9706133-7 IIOS

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : A61F 13/15, 13/20	A1	(11) International Publication Number: WO 97/00059
		(43) International Publication Date: 3 January 1997 (03.01.97)

(21) International Application Number: PCT/US96/08667

(22) International Filing Date: 4 June 1996 (04.06.96)

(30) Priority Data:
95830255.6 19 June 1995 (19.06.95) EP
(34) Countries for which the regional or international application was filed: BE et al.

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(81) Designated States: AL, AM, AT, AU, AZ, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: SANITARY ARTICLES WITH DUAL LAYER TOPSHEETS

(57) Abstract

The present invention relates to absorbent articles, particularly sanitary napkins having layered topsheets. In particular, a first layer receiving the liquids to be absorbed comprises aperture of at least 1.4 mm^2 area in a film. These large apertures provide exceptionally good liquid intake performance for the absorbent article. A second layer provides a liquid receiving volume reservoir by having and resiliently maintaining a minimum thickness of 0.3 mm. Additionally, the second layer provides visual masking of absorbent liquids in the area of the large apertures of the first topsheet layer.

Sanitary Articles With Dual Layer Topsheets

Field of the invention

The present invention relates to absorbent articles particularly sanitary napkins having layered topsheets. In particular a first layer receiving the liquids to be absorbed comprises apertures of at least 1,4 mm^2 area in a film. These large apertures provide exceptionally good liquid intake performance for the absorbent article. A second layer provides a liquid receiving volume reservoir by having and resiliently maintaining a minimum thickness of 0,3 mm. Additionally the second layer provides visual masking of absorbent liquids in the area of the large apertures of the first topsheet layer.

Background of the invention

Sanitary articles such as sanitary napkins, baby diapers, absorbent inserts, and absorbent adult incontinence articles are well-known in the art. Typically all these articles comprise a wearer facing surface ("internal") and a garment facing surface ("external"). The wearer facing surface receives from the wearer of such articles liquids, bodily discharges such as menses, to be absorbed. In order for the article to store the liquid the wearer facing surface has to be liquid permeable while maintaining integrity of the outer wearer facing surface of the absorbent article. This wearer facing surface is provided by a topsheet and is the one which comes into contact with the wearer's skin.

Well-known topsheets in the art of absorbent articles are non-woven fabrics, woven fabrics or films. Films have to be rendered permeable by aperturing. Fabrics or

non-woven fabrics are made of fibers which by their nature provide non-linear apertures of varying and changing size depending on the selected direction for liquid transport through them. Films are often made of polymeric material and typically comprise apertures which have been engineered to provide certain characteristics. These apertures can vary in shape and size. The walls of the apertures define the amount of extension - if any - beyond the plane of the film thickness and the direction of such extensions. The film apertures also can be provided in the shape of a funnel.

A typical topsheet made of polyethylene film has been successfully used in sanitary articles and adult incontinence products as well as inserts and baby diapers. One problem remaining is the total amount of liquid capable of passing through such a topsheet under usual usage conditions due to the total amount of open area of all apertures and individual aperture size and shape in particular. Exceptionally large apertures increase the liquid passage rate but pose the problem of masking because liquids such as menses remain visible to the wearer, which is considered undesirable. Also large apertures promote a backflow of absorbed liquid, so called rewet, which is undesirable. Small individual apertures on the other hand cannot provide the liquid passage characteristics required to let liquids of high surface tensions pass through; this can be a problem in an absolute sense for very small apertures or cause too low a rate of liquid flow.

It also has been found that the total amount of open area for a given aperture size and shape is approximately linearly related to the rate of liquid passage. Again, masking of the liquid which has passed through but also material strength and other appearance considerations are limiting the extent as to which the total open area in a film topsheet can be selected.

From the aforesaid it is clear that a balancing problem between masking, material strength, other appearance considerations and total open area as well as individual aperture size and shape exists in the state of the art. The present invention does not attempt to provide selection criteria for this balancing problem but to shift the balance for this problem in order to obtain improved absorbent articles in respect to their capability of fast liquid intake as well as rewet and masking of the liquid received while maintaining acceptable characteristics of material strength and other considerations for topsheets.

