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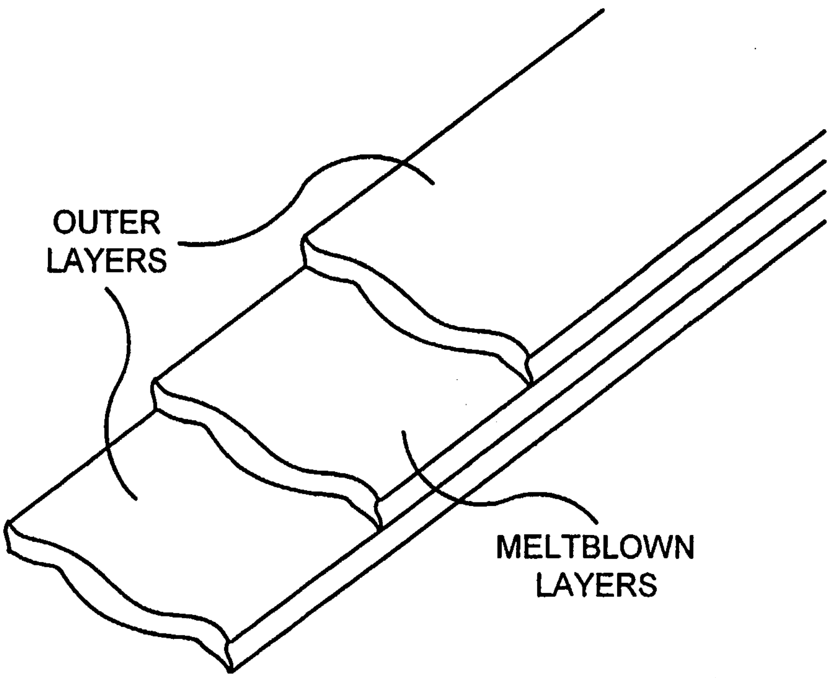
(57) Abstract

The invention relates to a non-woven wiper comprising a meltblown thermoplastic microfibre layer sandwiched between at least two porous, low-linting outer layers, at least one of the outer layers being provided by a bonded carded web. Such a wiper is suitable for cleaning surfaces and/or workpieces.



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Wiper

This invention relates to a wiper useful for a wide variety of industrial and consumer applications including those in the automotive and electrical industries as well as for general purpose wiping. In particular, the invention relates to a soft, low linting wiper having high absorbency.

A wide variety of non-woven wiper products are currently employed both for specific applications and general purpose wiping. For many such applications, non-woven wipers can out perform traditional cloth and paper wiping products. However, it is generally desirable to further improve the properties of non-woven wipers, in particular their propensity to linting, their absorbency and conformability.

US Patent No. 4,307,143 discloses a non-woven wiper designed to absorb oil and water comprising a low basis weight web of synthetic, thermoplastic microfibres treated with a wetting agent to improve water and oil absorption. US Patent No. 4,041,203 describes a non-woven double layer wiper having high tensile strength comprising an integrated mat of generally discontinuous thermoplastic polymeric microfibres and a web of substantially continuous and randomly deposited molecularly orientated filaments of a thermoplastic polymer.

US Patent No. 4,298,649 describes a non-woven disposable wiper intended for use on metal surfaces and having a reduced tendency to accumulate metal chips or other small, sharp foreign objects. The wiper comprises a combination of a meltblown microfibre web laminated to a web of interconnected aligned split filaments. In US Patent No. 4,436,780 a wiper is described which comprises a meltblown central layer sandwiched between two spun-bonded layers. In WO 90/04060 there is described a three layer wiper in which a meltblown layer is sandwiched between a spun-bonded layer and another meltblown layer. In US Patent No. 4,328,279 a non-woven wiper is described specifically for use in cleaning microelectronic devices. Resistance to linting and a reduction in the sodium ion content of the wiper is achieved using a mixture of wetting agents.

When cleaning surfaces and workpieces, especially in industry, it is desirable to keep these as free from contamination as possible. It is therefore essential that the wiper itself, in addition to being able to wipe cleanly, should be low linting. Although conventional meltblown wipers, such as that described in US Patent No. 4,307,143, have relatively low air-born lint, these are high linting under 'sticky tape' methods such as EDANA lint test and therefore have a tendency to contaminate surfaces during wiping. In particular, it has proved difficult to produce a bulky and hence highly absorbing meltblown wiper whilst maintaining low linting properties. Conventional meltblown wipers also lack the random orientation of fibres and range of fibre sizes required to give clean wiping.

Thus, there is still a need for an improved wiper which in addition to low linting provides high absorbency in combination with conformability.

We have now found that a soft, highly absorbent product having low linting properties may be provided by sandwiching at least one highly absorbent meltblown layer between at least two porous, low-linting outer layers. While serving to permit the passage of fluids, e.g. oil, solvents and water, into the inner meltblown layer, the outer layers effectively trap the linting fibres. The outer layers provide strength and low linting properties and by careful selection of the nature of the outer layers may also provide improved absorbency and absorbency rates.

Thus, viewed from one aspect the invention provides a non-woven wiper comprising a meltblown thermoplastic microfibre layer, preferably having a basis weight in the range of from about 5 to 150 g/m^2, more preferably 20 to 100 g/m^2, e.g. 30 to 80 g/m^2, especially 40 to 60 g/m^2, sandwiched between at least two porous, low-linting, preferably non-linting outer layers. Preferably, at least one of the outer layers is provided by a bonded carded web.

Viewed from another aspect the invention provides a process for the preparation of a wiper as herein described, said process comprising laminating a meltblown thermoplastic microfibre layer between at least two porous, low-linting outer layers, preferably wherein at least one of said outer layers is a bonded carded web.

