

Nonwoven laminate wiper

This invention relates to nonwoven laminate wipers, in particular wipers useful for a wide variety of industrial and consumer applications including those in the automotive, food services, and electrical industries as well as for general purpose household wiping. Such wipers must be low cost and yet provide the strength, absorbency, cloth-like character and other properties desirable for such wiping applications. Nonwoven fabrics, in general, have received wide acceptance as nonwoven disposable wipers both for specific applications and general purpose wiping. For many such applications nonwoven wipers can out-perform traditional cloth and paper wiping products. However, for some applications, it is desired to improve even further certain nonwoven wiper properties such as resistance to linting and streaking, and it is generally desirable to increase wiper absorbency and strength.

U.S. Patent 4,307,143 to Meitner issued 22 December 1981 describes meltblown microfiber wipers treated with a surfactant and embossed. Such wipers are demonstrated to have improved absorbency and wiping properties when compared with traditional wiper materials. U.S. Patent 4,298,649 to Meitner dated 3 November 1981 describes a multi-component nonwoven wiper having a layer of meltblown microfibers combined with a split film or fibrillated foam layer. This wiper exhibits low metal chip pick-up characteristics of particular interest in the automotive finishing application. This property is obtained without significant deterioration in wiping properties. U.S. Patent 4,328,279 to Meitner and Englebert dated 4 May 1982 relates to a meltblown nonwoven wiper treated with certain surfactants

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to result in low sodium content of particular interest in electronics industry wiping application. U.S. Patent 4,041,203 to Brock and Meitner dated 9th August 1977 relates to nonwoven fabrics and sterile wrapper materials made by combining layers of meltblown thermoplastic fibers with one or more continuous thermoplastic filament layers. The disclosure recognizes that such materials can be treated for absorbency and used in wiper applications. U.S. Patent 4,196,245 to Kitson, Gilbert, Jr., and Israel dated 1 April 1980 relates to a composite nonwoven fabric useful in disposable surgical items and which can comprise one or more meltblown layers loosely bonded to one or more spunbonded layers.

15 The preparation of polyolefin microfiber webs is known and described, for example, in Wendt, Industrial and Engineering Chemistry, Vol.48, No.8 (1956) pages 1342 through 1346 as well as in U.S. Patents Nos. 3,978,185 to Buntin et al issued 31 August 1976, 3,795,571 to Prentice, issued 5 March 1974, and 3,811,957 to Buntin issued 21 May 1974. The Buntin et al patent further discloses that mats of meltblown polyolefins are useful in wiping cloths and hydrocarbon absorption material.

25 Production of substantially continuous filaments is also known, and illustrative techniques are set forth in Kinney U.S. Patents 3,338,992 and 3,341,394, Levy U.S. Patent 3,276,944, Peterson U.S. Patent 3,502,538, Hartmann U.S. Patents 3,502,763 and 3,509,009, Dobo U.S. Patent 3,542,615 and Hamon Canadian Patent 803,714. Reference may also be had to the above identified Brock and Meitner U.S. Patent 4,041,203 for methods of producing combinations of meltblown thermoplastic fibers and continuous filament thermoplastic fibers. U.S. Patent 4,340,563 dated 20 July 1982 and assigned to Kimberly-Clark Corporation, describes an alternative method for producing continuous filament thermoplastic webs.

It is an object of the present invention to provide an improved nonwoven wiper having low lint and reduced streaking characteristics while also demonstrating improved absorbency.

5 According to one aspect of the invention there is thus provided a wiper comprising a laminate including an inner web having a basis weight in the range of from 17 to 170 g/m² comprising meltblown thermoplastic microfibers having an average diameter
10 in the range of up to 10 microns and treated with a surfactant and, on both sides of said inner web, an outer web having a lower basis weight than said inner web and comprising generally continuous thermo-
15 plastic filaments having an average diameter in excess of 10 microns and optionally being treated with a surfactant, wherein the ratio of the weight of said inner web to the combined weights of said
20 outer webs is at least 54:31 and the basis weight of said outer web is in the range of from 7 to 34 g/m².