It is hence on objective of the present invention to provide an apertured topsheet for absorbent articles which has larger apertures than those commonly found acceptable in film apertured topsheets while effectively improving or at least not deteriorating the rewet and masking of absorbed liquids.

Description of the invention

The present invention provides an absorbent article having all the benefits of a large aperture film topsheet without the masking and rewet problems of the prior art. In particular, the absorbent article comprises a laminate topsheet having a wearer facing surface and a garment facing surface. The topsheet comprises a first and second layer which are preferably joined to each other. An absorbent article generally further comprises a backsheet and an absorbent structure alternatively called absorbent core placed between the topsheet and the backsheet.

Absorbent structure

The absorbent structure can include the following components: (a) optionally a primary fluid distribution layer preferably together with a secondary optional fluid

distribution layer; (b) a fluid storage layer; (c) optionally a fibrous ("dusting") layer underlying the storage layer; and (d) other optional components.

(a) Primary/Secondary Fluid Distribution Layer

One optional component of the absorbent structure according to the present invention is a primary fluid distribution layer and a secondary fluid distribution layer. The primary distribution layer typically underlies the topsheet and is in fluid communication therewith. The topsheet transfers the acquired fluid to this primary distribution layer for ultimate distribution to the storage layer. This transfer of fluid through the primary distribution layer occurs not only in the thickness, but also along the length and width directions of the absorbent product. The also optional but preferred secondary distribution layer typically underlies the primary distribution layer and is in fluid communication therewith. The purpose of this secondary distribution layer is to readily acquire fluid from the primary distribution layer and transfer it rapidly to the underlying storage layer. This helps the fluid capacity of the underlying storage layer to be fully utilized. The fluid distribution layers can be comprised of any material typical for such distribution layers. In particular fibrous layers maintain the capillaries between fibers and even when wet are useful as distribution layers.

(b) Fluid Storage Layer

Positioned in fluid communication with, and typically underlying the primary or secondary distribution layers, is a fluid storage layer. The fluid storage layer can comprise any usual absorbent material or combinations thereof. It preferably comprises absorbent gelling materials usually referred to as "hydrogel", "superabsorbent", "hydrocolloid" materials in combination with suitable carriers.

The absorbent gelling materials are capable of absorbing large quantities of aqueous body fluids, and are further capable of retaining such absorbed fluids under moderatle pressures. The absorbent gelling materials can be dispersed homogeneously or non-homogeneously in a suitable carrier. The suitable carriers, provided they are absorbent as such, can also be used alone.

Suitable absorbent gelling materials for use herein will most often comprise a substantially water-insoluble, slightly cross-linked, partially neutralized, polymeric gelling material. This material forms a hydrogel upon contact with water. Such polymer materials can be prepared from polymerizable, unsaturated, acid-containing monomers which are well-know in the art.

Suitable carriers include materials which are conventionally utilized in absorbent structures such as natural, modified or synthetic fibers, particularly modified or non-modified cellulose fibers, in the form of fluff and/or tissues. Suitable carriers can be used together with the absorbent gelling material, however, they can also be used alone or in combinations. Most preferred are tissue or tissue laminates in the context of sanitary napkins/panty liners.

An embodiment of the absorbent structure made according to the present invention comprises a double layer tissue laminate formed by folding the tissue onto itself. These layers can be joined to each other for example by adhesive or by mechanical interlocking or by hydrogen bridge bonds. Absorbent gelling material or other optional material can be comprised between the layers.

Modified cellulose fibers such as the stiffened cellulose fibers can also be used. Synthetic fibers can also be used and include those made of cellulose acetate, polyvinyl fluoride, polyvinylidene chloride, acrylics (such as Orlon), polyvinyl acetate,

non-soluble polyvinyl alcohol, polyethylene, polypropylene, polyamides (such as nylon), polyesters, bicomponent fibers, tricomponent fibers, mixtures thereof and the like. Preferably, the fiber surfaces are hydrophilic or are treated to be hydrophilic. The storage layer can also include filler materials, such as Perlite, diatomaceous earth, Vermiculite, etc., to improve liquid retention.

If the absorbent gelling material is dispersed non-homogeneously in a carrier, the storage layer can nevertheless be locally homogeneous, i.e. have a distribution gradient in one or several directions within the dimensions of the storage layer. Non-homogeneous distributions can also refer to laminates of carriers enclosing absorbent gelling materials partially or fully.

