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Señora Jefe
DIVISIÓN DE NUEVAS CREACIONES
SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO
Bogotá, D.C.

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO
Rad. 04-075592-00002-0000
FEV/2008-05-07 16:51:25 Dep. 2020 NUECREACIONE
ITA/11 PATENTE/II
Eva 379 FASE NACIONAL II
Act 533 PETICION Folios: 20

Re.: Expediente No. 04 75.592
Fase Nacional Solicitud de Patente PCT
a nombre de
H.B. FULLER LICENSING & FINANCING, INC.
Código 011 - 379 - 538

En relación con la solicitud contenida en el Expediente de la referencia y, en particular, con la publicación del extracto de la misma en la Gaceta de la Propiedad Industrial No. 560 de 31 de Enero de 2006, por medio del presente escrito muy respetuosamente me permito solicitarle se sirva proceder a efectuar el **EXAMEN DE PATENTABILIDAD** de la solicitud aquí contenida.

Para el efecto, acompaño el comprobante de pago por concepto de la tasa correspondiente, Recibo No. 16-42,948.

De Usted Atentamente,

GERMAN CASTILLO GRAU
T.P. No. 2878 del C.S.J.

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SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO

NIT : 800176089-2

RECIBO OFICIAL DE CAJA : 06 - 42,948
FECHA : JUNIO 7 DE 2006

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO
Rec: 04-075582-00002-0000
FE: 2006-06-07 16:31:23 Dep. 2020 NUECREACIONE
TR. 11 PATENTEYU
EVI: 879 FASENACIONALI
AD: 533 PETICION Folios: 20

CONSIGNACION

DEPOSITANTE	TIPO PAGO	BANCO	CUENTA	No. PAGO	FECHA PGO	Vr. PAGO
WILLO GRAU Y ASOCIADOS	CONSIGNACION	BANCO POPULAR	050-00110-6	54931286	07/06/2006	1,339,800.00

CONCEPTO

CANT.	RENTISTICO	CONCEPTO	TOTAL CONCEPTO
1	50005-01-01	SOLICITUDES	114 PTC CAP-II EXAMEN DE PATENTIBILID
		TOTAL :	\$ 194,000.00

SON: CIENTO NOVENTA Y CUATRO MIL PESOS

RESPONSABLE : _____
RECIBO DE CAJA APLICADO AL EXPEDIENTE No. _____

DIVISION DE NUEVAS CREACIONES

RADICACIÓN EXPEDIENTE No. 04-75592

**EL EXTRACTO DE LA PRESENTE SOLICITUD DE PATENTE DE INVENCION -
PCT FUE PUBLICADO EN LA GACETA DE PROPIEDAD INDUSTRIAL No 560,
DE FECHA 31 DE ENERO DE 2006, EL TERMINO HABIL SEÑALADO POR LA
LEY EXPIRA EL 28 DE ABRIL DE 2006.**

NOTA: Dentro del plazo de los seis (6) meses siguientes a partir de la fecha de publicación en la gaceta de Propiedad Industrial, deberá solicitar y cancelar el examen de patentabilidad so pena de que la solicitud caiga en abandono, de acuerdo con lo establecido en el Artículo 44 de la Decisión 486/2000.

SE PRESENTARON OPOSICIONES POR PARTE DE TERCEROS.

SI _____

NO ☒ _____

**SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO
DIVISIÓN DE NUEVAS CREACIONES**

2020

Bogotá, D. C., 2 de Marzo de 2007

Doctor

GERMAN CASTILLO GRAU

Representante **H. B. FULLER LICENSING & FINANCING, INC.**

ASUNTO

Radicación No.	04-75592
Trámite	002
Evento	001
Actuación	430
Oficio	3521
Folios	073

Como resultado del examen de fondo, realizado con fundamento en el artículo 45 de la Decisión 486 de la Comisión de la Comunidad Andina, se le comunica

1) Documentos estudiados:

- a) Para el presente estudio se tendrán en cuenta el capítulo descriptivo, comprendido en los folios 12 a 27 de la solicitud en estudio.
- b) Para el presente estudio se tendrá en cuenta el capítulo reivindicatorio que comprende 17 reivindicaciones en los folios 28 a 30 de la solicitud en estudio.
- c) Conforme lo establece los artículos 9, 10 y 11 de la Decisión 486 de la Comisión de la Comunidad Andina, la presente solicitud en estudio fue presentada el 4 de agosto de 2004, y en el momento de la radicación se presentó como solicitud PCT FASE NACIONAL y donde SI se reclamó prioridad de la primera solicitud presentada en Estados Unidos US10/066935.

2) Objeto de la Invención

- a) Las reivindicaciones 1 a 17 de la solicitud en estudio se refieren a un artículo absorbente que tiene un núcleo que comprende un compuesto que comprende: polímero superabsorbente; una red no tejida de alto espesor impregnada con polímero superabsorbente; el cual polímero superabsorbente ha sido formado in situ; el mencionado compuesto comprende de 10% en peso hasta cerca de 90% en peso de polímero superabsorbente.
- b) El anterior producto busca mejorar las propiedades de artículos absorbentes desechables.
- c) Según la Clasificación Internacional de Patentes, la codificación para esta solicitud corresponde a: A 61 F 13/15.

3) Claridad de la Solicitud

- a) El artículo 28 de la Decisión 486 de la Comisión de la Comunidad Andina de Naciones establece

"La descripción deberá divulgar la invención de manera suficientemente clara y completa para su comprensión y para que una persona capacitada en la materia técnica correspondiente pueda ejecutarla"

La descripción no es clara toda vez que las unidades no están en el Sistema Internacional de Unidades. Asimismo, se recomienda no ejemplar la frase "peso básico" cuando en lo que de verdad se quiere decir es "peso base"

- b) El artículo 30 de la Decisión 486 de la Comisión de la Comunidad Andina establece que

"Las reivindicaciones definirán la materia que se desea proteger mediante la patente. Deben ser claras y concisas y estar enteramente sustentadas por la descripción. Las reivindicaciones podrán ser independientes o dependientes. Una reivindicación será independiente cuando defina la materia que se desea proteger sin referencia a otra reivindicación anterior. Una reivindicación será dependiente cuando defina la materia que se desea proteger refiriéndose a una reivindicación anterior. Una reivindicación será dependiente cuando defina la materia que se desea proteger refiriéndose a una reivindicación anterior.- Una reivindicación que se refiera a dos o más reivindicaciones anteriores se considerará reivindicación dependiente múltiple."

El capítulo reivindicatorio no es claro toda vez que:

- i) Presenta frases ambiguas tales como "alto espesor", "cerca de" y similares. Dichas frases son inaceptables en un capítulo reivindicatorio por lo que deben eliminarse.
- ii) La reivindicación 10 es inaceptable, toda vez que quiere proteger el mismo objetivo a lograr.

De acuerdo a lo anterior, el capítulo reivindicatorio no cumple con el requisito de claridad de acuerdo a lo establecido en el Art. 30 de la Decisión 486.

4) Determinación del Estado de la Técnica

El artículo 16 de la Decisión 486 de la Comisión establece:

"El estado de la técnica comprenderá todo lo que haya sido accesible al público por una descripción escrita u oral, utilización, comercialización o cualquier otro medio antes de la fecha de presentación de la solicitud de patente o, en su caso, de la prioridad reconocida."

"Sólo para el efecto de la determinación de la novedad, también se considerará dentro del estado de la técnica, el contenido de una solicitud de patente en trámite ante la oficina nacional competente cuya fecha de presentación o de prioridad fuese anterior a la fecha de presentación o de prioridad de la solicitud de patente que se estuviese examinando, siempre que dicho contenido este incluido en la solicitud de fecha anterior cuando ella se publique o hubiese transcurrido el plazo previsto en el artículo 40."

Consultadas las bases de datos y los archivos con que cuenta la entidad, especialmente bajo las clasificaciones A 61 F 13/15 y las más cercanas a ellas, se encontró que antes del 4 de febrero de 2002 (fecha para determinar el estado de la técnica) habían sido publicados los documentos que se enumeran en la siguiente tabla los cuales se relacionan con artículos absorbentes que incorporan superabsorbentes.

De acuerdo con o establecido en el artículo 16 se determinó el estado de la técnica y se encontró el siguiente antecedente:

Nº	Documento	Título	Fecha de Publicación
D1	US 6088620	Absorbent laminate	2000.05.30
D2	US 5788684	Liquid absorbing article	1998.08.04
D3	US2003/0105441	Absorbent article comprising polymer with low gel integrity	2003.06.05
D4	WO 01/41818	Superabsorbent polymers having a slow rate of absorption	2001.06.14
D5	WO 00/26458	Uniformly treated fibrous webs and method of making the same	2000.05.11
D6	Múltiples documentos	.	

5) Evaluación de los requisitos de patentabilidad

El artículo 14 de la Decisión 486 de la Comisión de la Comunidad Andina establece:

"Los Países Miembros otorgarán patentes para las invenciones, sean de producto o procedimiento, en todos los campos de la tecnología, siempre que sean nuevas tengan nivel inventivo y sean susceptibles de aplicación industrial".

En cumplimiento con este artículo, se procedió a evaluar los requisitos de novedad, nivel inventivo y aplicación industrial con el fin de establecer la patentabilidad de la invención reivindicada en la solicitud en estudio.

a) Evaluación de la novedad y el del Nivel Inventivo

El art. 16 de la Decisión 486 de la Comisión de la Comunidad Andina establece:

"Una invención se considerará nueva cuando no está comprendida en el estado de la técnica." "El estado de la técnica comprenderá todo lo que haya sido accesible al público por una descripción escrita u oral, utilización comercialización o cualquier otro medio antes de la fecha de presentación de la solicitud de patente o, en su caso, de la prioridad reconocida."

"Sólo para el efecto de la determinación de la novedad, también se considerará dentro del estado de la técnica, el contenido de una solicitud de patente en trámite ante la oficina nacional competente, cuya fecha de presentación o de prioridad fuese anterior a la fecha de presentación o prioridad de la solicitud de patente que se estuviese examinando, siempre que dicho contenido esté incluido en la solicitud de fechas de prioridad cuando ella se publique o hubiese transcurrido el plazo previsto en el artículo 40."

El art. 18 de la Decisión 486 de la Comisión de la Comunidad Andina establece:

"Se considerará que una invención tiene nivel inventivo, si para una persona del oficio normalmente versada en el arte en la materia técnica correspondiente, esa invención no hubiese resultado obvia ni se hubiese derivado de manera evidente del estado de la técnica".

La presente solicitud contempla un artículo absorbente que tiene un núcleo que comprende un compuesto que comprende un polímero superabsorbente y una red no tejida, el polímero superabsorbente ha sido formado in situ; el mencionado compuesto comprende de 10% en peso hasta cerca de 90% en peso de polímero superabsorbente. Dado lo general de lo que el solicitante busca que se le proteja, existe un gran número de documentos que relacionan lo mismo que el solicitante quiere proteger. Como se observa los documentos D1 a D5, tomados como lo más representativo del arte previo, relacionan también núcleos de artículos absorbentes que involucran polímeros superabsorbentes en los porcentajes que muestra la solicitud así como con la conformación que expresa el solicitante. De la misma forma, existen los documentos EP1013290, EP 0169184, EP0402650, EP 0478011, EP0514775, WO9513778, EP0719531, EP1023884, WO0121122, WO0134082, WO0174282, EP0359501, EP702031, EP0708119, EP0992250 o WO0061642 entre otros, donde de forma explícita revelan prácticamente lo mismo que el solicitante quiere que se le proteja. En general no podría decirse que la solicitud cumpla con los requisitos para que se le otorgue el privilegio solicitado.

b) Resumen

En conclusión los requisitos de patentabilidad de la presente solicitud se podrían ver afectados así:

Nº	Documento	Relvindicaciones afectadas	Requisito que afecta
D1	US 6068620	1 - 17	Novedad
			Nivel inventivo
D2	US 5788684	1 - 17	Novedad
			Nivel inventivo
D3	US2003/0105441	1 - 17	Novedad
			Nivel inventivo
D4	WO 01/41818	1 - 17	Novedad
			Nivel inventivo
D5	WO 00/26458	1 - 17	Novedad
			Nivel inventivo
D6	Múltiples documentos	1 - 17	Novedad
			Nivel inventivo

6) **Notificación**

En cumplimiento del artículo 45 de la Decisión 486 de la Comisión de la Comunidad Andina, se le indica que dentro del término de sesenta días contados a partir de la fecha de la notificación de la presente comunicación debe responder a la notificación. En caso de no dar respuesta al presente requerimiento, o si a pesar de la respuesta subsistieran los impedimentos para la concesión, se denegará la patente.

Notifíquese el presente oficio conforme a lo dispuesto por el numeral 5.2, literal e) del capítulo quinto del título primero de la Circular Única Nº 10 de 2001



ALIX CARMENZA CÉSPEDES DE VERGEL
Jefe División de Nuevas Creaciones

El anterior requerimiento fue notificado por fijación en la lista, de fecha

16 MAR 2007

Concepto Técnico Nº	EXAMINADOR TÉCNICO Código No.	EXAMINADOR JURÍDICO Código No.
374	202003	

 16/03/04

[54] **ABSORBENT LAMINATE**
[75] **Inventor:** Harry J. Chabowski, Nassau, Ga.
[73] **Assignee:** Pampex Trade Brands, Nassau, Ga.
[21] **Appl. No.:** 09/081,883
[22] **Filed:** Mar 30, 1998
[31] **Int. Cl.:** A61F 13/18
[32] **U.S. Cl.:** 604/376; 604/378; 604/387;
604/388; 604/371; 604/381; 604/382;
604/379; 604/377; 604/375; 604/373
[36] **Field of Search:** 604/388, 379,
371, 372, 373, 375, 378

[52] **U.S. Cl.:** 604/388; 604/378; 604/387;
604/388; 604/371; 604/381; 604/382;
604/379; 604/377; 604/375; 604/373
[57] **ABSTRACT**
A disposable absorbent garment comprising a topsheet, a backsheet and an absorbent core disposed between the topsheet and backsheet is disclosed. The absorbent core is formed from at least one and preferably more than one layer comprising three layers, including an upper layer, a lower layer and a central flaps layer containing from about 50-90% by weight superabsorbent polymer. The upper and lower layers comprise flaps, which flaps poly or separate anti-woven flaps layer. The upper and lower layers together serve to maintain the integrity of the core during manufacture and in use, contain the superabsorbent polymer within the reach area of the garment and act to define multiple layers so that gel blocking is minimized. The absorbent garment thus formed is very thin, lightweight and comfortable.

