MULTIPLE LAYERED ABSORBENT FABRIC

A multiple layered absorbent fabric comprising a liquid pervious layer comprising at least one hydrophilic nonwoven web of melt spun continuous multiple component fibers, a liquid impervious layer comprising a film, and an absorbent layer comprising a spunlaced web disposed between the liquid pervious layer and the liquid impervious layer.
MULTIPLE LAYERED ABSORBENT FABRIC

BACKGROUND OF THE INVENTION

1. Field of the Invention
2. Background of the Invention

This invention relates to a multiple layered absorbent fabric that can be used in the medical and hygiene markets, especially for medical drapes.

Medical drapes are typically made from absorbent fabrics that are engineered to absorb bodily fluids on one side containing an absorbent layer and resist fluid migration out the other side by use of a liquid impervious layer. The absorbent layer often contains naturally absorbent fibrous materials such as wood pulp, cellulose, cotton, and absorbent particles. The liquid impervious layer is often made from a film laminated to the absorbent layer.

However, since the absorbent layer can be made with short discontinuous fibers or particles, the absorbent fabric can be susceptible to unacceptable linting. U.S. Patent Publication No. 2005/0054255 describes the use of a liquid pervious layer comprising a nonwoven fabric laminate adjacent the absorbent layer that allows fluids to pass through the liquid pervious layer while preventing the loss of absorbent material.

It would be a further improvement to a three layer absorbent fabric to make the liquid pervious layer autogenously bondable and have the ability to bond the liquid impervious layer of the three layer absorbent fabric to a backing layer without damaging the three layer absorbent fabric.

SUMMARY OF THE INVENTION

This invention is directed to a multiple layered absorbent fabric comprising a liquid pervious layer comprising at least one hydrophilic nonwoven web of melt spun continuous multiple component fibers wherein the multiple components are made from polymers with different melting points and wherein the melt spun fibers have a length and a surface and the polymers extend substantially along the complete length of the melt spun fibers with the polymer having the lowest melting point occupying at least a portion of the surface of the melt spun fiber, a liquid impervious layer comprising a film made from a polymer having a melting point below the melting point of the melt spun fiber polymers, and an absorbent layer comprising a spunlaced web disposed between the liquid pervious layer and the liquid impervious layer.

This invention is further directed to a multiple layered absorbent fabric described above wherein the absorbent fabric further comprises a backing layer comprising a fibrous web positioned adjacent the liquid impervious layer opposite from the absorbent layer.

DETAILED DESCRIPTION OF THE INVENTION

Reference now will be made to the embodiments of the invention, one example of which is set forth below. The example is provided by way of explanation of the invention, not as a limitation of the invention. In fact, it will be apparent to those skilled in the art that various modifications and variations can be made in this invention without departing from the scope or spirit of the invention. For instance, features illustrated or described as part of one embodiment can be used on another embodiment to yield a still further embodiment.

Thus, it is intended that the present invention cover such modifications and variations as come within the scope of the appended claims and their equivalents. Other objects, features, and aspects of the present invention are disclosed in or are obvious from the following detailed description. It is to be understood by one of ordinary skill in the art that the present discussion is a description of exemplary embodiments only, and is not intended as limiting the broader aspects of the present invention, which broader aspects are embodied in the exemplary constructions.

In general, the present invention is directed to an improved multiple layered absorbent fabric for use in the medical and hygiene markets especially medical drapes. The improved multiple layered absorbent fabric comprises a liquid pervious layer, a liquid impervious layer, and an absorbent layer disposed between the liquid pervious layer and the liquid impervious layer. The improvement comprises a liquid pervious layer of at least one hydrophilic nonwoven web of melt spun continuous multiple component fibers wherein the multiple components are made from polymers with different melting points and wherein the melt spun fibers have a length and a surface and the polymers extend substantially along the complete length of the melt spun fibers with the polymer having the lowest melting point occupying at least a portion of the surface of the melt spun fiber. By locating the lowest melting point polymer on at least a portion of the surface of the melt spun fiber, the hydrophilic nonwoven web can be heated to autogenously bond the fibers together to form a strong web.