(c) Optional Fibrous ("Dusting") Layer

An optional component for inclusion in the absorbent structure according to the present invention is a fibrous layer adjacent to, and typically underlying the storage layer. This underlying fibrous layer is typically referred to as a "dusting" layer since it provides a substrate on which to deposit absorbent gelling material in the storage layer during manufacture of the absorbent structure. Indeed, in those instances where the absorbent gelling material is in the form of macro-structures such as fibers, sheets or strips, this fibrous "dusting" layer need not to be included. However, this "dusting" layer provides some additional fluid-handling capabilities such as rapid wicking of fluid along the length of the pad.

(d) Other Optional Components of the absorbent structure

The absorbent structure according to the present invention can include other optional components normally present in absorbent webs. For example, a reinforcing scrim can be positioned within the respective layers, or between the respective layers,

of the absorbent structure. Such reinforcing scrims should be of such configuration as not to form interfacial barriers to fluid transfer. Given the structural integrity that usually occurs as a result of thermal bonding, reinforcing scrims are usually not required for thermally bonded absorbent structures.

Another component which can be included in the absorbent structure according to the invention and preferably is provided close to or as part of the primary or secondary fluid distribution layer are odor control agents. Active carbon coated with or in addition to other odor control agents, in particular suitable zeolite or clay materials, are optionally incorporated in the absorbent structure. These components can be incorporated in any desired form but often are included as discrete particles.

Backsheet

The backsheet primarily prevents the exudates absorbed and contained in the absorbent structure from wetting articles that contact the absorbent product such as underpants, pants, pyjamas and undergarments. The backsheet is preferably impervious to liquids (e.g. menses and/or urine) and is preferably manufactured from a thin plastic film, although other flexible liquid impervious materials can also be used. As used herein, the term "flexible" refers to materials that are compliant and will readily conform to the general shape and contours of the human body. The backsheet also can have elastic characteristics allowing it to stretch in one or two directions.

The backsheet typically extends across the whole of the absorbent structure and can extend into and form part of or all of the preferred sideflaps, side wrapping elements or wings.

The backsheet can comprise a woven or non-woven material, polymeric films such as thermoplastic films of polyethylene or polypropylene, or composite materials such as a film-coated non-woven material. Preferably, the backsheet is a polyethylene film having a thickness of from about 0.012 mm (0.5 mil) to about 0.051 mm (2.0 mils).

Exemplary polyethylene films are manufactured by Clopay Corporation of Cincinnati, Ohio, under the designation P18-0401 and by Ethyl Corporation, Visqueen Division, of Terre Haute, Indiana, under the designation XP-39385. The backsheet is preferably embossed and/or matte finished to provide a more clothlike appearance. Further, the backsheet can permit vapors to escape from the absorbent structure, i.e. be breatheable, while still preventing exudates from passing through the backsheet. Also breatheable backsheets comprising several layers, e.g. film plus non-woven structures, can be used.

The topsheet

The term "joined", as used herein, encompasses configurations in which the first layer is directly secured to the second layer by affixing the first layer directly to the second layer; configurations in which the first layer is indirectly secured to the second layer by affixing the first layer to intermediate layer(s) which in turn is (are) affixed to the second layer. Both layers are preferably joined to each other across at least 50% of their total surface.

The layers of the topsheet can be joined together by adhesives, stitching, heat and/or pressure bonds, dynamic mechanical bonds, ultrasonic bonds, intermingling or entanglement of the fibers and other structural elements comprising the layers of the

topsheet, such as by meltblowing the fibers of the second layer onto the film of the first layer, extruding one layer onto another, or by any other means known in the art.

The topsheet comprises a first passage layer which provides the user facing surface of the topsheet and a second passage layer between the first passage layer and the absorbent structure.

The topsheet as a whole and hence each layer individually needs to be compliant, soft feeling, and non-irritating to the wearer's skin. It also can have elastic characteristics allowing it to be stretched in one or two directions.

The first passage layer is provided by a film material having apertures which are referred herein as "large apertures" and optionally apertures which are referred herein as "small apertures". These apertures are provided to facilitate liquid transport from the wearer facing surface towards the absorbent structure.