Viewed from yet another aspect the invention provides the use of a wiper as herein described for cleaning surfaces and/or workpieces.

The laminate structure of the wiper of the invention permits an increase in the bulk and thus the absorbency of the inner meltblown thermoplastic microfibre layer (hereinafter 'meltblown layer') without the problem of linting. In general, an increase in bulk is achieved by employing process conditions during manufacture which result in a loose assemblage of fibres prone to lint. However, according to the present invention, increasing the bulk of the inner layer does not create more linting fibres since these are effectively trapped within the outer non-linting layers. Although any increase in the bulk of the inner meltblown layer may reduce its strength, the overall strength of the final laminate product is largely dependent on that of the outer layers which can be selected accordingly. The ability to improve the bulk of the meltblown layer without causing linting not only enables an increase in the absorption properties of the product, but also serves to improve the softness and feel of the product, i.e. its conformability. Use of a laminate having a meltblown layer with a relatively low basis weight but high bulk may further improve the softness of the product. Typically, the total basis weight of the laminated wiper will be in the range 50 to 120 g/m^2, e.g. 80 to 90 g/m^2.

The meltblown layer may comprise polyolefins or other thermoplastic polymers known in the art, e.g. polyesters, optionally together with one or more further synthetic or natural polymers or fibres. Preferred polyolefins include C_{2-10} polyolefins or copolymers thereof, especially C_{2-4} polyolefins, e.g. polyethylene and most especially polypropylene.

The further synthetic or natural polymers or fibres may be those conventionally employed in the manufacture of meltblown microfibre composite materials and may be selected from cellulose fibres, e.g. pulp and rayon, other thermoplastic polymers, e.g. polyesters and polyamides, cotton fibres. Synthetic polymers may be meltblown along with the polyolefin polymers or added at another suitable stage of the process. Natural polymers or fibres are generally unsuitable for meltblowing and are therefore added to the meltblown polymer at a convenient time after meltblowing. Thus, as used herein, the term 'meltblown layer' encompasses a composite comprising a meltblown polymer component and an additional natural or synthetic, e.g. polymer, component which need not be meltblown.

Particularly preferably, the meltblown layer will comprise wood pulp. The type and proportion of any additional natural or synthetic polymer is to a large extent determined by the intended use of the wiper product. For example, a wiper intended for use in mopping up water will typically comprise pulp in the meltblown layer since pulp aids water absorption. In any event, the desired nature of the meltblown layer will be readily formulated by the skilled artisan.

In cases where the meltblown layer comprises a natural or synthetic polymer or fibre in addition to a polyolefin then it is preferred that the polyolefin comprises at least 50% by weight, preferably at least 70% by weight of the meltblown layer. A meltblown layer comprising about 30% by weight wood pulp and about 70% by weight polyolefin, e.g. polypropylene, is especially preferred for use in the invention.

In cases where the meltblown layer comprises polyolefin in the absence of further natural or synthetic polymers or fibres, the polyolefin is most preferably polypropylene or a mixture of polypropylene and polyethylene.

The average fibre diameter of the microfibres of the meltblown layer may be between 0.1 to 100 μm, preferably 0.1 to 20 μm, especially 1 to 10 μm.

The dry thickness of the meltblown layer may be approximately 0.1 to 3 mm, preferably 0.5 to 2 mm, e.g. about 1 mm. Typically, the meltblown layer will be bulkier (i.e. thicker) than the outer low-linting layers. The total thickness of the wiper will generally be in the range 0.3 to 7 mm, preferably 0.5 to 1.5 mm.

The meltblown layer employed in the wiper laminate of the present invention will be readily prepared by the person skilled in the art. The preparation of polyolefin meltblown webs is known and described, for example, in US Patent Nos. 3,978,185, 3,795,571 and 3,811,957 the disclosures of which are herein incorporated by reference. The formation of meltblown webs having fibres or particles mixed therein is described, for example, in US Patent No. 4,100,324. Relatively bulky meltblown layers for use in the product of the invention may be formed by increasing (e.g. by 2 to 5 cm) the forming height of the meltblown layer compared to standard forming heights for meltblown polymers. The absorbency of the meltblown layer may be increased by modifying the manufacturing process to incorporate a hydraulic entangling step as described in US Patent No. 4950531.

The meltblown layer may also be made by the applicant's "Coform" process described in US Patent Nos. 4100324 and 5350624. In the "Coform process" a thermoplastic, e.g. polypropylene polymer is melted and liquefied and extruded through small volume die tips and attenuated under angled air flow as in analogous meltblown processes. At the point of extrusion, staple fibre or pulp may be separated in a picker and blown towards the extruded polymer such that the polymer becomes an intimate mixture of pulp or staple fibres and polymer. Surfactant may also be sprayed onto the polymer at this point as in analogous meltblown processes in order to improve the wettability of the polymer.

In particular, when a "Coform" process is employed to manufacture the meltblown layer then the meltblown layer may comprise up to 80% by weight of pulp although when the laminate is prepared by thermal bonding then the meltblown layer may comprise 10 to 50% by weight of pulp.

In a preferred embodiment the meltblown layer is treated or coated with a surfactant during extrusion in order to improve its wettability. Such a coating process is well known to the skilled artisan. Suitable surfactants are well known and include a wide variety of ionic and non-ionic surfactants, e.g. dioctylesters of sodium sulfosuccinic acids (e.g. Aerosol OT), isooctyl phenylpolyethoxy ethanols (e.g. Triton X-100 and X-102) etc. Typically, the surfactant may comprise from 0.1 to 10% by weight of the meltblown layer.

It is envisaged that the meltblown layer could itself comprise more than one layer, e.g. two layers, each having different absorption properties.