The wiper of the invention is a combination of a relatively high basis weight layer of meltblown thermoplastic microfibers having on either side thereof a relatively lightweight layer of continuous
25 filament thermoplastic fibers of larger diameter. Preferably all components are treated with a surfactant for wettability, and the combination is preferably bonded by the application of heat and pressure at bond regions distributed over the surface of
30 the laminate. The resulting wiper is fabric-like, conformable, and useful for many industrial applications as well as general purpose wiping. Preferred thermoplastic materials are polyolefins, such as polypropylene, and the individual components are preferably made
35 from the same polymer or polymers having similar melt temperatures. Preferred surfactants include ionic and nonionic surfactants, such as dioctylester of sodium sulfosuccinic acid (Aerosol OT).

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Meltblown webs produced for the wipers of the present invention are preferably manufactured in accordance with the process described in U.S. Patent 3,978,185 to Buntin et al dated 31 August 1976 to which reference may be made for details of the meltblown process. Although the example below was carried out with polypropylene, it will be understood that the invention is not limited thereto and that other thermoplastic polymers capable of meltblowing, including polyethylene, polyesters, and polyamides, may be utilized as well. It is also desirable, in some cases, to incorporate other materials into the inner meltblown web such as for example cellulose fibers, staple fibers or woodpulp. Such webs are described in U.S. Patent 4,100,324 to Anderson, Sokolowski and Ostermeier dated 11 July 1978. For best results, in accordance with this invention, the inner webs contain at least 30% by weight microfibers, preferably 50% by weight microfibers; thus, for example such webs may contain up to 70% by weight woodpulp or up to 70% by weight staple fibers.

The continuous filament outer webs may be produced as described in the above identified patents or in U.S. Patent 4,340,563 dated 20 July 1982. Suitable polymers include the same ones useful for the meltblowing process. Preferably polymers used for the component layers are the same.

In a preferred embodiment, the spunbonded layers are individually pattern bonded prior to combining with the meltblown layer. For example, a pattern as illustrated in U.S. Design Patent 239,566 to Vogt dated 13 April 1976 having about 153 bonds/in² (23.72 bonds/cm²) and about 25% bonded surface area may be employed as may be a pattern illustrated in U.S. Design Patent 264,512 dated 18 May 1982. Such prebonding permits the use of lower overall bonded area when bonding the laminate.

In accordance with the invention, the meltblown web (including added fibers) will have a relatively high basis weight in the range of from 17 to 170 g/m², preferably in the range of from about 34 to 85 g/m². In contrast, the individual continuous filament webs will have a relatively low basis weight in the range of from 7 g/m² to 34 g/m² and preferably 10 g/m² to 17 g/m². (17)

Any of a wide variety of surfactants, ionic and nonionic, may be employed with the individual component layers. These include, for example, dioctylester of sodium sulfosuccinic acid (Aerosol OT), isooctyl phenylpolyethoxy ethanol (Triton X-100 and X-102) and others.

Combining of the component webs is preferably accomplished by patterned application of heat and pressure. The particular bonding conditions will depend on the specific material, but in general, it is preferred to use a bond pattern employing 10 to 250 pins/inch² (1.55 to 38.75 per cm²) (more preferably 20 to 110 bonds/inch² (3.10 to 17.05 per cm²)) for a coverage of 5 to 25% (more preferably 10-15%) of the surface area. The bonding temperature, for polypropylene, for example, is preferably in the range of from about 180 to 330°F (82.2 to 165.6°C) with a pressure preferably in the range of from about 150 pli to about 400 pli (26.3 to 70.1 kN/m). Reference may be had to U.S. Design Patent No. 239,566 to Vogt dated 13 April 1976 and U.S. Patent 3,855,046 to Hansen and Pennings dated 17 December 1974 for illustrations of bonding patterns.

Embodiments of the wiper and laminate web of the invention will now be described by way of Example with reference to the accompanying drawings, in which:-

Figure 1 schematically illustrates a process for making the wipers of the present invention;

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Figure 2 illustrates a cut-away perspective view of a wiper of the present invention;

Figure 3 illustrates graphically capillary suction test results; and

5 Figure 4 illustrates graphically oil wiping test results.

Turning to Fig. 1, a process for forming the wiper material of the invention will be briefly described. Other forming and combining operations that may be utilized will be apparent to those skilled in the art, and it is not intended to limit the invention to the operation specifically set forth.