In another embodiment of the present invention, by selecting a liquid impervious layer comprising a film made from a polymer having a melting point below the melting point of the melt spun fiber polymers, a backing layer can be affixed to the liquid impervious layer by heating the four layer to cause the liquid impervious layer to bond to the backing layer without melting and damaging the fibers in the liquid pervious layer.

The liquid pervious layer comprises at least one hydrophilic nonwoven web. The hydrophilic nature of the web allows fluids to migrate through the web. If the web is not inherently hydrophilic or hydrophilic enough for the intended use of the absorbent fabric, then the web can be treated with a hydrophilic surfactant. The hydrophilic surfactant can be applied to the web by dipping the fabric in an aqueous solution containing the hydrophilic surfactant or other methods known in the art. An example of a hydrophilic surfactant is a nonionic fatty acid ester. Another method for making the web hydrophilic is spinning a hydrophilic additive into at least one polymer of the fibers of the web. This can be achieved by selecting a thermally compatible hydrophilic additive and blending it into the polymer prior to fiber spinning.

The hydrophilic nonwoven web of melt spun continuous multiple component fibers of the liquid pervious layer can comprise at least one spunbond web, at least one meltblown web, or combinations of thereof. Typically, spunbond webs are stronger than meltblown webs and at least one spunbond web would be located on the outermost location of the absorbent fabric. The presence of the meltblown web, which can have smaller diameter size fibers than spunbond fibers, typically forms a more efficient barrier for absorbent materials and particles to pass through than a spunbond web. Therefore, a hydrophilic nonwoven web comprising the combination of at least one spunbond web and at least one meltblown web wherein the at least one meltblown web is dis-
posed between the at least one spunbond web and the absorbent layer provides a strong barrier for resisting absorbent material migration through the liquid pervious layer. A typical combination of spunbond and meltblown webs is a spunbond-meltblown-spunbond or SMS construction. This produces a strong composite web with strong particle barrier properties.

The multiple component fibers of the liquid impervious layer are made from polymers with different melting points and wherein the melt spun fibers have a length and a surface and the polymers extend substantially along the complete length of the melt spun fibers with the polymer having the lowest melting point occupying at least a portion of the surface of the melt spun fiber. By locating the lowest melting point polymer on at least a portion of the surface of the melt spun fiber, the hydrophilic nonwoven web can be heated to autogenously bond the fibers together to form a strong web. The polymers of the multiple components are selected from the group consisting of polyolefins, polyesters, polyamides, and copolymers thereof. Multiple component fibers typically include bicomponent fibers. A useful combination of polymers of the bicomponent fibers comprises a polyolefin and a polyester. Methods to produce these types of spunbond and meltblown webs are disclosed for example in U.S. Pat. Nos. 6,831,025 and 6,776,858 herein incorporated by reference.

The film of the liquid impervious layer is made from a polymer having a melting point below the melting point of the melt spun fiber polymers. Examples of polymers suitable for use in the present invention include polyolefins, ethylene vinyl acetate copolymers, and ethylene maleic anhydrides. The film layer is attached to the absorbent layer using a pressure sensitive adhesive or other method known in the art.

The absorbent layer comprises a spunlaced web disposed between the liquid pervious layer and the liquid impervious layer. The spunlaced web can include at least one naturally absorbent fibers such as wood pulp, cellulose or cotton. The spunlaced web can also include at least some synthetic fibers such as polyester fibers. A preferred spunlaced web includes a blend of polyester fibers and wood pulp. The preparation of a spunlaced web is well known in the art.

The multiple layered absorbent fabric can include a fourth layer or backing layer comprising a fibrous web positioned adjacent the liquid impervious layer opposite from the absorbent layer. The fibrous web is affixed to the film of the liquid impervious layer by heating all four layers of the multiple layered absorbent fabric to a temperature that causes the film to bond to the fibrous web without melting or damaging the fibers in the hydrophilic nonwoven web.