[30] **References Cited**
U.S. PATENT DOCUMENTS
5,081,020 6/1991 Mao
5,282,287 1/1994 Chabowski et al.
5,312,213 6/1994 Shiao et al.
5,320,230 9/1994 Jackson et al.
5,396,000 12/1994 Smith et al.
5,411,097 3/1995 Shiao et al.
5,420,028 7/1995 Tikh et al.
5,477,277 12/1995 Shiao et al.
5,494,882 3/1996 Smith et al.
5,500,070 3/1996 Wadsworth et al.
5,508,025 9/1995 Shiao et al.
5,523,045 12/1995 Shiao et al.
5,571,815 11/1996 Shiao et al.

FOREIGN PATENT DOCUMENTS
071,689 2/1997 WFO.
Primary Examiner—John G. Wain
Assistant Examiner—Murray Craig Pappas
Attorney Agent, or Firm—Hansen & Williams

23 Claims, 8 Drawing Sheets

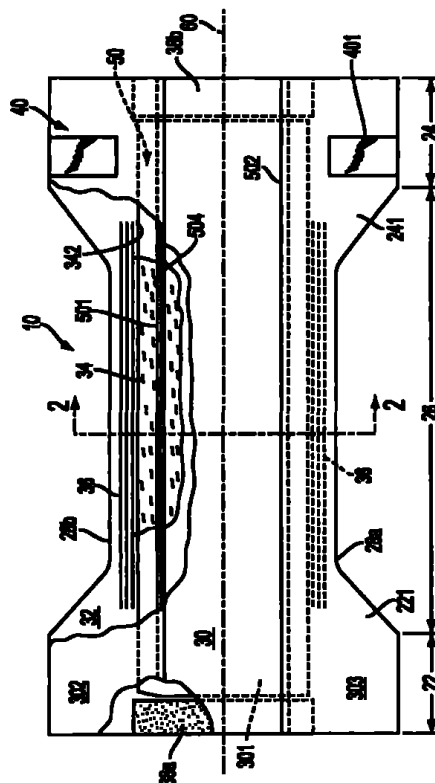
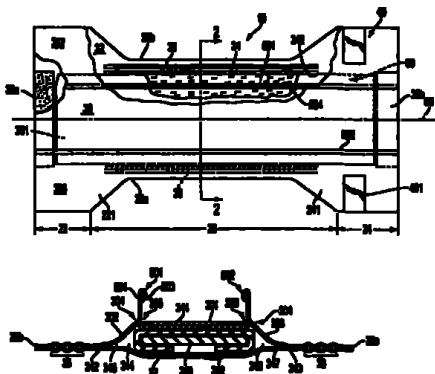


FIG. 1

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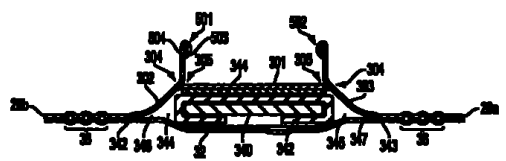


FIG. 2

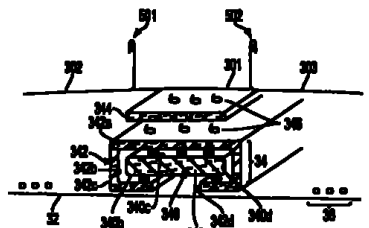


FIG. 3

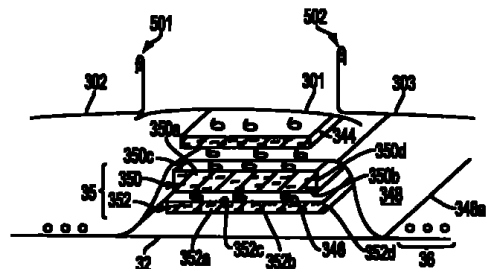


FIG. 4

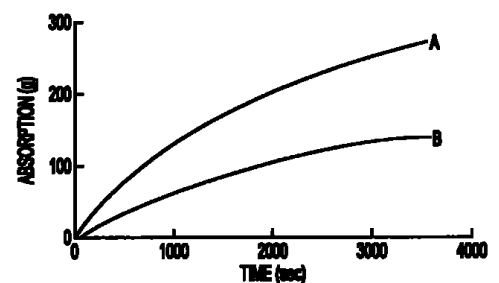


FIG. 5

Handwritten mark resembling a stylized 'e' or a signature.

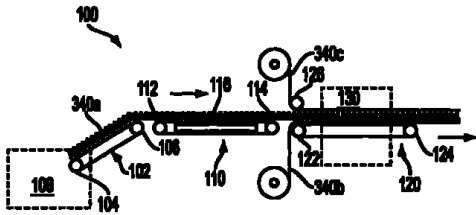


FIG. 6

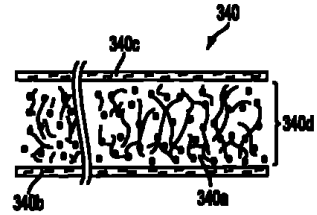


FIG. 8

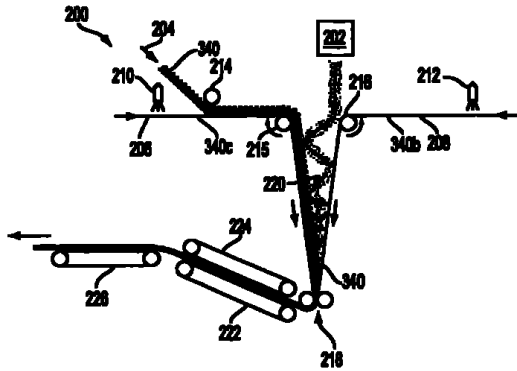


FIG. 7

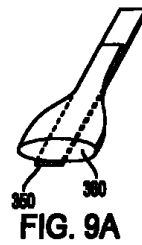


FIG. 9A

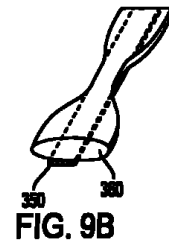
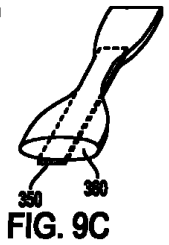


FIG. 9B



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ABSORBENT LAMINATE
FIELD OF THE INVENTION

The present invention relates generally to an absorbent core for a disposable absorbent garment, and more particularly to an absorbent core comprising one or more laminates in which one of the layers of the laminate or laminates contains from about 50-95% by weight particulate or fibrous superabsorbent polymer (SAP).

BACKGROUND OF THE INVENTION

Traditionally, disposable absorbent garments such as infant diapers or training pants, which incorporate products and other such products are constructed with a water-impermeable outer backing sheet, a moisture-permeable body-confining inner liner sheet, and a moisture-absorbent core sandwiched between the liner and backing sheets.

Much effort has been expended to find cost-effective materials for absorbent cores which display good liquid absorbency and retention. Superabsorbent materials in the form of granules, beads, fibers, bits of film, gels, etc., have been favored for such purposes. Such superabsorbent materials are generally polymers or gelling materials which are capable of absorbing and retaining even water moisture in large quantities of liquid, such as water and body wastes, relative to their weight.

The superabsorbent material is generally a water-swollen but water-insoluble polymeric substance capable of absorbing water in an amount which is at least ten times the weight of the substance in its dry form. In one type of superabsorbent material, the particles or fibers may be chemically modified to having a back bone of natural or synthetic polymers with hydrophilic groups or polymers containing hydrophilic groups being chemically bonded to the back bone or on separate side chains. Another type of this class of materials are such modified polymers as sodium carboxymethyl cellulose, polyacrylates and polyacrylamides including, for example, cellulose and starch and superabsorbents which are modified to be carboxymethyl, phosphorylated, sulfonated or phosphonated, causing the SAP to be highly hydrophilic. Such modified polymers may also be cross-linked to reduce their water-solubility.

The ability of a superabsorbent material to absorb liquid is dependent upon the form, particle size, manner in which particles of the superabsorbent are incorporated into the absorbent core. Whenever a particle of the superabsorbent material and absorbent core is wetted, it swells and forms a gel. Gel formation can block liquid transmission into the interior of the absorbent core, a phenomenon called "gel blocking." Gel blocking prevents liquid from rapidly diffusing or wicking past the "blocking" particles of superabsorbent, causing portions of a partially hydrated core to become inaccessible to multiple doses of urine. Further absorption of liquid by the absorbent core must then take place via a diffusion process. This is typically much slower than the rate at which liquid is applied to the core. Gel blocking often leads to leakage from the absorbent article well before all of the absorbent material in the core is fully saturated.

Despite the limitations of gel blocking, superabsorbent materials are commonly incorporated into absorbent cores because they absorb and retain large quantities of liquid, even under load. However, in order for superabsorbent materials to function, the liquid being absorbed in the absorbent system must be transported to unsaturated

superabsorbent material. In other words, the superabsorbent material must be placed in a position to be contacted by liquid. Furthermore, as the superabsorbent material absorbs the liquid it must be allowed to swell. If the superabsorbent material is prevented from swelling, it will cause absorbing liquid.

Appropriate absorbency of liquid by the absorbent core at the point of initial liquid contact and rapid distribution of liquid away from this point is necessary to ensure that the absorbent core has sufficient capacity to absorb subsequently deposited liquid. Prior art absorbent cores have thus attempted to absorb rapidly and distribute large quantities of liquid throughout the absorbent core while minimizing gel blocking during absorption of multiple doses of liquid.

In general, some of the most important performance attributes of an absorbent core of a diaper (or any other absorbent garment) are functional capacity, rate of absorption, and core stability in use. Absorption under load or AUL is a good measure of functional capacity and the rate at which fluid absorption occurs. AUL is a function of both SAP load weight (grams per unit area) and composition of SAP used in the composite. Baby diaper cores that contain only fluff pulp and a high gel strength SAP materials absorb SAP efficiency if the core contains less than about 30% SAP. Fluff/SAP diaper cores containing more than 30% SAP result in lower SAP efficiency because of gel blocking. Although fluff/SAP cores at greater than 30% SAP can provide adequate absorbency, the overall load weight of the core must be increased to compensate for the lower efficiency of the SAP. Increasing the load weight decreases the performance rate of the absorbent core, making them uncomfortable. Also, increased load weights tend to affect the fit and comfort of the garment, as well as impacting the packaging and shipping costs.

There are just a few of the disadvantages of the prior art which the preferred embodiments seek to address.

SUMMARY OF THE INVENTION

It is an object of the invention to provide an absorbent garment having an improved ability to wick fluid.

It is a further object of the invention to provide an absorbent garment with an absorbent core having SAP particles as a substantial percentage of its bulk weight, but at the same time reducing gel blocking, i.e., reducing high SAP efficiency.

It is still yet a further object of the invention to provide an absorbent garment with an absorbent core having high dry out and wet strength for processing and in-use performance.

It is yet a further object of the invention to provide an absorbent core comprising one or more laminates wherein one of the layers of the laminate or laminates is a high-density, SAP-containing layer.

It is still yet a further object of the invention to provide a thin, dense absorbent laminate which may be combined with other such thin, dense absorbent laminates to form an absorbent core.

These and other objects of the invention are achieved by a disposable absorbent article comprising a top sheet, at least a portion of which is liquid permeable, a substantially liquid impermeable back sheet and an absorbent core disposed between the top sheet and the back sheet. The absorbent article has a front waist region, a rear waist region and a crotch region positioned between the front and rear waist regions. Leg elastic are provided along the leg openings for securely holding the leg openings against the thighs of the

viewer to improve containment and fit. A fastening system, either elasticized or pressure, holds the absorbent article around the wearer's waist. A pair of stand-up leg portions or waist containment legs may be attached to or formed from the body's skin surface of the top sheet.

The preferred embodiments of the absorbent garment such laminates as absorbent core comprising one or more laminated layers. Each laminate is formed from one or more layers, and preferably three layers. The laminates preferably comprise three layers, a high efficiency, SAP-containing layer sandwiched between fluff layers. Other non-SAP-containing soft good materials such as latex or thermally treated fluff pulp, (e.g., roll good available from Waltham, Maine or Fort Jones), or synthetic superabsorbent, or hygroscopic non-oxen may be positioned above and below the absorbent core. At least one of the laminates in the absorbent core preferably contains 50-95% by weight particulate or fibrous SAP and at least one other fluff or particulate material that is capable of maintaining high SAP efficiency. SAP efficiency can be expressed in the ratio of the actual SAP absorbency under load, or AUL, (expressed in grams of urine absorbed per gram of SAP in the laminate), and the maximum SAP AUL obtained under load conditions of low load weight when gel blocking does not occur. SAP concentrations of 50-95% provide fluffier roll good materials for efficient shaping and handling. High SAP concentrations also provide fluffier absorbent cores which provide new options for product design. The laminates can be made using either a wet or dry process.

More preferably, the absorbent garment of the preferred embodiments includes an absorbent core comprising two laminates. Each of the two laminates are similar in design and preferably comprise outer fluff layers between which is sandwiched 50-95% by weight particulate or fibrous SAP, with the laminates comprising at least one other fluff or particulate material. The end edges of the laminates are generally exposed. Since the laminates each contain a relatively high concentration of SAP, provision is made to contain the SAP within the absorbent core proper.

In one preferred embodiment, one of the laminates is covered along its longitudinal length by another C-folded laminate, with the C-folded laminate oriented to the back sheet. In an alternative embodiment, one laminate also may appear laminate. A third layer is positioned above the upper laminate and covers beyond the exposed side edges of the laminates. The third layer is oriented to the backsheet at opposite lateral sides of the laminates for SAP containment.

Forming the absorbent core with one or more laminates "designed" by performance attributes of individual absorbent cores. In general, the various layers of an absorbent core are designed with competing interests. A compromise is usually made at the surface of the optimal performance attributes of each of the individual layers. By "designing" the performance attributes of the individual layers, the absorbent core of the preferred embodiments optimizes the key performance performance attributes of each of the laminates resulting in overall improved performance over prior art absorbent cores. More particularly, outer layers of absorbent cores are generally designed for optimal wicking strength, liquid acquisition and distribution, and SAP containment. The inner layers of absorbent cores are generally designed for optimal absorbency and SAP efficiency. Designs of absorbent cores in the past have had to combine the attributes of the outer and inner layers into a homogeneous composite, often leading to an unacceptably compromise.

The absorbent core of the preferred embodiments, by having one or more laminates with high density SAP in the center or within layer design, allows the absorbent core to be designed without compromising performance attributes of the individual components. For example, significant SAP efficiency improvement is realized when one or more laminated layers is employed. Specifically, the absorbent core of the preferred embodiments attains about 23 g/g SAP or about 2100-6000 SAP efficiency. This prior art, in comparison, attains equal to or less than about 700 SAP efficiency for SAPs in a homogeneous core that is equal to or greater than 80% SAP and 20% fluff pulp.