For all measurements regarding the apertures in the first passage layer the plane of the smallest cross sectional areas of the aperture should be used, unless otherwise mentioned.

The large apertures have an individual open area of from 1.4 mm^2, to 3.0 mm^2 and preferably from 1.5 mm^2 to 2.5 mm^2. The total open area of the large apertures in the upper passage layer excluding all other liquid transport apertures should be in the range from 5% to 20%, preferably from 10% to 20% of the surface area of the first layer of the topsheet.

The optional small apertures in the first layer of the topsheet of the absorbent article have an individual open area of less than 1.4 mm^2 and typically not smaller than 0.15 mm^2. Apertures which are even smaller are usually not suitable for liquid transport at all and would only function as gas permeable apertures for example for

breatheability purpose. Preferably, the optional small apertures are in the range of 0.25 mm^2 to 0.4 mm^2.

The apertures are preferably substantially circular or polygonal. Their shape is limited by having a ratio of the largest to the smallest inner diagonal length in the range between 1 and 6, preferably 1 and 3. The total open area of all liquid transport apertures in the first layer is in the range of 10% to 40%, preferably 15% to 35% of the total area of the first layer. When approaching the upper limit of this total open area of the first layer, i.e. above a total open area of about 30%, the distribution of apertures needs to be homogeneous, i.e., there should not be a specific area where more aperture areas are concentrated than elsewhere. First passage layers not having a homogeneous distribution of liquid passage ways are also contemplated by the present invention and would have a highest concentration of apertures in the area where liquid is expected to be discharged to.

The liquid transport apertures are formed in the film such that the walls of the apertures extend beyond the plane of the surface of the basic film, i.e. the film surface, before the film is apertured. The direction of these extending walls in the absorbent article is towards the garment facing surface of the article. The amount of extension of the walls of the apertures in the first layer is at least 0.3 mm beyond the film surface from which the walls of the apertures depend. Preferably the walls of the apertures form funnels or Venturi channels as is well-known in the art.

To ensure material stability the smallest distance between neighboring large apertures regardless of their particular shape and size is preferably at least 1.0 mm, more preferably 1.5 mm. This distance is measured on the surface of the film on the side closest to the user facing surface of the absorbent article.

Also, as is typical for topsheets, the film material is preferably rendered hydrophilic to such a degree that the contact angle is less than 90° with distilled water upon first contact with the water. For films this can be achieved by surfactant treatment. For surfactant treated polymeric films providing the first layer it has been found that it is beneficial to use films where the surfactant is permanently fixed on the film surface. These are so-called film materials with resin integrated surfactant. For these films even repeated wetting by distilled water would provide approximately the same contact angle as the first contact with distilled water.

In another preferred execution of the first layer of the topsheet the wearer facing surface is treated with an agent such that liquids are directed towards the apertures. Such agents can be silicon or teflon which provide the treated surface with a self-cleaning effect. This treatment can be in addition to the above mentioned surfactant treatment.

Films such as those disclosed in EP-O 205 286, EP-0-165 208, EP-0-18 020, EP-0-59 506 or US-3,929,135 are explicitly referred to as suitable as first passage layer of the topsheet provided the requirements of the claims are met. Other suitable formed films, provided the requirements for the first passage layer are met, are described in U.S. Patent 4,324,246, U.S. Patent 4,342,314, U.S. Patent 4,463,045 and U.S. Patent 5,006,394. Particularly preferred microaperturing of formed film is disclosed in U.S. patent 4,609,518 and U.S. patent 4,629,643. These microapertures can also be included in the first passage layer of the topsheet provided they are less than 0.15 mm^2 and hence essentially provide breatheability. Ways of making such films are well-known in the art and have also been disclosed in the above prior art references.

The second passage layer of the topsheet is provided by a high loft resilient fibrous material. The high loft resilient fibrous material should have a total void volume of more than 50%, preferably more than 90%, preferably a minimum thickness of 0.3 mm, more preferably at least 0.5 mm. The basis weight of such fibrous materials preferably is in the range of 20 g/m^2 to 100 g/m^2 and most preferably be in the range of 25 g/m^2 to 60 g/m^2.