As shown, meltblowing die 10 deposits microfibers 12 onto a moving wire, belt, web or screen 14 supported by rolls 16, one or more of which may be driven. A loose bat 18 is formed to which is added wetting agent 20 by spray nozzle 22. Spunbonded continuous filament webs 24 and 26, from parent rolls 23 and 25 respectively, are combined over turning rolls 27 and 29, with bat 18 at nip 31. The combination is bonded by heat and pressure at pattern calendar nip 30 between patterned roll 33 and anvil roll 35, and laminate 37 is wound onto parent roll 32 which may be slit into individual wipers shown, for example, in Fig. 2. Turning to Fig. 2, a three-ply laminate wiper 34 is illustrated including microfiber layer 38 and continuous filament layers 36, 40 with pattern bond regions 42.

30 The invention will now be described by way of further example in terms of specific examples illustrating embodiments thereof. The wipers and webs produced according to the foregoing description and the following Examples have basis weights and 35 fibre diameters within the required ranges hereinbefore specified.

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Example 1

A meltblown microfiber web having a basis weight of 54 g/m² was formed in accordance with the process described in U.S. Patent 3,978,185 to Buntin et al as follows:
polypropylene resin having a melt index of 145 g measured at 177°C and identified as Exxon PD 3145 was used. Production was at a rate of 20,000 yd² per hour (16722 m²/h) and collected at a distance of 14 in. (35.5 cm) on a forming screen. The meltblown fibers were integrated into a web as formed generally in the manner illustrated in Fig. 1. Continuous filament webs formed from polypropylene resin having a melt index of 10-11 g measured at 177°C and identified as Exxon PD 3045 prepared in accordance with U.S. Patent 4,041,203 to Brock and Meitner dated 9 August 1977 were each applied on opposite sides of the meltblown web and pattern bonded with a pattern generally as illustrated in U.S. Design Patent 264,512 dated 18 May 1982 at a temperature of 290°F (143.3°C) and pressure of 220 pli (38.5 kN/m) with a bond pattern having 47 pins/in² (7.29 per cm²) with each pin having an average individual area of 0.0028 in² (0.018 cm²). The combination had a basis weight of 85 g/m² and other properties as described in the Table below. (Exxon is a registered Trade Mark).

Example 2

Example 1 was repeated except that the meltblown web also contained 50% by weight woodpulp fibers added in the manner described in U.S. Patent 4,100,324 to Anderson, Sokolowski, and Ostermeier dated 11 July 1978. The combination had a basis weight of 110 g/m² including 86 g/m² of meltblown/woodpulp and 12 g/m² of each spunbonded polypropylene.

Example 3

Example 1 was repeated except that the meltblown web also contained 50% by weight of polyester staple

fibers added in the manner described in U.S. Patent 4,100,324 to Anderson, Sokolowski, and Ostermeier dated 11 July 1978. The combination had a basis weight of 110 g/m² including 86 g/m² of meltblown/staple and 12 g/m² of each spunbonded polypropylene.

The materials of Examples 1-3 were tested as indicated in the Table below as were materials representative of U.S. Patents 4,307,143 to Meitner dated 22 December 1981 and 4,041,203 to Brock and Meitner dated 9 August 1977, with two examples of the latter, one a three layer laminate, and the other a two layer laminate.

The oil absorbency of the material of Example 1 was also tested and the results of that testing are shown graphically in Figures 3 and 4 in which the material of Example 1 is identified as 85 GSM LAMINATE ACTUAL. In these Figures are also shown the results for the non-laminated microfiber and continuous filament component webs and theoretical results derived from these results for a laminate having the composition of the material of Example 1. Figure 4 also show comparative results obtained with 77 g/m² 3-layer and 50 g/m² 2-layer laminates according to US Patent No. 4041203.