In addition to the foregoing advantages, the absorbent garment having an absorbent core comprising one or more highly concentrated SAP laminates improves the comfort and fit of the garment. Further, due to the thickness of the resulting product, less padding material is needed for the same amount of product, and shipping and handling costs are lowered.

These and other objects, features and advantages of the preferred embodiments will become more readily apparent when the detailed description of the preferred embodiments is read in conjunction with the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of an absorbent garment incorporating the flow laminate absorbent core with the effects of the design of the garment removed.

FIG. 2 is a cross-section of the absorbent garment taken along line 2-2 of FIG. 1 illustrating one embodiment for the flow laminate absorbent core.

FIG. 3 is an exploded partial cross-sectional schematic perspective view of the absorbent garment of FIG. 2.

FIG. 4 is an exploded partial cross-sectional schematic perspective view, similar to FIG. 3, but illustrating another preferred embodiment for the flow laminate absorbent core. FIG. 5 is a graph of absorption vs. time for two flow laminate absorbent cores according to the preferred embodiment.

FIG. 6 is a schematic illustration of one method of manufacturing the flow laminate absorbent core of the preferred embodiment.

FIG. 7 is a schematic illustration of another method of manufacturing the flow laminate absorbent core of the preferred embodiment.

FIG. 8 is a cross-section of one of the laminates in the absorbent core of the preferred embodiment.

FIGS. 9A-9C are schematic perspective views of alternative absorbent core embodiments.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As used herein, the term "absorbent garment" refers to garments that absorb and contain moisture, and more specifically, refers to garments which are placed against or proximately to the body of the wearer to absorb and contain the various exudates discharged from the body. A non-exhaustive list of examples of absorbent garments includes diapers, diaper covers, absorbent diapers, training pants, feminine hygiene products and adult incontinence products. The term "disposable absorbent garment" refers to absorbent garments that are intended to be discarded or partially discarded after a single use (i.e., they are not intended to be laundered or otherwise restored or reused). The term "ret-

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any disposable absorbent garment" refers to a disposable absorbent garment that is essentially a single structure (i.e., it does not require separate manufacturing parts such as a diaper cover and insert). As used herein, the term "diaper" refers to an absorbent garment generally worn by infants and locomotor persons about the lower torso.

The claims are intended to cover all of the foregoing classes of absorbent garments, whether laminated, elasticized, unitary or otherwise. These classifications are used interchangeably throughout the specification, but are not intended to limit the claimed invention. The invention will be understood to encompass, without limitation, all classes of absorbent garments, including those described above. Preferably, the absorbent core is able to absorb the moisture and appearance of a garment. The importance of this, comfortable garments is disclosed, for example, in U.S. Pat. No. 5,095,425 to Finnish et al., which is hereby incorporated by reference.

A preferred embodiment of the present invention comprises a disposable absorbent garment 10 such as shown, for example, in FIG. 1. Again, it should be understood, however, that the present invention is applicable to other types of disposable garments. For example, the invention 100 is described in terms of a diaper. With reference to FIG. 1, the diaper 10 according to a first preferred embodiment is shown in a natural condition with the effect of the elastic members for purposes of clarity in description. The diaper 10 has a generally rectangular shape and can generally be defined in terms of a front waist region 22, a back waist region 24, and a crotch region 26. Alternatively, the diaper can be configured in a generally rectangular shape or in a "T" shape. A pair of leg openings 28a, 28b extend along at least a portion of the top sheet 30 and back sheet 32. One or more pairs of leg elastic 28a, 28b are shown in FIG. 1) extend adjacent to leg openings 28a, 28b, respectively.

The diaper may further include a front waist elastic system 28a, a back waist elastic system 28b, a fastening system 40 (e.g., tape or other suitable attachment means) and a waste containment system 30 in the form of waste containment flaps 30a, 30b. Waste containment flaps 30a, 30b (FIG. 2) preferably extend from the front waist region 22 to the back waist region 24 along opposite sides of a longitudinal center line or midline 60 of the diaper 10, or alternatively only along a portion thereof. The front waist region 22 and rear waist region 24 include an opening 22a, 24a extending laterally from the leg openings 28a, 28b.

Due to the wide variety of leading and rear sheet construction and materials currently available, the invention is not intended to be limited to any specific materials or combinations of these components. The back sheet 32 is of any suitable pliable liquid-imperious material known in the art. Typical back sheet materials include films of polyethylene, polypropylene, polybutene, nylon, and polyethylene terephthalate and blends of these materials. For example, the back sheet can be of a pigmented polypropylene film having a thickness in the range of 0.015-0.025 mm. The absorbent portion top sheet 30 can be of any suitable relatively liquid-permeable material known in the art that permits passage of liquid therethrough. Non-woven fiber sheet materials are commonly known such materials readily allow the passage of liquid to the underlying absorbent core 34. Examples of suitable fiber sheet materials include non-

woven apertured or corded webs of polypropylene, polyethylene, nylon, polyester and blends of these materials.

The backsheet 32 and the topsheet 30 are "connected" with one another. The term "connected" encompasses configurations whereby the topsheet 30 is directly joined to the backsheet 32 by affixing the topsheet 30 directly to the backsheet 32, and configurations whereby the topsheet 30 is indirectly joined to the backsheet 32 by affixing the topsheet 30 through an intermediate layer or layers which in turn are affixed to the backsheet 32. While the backsheet 32 and topsheet 30 in the preferred embodiment have substantially the same dimensions, they may also have different dimensions.

In addition, the backsheet 32 may be covered with a woven, nonwoven fabric such as is disclosed for example in U.S. Pat. No. 4,645,262, which is hereby incorporated by reference. Materials for such a fabric cover layer include a spun-bonded nonwoven web of synthetic fibers such as polypropylene, polyethylene or polyester fibers; a nonwoven web of cellulosic fibers, batts such as rayon fibers, cotton and the like, or a blend of cellulosic and batts fibers; a spun-bonded nonwoven web of synthetic fibers such as polypropylene, polyethylene or polyester fibers; or a nonwoven web of cellulosic fibers, batts such as rayon fibers, cotton and the like, or a blend of cellulosic and batts fibers. Alternatively, the backsheet may comprise three panels wherein a central poly backsheet panel is positioned adjacent the absorbent core with lateral non-woven flaps, the central poly backsheet panel are attached to the side edges of the central poly backsheet panel. Alternatively, the backsheet may be formed from nonwoven poly nonwoven the sheet backsheet.

Alternatively, the top sheet may be formed of three separate portions or panels. The first top sheet panel 30a may comprise a central top sheet panel formed from a liquid-permeable material that is either hydrophobic or hydrophilic. The central top sheet panel 30a may be made from any number of materials, including synthetic fibers (e.g., polypropylene or polyester fibers), natural fibers (e.g., wood or cotton), spun-bonded plastic fibers, extruded fibers and porous fibers in some a form. One preferred material for a central top sheet panel 30a is a cover sheet of single ply non-woven material which may be made of corded fibers, other synthetic or thermally bonded, perforated plastic film, apertured films, or woven or non-woven fibers, which generally weigh from 0.3-0.7 oz./sq. yd. and have openings and elastic members disposed and non-woven fibers strength suitable for use as a baby diaper cover sheet material. The central top sheet panel 30a preferably extends from substantially the front waist region 22 to the back waist region 24 or a portion thereof.

The second and third top sheet panels 30b, 30c in this alternative embodiment may be positioned laterally outside of the central top sheet panel 30a. The outer top sheet panels 30b, 30c are preferably substantially liquid-imperious and hydrophobic, particularly at least in the crotch area. The side edges of the outer top sheet panels may substantially follow the corresponding outer periphery of the back sheet 32. The material for the outer top sheet portions or panels is preferably polypropylene and can be woven, non-woven, apertured, corded or the like, depending on the application.

The lower edges 30d (FIG. 2) of the outer topsheet portions or panels 30b, 30c preferably are attached by, e.g.,

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an adhesive, in the outer edges 30d of the lower topsheet portions or panel 30c. At the point of connection with the outer edges 30d of the lower topsheet portions or panel 30c, the lower edges 30d of the outer topsheet portions or panels 30b, 30c extend upwardly to form waste containment flaps 30a, 30b. The waste containment flaps 30a, 30b are preferably formed of the same material as the outer topsheet portions or panels 30b, 30c, as is the embodiment shown. They are preferably an extension of the outer topsheet portions or panels 30b, 30c.

The waste containment flaps 30a, 30b may be treated with a suitable surfactant to modify their hydrophobicity/hydrophilicity as desired. Alternatively, the waste containment flaps 30a, 30b may be formed to separate channels and flow attached to the body side flaps. In this alternative embodiment, the central topsheet portions or panel 30a may extend past the connection point with the waste containment flaps 30a, 30b, and even extend to the periphery of the backsheet 32. In this case, the central topsheet portions or panel 30a could extend fully between the outer topsheet portions or panels 30b, 30c and the webbing 34a and even beyond so that the outer edges 30d of the central topsheet portions or panel 30a are continuous with and non-attached between the outer topsheet portions or panels 30b, 30c and the backsheet 32.

The waste containment flaps 30a, 30b preferably include a portion 30d which folds over onto back to form a small enclosure. At least one, and depending on the size of the enclosure, several more than one, elastic members 30d (FIG. 2) is secured in the enclosure in a stretched condition. As has been known at least as long as the existence of Tension, Japanese Patent document 40-11543, when the flap elastic 30d attempts to restore the relaxed, unstretched condition, the waste containment flaps 30a, 30b rise above the surface of the central topsheet portions or panel 30a.

The waste elastic 30a, 30b may be similar systems or different to impart similar or different elastic characteristics to the front and back waist portions of the diaper. In general, the waste elastic may comprise three major portions at the front and back waist regions 22, 24. The front elastic is preferably about 16 to 18 inches wide and about 3-6 inches long. The front elastic is preferably positioned between the top sheet portions or panels and the back sheet 32. Alternatively, a plurality of elastic strands may be employed as waste elastic rather than front elastic. The front elastic is preferably polypropylene, but could be any other suitable material which decreases waist band roll over, reduces leakage over the waist ends of the absorbent garment, and generally improves comfort and fit. The front and back waist elastic 30a, 30b are attached 50-150%, preferably 100% being attached directly secured between the back sheet 32 and top sheet 30.

In any or all of the foregoing embodiments, the top sheet may comprise a single sheet of material having different characteristics (e.g., liquid-imperious/non-liquid-imperious and/or hydrophobic/hydrophilic) and have regions of tension or elastic characteristics.

Each leg opening 28a, 28b is provided with a leg elastic containment system 34. In the preferred embodiment, three strands of elastic fibers are positioned to extend adjacent to leg openings 28a, 28b between the outer top sheet portions or panels 30b, 30c and the back sheet 32. Any suitable elastomeric material exhibiting at least an elongation (defined herein as 1-1.5 times L₀ when L₀ is the stretch length of an elastic strand and L₁ is stretched length, multiplied by 100 to obtain percent elongation) in the range of

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50-200%, preferably in the range of 200%-300%, can be employed for the leg elastic 34. The leg elastic 34 may be attached to the diaper 10 in any of several ways which are known in the art. For example, the leg elastic 34 may be ultrasonically bonded, heat-sealed, sealed using a variety of bonding patterns, or glued to the diaper 10.

Various commercially available materials can be used for the leg elastic 34, such as natural cotton, knitted rubber or other synthetic cotton, synthetic elastomeric materials such as LYCRA (DuPont), CLIMAFLEX (Chico) or SPANDEX 7000 (Pulver).

The fastening system 40 of the preferred embodiment is attached to the back waist region 24, and preferably comprises tape tabs or mechanical fasteners 40a. However, any fastening known in the art will be acceptable. Moreover, the fastening system 40 may include a microchannel patch below the front waist portion so that the diaper may be checked for leaking without compromising the ability to close the fastener. Alternatively, other diaper fastening systems are also possible, including velcro, pins, buttons, and snap.

As stated previously, the invention has been described in connection with a diaper. The invention, however, is not intended to be limited to application only in diapers. Specifically, the absorbent features of the preferred embodiment may be easily adapted for use in other absorbent garments including diapers, incontinence pads, but not limited to, training pants, disposable hygiene products and adult incontinence products.

The underlying structure beneath the topsheet 30 may include, depending on the diaper construction, various combinations of elements, but in each embodiment, it is contemplated that the absorbent garment will preferably include an absorbent core comprising one or more laminated portions between the topsheet 30 and backsheet 32. The absorbent core may take a number of different configurations, depending on how the laminates are configured with respect to one another. However, in each, one of the laminates has a layer primarily extending about 50-95% by weight SAP.

With particular reference to FIG. 3, there is illustrated an exploded partial cross-sectional schematic view of the absorbent core 34 according to one preferred embodiment of the invention. The absorbent laminate 34 comprises a central absorbent laminate 34a and a wrapping absorbent laminate 34b wrapping the central laminate 34a. With particular reference to FIG. 3, in comparison with FIG. 2, the construction of central laminate 34a is depicted. Central laminate 34a comprises a central absorbent layer 34a1 and side-wings laminate upper and lower flaps 34a2, 34a3. The upper and lower flaps 34a2, 34a3 are preferably substantially co-extensive with the upper and lower portions of the central absorbent layer 34a1 or alternatively flaps 34a2, 34a3 may be slightly wider than the upper and lower portions of central absorbent layer 34a1.

The construction of absorbent laminate 34b is preferably substantially the same as the construction of absorbent laminate 34a in that laminate 34b, 34c preferably comprises three layers: a central absorbent layer 34b1 between upper and lower flaps. More particularly, wrapping laminate 34b1 comprises a central absorbent layer 34b1a sandwiched between an inner core layer 34b1b and an outer core layer 34b1c. Core layer 34b1a and side edges 34b1d of wrapping laminate 34b1 extend substantially beyond without being covered by flaps 34a2, 34a3. Under normal circumstances, the leg opening side edges of the absorbent laminate comprising about 50-95% by weight SAP may be problematic in that

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Shores and Wetzelbach studied various models for SAG off-shore when the SAG concentration is in the range of about 30-50%. SAGMAP can then combine greater than about 30% SAG surface addition structure or design measures to consider the SAG in the core and provide additional stability. The model can be used to determine the effect of SAG on stability to ultimately or ultimately limit the shear stress and provide a means to improve unit strength and core stability. This, unfortunately, results in lower than adequate rates of shear for upper SAGMAP. The model can be used to determine the effect of SAG on stability to ultimately limit the shear stress and provide a means to improve unit strength and core stability. This, unfortunately, results in lower than adequate rates of shear for upper SAGMAP.