The outer low-linting layers may be made from the same or different polymers. Preferably, these will be made from the same polymer having similar melt temperatures. As mentioned above, it is preferable that at least one of the outer sandwiching layers is a bonded carded web layer. Although it is envisaged that the meltblown layer could be sandwiched between two or more layers, preferably this will be provided between two low-linting layers.

The second outer layer may comprise a bonded carded web layer or a spun-bonded layer. However, since an outer spun-bonded layer often imparts a slippery feel to the product and the product lacks tactile properties, it is preferred that both outer sandwiching layers should comprise a bonded carded web. Spun-bonded materials are produced by extruding thermoplastic polymer through a spinneret to form continuous fibres and then drawing and laying the fibres to form a random web. Bonded carded web fibres are produced by combing out a blend of natural and/or synthetic staple fibres of discrete fibre lengths to form a more or less unidirectionally orientated web. This structure aids wicking and "mop-up" properties and may help liquid to become distributed within the meltblown area more widely, more rapidly.

In cases where an outer layer is a bonded carded web layer, this layer may comprise polyolefin or other thermoplastic polymers, e.g. polyesters, optionally together with one or more further synthetic or natural polymers or fibres. Preferred polyolefins include C_{2-10} polyolefins or copolymers thereof, particularly preferably C_{2-4} polyolefins, especially polyethylene and most especially polypropylene. The further synthetic or natural polymers or fibres may be chosen from those listed above in relation to the inner meltblown layer and for the bonded carded web layer any additional component is preferably synthetic e.g. rayon.

The outer bonded carded web layer comprises a natural or synthetic polymer or fibre in addition to a polyolefin then it is preferred that the polyolefin is present in at least 50% by weight of the outer layer, preferably 80% by weight. For example, a preferred bonded carded web outer layer comprises 80% by weight polypropylene and 20% by weight of rayon. Where the outer layer comprises polyolefin in the absence of other polymers, the polyolefin is preferably polypropylene or a mixture of polypropylene and polyethylene.

In cases where an outer layer is a spun-bonded layer, natural or synthetic polymers or fibres are not normally added in addition to the polyolefin. Any spun-bonded layer will preferably consist entirely of polyolefin. Preferred polyolefins include C_{2-10} polyolefins or copolymers thereof, especially polyethylene and most especially polypropylene.

Where the outer layer is a bonded carded web layer, the fibres therein should be approximately 10 to 50 microns in diameter and 10 to 100 mm, especially 30 to 50 mm in length. Where the outer layer is a spun-bonded layer the fibres of the spun-bonded layer should preferably be between 5 to 25 microns in diameter although fibres of other diameters could be employed.

The outer layer should be low-linting, preferably non-linting, non-abrasive and add strength to the wiper. It should also give rise to a wiper which has a soft, pleasant feel, which is tactile and which may also aid in the absorption of liquid into the wiper.

As mentioned above, a high bulk meltblown layer tends to reduce the strength of the meltblown layer. The outer layers are intended to counteract this potential loss in strength. A bonded carded web outer layer gives rise to a product having high tensile strength, in particular in the machine direction (MD). A spun-bonded outer layer provides strength in both the machine and cross directions (MD and CD). The strength of the product can thus be tailored according to the desired end use.

It has also been found that a bonded carded web outer layer may help a liquid become distributed within the meltblown area more widely, more quickly. In particular, the vertical wickability, especially water wickability, in both machine and cross directions is surprisingly high in a laminate containing outer bonded carded web layers. The vertical water wickability of the laminate of the present invention is preferably in the range 1.0 to 4.0 cm, especially 2 to 3 cm for a 15 second test conducted as described in Example 3.

Each outer layer may have substantially the same thickness or alternatively may be of different thicknesses. Each outer layer will preferably have a dry thickness in the range of 0.1 to 2 mm, preferably 0.2 to 0.8 mm. The two outer layers will generally comprise 30 to 50% by weight of the product and 30 to 50% by thickness.

The outer layer may also be treated with a surfactant for wettability. Suitable surfactants include those described in relation to the meltblown layer. Typically, these will be ionic or non-ionic surfactants, e.g. Aerosol OT, Triton X-100 and X-102 etc.

The outer layers may be produced by techniques well-known to the person skilled in the art and are readily available from suppliers such as Lohmann and Sandler. For example, for the preparation of a bonded carded web, staple fibre, i.e. discrete lengths of fibre are combed out, generally orientating the fibres in the machine direction. Cross lapping, where fibres are then laid s-shaped along the machine direction, may provide better cross direction strength.

The bonded carded web layer may be thermally or chemically bonded. Bonding may be achieved by spraying or dosing the web with an adhesive material which locks the fibres into place usually with heat treatment to activate the adhesive. Such webs are termed chemically bonded. Alternatively, the web comprises a thermoplastic component as one of the staple fibres, e.g. polyolefin, which allows thermal bonding to be achieved either all over the web or at discrete points.

The basis weight of the bonded carded web layer is preferably 10 to 30 g/m^2, especially 15 to 20 g/m^2.

Spun-bonded outer layers are generally manufactured from low MFR polypropylene which may give rise to a slippery hydrophobic feel on the wiper surface.

The ratio of meltblown layer to outer layers will be readily determined by the person skilled in the art. Preferably, the outer layer comprises between 20 to 60%, especially 30 to 45% by weight of the wiper weight.

The grab tensile strength of the laminate structure in the machine direction of the wiper may be 5000 to 15000, e.g. 7500 to 10000 g. The grab tensile strength of the laminate structure in the cross direction of the wiper may be 2000 to 5000, e.g. 3300 to 3800 g. These tensile values are dependent on the basis weight of the bonded carded web layer employed.