It is necessary that the fibrous material is at least as hydrophilic as the film material of the first layer in order to present no barrier for the liquid. Better yet it is more hydrophilic (or less hydrophobic) than the film and creates a directing force for the liquid towards the absorbent structure after passing the first layer. Hence if the fibers are made of synthetic fibers such as polypropylene, polyethylene, bicomponent polypropylene/polyethylene, polyester, polyamid fibers or artificial fibers preferably rayon, viscose fibers or mixtures thereof, it may be necessary to treat these fibers in a similar fashion as the film in order to provide them with the required hydrophilic (or hydrophobic) characteristic.

The fibers in this second layer should preferably be thermally bonded in order to provide integrity and resiliency to the network of fibrous material desired under the present invention. The fibrous layer should be resilient in the sense that it returns to at least 80% of its original volume after being compressed to 50% of the starting volume in a dry state. In a wet state the layer should return to at least 65% of its original volume after being compressed to 50% of the starting volume.

For carded fibrous materials the individual fiber length should be preferably from 25 mm to 50 mm, while the preferred air-laid fibers are preferably 1 o 10 mm,

most preferably 4 o 8 mm long. Fibers should have a weight per length in the range from 1.5 to 10 x 10^{-7} kg/m, preferably 3.3 to 6.7 x 10^{-7} kg/m (decitex).

Fibrous layers are well-known in the art of absorbent articles to provide topsheets. Such fibrous layers, provided the requirements as indicated in the claims are met, can be used as the second layer in the context of the present invention. In particular fibrous layers in accordance with US-Application 08/141,156 of October 21, 1993 or US 3,994,771 are useful as the second layer of the topsheet according to the present invention.

Since both layers of the topsheet, individually, are well-known in the art it is not necessary to elaborate on further details of the topsheet layers of the present invention but to exemplify the performance of the heretofore unknown dual layer topsheet combination in the following examples.

The tests to analyze liquid intake rate, rewet and masking are simple tests to review the specific performance aspect of a product in relation to an alternative product. The results are intended to identify the qualitative difference between alternative executions and give an indication of the relative magnitude of improvements. Since the topsheet combination distinguishes the present invention from the prior art, a back sheet and core combination, commercially available, with usual characteristics will typically be sufficient to evaluate alternative topsheet combinations.

For the tests described below a commercially available sanitary napkin having a polyethylene backsheet and a tissue laminate (tissue folded around and onto itself including an absorbent gel material) was used as a base in combination with alternative topsheet combinations.

The tested topsheet was made of a first film layer glued by a hotmelt adhesive to a fibrous layer, the second layer according to the present invention. The hotmelt adhesive was applied in a quantity of 3 g/m^2 by spiral gluing and the adhesive which was used is available as H 2031, by Findley, Euro B.V. from The Netherlands.

The reference film layer was 'DriWeave" film available from The Procter & Gamble Company, Cincinnati, Ohio, USA and commercialized on their Always ® and Aldays ® brands. This film is essentially identical with the first layer of the topsheet of the present invention but for the aperture size. Apertures in the reference film would only qualify as small apertures since they had 0.34 mm^2 open area. The total open area was 31.28% with 92 apertures per cm^2.

The first layer film according to the present invention had circular, slightly funnel shaped apertures of 1.7 mm^2 area for the large apertures and 0.20 mm^2 for the small apertures. The total open area was 32.82% with 11.24% due to the large apertures and 21.58% due to the small apertures. The average number of apertures per cm^2 was 6.61 for the large apertures and 107.9 for the small apertures. The walls of the apertures including the basic film has a caliper of 0.427 mm while the film thickness was 0.0255 mm (such that the wall extended about 0.4 mm from the plane of the film).

The second layer according to the present invention was commercially available high loft fibrous material from Walkisoft Company, Arhus, Denmark under code P 50 (IP). This material is made of polypropylene/polyethylene bicomponent, air-laid fibers which are thermobonded by hot air. It has a void volume of more than 90% and a caliper of 2.5 mm. The individual fiber length was 6 mm and the basis weight of the layer was 60 g/m^2.

The reference second layer is available from Suominen under reference F3200. It provides a caliper of 0.5 mm and basis weight of 50 g/m^2 at a void volume of 25%.