Prior to any full-scale SAP campaign containing 20-50% EAP, SAPs are often too weak for persuading on a deeper audience, have inadequate vet strength for in-area case stability, and the EAP is not accepted within the companies. These results indicate that have adequate strength to test to have EAP efficiency because they model strongly the EAP in the companies. Attempts to boost the EAP within the companies inevitably reduce the shrewdness and efficiency of the companies. The standard case, SAP 34, 35 of the preferred configurations below the prior set problems of understanding adequate levels of dry insight strength, case stability in use, and EAP confidence. The standard set and comparison of the standard SAPs 34, 35 and 36 are shown in the table below. The optimal shrewdness and EAP efficiency. The standard and comparison of the standard indicators 34, 35, 36 are probably designed for optimal strength, EAP confidence, and EAP shrewdness.

Depending on whether a wet or dry process is used to make the laminates 3400, 3405, bonding aluminum layers 3400, 3405 with wet tapes layers 3400, 3405, 3405 can be achieved with hydrogen or ordinary kerosene. If the material used to form the laminates 3400, 3405 contains about 1-5% by weight hydrogen-bonded synthetic fibers, bonding can be achieved with thermal bonds. When the upper and lower tapes are these tapes and are hydrogen bonded using water to stabilize layer 3400, 3405, unexpectedly great "cross-stitching" is realized. "Cross stitching" is the percentage of the total capacity of a core that can be obtained in a demand demand unit. This unexpected performance improvement is believed to be the result of the good liquid sheathes that are formed with a high viscosity, non-gel liquid sheathes 3400, 3405, and the use of a thermal bond that is formed by bonds in the films of the tapes layers 3400, 3405 of the laminate.

Sample	Location	Composition			Absorbent Laminate		
		For Use In (Type of)	Test Sub (Type of)	Weight (gms)	Upper Layer	Control Layer	Lower Layer
1	High SAP Laminate with Acrylonitrile/Butadiene/Polymer	705.4	250 gms		705.4 gms	705.4 gms	705.4 gms
2	High SAP Laminate with High SAP Content	705.4, 4	250 gms		705.4 gms	705.4 gms	705.4 gms
3	High SAP Laminate with High SAP Content	705.4	250 gms		705.4 gms	705.4 gms	705.4 gms

The absorbent laminates of Examples 1-3 readily absorb 90% SAP efficiency. This is a marked increase in core efficiency as compared with conventional high concentration SAP-type absorbent cores, which typically exhibit core efficiencies of about 70%. The following chart summarizes polydispersity (PDI) of various compositions. ALL defines the spectra of liquid of a specimen while a band is applied to the specimen.

Core	ALL Poly of SAP*
SAP only Low MW	20
SAP only - High MW	21
70% Polydispersity - 100 gms	22
High SAP	23
High SAP	24
High SAP	25
High SAP	26
High SAP	27
High SAP	28
High SAP	29
High SAP	30
High SAP	31
High SAP	32
High SAP	33
High SAP	34
High SAP	35
High SAP	36
High SAP	37
High SAP	38
High SAP	39
High SAP	40
High SAP	41
High SAP	42
High SAP	43
High SAP	44
High SAP	45
High SAP	46
High SAP	47
High SAP	48
High SAP	49
High SAP	50
High SAP	51
High SAP	52
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High SAP	84
High SAP	85
High SAP	86
High SAP	87
High SAP	88
High SAP	89
High SAP	90
High SAP	91
High SAP	92
High SAP	93
High SAP	94
High SAP	95
High SAP	96
High SAP	97
High SAP	98
High SAP	99
High SAP	100

*After 20 absorbency 1.7 pt.

The invention has been described in connection with the preferred embodiment. Those embodiments, however, are merely for example and the invention is not limited thereto. It will be understood by those skilled in the art that other variations and modifications can easily be made within the scope of the invention as defined by the appended claims.

1 claim:

1. An absorbent article comprising:
 - a liquid permeable topsheet;
 - a liquid impermeable backsheet associated with said topsheet; and
 - an absorbent core positioned between the topsheet and the backsheet, the absorbent core comprising a first absorbent laminate, said first absorbent laminate comprising:
 - an upper layer near the topsheet;
 - a lower layer near the backsheet; and
 - an absorbent layer positioned between the upper and lower layers, wherein:
 - the side edges of said absorbent layer are substantially uncovered by said upper and lower layers;
 - said upper layer comprises a material selected from the group consisting essentially of fluff, absorbent fluff pulp and synthetic non-wovens;

said lower layer comprises material selected from the group consisting essentially of fluff, absorbent fluff pulp and synthetic non-wovens; and

said absorbent layer comprising about 50-95% SAP by weight and having a SAP efficiency (AUL) of at least 100%.

2. The absorbent article of claim 1, wherein said upper layer and said lower layer are hydrogel based or said absorbent layer.

3. The absorbent article of claim 1, said absorbent layer comprising fluff selected from the group consisting essentially of cellulose acetate fluff, rayon fluff, LYOCCELL fluff, polyacrylonitrile fluff, rayon fluff and cotton fluff fluff.

4. The absorbent article of claim 1, said absorbent layer comprising fluff selected from the group consisting essentially of surface modified (hydrophilic) polyester fluff, surface-modified polyethylene/polyester blend fluff, and surface-modified polyethylene/polyester blend fluff.

5. The absorbent article of claim 1, said absorbent layer having about 5-50% by weight composition of fluff.

6. The absorbent article of claim 1, said first absorbent laminate having a total basis weight of about 100-400 grams per square meter.

7. The absorbent article of claim 1, said first absorbent laminate having a total basis weight of about 150-350 grams per square meter.

8. The absorbent article of claim 1, said absorbent layer further comprising up to 10% by weight soft pulp fluff.

9. The absorbent article of claim 1, said absorbent layer further comprising up to 5% by weight thermally labile fluff.

10. The absorbent article of claim 1, wherein the absorbent layer further comprises particulate additives.

11. The absorbent article of claim 1, said particulate additives comprising lamellar, hydrophilic polymers with particle diameter of 100 μ m or less.

12. The absorbent article of claim 1, said particulate additives selected from the group consisting essentially of protein, case, wheat, and rice starch, and partially coated or modified starches.

13. The absorbent article of claim 1, said fluff, said absorbent fluff pulp and said synthetic non-wovens of said upper and lower layers having basis weights of about 10-60 grams per square meter, 50-150 grams per square meter and 10-60 grams per square meter, respectively.

14. The absorbent article of claim 1, further comprising a transfer layer positioned between said topsheet and said

upper layer, said transfer layer adhesively secured to said upper layer and to said topsheet.

15. The absorbent article of claim 1, said absorbent layer further comprising particulate additives, wherein said particulate additives comprise aggregates of SAP particles.

16. The absorbent article of claim 1, said particulate additives comprising lamellar, hydrophilic polymers having particle diameter of about 100 μ m or less.

17. The absorbent article of claim 1, said particulate additives selected from the group consisting essentially of protein, case, wheat, and rice starch, and partially coated or modified starches.

18. An absorbent article comprising:

- a liquid permeable topsheet;
- a liquid impermeable backsheet associated with said topsheet; and
- an absorbent core positioned between the topsheet and the backsheet, the absorbent core including:
 - a central absorbent laminate comprising an absorbent layer sandwiched between an upper layer and a lower layer, wherein the side edges of said absorbent layer are substantially uncovered by said upper and lower layers; and
 - wrapping absorbent laminates substantially enclosing said central absorbent laminate;

wherein the side edges of said absorbent layer are substantially uncovered by said upper and lower layers; and

said absorbent layer of said absorbent laminate formed from about 75-95% by weight super absorbent polymer (SAP) and about 5-25% by weight composition of additives.

said upper and lower layers of said absorbent laminates selected from the group consisting essentially of absorbent fluff pulp, synthetic non-wovens, and fluff; and

an upper absorbent layer positioned above said absorbent laminate, said upper absorbent layer comprising cellulose fluff, wherein:

said absorbent laminate has a width dimension which is substantially constant along its length and said upper absorbent layer has varying width dimension along the longitudinal length thereof;

20. The absorbent article of claim 19, said absorbent layer being formed from fluff selected from the group consisting essentially of cellulose acetate fluff, rayon fluff, LYOCCELL fluff, polyacrylonitrile fluff, rayon fluff and cotton fluff fluff.

21. The absorbent article of claim 19, said absorbent layer having about 5-50% by weight composition of fluff.

22. The absorbent article of claim 19, said absorbent layer having a total basis weight of about 100-400 grams per square meter.

23. The absorbent article of claim 19, said absorbent layer further comprising up to 10% by weight soft pulp fluff.

24. The absorbent article of claim 19, said absorbent layer further comprising up to 5% by weight thermally labile fluff.

25. The absorbent article of claim 19, wherein the absorbent layer further comprises particulate additives.

26. The absorbent article of claim 19, said particulate additives comprising lamellar, hydrophilic polymers with particle diameter of 100 μ m or less.

27. The absorbent article of claim 19, said particulate additives selected from the group consisting essentially of protein, case, wheat, and rice starch, and partially coated or modified starches.

28. The absorbent article of claim 19, wherein said central absorbent laminate has a length which is about half the length of said wrapping absorbent laminates.

29. An absorbent laminate for absorbent garments comprising:

- a central absorbent layer formed from about 75-95% by weight superabsorbent polymer and 5-25% by weight composition of additives;
- an upper layer positioned above said central absorbent layer, said upper layer selected from the group consist-

ing essentially of absorbent fluff pulp, synthetic non-wovens and fluff; and

a lower layer positioned below said central absorbent layer, said lower layer selected from the group consisting essentially of absorbent fluff pulp, synthetic non-wovens and fluff;

wherein the side edges of said absorbent layer are substantially uncovered by said upper and lower layers.

20. The absorbent laminate of claim 19, said additives comprising fluff selected from the group consisting essentially of cellulose acetate fluff, rayon fluff, LYOCCELL fluff, polyacrylonitrile fluff, rayon fluff and cotton fluff fluff.

21. The absorbent laminate of claim 19, said additives comprising fluff selected from the group consisting essentially of surface modified (hydrophilic) polyester fluff, surface-modified polyethylene/polyester blend fluff, and surface-modified polyethylene/polyester blend fluff.

22. The absorbent laminate of claim 19, said additives having about 5-50% by weight composition of fluff.

23. The absorbent laminate of claim 19, said additives having a total basis weight of about 100-400 grams per square meter.

24. The absorbent laminate of claim 19, said additives further comprising up to 10% by weight soft pulp fluff.

25. The absorbent laminate of claim 19, said additives further comprising up to 5% by weight thermally labile fluff.

26. The absorbent laminate of claim 19, wherein the absorbent laminate further comprises particulate additives.

27. The absorbent laminate of claim 19, said particulate additives comprising lamellar, hydrophilic polymers with particle diameter of 100 μ m or less.

28. The absorbent laminate of claim 19, said particulate additives selected from the group consisting essentially of protein, case, wheat, and rice starch, and partially coated or modified starches.

29. The absorbent laminate of claim 19, wherein said central absorbent laminate has a length which is about half the length of said wrapping absorbent laminates.

30. The absorbent laminate of claim 19, wherein said upper absorbent layer has a length dimension which is about half that of said upper absorbent layer.

31. The absorbent laminate of claim 19, said absorbent core adapted to be positioned in a diaper, wherein the diaper includes opposing waist regions and a narrow crotch region, said width dimension of said absorbent laminate being equal to or less than the width dimension of the crotch of the diaper.

32. The absorbent core of claim 19, said absorbent core adapted to be positioned in a diaper, wherein the diaper includes opposing waist regions and a narrow crotch region, said width dimension of said absorbent laminate being equal to or less than the width dimension of the crotch of the diaper.

33. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

34. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

35. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

36. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

37. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

38. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

39. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

40. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

41. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

42. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

43. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

44. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

45. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

46. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

47. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

48. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

49. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

50. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

51. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

52. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

53. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

54. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

55. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

56. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

57. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

58. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

59. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

60. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

61. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

62. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

63. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

64. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

65. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

66. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

67. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

68. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

69. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

70. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

71. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

72. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

73. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

74. The absorbent core of claim 19, said upper absorbent layer further comprising super absorbent polymer positioned adjacent to said cellulose fluff.

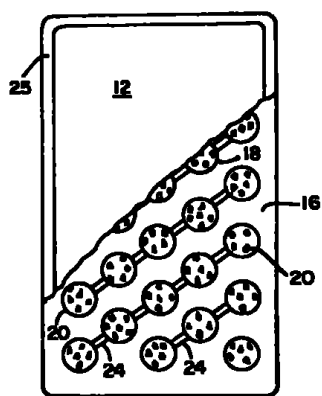


FIG. 5

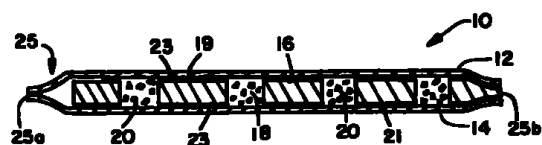


FIG. 6

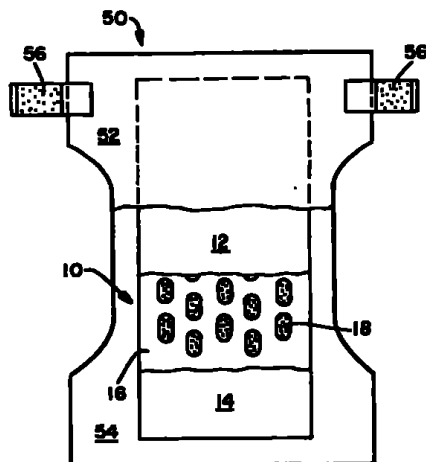


FIG. 7

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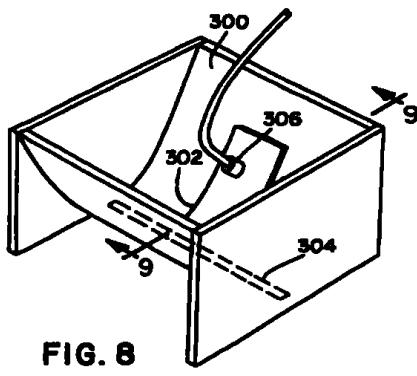