The stiffness in the machine direction of the wiper is 1 to 8, especially 3 to 5 measured according to the Shirley Institute Stiffness test method. The stiffness in the cross direction of the wiper is preferably 1 to 8, especially 2 to 4 measured according to the Shirley test mentioned above.

The wiper may have a water absorbency capacity of 200 to 600%, preferably 350 to 450% by weight and oil absorbency of 300 to 800%, preferably 500 to 650% by weight.

The outer and meltblown layers of the product are preferably laminated together by a patterned application of heat and pressure, i.e. by thermal bonding, or by ultrasonic bonding. Such embossing or pattern bonding processes are well known to those skilled in the art. For example, pattern bonding may be carried out by a process substantially as described in any of US Design Patent Nos. 264,512, 239,566 and US Patent No. 3,855,046.

Suitable embossing/pattern bonding conditions will depend on the specific nature of the wiper, but in general a bond pattern of approximately 2 to 50 pins/cm^2 (pin heads 0.018 cm^2) giving approximately 4 to 20 bonds/cm^2 for a coverage of 5 to 25% of the wiper surface area may be used.

Ultrasonic bonding may be employed to bond materials which are difficult to bond thermally.

In a preferred embodiment, the wiper is provided with a number of holes or apertures to improve absorbency. These may constitute between 1 and 40%, preferably 1 to 30% of the area of the wiper and may penetrate only the outer layer, may partially penetrate both the outer and meltblown layer or may penetrate through the entire width of the wiper. Normally, the apertures or perforations will penetrate through the wiper. The apertures aid in picking up small particles. The apertures are conveniently introduced at the embossing stage and may be formed using the process described in European Patent Publication No. 080383.

A process for forming the wiper of the present invention will now be described although this process is of course one of a variety of processes suitable for wiper preparation.

Referring therefore to figure 1, meltblowing die (1) deposits microfibres onto inclined moving outer layer (2) coming from feeder roll (3). The outer layer (2) is supported on inclined wire (4), the wire being supported by rollers (5) which may be driven by conventional means. Surfactant spraying (not shown) may occur at this point. Outer layer (6) from feeder roll (7) is laid on top of meltblown layer (8) via turning roller (9). The combination is bonded by heat and pressure at embossing point (10) between a patterned roller (11) and roller (12). Optionally, roller (12) comprises tiny pins and rotates slightly faster than patterned roller (11) hence introducing tiny holes into the laminate. Laminate (13) is rolled into a parent roll (14) which may be slit into component wipers as required (not shown).

The wiper laminate of the invention may be further treated with standard chemicals such as flame retardant finishes, antistatic agents, fragrances etc. An adhesive should preferably be present in the meltblown layer since this will aid binding to the outer layers and further serve to prevent linting.

The wiper in accordance with the invention may be used for a variety of industrial and consumer applications, including those in the automotive and electrical industries as well as for general purpose wiping. The wiper is particularly useful for mopping up oils, solvents and water and may be used in smooth and critical surface wiping, and in wiping industrial machines, machine parts and tools.

It is envisaged that the wipers of the invention may be re-usable or disposable although where the wiper is employed to mop up oil or solvent, it is preferred that the wiper is simply thrown away after use. Where the wiper is used to mop up water, the wiper may be rinsed, dried and re-used. In this regard, a laminate having two bonded carded web outer layers has a greater ability to reabsorb liquid after having been used and wrung out.

All documents are mentioned herein are herein incorporated by reference. The invention will now be described with reference to the following non-limiting examples and the accompanying Figures in which:

Figure 1 shows an apparatus for the manufacture of a wiper in accordance with the invention; and

Figure 2 shows a representation of a wiper of the invention.

Figures 3 and 4 illustrate the results of lint tests carried out on products in accordance with the invention and conventional meltblown materials.

Example 1

Raw materials used were polypropylene (400 MFR) sourced from Borealis (520 ML). Bonded carded web at a basis weight of 16 g/m^2 was supplied by Lohmann and was composed of 100% polypropylene staple fibre at a denier of 2.2 and a fibre length of 40 mm. The bonded carded web was thermally point bonded.

The structure was made by unwinding one layer of bonded carded web onto a wire where the extruded meltblown was then laid directly onto the bonded carded web. The process conditions for the meltblown being such that high bulk and absorbency were attained at a throughput of e.g. 15PIH and forming height of 17 inches from the forming wire. The line speed was adjusted to attain a basis weight of the meltblown layer of 50 g/m^2. After forming the meltblown layer, layer 3 also of bonded carded web was unwound and the 3 layered structure entered the embossing station where patterned pin and smooth anvil rollers point bonded the layers to produce a laminated structure with good bulk, absorbency, softness and lint parameters. The combination had a basis weight of 82g/m^2 and had properties as follows.

Basis weight (g/m^2)	82
Dry thickness (mm)	1.03
Wet thickness (mm)	0.99
MD Grab strength (g)	8172
CD Grab strength (g)	3268
EDANA lint (300-89)	1.02
Water Absorbent Capacity (%)	400
Oil Absorbent Capacity (%)	613
MD stiffness (Shirley stiffness, 8 = max)	3.82
CD stiffness (Shirley stiffness, 8 = max)	2.30

Example 2

In table 1 below, the preferred properties of the non-woven wiper laminate of the present invention are compared against the properties of meltblown layers alone without the presence of sandwiching outer layers.