TABLE

Property/ Sample	Basis Wt (g/m ²)	Lint ¹ (.5")	Water ² Absorbency %	Residue(g ²)	Trapezoidal ⁴ Tear (MD(g))	Tensile ⁵ Strength ⁷ MD(g/in)	Bulk ⁶ (NI)
Example 1	85	27	517	.075	1760	2170 (854)	.79
Example 2	110	240	455	.122	1760	1930 (760)	1.22
Example 3	110	-	395	.137	-	-	1.07
KIMTEX™							
Patent 4,307,143	81	57	500	.150	817	1020 (402)	.84
Patent 4,041,203							
3 Layer Laminate	77	27	335	.150	3050	2840 (1118)	.56
2 Layer Laminate	50	-	389	.240	2490	2380 (937)	.43

(1) As described in U.S. Patent 4,328,279 to Meitner and Englebert dated 4 May 1982.

(2) T.A.P.P.I. - T - 432

(3) As described in U.S. Patent 4,307,143 to Meitner dated 22 December 1981.

(4) ASTM D-2263-34, page 483, part 24.

(5) ASTM D-1117-74

(6) Ames Bulk Tester

(7) Figures in brackets in g/cm

As shown, the wiper of the present invention exhibits improved characteristics for wipers for oil and water, particularly in the features of absorbency and streak-free wiping. These results are particularly advantageous in food service wipes applications, for example, where leaving a streak-free stainless steel surface is often very important. Furthermore, the low lint characteristics are important for electronics and other applications where a dust-free environment is considered necessary. Other applications for high quality wiper products will be apparent such as, for example, in health care as surgeons' hand towels and the like.

While it is not desired to limit the invention to any theory, it is believed that the lightweight continuous filament outer webs provide wicking action which rapidly draws liquids through to the highly absorbent microfiber layer. This microfiber layer then aggressively holds the liquid within its interstices and resists streaking.



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Claims:

1. Wiper comprising a laminate including an inner web having a basis weight in the range of from 17 to 170 g/m² comprising meltblown thermoplastic microfibers having an average diameter in the range of up to 10 microns and treated with a surfactant and, on both sides of said inner web, an outer web having a lower basis weight than said inner web and comprising generally continuous thermoplastic filaments having an average diameter in excess of 10 microns and optionally being treated with a surfactant, wherein the ratio of the weight of said inner web to the combined weights of said outer webs is at least 54:31 and the basis weight of said outer web is in the range of from 7 to 34 g/m².
2. A wiper as claimed in claim 1 wherein the proportion of the weights of the said inner web to the combined weights of the said outer webs is 2 to 1 to 4 to 1.
3. A wiper as claimed in either of claims 1 and 2 wherein the said inner and outer webs comprise polypropylene.
4. A wiper as claimed in any one of claims 1 to 3 wherein the surfactant with which the fibers of the said inner web are treated comprises an ionic and/or a nonionic surfactant and the filaments of the said outer webs are treated with an ionic and/or a nonionic surfactant.
5. A wiper as claimed in any one of claims 1 to 4 wherein the said laminate is bonded by the application of heat and pressure at bond regions distributed over the surface of the said laminate.
6. A wiper as claimed in claim 5 wherein the said bond regions occupy 5% to 25% of the laminate surface.
7. A wiper as claimed in claim 6 wherein the density of the said bond regions is in the range



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of from 10 to 250 per square inch (1.55 to 38.75 /cm²) of the laminate surface area.

8. A wiper as claimed in any one of claims 5 to 7 wherein the arrangement of said bond regions over the surface of the said laminate is patterned.

9. A wiper as claimed in any one of claims 5 to 8 wherein the continuous filament outer webs are prebonded prior to lamination with the inner web.

10. A wiper as claimed in any one of claims 1 to 9 wherein the said inner web contains up to 70% by weight woodpulp.

11. A wiper as claimed in any one of claims 1 to 10 wherein the said inner web contains up to 70% by weight staple fibers.

12. A wiper substantially as hereinbefore described comprising a meltblown microfiber inner web of basis weight 17 to 170 g/m² laminated between continuous filament outer webs of basis weight 7 to 34 g/m².