FIG. 8

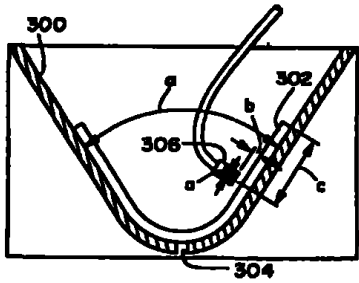


FIG. 9

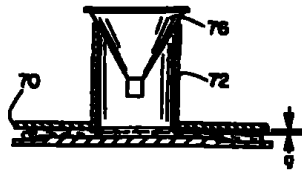


FIG. 11

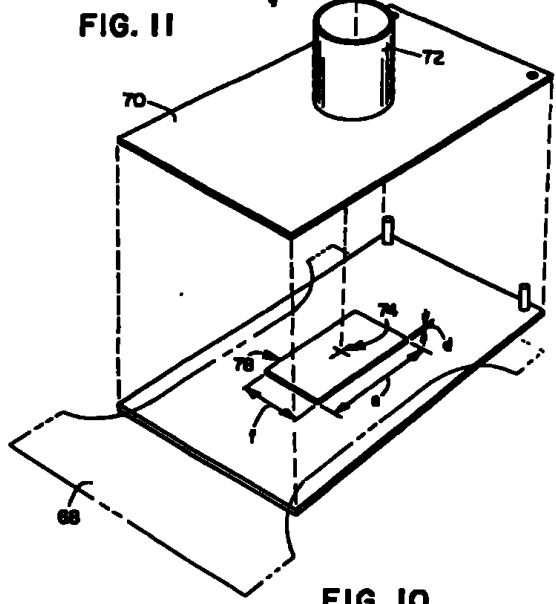


FIG. 10

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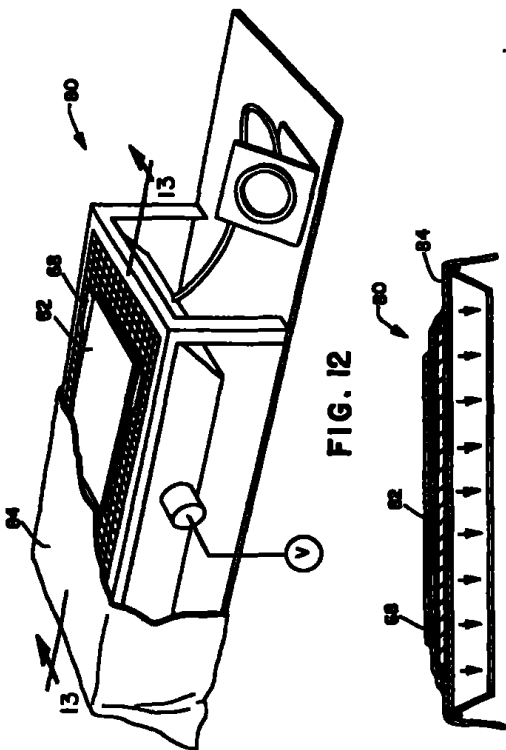


FIG. 12

FIG. 13

LIQUID-ABSORBING ARTICLE

This application is a continuation of application Ser. No. 60,291,115 entitled "LIQUID-ABSORBING ARTICLE" and filed in the U.S. Patent and Trademark Office on Aug. 21, 1954, now abandoned. The entirety of this application is hereby incorporated by reference.

FIELD OF THE INVENTION

The present invention is directed to a liquid-absorbing article, more specifically, the present invention is directed to a liquid-absorbing article which has particular utility in an absorbent system for use in personal care absorbent products such as diapers, sanitary pads, sanitary napkins, tampons, and the like.

BACKGROUND OF THE INVENTION

As advances in liquid absorption progress, the understanding of the various materials and components used to absorb liquids and their interaction have greatly improved. This is especially true with respect to the absorbent system used in personal care absorbent products. Using disposable diapers as an example, regardless of the design of each diaper used, wood pulp fluff is the only material for absorbing liquid in this case.

As the advances in diaper construction progress, high absorbency materials such as superabsorbents were added to the wood pulp fluff to increase the overall liquid absorbing capacity of the diaper's absorbent core. This in turn allowed for a reduction in the overall thickness of the diaper by removing a portion of the wood pulp fluff and supplementing it with higher and higher quantities of the superabsorbent. Despite the decrease in the overall size of the absorbent core and the increase in the overall liquid absorbing capacity, there was still a problem with the ability of the diaper's absorbent core to accept rapid inflows of urine, especially an unaided, tidal and thrust inflow, without the risk of the urine pooling on the surface and leaking out. One aspect of this problem was the superabsorbent itself.

To permit rapid uptake of liquid in an absorbent core of a diaper or other personal care absorbent product, there must be sufficient interstitial spacing between the fibers to permit fluid transport. Unfortunately, many superabsorbents swell as they absorb liquid thereby closing the interstitial spaces and causing a phenomenon known as "gel blocking". Once gel blocking has occurred, rapid liquid transport through the gel blocked core is difficult.

To avoid or minimize this problem and to further attempt to reduce the pooling of rapidly deposited liquid on the surface of the diaper, several other advancements were designed. One was the selective placement of the superabsorbent within localized regions of the absorbent core as, for example, in no leather layer within the absorbent core or in discrete particles as shown in U.S. Pat. No. 4,052,110 to Kerner. Another solution was the inclusion of additional layers within the diaper, elsewhere above the absorbent core to act as a dispersal or temporary reservoir for the incoming liquid until such time as the absorbent core had time to fully absorb the liquid. These added layers were again incorporated into the overall thickness of the diaper which was contrary to the general trend to make such products as thin as possible. Another problem with using multiple layers was the transport of liquid across the junctures of the two materials. It has

been found that liquids frequently have difficulty transferring from one material to another because of problems at the interface between the two materials. It therefore would be desirable if some of this liquid transfer could take place within the same general horizontal plane within the diaper or other personal care absorbent product so as to minimize the number of liquid across the junctures of adjacent but different materials in the vertical direction.

Another problem when using superabsorbents is their need to swell or expand as they absorb liquid. If the particles are too closely contacted, the particles cannot freely expand and/or the swollen particles can cause clogging of the particles around them which in turn can allow the superabsorbent to swell out and possibly cause it to contact with the surface. Consequently, there is a need for an improved liquid-absorbing article containing a high absorbency material which can readily accept and evenly deposited liquid.

SUMMARY OF THE INVENTION

The present invention is directed to a liquid-absorbing article which has particular utility in an absorbent system for use in personal care absorbent products such as diapers, sanitary pads, sanitary napkins, tampons, and the like. In its most basic design, the liquid-absorbing article according to the present invention includes a liquid permeable top sheet and a bottom sheet with an absorbent core disposed therebetween. The absorbent core defines a plurality of apertures which extend from the top surface of the absorbent core through the absorbent core to a bottom surface thereof. This top surface is attached to the top sheet and the bottom surface of the absorbent core is attached to the bottom sheet. A high absorbency material is located within at least a portion of the apertures. In some preferred embodiments, the top sheet and/or bottom sheet can be selectively attached to the absorbent core by attachment means. The attachment means can provide a bond strength between the absorbent core and either the top sheet or the bottom sheet which is less than the swelling force exerted on the top sheet or the bottom sheet when the high absorbency material is exposed to an aqueous liquid. As a result, the top sheet or bottom sheet will delaminate from the absorbent core before the top sheet or bottom sheet ruptures from the swelling force.

The absorbent core can be designed to have a number of specifically defined properties including a density of less than 1.05 grams per cubic centimeter, a fluid air permeability greater than 60 cubic centimeters per square meter per minute, a thickness under a pressure of 0.5 kilograms of at least 0.5 centimeters, and a specific volume of less than 1.0 cubic centimeters per gram. The density, fluid air permeability, thickness and specific volume of the absorbent core material which is disposed of the plurality of apertures and the high absorbency material.

In other embodiments of the present invention, the absorbent core may have a plurality of channel areas. If desired, these channel areas may extend between and connect at least a portion of the plurality of apertures so as to further aid lateral movement of the liquid to be absorbed across the x-y plane of the structure.

In further embodiments of the present invention, the absorbent core may be comprised of a fibrous nonwoven web in which all or a portion of the fibers are biodegradable fibers.

In still a further embodiment of the present invention, the liquid-absorbing article can include a liquid permeable top

two parts. It could cover the three top sheet 13 to replace which is generally undesirable. As a result, it may be desirable to select an alternative means 23 which is not to attach the top and bottom sheet to the sheet cover 16 and cover the top sheet 13 or the bottom sheet 14 which is less than the swelling force caused by the high absorbency material 20 on the top sheet 13 or bottom sheet 14. Thus, when the high absorbency material 20 is exposed to an aqueous liquid the least strength is designed on the top sheet or bottom sheet with dependence from the sheet cover 16 before the top sheet or bottom sheet separates from the swelling force. This can be accomplished, for example, by selecting an adhesive with a low bond strength, applying selected quantities of adhesive or applying the adhesive in select locations. Alternatively, when using heated bonding or ultrasonic bonding, the degree of bonding and the surface area of the bonding can be adjusted to achieve the same result.

Turning to FIGS. 3 and 4 there is shown a more detailed sheet cover 16. As shown in these Figures the sheet cover 16 includes a first portion 16' and a second portion 17. Though not shown, it is also within the scope of the present invention to provide even more layers, portions or regions within the x-y plane and the z-axis dimension of the sheet cover 16 if so desired. In FIG. 3 the first portion 16' has a first plurality of apertures 18a and the second portion 17 has a second plurality of apertures 18b which are in vertical registry with one another. If desired, the first portion 16' can be made from a highly porous material such as a fibrous nonwoven web having a large void volume so that it will quickly absorb any liquid passed to it through the liquid absorbent top sheet 13. In contrast, if so desired, the second portion 17 may be made from a material having a more uniform pore structure so that the liquid received from the first portion 16' can be controlled and distributed laterally through the structure and greater utilization of the sheet cover 16 can be achieved in the x-y plane of the structure. Typically, to achieve these objectives, the first portion will have a lower density than the second portion. In addition, it has been found that such structures function particularly well when made from fibrous nonwovens with controlled management flows. Management flows are those which either flow or more preferably, typically with different swelling or absorbing ability in different regions of the sheet. The lower swelling point component can be used to bend the sheet together. Absorbent areas made from apertured management flow webs have been found to work particularly well on sheets by the example below. The method for producing such webs is taught in U.S. Pat. No. 5,326,922 to Blank et al. which is incorporated herein by reference in its entirety.

Turning to FIG. 4, there is shown a liquid-absorbent article 20 showing the apertures 18a in the first portion 16' of the sheet cover 16 are shown from one direction and are not in vertical registry with the apertures 18b in the second portion 17 of sheet cover 16. This design, among other things, provides greater surface area per volume within the individual apertures 18a and then by liquid contact with the high-absorbency material 20 contained within the apertures 18. Another advantage of the sheet design in FIG. 4 is that the type of high absorbency material 20 within the apertures 18a and 18b can be varied. There are many available a number of types of superabsorbents with various properties. Some superabsorbents absorb liquids more quickly than others while other superabsorbents are able to absorb greater quantities of liquid while under a certain load or pressure,

commonly referred to as "high ASL" (Absorbency Under Load) superabsorbents. As a result, it may be desirable to use different types of superabsorbents 20, such as a low absorbing superabsorbent, and the lower apertures 18b with another type of superabsorbent or vice versa.

As a further option, in the present invention, the liquid-absorbent article 20 may have a plurality of different areas such as indicated channels 24 extending through at least the sheet cover 16 from FIG. 3. If not, if desired, the top sheet 13 and bottom sheet 14, both elements 20 can be made by combining the sheet cover 16 in which case, or between the apertures 18, through the use of embossing rolls. By embossing the apertures 18 on the channels 24, another means is provided for increasing the lateral flow of liquid across the structure and to or away from superabsorbent-containing apertures or portions.

Still a further refinement of the present invention is shown in cross-section in FIG. 5 of the design. As noted previously, when the high absorbency material 20 within the apertures 18 is contacted by an aqueous liquid such as urine, urine either so or when, the material 20 will begin to expand and exert forces against the surrounding materials including the top sheet 13 and bottom sheet 14. As a result, it is desirable that the sheet cover 16 provide sufficient bond strength between the top sheet 13 and bottom sheet 21 of the sheet cover 16 and the top sheet 13 and bottom sheet 14 which are less than the swelling force exerted on the top sheet 13 or bottom sheet 14 when the high-absorbency material is exposed to an aqueous liquid so that the top or bottom sheet will separate from the sheet cover 16 before the top sheet or bottom sheet separates from the swelling force. If this determination occurs, the high absorbency material can begin to migrate through the liquid-absorbent article 20. To prevent the material 20 from leaking out the sides of the article 20, it is desirable that the top sheet 13 and bottom sheet 14 be attached to one another by a peripheral seal 22 which has a greater bond strength than the bond strength between the top sheet 13 and the top surface 19 of the sheet cover 16 or the bottom sheet 14 and the bottom surface 21 of sheet cover 16. In so doing, the top sheet 13 and bottom sheet 14 form an envelope around the sheet cover 16. As shown in FIG. 6, the peripheral seal 22 is directly between the top sheet 13 and the top surface 19 of the sheet cover 16 or the bottom sheet 14 and the bottom surface 21 of sheet cover 16. It is also possible, however, to form a peripheral seal 22 through the sheet cover 16, which means the peripheral seal 22 is between the top sheet 13 and bottom sheet 14 and the sheet cover 16.

Turning to FIG. 7, the liquid-absorbent article 20 may be incorporated within a personal care sheet cover 26. For purposes of illustration only, the present care sheet cover 26 is shown in the form of a diaper. This illustration, however, should not be construed as a limitation as to the scope of the present invention.

The present care sheet cover 26 in FIG. 7 includes a backsheet layer 28 and a topsheet layer 30 with the liquid-absorbent article 20 disposed between the backsheet layer 28 and the topsheet layer 30. To ensure the present care sheet cover 26 does not leak a waste (not shown), the article is typically provided with some type of leakage means 32 such as a diaper fastening tape. The liquid-absorbent article 20 is positioned within the diaper 26 such that the top sheet 13 is positioned adjacent the backsheet layer 28. If desired, the article 20 may be connected to the diaper 26 by gluing the article 20 to backsheet layer 28 under the backsheet layer 28. The sheet cover 26 function well in absorbing liquids especially when exposed to multiple leaks.

During described the present invention in detail, several examples were presented, measured and tested. The test procedures and examples are set forth below.

TEST PROCEDURES

A table of test procedures are set forth below. These test procedures were used to measure various properties of the present invention.

Fluid Air Permeability
The procedure used to determine Fluid Air permeability was contained in accordance with the specifications of method 5405, Federal Test Methods Standard No. 591. A sample that specimen sheet was 8 inches (20 centimeters) high and 7 inches (18 centimeters) wide. The larger also made it possible to ensure that all sides of the specimen remained well beyond the swelling ring and facilitated changing of the specimen assembly and thereby ensure the uniform. Volume gas flow in cubic centimeters per square meter per second (cc/m²/sec). Further, when calculating the Fluid Air permeability of the sheet cover, the value should be calculated for a piece of material which is devoid of the apertures 18 and superabsorbent 20.

