protective Fabrics,” TMI Graduate Seminar Series, UGA, December 2021.

“Overview of Georgia Textile Industry and UGA Textile Program,” Virtual Event: Georgia’s Role in the Textile Industry: Research & Company Perspectives, USA-Germany Collaboration, June 23, 2021

“Nonwovens in Filtration: An Overview on Nonwoven Products and Process Technologies,” Waterloo Filtration Institute, Virtual March 23, 2021

“Melt Blown Nonwovens and Face Masks for Covid19 and Beyond,” TMI Seminar Series, UGA, September 2020.

“An Overview on Nonwoven Products and Process Technologies,” Waterloo Filtration Institute, Virtual May 12, 2020.

“Hospital Air Filtration and Facemasks to fight Covid 19,” Waterloo Filtration Institute, Webinar, April 23, 2020.

“Nonwovens Research at UTNRL and Role of COE.” Zirve University, Gaziantep, Turkey, June 16, 2014

“Meltblown Nanofiber Webs: Processing, Structure And Properties.” Pamukkale University, Denezli, Turkey, May 21, 2014

“Meltblown Nanofiber Webs: Processing, Structure And Properties,” University of New south Wales, Sydney, Australia, May 16, 2013.

“Nonwoven-based Compostable Automotive Composites,” International R&D Project Brokerage Event, Bursa, Turkey, April, 2013.

“Durable Flame Retardant Treatments for Cotton-based Nonwovens,” International R&D Project Brokerage Event, Bursa, Turkey, April, 2013.

PRIOR EXPERT WITNESS EXPERIENCE

1. *Kimberly-Clark Corp. v. Extrusion Grp.*, Civil Action File No. 1:18-cv-04754-SDG (N.D. Ga. Jul. 15, 2020).
2. *Precision Fabrics Grp., Inc. v. Tietex Int'l, Ltd.*, 367 F. Supp. 3d 487 (D.S.C. 2019).
3. *Stretchline Intellectual Props. Ltd. v. H&M Hennes & Mauritz LP*, CIVIL ACTION NO. 2:10-cv-371 (E.D. Va. Sep. 3, 2015)
4. *Alpha Pro Tech, Inc. v. VWR Int'l LLC*, CIVIL ACTION No. 12-1615 (E.D. Pa. Nov. 25, 2013).