The following tests samples were prepared in sufficient quantity for statistical analysis of the test results:

Product Code	A	B	C	D
first layer of topsheet	reference	reference	film according to present invention	film according to present invention
second layer of topsheet	reference	Walkisoft	Walkisoft	reference

Core+Backsheet -commercially available core plus backsheet of Always Ultra Medium Size sanitary napkins

The tests were an acquisition test, a rewetting test and visual inspection on all test samples as to masking.

Acquisition test procedure

Principle:

This procedure measures a product's ability to 'keep on absorbing" (acquisition decay) subject to repeat assaults of fluid under a prescribed set of conditions. This procedure is recommended for multiple product comparisons.

This method evaluates the time required for the acquisition of given amounts of liquid during repeated imbibitions (three in this case), at relatively high speed (about 3 ml/sec) and under pressure of 1723.7 Pa (0.25 PSI), to model 'in use" pressure while wearing.

Each product is laid down on a flat surface and an acquisition plate is placed on it. The acquisition plate comprises a rectangular plexiglass plate 70 x 220 x 8 mm with an aperture 22 mm in diameter formed therein. A cylinder 45 mm high and 22 mm in internal diameter is located over the aperture in sealing contact with the plate. The cylinder is filled with Artificial Menstrual Fluid (AMF), and a pressure of 1723.7 Pa (0.25 PSI) is applied to the plate, obtained with appropriate weights positioned on the plate, the pressure being that measured with reference to the portion of the product under the acquisition plate. The acquisition time is the time from the beginning of each imbibition until the disappearance of the liquid from the interior of the cylinder. A waiting time of 10 minutes is left after each imbibition before repeating the procedure.

Rewetting test procedure

Drop 7 ml of Artificial Menstrual Fluid (AMF) over 90 sec onto the center of a sanitary napkin.

Dropping area is 3x4 cm^2, with 4 cm being in the longitudinal direction of the sanitary napkin.

Let the pad stand for 20 min.

Place 7 layers of preweighed blotting paper (*) in the center of the pad.

Apply the pressure of 70 g/cm^2.

Wait for 15 sec. with the pressure applied.

Remove the blotting paper and measure the weight.

Final rewet result = Sum of the weight of liquid on 7 blotting papers.

(*) blotting paper: from Schleicher & Schuell, code

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Composition of Artificial Method Fluid (AMF) used in the tests

Defibrinated Sheep Blood (from UNIPATH S.p.A., Milano, Italy) = 50%

Phosphate Buffered Saline Solution (from SIGMA Chemie) = 45%

Gastric Mucin type III (from SIGMA) = 4%

Other ions present:

- 0.37% KOH
- 0.23% K_2HPO_4 = 1%
- 0.30% NaCl
- 0.1% Kcl

100%

Surfactant plus water (to adjust viscosity)

N.B. Chemicals: from SIGMA-ALDRICH, Milano, Italy

Test results

The test results for acquisition and rewet can be found as index % in the following tables.

From visual inspection no deterioration of the masking was detectable between product C and products A or B.

Acquisition time results (index %)

1. Testfluid at viscosity of 7mPa.s

Cumulative amount of liquid 5 ml 10 ml 15 ml

Product A	1000%	3000%	5000%
Product B	100%	150%	200%
Product C-basis	100%	100%	100%

2. Testfluid at viscosity of 22 mPa.s

Cumulative amount of liquid	5 ml	10 ml	15 ml
Product A	788%	1636%	2400%
Product B	138%	145%	170%
Product C-basis	100%	100%	100%

The results clearly show that only the combination of the layers according to the present invention can provide the desired benefits of acquisition speed while prior art combinations fail already at low viscosity and always fail at high viscosity.

Rewet

In respect to rewet the problem prejudicially expected with large aperture film topsheets is shown by the following rewet data. The topsheet according to the present invention addresses this problem and provides even an improvement over the small aperture topsheet reference.