Field Size-Off Evaluation
For purposes of the present invention, the field size-off evaluation is determined by providing a sample which is 13 inches long (33 centimeters) and 4 inches (10 centimeters) wide. Referring to FIGS. 4 and 5 the sample 200 is placed in a trough 202 having an internal angle (angle of 60°). Though 200 defines a 304 extending across the entire width of the trough 202 at its lowest point. The trough 202 is at least 4 inches (10 centimeters) wider than the sample 200 to be tested. A collection device (not shown) is placed under the trough 202 to collect field which passes out of the trough 202 along the 6-6' of FIG. 5. As can be seen from reference to FIG. 5, the field is delivered to the sample 200 to be tested from a source 204 having a 3 millimeter diameter (d) which is attached to a portable pump supplied with a pulse regulator. The source is placed a distance (D) of 64 millimeters from the surface of the sample to be tested at a distance (d) of about 5.5 inches (14 centimeters) from the end of the sample to be tested such that the source is generally perpendicular to the horizontal segment surface of the sample 200 to be tested. This positioning should be maintained throughout the test. The sample to be tested is subjected to four 20 millimeter bursts of urine solution. The urine solution is applied through the source 204 at a rate of approximately 12 milliliters per second and a velocity of about 220 centimeters per second. Each of the four 20 millimeter bursts is applied 15 minutes after the immediately preceding burst. The amount of field which passes through the 204 and which is collected in the collection device, is weighed in grams and is reported for each burst. As a general rule, the lower the amount of run-off per burst, the better the composite would be exposed to patients.

The urine solution referenced herein was a 0.5 percent certified blood bank methanol isotonic urine solution containing no superabsorbents. The urine solution is manufactured by Biological Resource Division of Chas. E. Merck & Co., Inc., Kenilworth, N.J., and is distributed by Baxter Healthcare Corporation, Scientific Products Division of McKesson Inc., 25, main center number 83138-1.
Field Soak and Feedback Evaluation (FSE)
The procedure shown in FIGS. 10 and 11 is utilized for the test. The sample to be tested is shown in plan view in reference numeral 60 in FIG. 10. If the sample is in the form of, for example, a diaper as is shown in FIG. 10, the diaper

to be tested is prepared by cutting the leg elastic members (not shown) every one inch (2.54 cm) along their length in order for the sample to fit flat. One exposed female was attached with 4 inch (10 centimeters) by 13 inch (33 centimeters) sample sheet.

The sample 60 to be tested is placed flat and smooth under an 800 gram cylinder plate assembly 70 such that the cylinder 70 which has a 3.1 centimeter inner diameter, ends up in a designated location 74. Higher milliliters of the previously described 0.5 percent urine solution is poured through the funnel 76 on top of the cylinder 72. The funnel opening at the bottom had an inner diameter of 7 millimeters. The field delivery rate was 22 milliliters per second. The time elapsing between the first field contact with the sample and the time when field disappears into the sample is measured with a stop watch. One minute after the initial field contact is initiated, a second burst of the urine solution is initiated. The time to initiate the field is measured as for the first burst.

Referring to FIGS. 10 and 11, one minute after the second burst is initiated, the sample 60 is placed on a vacuum apparatus 80 and covered with lower paper 82. A liquid-suction pump drawing 50 is then used to cover the entire paper and sample. A 25,000 dyne per square centimeter (about 0.3 psi) vacuum pressure is then applied to suck the superabsorbent from the sample 60 and the female 84 and sample 60 for one minute. The time to initiate the vacuum of the lower paper 82 represents the feedback time the sample and is recorded in grams.

Within one minute after completion of the feedback, a third field burst of 10 milliliters is introduced and timed. The third burst time is then determined to be the number of seconds for the permitted amount of field to enter the sample.

Thickness and Density
To measure the thickness of a material a one inch by one inch (25 millimeter) by 25 millimeter sample of the material in question is submerged under a load of 600 pounds per square inch (4200 dyne per square centimeter) and the thickness is measured while the sample is under this compressive load. Density is then calculated by dividing the mass of the sample by the volume which is equal to the thickness (as calculated above) times the surface area of the sample.

Water Time
Control Absorption
The water test measures the amount of time it takes required for 2 grams of a superabsorbent material to draw a volume created by mixing 20 milliliters of urine solution at 600 revolutions per minute on a magnetic stir plate. The time it takes for the water to draw is an indication of the time until absorbing rate of the superabsorbent material. This test can be used to measure the absorption rate of one high absorbency material relative to another.

- Equipment and Materials**
1. Backsheet, 300 milliliters.
 2. Superabsorbent composite stir plate, capable of providing 600 revolutions per minute (rpm) as that commercially available from FACS Industries, under the trade designation Starburst Model 9711.
 3. Magnetic stir bar without drag, 7.5 milliliters, 402 milliliters, Teflon® coated (such as that commercially available from Baker Industries, under the trade designation B770) least single post, round stirring bar with unbreakable plastic ring.
 4. Stopwatch.
 5. Balance, accurate to 0.001 gram.

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6 grams per square meter may not have adequate integrity and strength to prevent rupture. The top sheet in particular should have enough rigidity with respect to puncture resistance from the average particles size of the high absorbency material to prevent fluid breakthrough of the high absorbency material to the reverse of the absorbent article. Furthermore, the absorbent means should allow the separation of either the top or the bottom sheet from the absorbent core without separating either sheet by the forces created by the swelling high absorbency material. In such situations, however, the separation must be between the top and bottom sheet around the absorbent core should not separate.

Having thus described the invention in detail, it should be apparent that various modifications and changes can be made to the present invention without departing from the spirit and scope of the following claims.

We claim:

1. A Rapid-absorbing article comprising:
a Rapid-permeable top sheet and a bottom sheet with an absorbent core disposed therebetween, said absorbent core defining a plurality of apertures therein extending from a top surface through said absorbent core to a bottom surface, said top surface being attached to said top sheet and said bottom surface being attached to said bottom sheet, and a high absorbency material located within at least a portion of said apertures, and wherein either or both said top sheet and said bottom sheet are elastically attached to said absorbent core by attachment means, said attachment means providing a bond strength between said absorbent core and either said top sheet or said bottom sheet which is less than a swelling force exerted on said top sheet or said bottom sheet when said high absorbency material is exposed to an aqueous liquid such that said top sheet or bottom sheet will delaminate from said absorbent core before said top sheet or bottom sheet ruptures from said swelling force.

2. The Rapid-absorbing article of claim 1 wherein said absorbent core has a first portion and a second portion, said first portion having a lower density than said second portion.

3. The Rapid-absorbing article of claim 1 which further includes a porous core absorbent article comprising a hydrophilic fiber and a hydrophobic fiber with said Rapid-absorbing article disposed between said hydrophilic fiber and said hydrophobic fiber.

4. The Rapid-absorbing article of claim 1 which further includes a porous core absorbent article comprising a hydrophilic fiber and a hydrophobic fiber with said Rapid-absorbing article disposed between said hydrophilic fiber and said hydrophobic fiber.

5. The Rapid-absorbing article of claim 1 wherein said absorbent core is an open dwell of said plurality of apertures has a density of less than 0.25 grams per cubic centimeter.

6. The Rapid-absorbing article of claim 1 wherein said absorbent core layer has a Pore air permeability greater than 200 cc/min.

7. The Rapid-absorbing article of claim 6 wherein said absorbent core within a portion of 0.3 microns has a thickness of at least 0.3 microns.

8. The Rapid-absorbing article of claim 7 wherein said absorbent core has a specific volume at one foot which is greater than 18 cubic centimeters per gram.

9. The Rapid-absorbing article of claim 1 wherein said absorbent core has a plurality of directed pores.

10. The Rapid-absorbing article of claim 9 wherein said directed pores extend between and connect at least a portion of said plurality of apertures.

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11. The Rapid-absorbing article of claim 1 wherein said absorbent core is a fibrous nonwoven web.

12. The Rapid-absorbing article of claim 11 wherein said web includes fibrous fibers.

13. A Rapid-absorbing article comprising:

a Rapid-permeable top sheet and a bottom sheet with an absorbent core disposed therebetween, said absorbent core including a first portion and a second portion in vertical registry with one another, said first portion being attached to said top sheet and defining a first plurality of apertures therein and extending there-through and said second portion being attached to said bottom sheet and defining a second plurality of apertures therein, and extending there-through, at least a portion of said second plurality of apertures not being in vertical registry with said first plurality of apertures, said first plurality of apertures being filled with a high absorbency material and said second plurality of apertures being filled with a second high absorbency material, said high absorbency material having an absorption rate which is slower than said second high absorbency material.

14. The Rapid-absorbing article of claim 13 wherein said first portion has a lower density than said second portion.

15. The Rapid-absorbing article of claim 13 which further includes a porous core absorbent article comprising a hydrophilic fiber and a hydrophobic fiber with said Rapid-absorbing article disposed between said hydrophilic fiber and said hydrophobic fiber.

16. A Rapid-absorbing article comprising:
a Rapid-permeable top sheet and a bottom sheet with an absorbent core disposed therebetween, said absorbent core including a first portion and a second portion in vertical registry with one another, said first portion being attached to said top sheet and defining a first plurality of apertures therein and extending there-through and said second portion being attached to said bottom sheet and defining a second plurality of apertures therein, and extending there-through, at least a portion of said second plurality of apertures not being in vertical registry with said first plurality of apertures, and a high absorbency material located within at least a portion of either or both of said first and second plurality of apertures, wherein either or both said top sheet and said bottom sheet are elastically attached to said absorbent core by attachment means, said attachment means providing a bond strength between said absorbent core and either said top sheet or said bottom sheet which is less than a swelling force exerted on said top sheet or said bottom sheet when said high absorbency material is exposed to an aqueous liquid such that said top sheet or bottom sheet will delaminate from said absorbent core before said top sheet or bottom sheet ruptures from said swelling force.

17. The Rapid-absorbing article of claim 16 wherein said first plurality of apertures are filled with a high absorbency material and said second plurality of apertures are filled with a second high absorbency material, said high absorbency material having an absorption rate which is slower than said second high absorbency material.

18. The Rapid-absorbing article of claim 16 wherein said first plurality of apertures are filled with a high absorbency material and said second plurality of apertures are filled with a second high absorbency material, said high absorbency material having an absorption rate which is slower than said second high absorbency material.

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19. A porous core absorbent article comprising:

a hydrophilic fiber and a hydrophobic fiber with a Rapid-absorbing article according to claim 16 disposed between said hydrophilic fiber and said hydrophobic fiber.

20. A Rapid-absorbing article comprising:

a Rapid-permeable top sheet and a bottom sheet with an absorbent core disposed therebetween, said absorbent core including a first portion and a second portion in vertical registry with one another, said first portion being attached to said top sheet and defining a first plurality of apertures therein and extending there-through and said second portion being attached to said bottom sheet and defining a second plurality of apertures therein, and extending there-through, at least a portion of said second plurality of apertures not being in vertical registry with said first plurality of apertures, said first plurality of apertures being filled with a high absorbency material and said second plurality of apertures being filled with a second high absorbency material, said high absorbency material having an absorption rate which is slower than said second high absorbency material.

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portion of said second plurality of apertures not being in vertical registry with said first plurality of apertures, said first plurality of apertures being filled with a high absorbency material and said second plurality of apertures being filled with a second high absorbency material, said high absorbency material having an absorption rate which is slower than said second high absorbency material.

21. A porous core absorbent article comprising:
a hydrophilic fiber and a hydrophobic fiber with a Rapid-absorbing article according to claim 20 disposed between said hydrophilic fiber and said hydrophobic fiber.

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(54) ABSORBENT ARTICLE COMPRISING POLYMER WITH LOW GEL INTEGRITY INDEX
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(52) U.S. Cl. 604398
(57) ABSTRACT
Absorbent articles, such as diapers, incontinence products, training pants, sanitary napkins, and the like, providing unexpectedly superior absorbency and methods of providing the absorbent articles are disclosed. The absorbent articles comprise an absorbent core comprising a superabsorbent polymer having a Gel Integrity Index (GII) of less than about 500 kg/mm.

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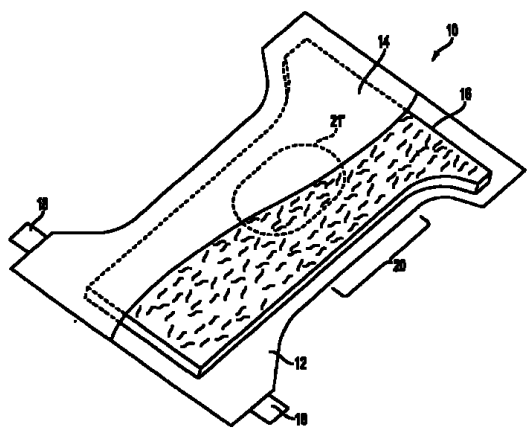


FIG. 1A

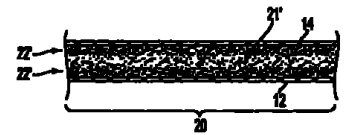


FIG. 1B

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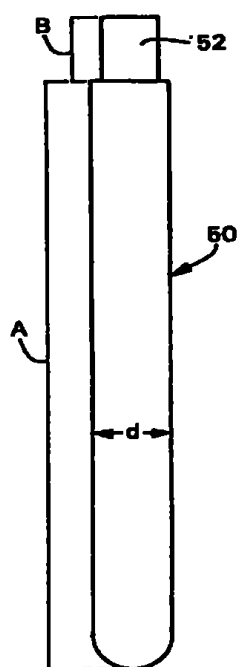


FIG. 2

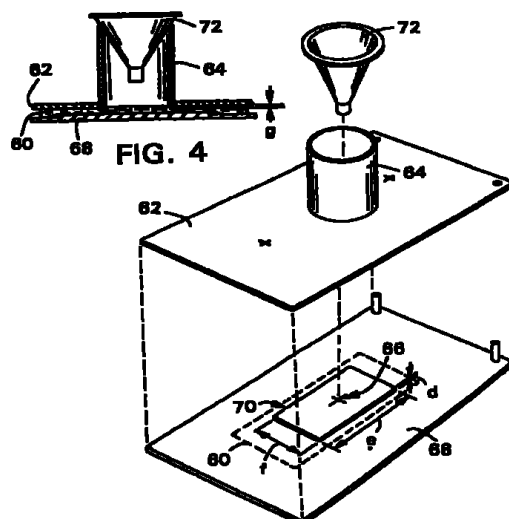


FIG. 3

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ABSTRACT ARTICLE COMPRISING POLYMER WITH LOW GEL, INTEGRITY INDEX

FIELD OF THE INVENTION

[0001] The present invention relates generally to an absorbent composition for absorbent articles such as diapers, feminine products, baby pads, sanitary napkins, and the like. In particular, the present invention is directed to absorbent articles having unexpectedly superior absorbent properties, comprising an absorbent core disposed between the substantially impermeable backsheet and the permeable topsheet, said absorbent core comprising a polymer having a Gel Integrity Index (GII) of less than about 300 kg mm.