Table 1

Wiper	Laminate Structure	Meltblown alone	Meltblown alone
Basis Weight (g/m^2)	80-90	80-90	105-115
Dry thickness (mm)	0.95-1.05	0.70-0.80	0.85-1.05
Wet thickness (mm)	0.95-1.05	0.70-0.80	0.85-1.05
MD Grab tensile (g)	7500-10000	2800-3800	4000-5000
CD Grab Tensile (g)	3300-3800	2500-3500	3500-4500
Water absorption capacity (%)	350-450	275-325	275-325
Oil absorption capacity (%)	500-650	320-350	300-350
Water absorption rate (secs)	<2	<2	<2
MD stiffness	3-5	>4	>5
CD stiffness	2-4	>3	>3
EDANA lint	<2.0	1.5-3.0	2.0-3.5

As may be seen from Table 1 above, water and oil absorbency and Grab tensile strength in both machine and cross directions increase with the presence of the sandwiching layers. Stiffness in both machine and cross directions is decreased and the amount of linting is reduced when analysed using the standard EDANA "sticky tape" method with the presence of the sandwiching layers. Even when the basis weight of the meltblown is increased from 80-90 to 105-115 the properties of the sandwiched laminate are still superior.

Example 3

Table 2 below shows vertical water wicking results for two 3-layered wiper laminates. The "SMS" wiper contains an inner meltblown layer sandwiched between two spun-bonded layers. The basis weight of the spun-bonded layers is 15 g/m^2, the basis weight of the meltblown layer is 50 g/m^2 and the basis weight of the laminate is 80 g/m^2. The "BMB" wiper contains an inner meltblown layer sandwiched between two bonded carded web layers. The bonded carded web layers comprise 80% polypropylene (denier 2.2, length 40 mm and 20% rayon (denier 1.7, length 40 mm). The basis weight of the bonded carded web layers is 16 g/m^2, the basis weight of the meltblown layer is 50 g/m^2 and the basis weight of the laminate is 82 g/m^2.

Sample strips of constant length and width are cut and held vertically in a water bath for a fixed length of time (15 or 45 seconds). The level the water has reached up the strip at that time is measured from the water surface.

TABLE 2	Direction	SMS (cm)	BMB (cm)
15 secs	MD	1.7	2.3
15 secs	CD	1.7	2.5
45 secs	MD	3.3	4.4
45 secs	CD	3.1	4.2

Clearly, the "BMB" laminate has a higher water vertical wickability than the "SMS" laminate.

Example 4

Table 3 below shows the "Mop Up" capacity of the "SMS" and "BMB" laminates of Example 3. Mop up capacity is a measure of the ability of the laminate to reabsorb liquid after having been used and wrung out. Higher values indicate more capacity for reabsorption.

Saturated samples, in oil or water, are drained on porous felts to remove excess liquid and then folded and twisted 180° to displace excess liquid. The difference in weight between the saturated and twisted sample is the weight available for re-absorption of liquid. In Table 3 this weight is expressed as a percentage of the dry weight of the laminate.

TABLE 3	SMS	BMB
Water Mop Up %	24	58
Oil Mop Up %	44	89

Hence BMB laminates show a greater capacity for reabsorption.

Example 5

Two types of 3-layer wiper were produced: Bonded Carded Web (BCW)/meltblown/BCW (herein referred to as 'BMB') and BCW/meltblown/spunbond (herein referred to as 'BMS'). The specifications of the different outside layers were as follows:

BCW: Litovel 18gsm, 80:20 PP/viscose, white
Lohmann 16gsm, 80:20 PP/viscose, white
(PP = polypropylene)

Spunbond: Corovin 14gsm, 100% PP, white

3 types of finished products were produced during the trial:

BMS Roll 20: Lohmann BCW/50 gsm meltblown/Corovin spunbond

BMB Roll 23: Litovel BCW/50 gsm meltblown/Litovel BCW

BMS Roll 25: Litovel BCW/50 gsm meltblown/Corovin spunbond

To manufacture these products, BCW was unwound from its reel and spunbond or BCW was unwound from its reel. The BCW reels were loaded in such a way that they would unwind with the 'hairy' side towards the middle of the wiper.

Experimental Results

The properties of the 3-layer wiper samples in accordance with the invention were compared to Kimtex Plus and Kimtex Classic (these are single layer 100% polypropylene meltblown products with differing basis weights available from Kimberly-Clark Corporation, USA).

Basis Weight

Depending on the outside layer used, the basis weight of the different 3-layer wiper samples varied from 85 to 92 gsm. The 3-layer wiper samples had a similar basis weight to Kimtex Classic. The basis weight of Kimtex Plus was 106 gsm, 16 to 20% higher than the rest of the samples.

Bulk

All three 3-layer wiper samples had a bulk of around 1.00 mm.

Lint - EDANA lint test

An EDANA lint test was carried out according to test method 300.0-84. The 3-layer wiper samples produced

57.3% and 63.38% less lint than Kimtex Plus and Kimtex Classic respectively.

Roll 25 BMS linted 10% less than Roll 20 BMS. This difference was caused by the 'hairiness' of Lohmann BCW.

Lint - GELBO lint test

A GELBO lint test was carried out according to the test method described in the Institue of Environmental Science IES-RP-CC004.2. The samples were ordered in lint performance, from best to worst: Roll 25 BMS; Roll 23 BMB; Roll 20 BMS; Kimtex Classic; Kimtex Plus.

3-layer wiper samples linted much less than 100% meltblown samples. For example, Roll 25 BMS produced 95% less particles >10μm than Kimtex Plus.

The results of the EDANA and GELBO lint tests are illustrated in Figures 3 and 4 respectively.

Canadian Crush

This test, which determines the stiffness/softness of nonwoven articles, was carried out using an Intron Universal Testing Instrument to measure the amount of energy required to "crush" a sample. Canadian crush depends on the basis weight of the sample, the higher the basis weight the stiffer the product hence the higher the Canadian crush values.