Rewet index of test fluid at viscosity of 11 mPa.s

Product A	140%
Product D	640%
Product C	100%

CLAIMS

1. Absorbent article, having fast liquid intake, low rewet, and good masking performance, said article comprising a topsheet, a backsheet, and an absorbent structure placed between said topsheet and said backsheet, said topsheet having a wearer facing surface and a garment facing surface and said topsheet comprising

- a first passage layer, said first passage layer providing said user facing surface of said topsheet, and

- a second passage layer, said second passage layer being placed between said first passage layer and said absorbent structure,

- both said passage layers being preferably joined to each other,

- said first passage layer being provided by a film material having large apertures for liquid transport,

- said large apertures having an individual open area in the range from 1.4 mm^2 to 3.0 mm^2,

- said large apertures have a total open area in the range of from 5% to 20% of the total area of said first passage layer,

- said liquid transport apertures having a largest inner diagonal length and a smallest inner diagonal length, the ratio of said largest to said smallest inner diagonal lenght being in the range of from 1 to 6 for any individual aperture,

- said liquid transport apertures having walls which depend at least 0.3 mm from the surface of said film, said walls depending in a direction towards said garment facing surface,

- said film material being rendered hydrophilic such that it forms a contact angle of less than 90 degrees with distilled water upon first contact with distilled water,

- the second passage layer being provided by a high loft fibrous material,

- said fibrous material having a void volume of more than 50%, and preferably a thickness of at least 0.3 mm,

- said fibrous material being at least as hydrophilic as said film material of said first passage layer.

2. Absorbent article according to claim 1 wherein said large apertures have an individual area in the range of from 1.5 mm^2 to 2.5 mm^2.

3. Absorbent article according to any of the preceding claims wherein said large apertures have a total open area in the range of from 10% to 20% of the total area of said first passage layer.

4. Absorbent article according to any of the preceding claims wherein said first passage layer is provided by a film material further having small apertures for liquid transport,

- said small apertures having an individual open area in the range of from 0.15 mm^2 to less than 1.4 mm^2,

- the total open area of all said liquid transport apertures in said first passage layer being in the range of from 10% to 40% of the total area of said first passage layer.

5. Absorbent article according to claim 4 wherein said small apertures have an individual open area in the range of from 0.25 mm^2 to 0.4 mm^2.

6. Absorbent article according to claim 4 or 5 wherein the total open area of all said liquid transport apertures in said first passage layer is in the range of from 15% to 35% of the total area of said first passage layer.

7. Absorbent article according to any of the preceding claims wherein the smallest edge to edge distance between large apertures in said first passage layer is at least 1.0 mm.

8. Absorbent article according to claim 7 wherein the smallest edge to edge distance between large apertures in said first passage layer is at least 1.5 mm.

9. Absorbent article according to any of the preceding claims wherein said fibrous material has a void volume of more than 90%.

10. Absorbent article according to any of the preceding claims wherein said fibrous material has a thickness of at least 0.5 mm.

11. Absorbent article according to any of the preceding claims wherein said fibrous material has a basis weight of from 20 g/m^2 to 100 g/m^2.

12. Absorbent article according to claim 11 wherein said fibrous material has a basis weight of from 25 g/m^2 to 60 g/m^2.

13. Absorbent article according to any of the preceding claims wherein said fibrous material comprises fibers which have a thickness of from 1.5 to 10 x 10^{-7} kg/m (decidex) and said fibers are selected from synthetic fibers, artificial fibers, or mixtures thereof.

14. Absorbent article according to claim 13 wherein said fibrous material comprises fibers which have a thickness of from 3.3 to 6.7 x 10^{-7} kg/m (decitex).

15. Absorbent article according to claim 13 or 14 wherein said fibers are selected from polypropylene-fibers, polyethylene-fibers, bicomponent

polypropylene/polyethylene-fibers, polyester-fibers, polyamid-fibers, rayon-fibers, viscose-fibers, or mixtures thereof.

16. Absorbent article according to any of the preceding claims wherein said fibrous material comprises fibers which are thermally bonded.

17. Absorbent article according to any of the preceding claims wherein said fibrous material is air-laid and comprises fibers which have a fiber length of from 1 mm to 10 mm.

18. Absorbent article according to claim 17 wherein said fibers have a fiber length of from 4 mm to 8 mm.

19. Absorbent article according to any of the claims 1 to 16 wherein said fibrous material is carded and comprises fibers which have a fiber length of from 25 mm to 50 mm.

20. Absorbent article according to any of the preceding claims wherein both said first and said second passage layer are joined directly to each other.