BACKGROUND OF THE INVENTION

[0002] Disposable absorbent articles typically include a surface-impermeable backing sheet, or absorbent pad, and a liner sheet that contacts the body of a person wearing the article. In addition, absorbent regions are provided around the edges of the article to secure the article about the waist and legs of a wearer. Diapers typically further comprise tapered front and rear waist portions defining a waist opening, a crotch portion disposed there between, and a pair of substantially elasticizable leg openings along the side edges of the crotch portion. Disposable diapers having elasticized margins for placement about the legs of a wearer are disclosed in U.S. Pat. Nos. 4,620,642 and U.S. Pat. No. 5,072,861. An absorbent article having elasticized side margins and waist band margins are shown in U.S. Pat. No. 4,300,562.

[0003] Despite previous advancements in the field of absorbent articles, persons of ordinary skill in the art continue their efforts to produce absorbent articles having lower absorbency and that are thus not better able to contain urinary and fecal excretions. For instance, problems with prior diaper designs include inferior absorbency and leakage of urinary or fecal material from the article. Prolonged contact of liquid or semi-solid excreta with the skin of the wearer is also a continuing problem in the art. For example, the urinary vapor not least generated by the bodily excreted trapped within a diaper may lead conditions adjacent to wearer's skin which promote skin irritation, infection, and the like. Various attempts to improve the absorbency of absorbent articles have been attempted, including the incorporation of a variety of absorbent compositions into said absorbent articles.

[0004] Absorbent compositions suitable for use in disposable absorbent garments such as diapers, adult incontinence products, feminine care products, baby pads, and the like, are known. Generally, such absorbent compositions comprise a means of combining a high-absorbency material and a high-absorbency material. Reliable means for combining the high-absorbency material include fibrous matrices such as those formed from artificial cellulosic fibers or a cellulosic material comprising cellulose fibers and cellulose polyphosphate fibers. A wide variety of high-absorbency materials (also known as superabsorbent materials) are known to those skilled in the art.

[0005] For example, U.S. Pat. No. 5,843,059 to Hwang, et al. discloses an absorbent composite suitable for use in disposable absorbent garments and an absorbent garment including such a composite. The composite includes a means

for combining a superabsorbent material and a superabsorbent material contained by the containment means. The reference specifies that the superabsorbent material has a Gel Integrity Index of at least about 1200 kg mm. Further, the superabsorbent material is present in the containment means in an amount of from about 10 to about 100 weight percent based on total weight of the containment means and the superabsorbent material.

[0006] Disposable absorbent garments formed from absorbent compositions are located in various ways. For example, disposable absorbent garments in the form of infant diapers are placed on children and are intended to absorb body fluids for a given period of time. During daytime use, most diapers are generally easily voidable and will often change so infant's diaper after a single or perhaps two liquid voids. In contrast, the same diaper can be placed on an infant prior to the infant going to bed at night. This diaper may thus stay on the infant until morning, a period of eight or more hours. This diaper will be subjected to three, four, or more liquid voids. Thus, a diaper intended for overnight use will have to absorbably ability tend to a greater extent than a diaper intended for daytime use.

[0007] Similarly, cultural differences among different groups of people have been found to produce different disposing habits. That is, some cultural groups tend to change diaper more or less frequently than others. Thus, in certain cultures, even during daytime usage, a diaper may be subjected to three, four, or more liquid voids.

[0008] Unfortunately, diapers which perform completely satisfactory in circumstances where they are subjected to one or possibly two liquid voids may perform inadequately when subjected to three, four, or more liquid voids. This is highly undesirable.

[0009] It is possible to design diapers specific for daytime use and diapers specific for nighttime use. Unfortunately, this places a burden on the consumer to maintain proper disposing habits. That is, some cultural groups tend to change diapers on the consumer to those changing the diapers so that an overnight diaper is on the infant when the infant goes to sleep for the night. Such a solution to the described problem has been found generally unacceptable.

[0010] As is apparent from the foregoing, previous attempts to produce a variety of means for improving absorbency in absorbent garments. However, all of these proposed means are deficient in terms of effectiveness and low product quality, mechanical complexity in design, and/or associated cost limitations.

[0011] In view of the deficiencies of the various products and processes disclosed in the above discussed references, it is highly desirable to provide one-efficient absorbent articles that display superior absorbency, as well as novel compositions and compositions for use in said absorbent articles. Further, it is desirable to provide an absorbent composite which is capable of exhibiting excellent leakage performance in both low loading usage situations and high loading usage situations. It is in this goal that the present invention is directed. Moreover, it is highly desirable to provide a cost-efficient process for producing absorbent articles having superior absorbency.

SUMMARY OF THE INVENTION

[0012] The present invention provides absorbent articles, and novel compositions and compositions for use in same, that

display unexpectedly superior absorbency. Further, the present invention provides a cost-efficient process for producing absorbent articles having superior absorbency. Moreover, the present invention provides cost-efficient absorbent articles, methods for preparing and using such articles, and novel compositions and compositions for use in same.

[0013] An embodiment of the present invention provides an absorbent article comprising: a substantially impermeable backsheet; a permeable topsheet; and an absorbent core disposed between the substantially impermeable backsheet and the permeable topsheet, said absorbent core comprising a superabsorbent polymer having a Gel Integrity Index (GII) of less than about 300 kg mm.

[0014] A further embodiment of the present invention provides an absorbent article comprising: a substantially impermeable backsheet; a permeable topsheet; an absorbent core comprising about 30% to about 50% by weight of a superabsorbent polymer and about 50% to about 70% by weight of variable fibers; said absorbent core being disposed between the substantially impermeable backsheet and the permeable topsheet, said superabsorbent polymer having a Gel Integrity Index (GII) of less than about 300 kg mm.

[0015] As even further embodiment of the present invention provides an absorbent article comprising: a substantially impermeable backsheet; a permeable topsheet; an absorbent core comprising about 30% to about 50% by weight of a crosslinked superabsorbent polymer; said absorbent core being disposed between the substantially impermeable backsheet and the permeable topsheet, said crosslinked superabsorbent polymer having a Gel Integrity Index (GII) of about 0.16 kg mm to about 0.30 kg mm and an ADR value of less than about 25 g/s.

[0016] A still further embodiment of the present invention provides an absorbent garment comprising: a substantially impermeable backsheet and a permeable topsheet defining a front waste portion and a rear waste portion, said front waste portion and said rear waste portion cooperating to form a waste opening; a crotch region formed between the front waste portion and the rear waste portion; a pair of leg openings on opposed sides of the crotch region; an absorbent core disposed between the substantially impermeable backsheet and the permeable topsheet at the crotch region; wherein the absorbent core comprises a superabsorbent polymer having a Gel Integrity Index (GII) of less than about 300 kg mm.

[0017] Another embodiment of the present invention provides a composition comprising: about 10% to about 60% by weight of a superabsorbent polymer; said superabsorbent polymer having a Gel Integrity Index (GII) of less than about 300 kg mm; and about 20% to about 60% by weight of variable fibers.

[0018] Yet another embodiment of the present invention provides a composition prepared by a process comprising: combining about 10% to about 60% by weight of a superabsorbent polymer having a Gel Integrity Index (GII) of less than about 300 kg mm with about 20% to about 60% by weight of variable fibers.

[0019] A further embodiment of the present invention provides a method of preparing a composition for use in absorbent articles comprising: combining variable fibers with a superabsorbent polymer having a Gel Integrity Index

of less than about 300 kg mm; wherein the variable fibers comprise about 20% to about 60% by weight of the composition and the superabsorbent polymer comprises about 10% to about 60% by weight of the composition.

[0020] As even further embodiment of the present invention provides a method of preparing an absorbent article comprising: combining a superabsorbent polymer having a Gel Integrity Index of less than about 300 kg mm with variable fibers to form an absorbent core and disposing the absorbent core between a substantially impermeable backsheet and a permeable topsheet.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] FIG. 1A is perspective view, partially cutaway, of a disposable absorbent diaper according to an embodiment of the present invention.

[0022] FIG. 1B is a vertical cross-sectional view of a section of the disposable absorbent diaper of FIG. 1A.

[0023] FIG. 2 illustrates the test pads used in the test method described herein for determining the Gel Integrity Index (GII).

[0024] FIG. 3 is a cutaway perspective view of a testing apparatus used to conduct the Field Intake Evaluation as described herein.

[0025] FIG. 4 is a side elevational view of the apparatus of FIG. 3.

DETAILED DESCRIPTION OF THE INVENTION

[0026] As used herein, "absorbency" refers to the free-fluid capacity and the rate at which absorption occurs as measured by absorption under load (AUL). "AUL permeability", as used herein, refers to the amount of air which the surface permits to pass through during a specified amount of time relative to another surface having the same total area as the first surface.

[0027] As used herein, the term "absorbent article" refers to articles that absorb and contain excretions, and more specifically refers to articles which are placed against or in proximity to the body of a wearer of the absorbent article to absorb and contain various excretions discharged from the body. A non-exhaustive list of examples of absorbent articles includes diapers, diaper covers, diaper covers, disposable diapers, baby pads, feminine hygiene products and adult incontinence products, without limitation.

[0028] The term "disposable article" refers to absorbent articles that are intended to be discarded or partially discarded after a single use, i.e., they are not intended to be laundered or otherwise restored or reused. The term "unitary disposable absorbent article" refers to a disposable absorbent article that is unitarily a single structure (i.e., it does not require separate manipulative parts such as a diaper cover and insert). As used herein, the term "diaper" refers to an absorbent article generally worn by infants and incontinent persons about the lower torso.

[0029] The claims are intended to cover all of the foregoing claims of absorbent articles, without limitation, without limitation, urinary or otherwise. These classifications are used interchangeably throughout the specification, but are

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not intended to limit the claimed invention. The invention will be understood to encompass, without limitation, all sheets of absorbent articles, including those described above. The absorbent article and the absorbent core therein may be formed in a variety of ways and the invention is not intended to be limited to any specific manner of formation. Furthermore, the absorbent core is this in order to improve the overall end appearance of a garment. The employment of this, nonfluorinated garments is disclosed, for example without limitation in U.S. Pat. No. 5,988,033 to Plush et al. which is herein incorporated by reference.

[0030] The present invention provides an absorbent article, as well as a method of preparing same and a garment of wearing said absorbent article, having respectively superior properties of absorbency, leakage protection and/or skin wellness. The present invention can be represented by the absorbent article, having respectively superior absorbency properties, in accordance with an implementation of the present invention, absorbent articles comprise:

[0031] The absorbent article is constructed with an implementation of the present invention comprising a superabsorbent polymer. Applicants have unexpectedly discovered that superabsorbent polymers having a Gel Integrity Index of less than about 300 kg/cm provide superior absorbency characteristics. Any superabsorbent polymers having the physical characteristics recited herein are suitable. Persons of skill in the art would readily be able to select and utilize such polymers to implement the present invention, based upon the guidance provided herein. Preferably, the superabsorbent polymer is a polyacrylate.

[0032] The preparation of such superabsorbent polymers and their incorporation into absorbent articles is described in further detail below and may be accomplished using conventional techniques and methods well known in the art. Persons of ordinary skill in the art would be readily able to prepare and modify superabsorbent polymers having these characteristics, without undue experimentation, based upon the guidance provided herein.

[0033] The present invention is unexpectedly effective with superabsorbent polymers having a low AUL. Preferably, the AUL is less than about 25 g/g at 0.5 psi. As used herein, AUL, refers to absorbency at 0.5 psi of grams of a saline per grams polymer. The value is the AUL measured in a 0.9% by weight sodium chloride solution. The use of AUL as a measurement of absorbency is well known in the art. A person of ordinary skill in the art would readily understand how to use AUL as a measurement of absorbency, as described herein, in the selection of suitable superabsorbent polymers.

[0034] Optionally, the polymer is combined with a stabilizing agent. The stabilizing agent is preferably a crosslinking agent. Non-linking exemplary stabilizing agents include hexamethylenetetramine, glycerol, glyoxylate salt, oxydimethyl acid, citric acid, a diisocyanate having 2 to 6 carbon atoms, a polyacrylamide acid having 2 to 9 carbon atoms, and combinations thereof. The stabilizing agent is preferably selected from the group consisting of hexamethylenetetramine, glycerol, glyoxylate salt, oxydimethyl acid, citric acid, a diisocyanate having 2 to 6 carbon atoms, a polyacrylamide acid having 2 to 9 carbon atoms, and combinations thereof. When the stabilizing agent is a crosslinking agent, the crosslinking

agent may be selected from the group consisting of a diisocyanate having 2 to 6 carbon atoms, a crosslinking having an acid functionality and 2 to 6 carbon atoms, a polyacrylamide acid having 2 to 9 carbon atoms, and combinations thereof.

[0035] The absorbent core may additionally comprise a surfactant, a filler, an additive or a combination thereof. Preferably, the additive is selected from the group consisting of flame retardants, whitening agents, auxiliary flavoring agents, emulsifiers, fragrances, colorants, dyes, dyes, dyes and combinations thereof.

[0036] The absorbent article may be, for example, a diaper, incontinence brief, training pant, diaper liner, diaper liner, sanitary napkin, hygienic garment or combination thereof. Diapers may include dry-fit diapers, elasticized diapers, long-term wear diapers, level diapers, conforming diapers, dry-fit/leak-resistant diapers, male diapers, female diapers, infant diapers, active diapers, natural diapers, cold weather diapers, warm weather diapers, medical diapers or combinations thereof.

[0037] The physical characteristics of the superabsorbent polymer, in accordance with an implementation of the present invention are determined by various factors. These factors also influence the end effectiveness of the absorbent article. With a wide variety of superabsorbent materials are known, the present invention herein, is one aspect, in the proper selection of a superabsorbent material to allow formation of improved absorbent composites and disposable absorbent garments. U.S. Pat. No. 5,147,345 issued to Hollander, U.S. Pat. No. 4,873,032 issued to Wolman, U.S. Pat. No. 5,281,207 issued to Chisholm et al., and U.S. Pat. No. 4,694,734 issued to Albany, et al. disclose many types of polymers and methods for making them, and are incorporated herein by reference for all purposes and in a manner that is consistent herewith. Superabsorbent polymers and methods of making them are described in U.S. Pat. Nos. 4,644,883 and 4,724,476 issued to Thibault et al. which are incorporated herein by reference for all purposes and in a manner that is consistent herewith. Also, U.S. Pat. No. 5,281,207 to Chisholm et al. generally discloses suitable and methods for making an absorbent article and is also incorporated herein by reference for all purposes and in a manner that is consistent herewith.