Hydrostatic Head Loss is a measure of the reduction in hydrostatic head that results from a specific treatment meant to simulate how the resistance of a sheet to penetration by water may be reduced by contact with another fabric. In this specific treatment, an absorbent material is placed in the sample holder of a Nu-Martindale Abrasion and Pilling Tester and 5 ml of an aqueous solution containing 0.9% (w/w) sodium chloride is allowed to absorb in to the fabric. A repellent material is then placed on top of the absorbent material and held in place by the sample holder. The repellent sheet is made from Suprel®, which is a spunbond-meltblown-spunbond (SMS) nonwoven made from polyethylene/polyester bicomponent fibers and is available from E. I. du Pont de Nemours and Company, Wilmington, Del. (DuPont).

The lid of the tester is then lowered on top of the samples and applies 12 kPa of pressure through a metal surface on to the back of the repellent fabric. The Nu-Martindale tester then makes 150 cycles in the “C” pattern. This action is meant to simulate the repeated contact that may occur when an absorbent fabric comes in to contact with a repellent fabric such as when a repellent operating room garment comes in to contact with an absorbent operating room drape. The hydrostatic head of the repellent fabric that has been subjected to this treatment is measured immediately after this treatment. The hydrostatic head of the untreated repellent material is also measured, where the “untreated repellent material” refers to the repellent material before it has been subjected to any treatment. The hydrostatic head loss is the difference between the hydrostatic head of the untreated repellent material and the hydrostatic head of the repellent material after this treatment and is reported in centimeters and as a percentage of loss from the untreated material.

EXAMPLES

Hereinafter the present invention will be described in more detail in the following examples.

Comparative Example A

A two-layer absorbent fabric was made by combining an absorbent layer and a liquid impervious layer. The absorbent layer was a spunlaced fabric containing wood pulp and poly(ethylene terephthalate) polyester fibers in a ratio of 55% (w/w) wood pulp to 45% (w/w) polyester having a basis weight of 71.5 grams per square meter available from DuPont as Sontara® style 9927. The liquid impervious layer was a film layer made from low density polyethylene and has a thickness of approximately 1 mil. The film layer was attached to the absorbent layer using a pressure sensitive adhesive (Sprayway® 82C Mist Adhesive).

In the hydrostatic head loss test, the untreated repellent fabric had a hydrostatic head of 84.4 cm and this fabric caused a hydrostatic head loss of 3.9 cm corresponding to a hydrostatic head loss percentage of 3.9%.

Comparative Example B

A two-layer fabric was made according to the procedure of Comparative Example A except that the absorbent layer was treated with a hydrophilic surfactant and an antistatic agent. The hydrophilic surfactant was a nonionic fatty acid ester available from Uniqema as Cirrasol® G2109. The antistatic agent was a phosphate ester available from Stepan as Zeelec® TY. The absorbent layer was dipped into an aqueous bath of 0.75% (w/w) Cirrasol G2109 and 0.25% (w/w)
Zelec TY. The sheet was then squeezed to remove excess liquid and dried in an oven at 160° C. for 2 minutes.

Example 1

A three-layer fabric was made in accordance with the invention by combining a liquid pervious layer, a spunlaced absorbent layer, and a liquid impervious layer. The liquid pervious layer was made by thermally bonding three layers of melt spun fibers where the first layer was a spunbond fabric made of bicomponent sheath/core fibers made with 50 wt % polyethylene melting point 128° C. sheath and 50 wt % poly(ethylene terephthalate) melting point 258° C. core. The second layer of the liquid pervious layer was made of a meltblown fabric having 30 wt % polyethylene melting point 128° C. and 70 wt % poly(ethylene terephthalate) melting point 258° C. side-by-side bicomponent fibers. The third layer of the liquid pervious layer was identical to the first. This spunbond-meltbond-spunbond sheet was treated by dipping in an aqueous solution of 20% (w/w) isopropanol wherein isopropanol is used as a wetting agent for this fabric, 0.75% (w/w) Cirrasol G2109 hydrophilic surfactant and 0.25% (w/w) Zelec TY antistatic agent. The sheet was then squeezed to remove excess liquid and dried in an oven at 105° C. for 2 minutes. The absorbent layer was a spunlaced fabric having a basis weight of 40 grams per square meter and having 65% (w/w) lyocell fibers and 35% (w/w) poly(ethylene terephthalate) fibers. The liquid impervious layer was a film made from a copolymer of ethylene and vinyl acetate having 18% (w/w) vinyl acetate and a melting point of 86° C. The film layer was attached directly to the absorbent layer by extrusion coating. The absorbent layer was attached to the liquid pervious layer using 3 grams per square meter of a hot-melt adhesive H2900 available from Bostik.