The 3-layer wiper samples had the same Canadian crush as Kimtex Classic. Kimtex Plus had a Canadian crush value 27% higher than the other samples.

Taber abrasion

This test determines the resistance of nonwoven articles to pressure and abrasion. The test was carried out using a Taber abrader according to Method 5306 Federal

Test Method Standard No. 191.A. Taber abrasion depends on the basis weight of the sample. It was expected that the higher the basis weight the more revolutions are required to damage the sample.

Kimtex Plus being the heaviest product had the highest resistance to abrasion. Kimtex Plus had 18% higher taber abrasion than the 3-layer wiper samples. However, the 3-layer wiper samples had on average 45% higher taber abrasion than Kimtex Classic.

For a given basis weight, the 3-layer wiper had a higher resistance to abrasion than a meltblown wiper.

Tensile strength

All 3-layer wiper samples were at least twice as strong in the machine direction (MD) than the Kimtex Plus and Classic samples. This improvement in strength was due to MD alignment of the BCW fibres.

BMS samples had higher cross direction (CD) strength than BMB or Kimtex samples because the spunbond had a higher CD strength than BCW and meltblown samples.

3-layer wiper samples, especially BMS samples, had better tensile properties than the Kimtex samples.

Cohesion

The cohesion strength of the 3-layer wiper samples was in the same range as Crew II samples (a spun-bonded/meltblown/spun-bonded product available from Kimberly-Clark Corporation, USA).

Water and oil capacities

Water and oil capacities were tested according to Test Method BS 1439. 3-layer wiper samples absorbed 40% more water and 50% more oil than meltblown samples. 3-layer wiper samples had higher water and oil capacities than the Kimtex samples.

Water and oil rates

3-layer wiper samples absorbed water 45% quicker than Kimtex Plus and 60% quicker than Kimtex Classic. 3-layer wiper samples absorbed oil more or less at the same rate as the Kimtex samples.

Appearance

3-layer wiper samples did not have any protruding fibres at the surface, whereas both Kimtex samples did.

3-layer wiper samples had a much softer feel than Kimtex samples.

Conclusion

Having analysed the properties of the 3-layer wipers against Kimtex products, it is possible to conclude that:

Kimtex Classic vs. 3-layer wiper

For a given basis weight of 87gsm, 3-layer wiper samples had better lint, taber abrasion, tensile strength, water and oil capacities and water and oil rates properties than Kimtex Classic. Canadian crush was the only property that was the same for 3-layer wipers and Kimtex Classic.

Kimtex Plus vs. 3-layer wiper

With 16 to 20% less basis weight, 3-layer wipers had better lint, tensile strength, Canadian crush and water and oil capacity properties than Kimtex Plus. Kimtex Plus was only superior on taber abrasion.

The results discussed above are illustrated in the following table:

Kimtex Plus 7826	
Kimtex Classic 7165	
Roll 20 BMS	16gsm Lohmann BCW/50gsm meltblown/14gsm Corovin spunbond
Roll 23 BMB	18gsm Litovel BCW/50gsm meltblown/18gsm Litovel BCW
Roll 25 BMS	18gsm Litovel BCW/50gsm meltblown/14gsm Corovin spunbond

Tests	**Kimtex Plus**	**Kimtex Classic**	**Roll 20 BMS**	**Roll 23 BMB**	**Roll 25 BMS**
Basis Weight(g)	106.00	86.9	85.60	92.80	88.80
Bulk Dry	0.88	0.75	1.00	0.99	0.99
Bulk Wet	0.87	0.73	0.96	0.99	0.99
Water Rate(s)	0.55	0.92	0.27	0.27	0.33
Water Capacity(%)	280.81	270.72	388.11	387.98	384.83
Oil Rate(s)	8.54	8.13	7.58	8.40	9.49
Oil Capacity(%)	295.36	314.2	437.23	437.23	467.37
MD Grabs Dry(g)	4738.80	3444.10	7998.30	8834.90	8151.30
MD Grabs Wet(g)	4343.90	2714.30	8635.10	8692.60	9170.00
CD Grabs Dry(g)	4273.90	3264.20	4896.20	3689.30	5296.00
CD Grabs Wet(g)	4613.80	30.91.20	5001.20	3480.30	5089.90
Elongation MD Dry(%)	19.13	17.56	31.97	39.04	31.66
Elongation MD Wet(%)	17.54	22.5	31.96	34.06	36.52
Elongation CD Dry(%)	27.55	13.91	46.24	49.51	51.65
Elongation CD Wet(%)	30.55	24.77	42.82	44.34	48.68
Taber (revs)	64	37	51	58	53
Martindale*	88	29	32	38	48
Cohesion (kg)	-	-	1276	1272	1316
Canadian Crush	743.71	544.97	537.67	521.30	550.66

* Carried out according to Abrasion Test Method EN 530.

Lint Tests

EDANA Tests

Lint EDANA mg/m2 (side A)	1.4258	1.5295	0.7009	0.6078	0.5613
Lint EDANA mg/m2 (side B)	1.3952	1.7463	0.5692	0.5852	0.5746
Lint EDANA mg/m2 (total)	2.8210	3.2758	1.2701	1.1930	1.1359

GELBO FLEX Test

>0.3 microns	3986.40	1663.2	220.88	298.28	63.84
>0.5 microns	3028.10	1150.9	138.26	238.38	30.06
>0.7 microns	1892.20	677.64	94.20	180.95	18.42
> 1 microns	945.26	353.64	71.24	131.25	14.52
> 5 microns	131.18	76.82	35.46	26.55	5.14
> 10 microns	61.90	34.56	21.42	10.35	2.50

Appearance

All 3-layer samples do not have protruding fibres at the surface and appear to be softer than both Kimtex products.