The linting generation test provided a linting coefficient of 3.72 for particles greater than 0.5 microns whereas a fabric similar to Comparative Example B generated a linting coefficient of 5.88 in this test. The presence of the liquid pervious layer in Example 1 provided a reduction in linting as compared to a fabric similar to Comparative Example B.

In the hydrostatic head loss test the untreated repellent fabric had a hydrostatic head of 84.4 cm and this fabric caused a hydrostatic head loss of 39.3 cm corresponding to a hydrostatic head loss percentage of 46.5%. Based on the hydrostatic head loss data, less hydrophilic surfactant is transferred from the absorbent drape to the untreated repellent material for Example 1 as compared to Comparative Example B. Although hydrophilic surfactant aids the transfer of water through the liquid pervious layer, less hydrophilic surfactant (and, hence, less contamination) is transferred to the untreated repellent material as compared to hydrophilic surfactant treated absorbent layer without a liquid pervious layer in Comparative Example B.

1-17. (canceled)

18. A multiple layered absorbent fabric comprising:
(a) a liquid pervious layer comprising at least one hydrophilic nonwoven web of melt spin continuous multiple component fibers wherein the multiple components are made from polymers with different melting points and wherein the melt spin fibers have a length and a surface and the polymers extend substantially along the complete length of the melt spin fibers with the polymer having the lowest melting point occupying at least a portion of the surface of the melt spin fiber;
(b) a liquid impervious layer comprising a film made from a polymer having a melting point below the melting point of the melt spin fiber polymers; and
(c) an absorbent layer comprising a spunlaced web disposed between the liquid pervious layer and the liquid impervious layer, and
(d) a backing layer comprising a fibrous web positioned adjacent the liquid impervious layer opposite from the absorbent layer.

19. The absorbent fabric of claim 18, wherein the hydrophilic nonwoven web is treated with a hydrophilic surfactant.

20. The absorbent fabric of claim 19, wherein the hydrophilic surfactant is a fatty acid ester.

21. The absorbent fabric of claim 18, wherein the hydrophilic nonwoven web comprises at least one spunbond.

22. The absorbent fabric of claim 18, wherein the hydrophilic nonwoven web comprises at least one spunbond web.

23. The absorbent fabric of claim 22, wherein the hydrophilic nonwoven web comprises at least one spunbond web and at least one meltblown web wherein the at least one meltblown web is disposed between the at least one spunbond web and the absorbent layer.

24. The absorbent fabric of claim 23, wherein the hydrophilic nonwoven web comprises two spunbond webs and at least one meltblown web wherein the at least one meltblown web is disposed between the two spunbond webs.

25. The absorbent fabric of claim 18, wherein the melt spun continuous multiple component fibers comprise bicomponent fibers.

26. The absorbent fabric of claim 25, wherein the polymers of the multiple components are selected from the group consisting of polyolefins, polyesters, polyamides and copolymers thereof.

27. The absorbent fabric of claim 25, wherein a combination of polymers of the bicomponent fibers comprises a polyolefin and a polyester.

28. The absorbent fabric of claim 18, wherein the polymer of the film is selected from the group consisting of polyolefin, ethylene vinyl acetate copolymer, and ethylene maleic anhydride.

29. The absorbent fabric of claim 18, wherein the spunlaced web comprises at least some naturally absorbent fibers.

30. The absorbent fabric of claim 29, wherein the naturally absorbent fibers are selected from the group consisting of wood pulp, cellulose, and cotton.

31. The absorbent fabric of claim 29, wherein the spunlaced web further comprises at least some synthetic fibers.

32. The absorbent fabric of claim 31, wherein the synthetic fibers are polyester fibers.