Claims:

1. A non-woven wiper comprising a meltblown thermoplastic microfibre layer sandwiched between at least two porous, low-linting outer layers, at least one of the outer layers being provided by a bonded carded web.

2. A non-woven wiper as claimed in claim 1 wherein the basis weight of said meltblown layer is in the range of from 20 to 100 g/m^2.

3. A non-woven wiper as claimed in claim 2 wherein the basis weight of said meltblown thermoplastic microfibre layer is in the range of from 40 to 60 g/m^2.

4. A non-woven wiper as claimed in any one of claims 1 to 3 wherein a second outer layer is spun-bonded.

5. A non-woven wiper as claimed in any one of claims 1 to 3 wherein a second outer layer is provided by a bonded carded web.

6. A non-woven wiper as claimed in any one of claims 1 to 5 wherein the meltblown layer and the outer layers comprise C_{2-10} polyolefins or copolymers thereof.

7. A non-woven wiper as claimed in claim 6 wherein the meltblown layer and the outer layers comprise polyethylene or polypropylene.

8. A non-woven wiper as claimed in any one of claims 1 to 7 wherein the meltblown layer and/or the outer layers are treated with a surfactant.

9. A non-woven wiper as claimed in any one of claims 1 to 8 wherein the meltblown layer further comprises

natural or synthetic fibres.

10. A non-woven wiper as claimed in claim 9 wherein C_{2-10} polyolefins comprise 50 to 70% by weight of the meltblown layer.

11. A non-woven wiper as claimed in claim 9 or 10 wherein said natural fibres comprise wood pulp.

12. A non-woven wiper as claimed in any one of claims 1 to 11 wherein said bonded carded web outer layer comprises natural or synthetic fibres and 50 to 80% by weight C_{2-10} polyolefin.

13. A non-woven wiper as claimed in any one of claims 1 to 12 wherein the wiper is provided with a plurality of holes or apertures.

14. A non-woven wiper as claimed in claim 13 wherein said holes cover between 1 and 40% of the area of the wiper.

15. A non-woven wiper as claimed in any one of claims 1 to 14 wherein the meltblown layer is treated with an adhesive.

16. A process for the preparation of a non-woven wiper as described in any one of claims 1 to 15 said process comprising laminating a meltblown thermoplastic microfibre layer between at least two porous, low-linting outer layers, wherein at least one of said outer layers is a bonded carded web.

17. A process as claimed in claim 16 wherein the wiper is laminated by patterned application of heat and pressure.

18. A process as claimed in claim 16 wherein the wiper is laminated by ultrasonics.

19. The use of a wiper as claimed in any one of claims 1 to 15 for cleaning surfaces and/or workpieces.

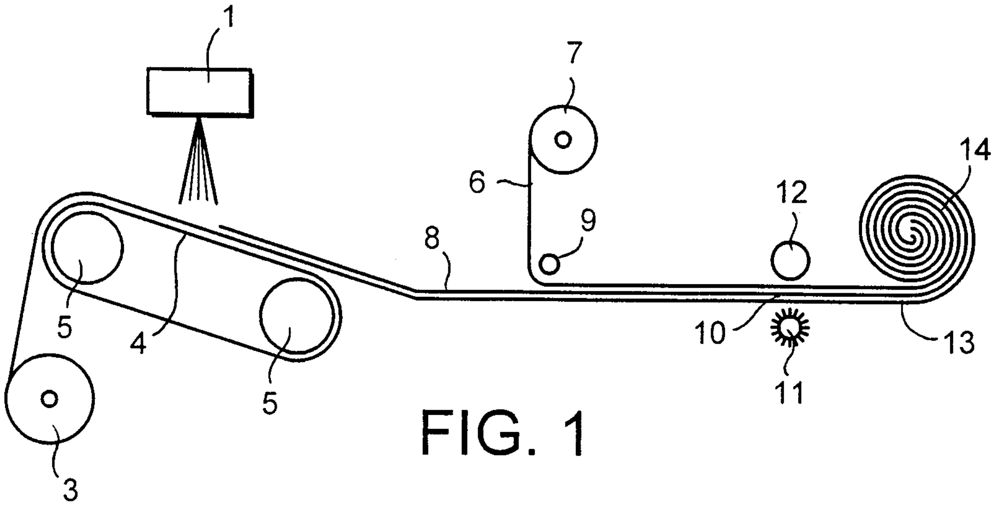

FIG. 1

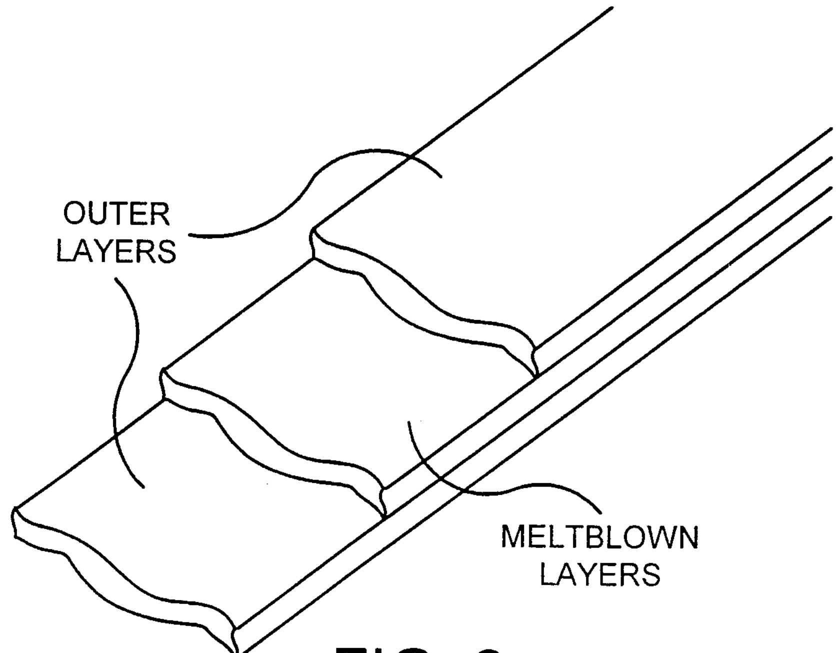

FIG. 2

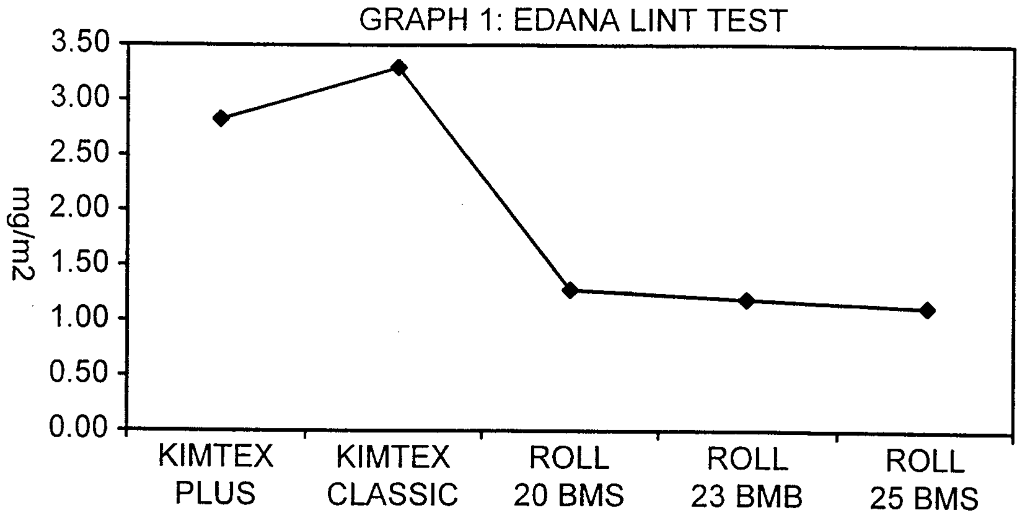
GRAPH 1: EDANA LINT TEST
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
mg/m2
KIMTEX PLUS
KIMTEX CLASSIC
ROLL 20 BMS
ROLL 23 BMB
ROLL 25 BMS

FIG. 3

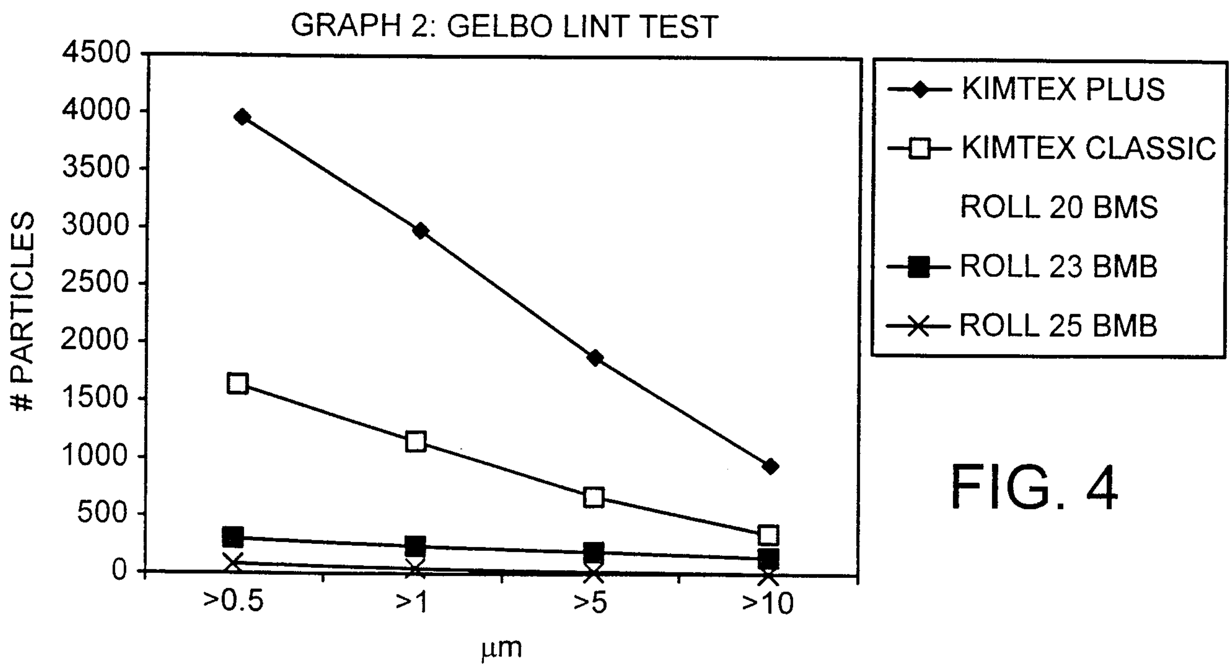
GRAPH 2: GELBO LINT TEST
4500
4000
3500
3000
2500
2000
1500
1000
500
0
PARTICLES
>0.5
>1
>5
>10
μm
KIMTEX PLUS
KIMTEX CLASSIC
ROLL 20 BMS
ROLL 23 BMB
ROLL 25 BMB

FIG. 4

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 00/00808

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 D04H13/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 D04H A47L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 June 2000	29/06/2000
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer Seabra, L

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