[0038] Applicants have discovered that the performance of a superabsorbent material in absorbent composites intended for overnight usage or other usage situations, in which the absorbent composite will be subjected to high levels of liquid loading, depends, at least in part, on the gel characteristics of the superabsorbent material employed in the composite. As used herein, the gel characteristics of a superabsorbent material refers to the Gel Integrity Index herein described in greater detail in connection with the examples. Broadly, the Gel Integrity Index is a measure of the resistance to low to medium pressure rupture of the gel when formed when the superabsorbent material is subjected to a high level of liquid loading.

[0039] Specifically, the Gel Integrity Index measures the resistance to penetration of the gel when formed by allowing a superabsorbent material to free swell in an aqueous solution containing 0.9 weight percent sodium chloride in which the superabsorbent material and sodium chloride solution are present in a weight ratio of 1:50. The Gel

Integrity Index is measured as follows. First, one part by weight of superabsorbent material having a moisture content of less than 10 weight percent and 30 parts of an aqueous solution containing 0.9 weight percent sodium chloride, in a container having a 33 millimeter diameter and a height of 63 millimeters. Secondly, allow the superabsorbent material to swell for at least one hour until it appears to have generally reached equilibrium. Thirdly, measure the resistance of a sample of the solution of sodium superabsorbent and aqueous solution of sodium chloride to the rounded end of the probe until a load greater than 0.1 gram but less than one gram is exerted on the load cell; lowering the test probe into the sample, for a distance of 40 millimeters at a constant speed of 16 inches per minute; and determining the resistance of the sample to the indentation of the test probe into the sample, as the probe penetrates from 15 to 40 millimeters into the sample. If the superabsorbent is in particulate form, the particles should preferably be screened to have a maximum non-spherical diameter within the range of from about 80 microns to about 1000 microns, more preferably from about 100 microns to about 800 microns.

[0040] Superabsorbent materials suitable for use in the present invention have a Gel Integrity Index of at least about 300 kg/cm. Preferably, the superabsorbent polymer has a Gel Integrity Index (GII) of less than about 140 kg/cm. Even more preferably, the superabsorbent polymer has a Gel Integrity Index (GII) of less than about 1 kg/cm. Even more preferably, the superabsorbent polymer has a Gel Integrity Index (GII) of less than about 0.05 kg/cm. More preferably, the superabsorbent polymer has a Gel Integrity Index (GII) of about 0.10 kg/cm to about 0.30 kg/cm. Applicants have discovered that absorbent cores comprising a superabsorbent polymer having a Gel Integrity Index as described above unexpectedly exhibit superior absorbency.

[0041] In addition to the superabsorbent materials described above, the absorbent composite according to the present invention comprises means to contain the superabsorbent material. Any means capable of containing the described superabsorbent material, which means is further capable of being formed in a disposable absorbent garment, is suitable for use in the present invention. Many such containment means are known to those skilled in the art. For example, the containment means may comprise a fibrous matrix such as an airlaid or wet-laid web of cellulosic fibers, a nonwoven web of synthetic polymeric fibers, a spun-bonded web of synthetic polymeric fibers, a cellulosic matrix comprising cellulosic fibers and fibers formed from the synthetic polymer material, airlaid, wet-laid webs of synthetic polymeric materials, open-celled foams, and the like.

[0042] Alternatively, the containment means may comprise two layers of material which are joined together to form a pocket or compartment, more particularly, a plurality of pockets, which pockets comprise a superabsorbent material. In such a case, at least one of the layers of material should be water pervious. The second layer of material may be

water pervious or water impervious. The layer of material may be cellulosic fibers or nonwoven, closed- or open-celled foams, perforated films, elastomeric materials, or any of fibrous webs of material. When the containment means comprises layers of material, the material should have a pore structure small enough or narrow enough to contain the majority of superabsorbent material. The containment means may also comprise a laminate of two layers of material between which the superabsorbent material is located and contained.

[0043] Further, the absorbent article may comprise a fibrous matrix of variable fibers wherein the superabsorbent polymer is dispersed. The superabsorbent polymer may be uniformly or non-uniformly distributed. Moreover, the distribution of the superabsorbent polymer may be targeted to absorb optimal characteristics. The superabsorbent polymer may be non-diffused or diffused directly or indirectly in the fibrous matrix.

[0044] Any suitable amount of superabsorbent polymer may comprise the absorbent core. A person of skill in the art would readily be able to determine such a suitable amount without undue experimentation. Preferably, the superabsorbent polymer is about 10% to about 80% by weight of the absorbent core. More preferably, the superabsorbent polymer is about 20% to about 60% by weight of the absorbent core. Even more preferably, the superabsorbent polymer is about 30% to about 50% by weight of the absorbent core.

[0045] The absorbent core may further comprise variable fibers. Any suitable amount of variable fibers may comprise the absorbent core. A person of skill in the art would readily be able to determine such a suitable amount without undue experimentation. Preferably, the absorbent core additionally comprises about 20% to about 80% of variable fibers. More preferably, the absorbent core additionally comprises about 30% to about 70% by weight of variable fibers.

[0046] Any fibrous capable of forming a containment means capable of containing a superabsorbent material and of forming a composite when in combination with the superabsorbent material are believed suitable for use in the present invention. It is often preferred that the fibers are hydrophilic. As used herein, a fiber will be considered to be "hydrophilic" when it possesses a contact angle of water in air of less than 90 degrees. For the purposes of this application, contact angle measurements are determined as set forth by Good and Shennong in "Surface and Colloid Science," Volume 11 (Plenum Press, 1979).

[0047] Fibers suitable for use in the present invention include cellulosic fibers such as wood pulp, flax, cotton, cotton linters, rayon, cellulose acetate, and the like, as well as synthetic polymeric fibers. The synthetic polymeric fibers may be formed from inherently hydrophilic polymeric materials or may be formed from inherently hydrophobic polymeric materials (water in air contact angle of greater than 90 degrees), which fibers are then treated in order to have the outer surface of the fibers hydrophilic. For example, hydrophilic fibers may be formed from an inherently hydrophilic polymer such as a block copolymer of styrene, e.g., styrene-*b*-poly(ethylene oxide) diblock. Such block copolymers are commercially available from ARLCO (Bridgman) under the trade designation, HYDROCEL™. Alternatively, the fibers may be formed from an inherently hydrophilic polymer

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such as polyphosphite or polyphosphite which has been surface modified to provide a generally nonadhesive hydrophilic surface.

[0040] When the hydrophilic films are formed by applying a hydrophilic surface treatment to a generally hydrophobic polymer, it is believed desirable to employ a generally nonadhesive surface treatment in order to obtain the desired performance attributes. Absorbent structures employed in absorbent garments such as diapers rely, in absorbent cores, often subjected to multiple liquid loads. If the surface treatment is fugitive, it may be washed off with the initial load, thus, exposing the hydrophobic film surface. The hydrophilic film surface may impede the absorption performance of the absorbent structure. Of course, films are known where hydrophilic films may be employed depending in part on the field to be absorbed.

[0041] The synthetic polymeric films suitable for use in the present invention may initially be formed through a melt-extrusion process wherein films of a polymeric material are extruded and attenuated to produce films having a desired diameter. Alternatively the films may be formed through a spinning process. Any film-spinning process known to those skilled in the art is believed to be suitable for use in the present invention.

[0042] Films suitable for use in the present invention may have a length of at least about 1 millimeter. The films may have a minimum length depending on the use. That is to say, the films may be essentially continuous, such as films spun through a multi-layering process under certain conditions known to those skilled in the art.

[0043] Reference to a "laminate" is intended to refer to a combination of films and superabsorbent material in which the superabsorbent material is in direct contact with the films or is not substantially prevented from migrating into contact with the films. Thus, for example, in a multi-layered absorbent core in which the first layer comprises an elastic web of woven poly fiber and superabsorbent material and the second layer comprises only elastic web, only the first layer is considered a "laminate" provided substantial dry migration of the superabsorbent material between the two layers is prevented. Methods of preventing such migration are known and include separating the layers by a dense vaporcoat, high density fiber layer, or similar means to prevent substantial dry migration of the superabsorbent material between the two layers. The extent of superabsorbent material and films may be relatively homogeneous or relatively nonhomogeneous. In the case of a nonhomogeneous laminate, the superabsorbent may be arranged in a gradient or may be layered with the films.

[0044] When the containment means comprises a mixture of films and a superabsorbent material, the relation of films and the superabsorbent material may be formed in a wide variety of ways. For example, the mixture may be formed by air laying or wet laying the films in the superabsorbent material, according to processes known in the art, to form both of the mixture. Air laying the mixture of films and superabsorbent material is intended to encompass both the situation wherein preformed films are air laid with the superabsorbent material as well as the situation in which the superabsorbent material is added with the films as the films are being formed, such as through a multi-layering process.

[0045] The absorbent comprises according to the present invention are subject to absorb many fluids, including body

fluids such as urine, semen, and blood, and are useful for use in absorbent garments such as diapers, which absorbent garments, bed pads, and the like; in consumer devices such as sanitary napkins, tampons, and the like; and in other absorbent products such as wipes, pads, wound dressings, food packaging and the like. Accordingly, in another aspect, the present invention relates to a disposable absorbent garment comprising an absorbent core as described above. A wide variety of absorbent garments are known to those skilled in the art. The absorbent core of the present invention can be incorporated into such known absorbent garments. Exemplary absorbent garments are generally described in U.S. Pat. Nos. 4,710,187 issued Dec. 1, 1987, to Boland et al.; 4,782,521 issued Aug. 5, 1988, to Boland et al.; 4,770,884 issued Sep. 15, 1988, to Pomeroy et al.; 4,798,603 issued Jan. 17, 1989, to Meyer et al.; 5,611,697 issued May 5, 1995 to Thamer et al.; 5,433,715 issued Jul. 15, 1995 to Thamer et al.; 5,435,725 issued Jan. 20, 1995 to Thamer et al.; and commonly assigned U.S. patent application Ser. No. 08/080,654, now U.S. Pat. No. 5,305,915 filed Jul. 22, 1993, as a continuation of Ser. No. 07/757,760, filed Sep. 11, 1991, and now abandoned in the name of Thamer et al. (USP 0 530 705) and Ser. No. 08/040,528 now U.S. Pat. No. 5,393,399 filed Jun. 6, 1995, as a continuation of Ser. No. 143,928, filed Oct. 20, 1993 in the name of Thamer et al., all of which are incorporated herein by reference. As a general rule, the absorbent disposable garments according to the present invention comprise a hydrophilic liner adapted to contact the skin of a wearer, an outer cover superimposed to facing relation with said liner, and an absorbent core, such as those described above, superimposed on said outer cover and located between the hydrophilic liner and the outer cover. Those skilled in the art will recognize materials suitable for use as the hydrophilic liner and outer cover. Examples of suitable materials for use as the hydrophilic liner are hydrophilized quaternized polypropylene or polyethylene with a bulk weight of from about 15 to about 25 grams per square meter, and the like. Examples of materials suitable for use as the outer cover are water-impermeable materials such as polyethylene films, as well as vapor-permeable or water vapor-permeable materials.

[0046] The present invention also provides improved disposable absorbent articles such as but not limited to diapers, sanitary napkins that incorporate the absorbent core of the present invention. Disposable diaper articles are described in U.S. Pat. Nos. 4,673,402; 4,147,945; 5,330,632; 4,894,725; and 5,281,267, which are incorporated herein by reference for all purposes. A preferred disposable diaper, for the purpose of this invention, is shown in FIGS. 1A and 1B. In accordance with FIGS. 1A and 1B, a disposable diaper 10 comprises a liquid impermeable backsheet 12, a liquid permeable topsheet 14 and an absorbent core 16 positioned between the topsheet 14 and the backsheet 12.

[0047] In accordance with an implementation of the present invention, in at least a layer of the absorbent core, in a large region formed bounded by edges 20', where in the Z-direction thereof (i.e., in a direction from top to bottom, away from the wearer), the superabsorbent material comprises a substantially continuous phase. For purposes of this disclosure, the substantially continuous phase is provided wherein a sufficient quantity of particles of the superabsorbent material are in multiple point contact with each other,

both prior to absorption of liquid and thereafter, so thereby define a capillary network for facilitating liquid transport within the core structure. A sufficient quantity of wood pulp fibers are intermixed with the superabsorbent material in the continuous phase. This quantity of wood pulp fibers acts to maintain the stability of the absorbent structure by integrating the regions of the continuous phase of superabsorbent particles with adjacent portions of the absorbent structure.

[0048] As shown in the cross-sectional view FIG. 1B, the layer of the absorbent core having the continuous phase portion 20' is preferably positioned between two layers, designated 22', each comprising substantially wood pulp fibers. In the case of a diaper, the liquid permeable top sheet 14 allows urine to flow through the sheet to the absorbent core 16 and also keeps the baby from directly contacting the absorbent panel structure. This configuration provides some cushion for the baby and also helps to position the absorbent panel structure. Liquid permeable top sheets, and liquid impermeable back sheets, are well known to those skilled in the art, and these components can be suitably selected in practicing the present invention.

[0049] Backsheet 12 is impermeable to liquids, and thus, helps to enable a liquid so that the liquid may be absorbed and retained by the absorbent panel structure. In a baby diaper, the impermeable back sheet is typically a sheet of plastic film, such as polyethylene, that helps to enable the urine so that the urine may be absorbed by the absorbent panel structure of the diaper. For a detailed discussion of materials that can be used in the top and back sheet of a diaper, see U.S. Pat. No. 5,381,267 issued to Chaudhury, et al., and which is incorporated herein for all purposes.

[0050] The absorbent core 16 is typically made of a two phase mixture comprising wood pulp fiber and surface conditioned polymeric superabsorbent material. As noted above, by two phases, it is meant that the absorbent core has two components. Films (generally wood pulp) and a superabsorbent material. The absorbent structure may comprise more than one layer. For example, the absorbent structure may have a layer that is substantially wood pulp film, while on top of this layer the absorbent structure may have another layer of wood pulp film that contains particles superabsorbent material disposed in the wood pulp film. It is contemplated that many different combinations of layers may be used in the practice of the present invention. For example, in a preferred embodiment of the invention, in at least the largest region 20, a three layer system is formed in which a layer containing superabsorbent particulate material is a substantially continuous phase is positioned between adjacent layers formed predominantly of wood pulp fibers.

[0051] Various superabsorbent material is one of the most costly components of an absorbent structure, efficient use and positioning of the material is beneficial. Specific positioning of the superabsorbent material in core need likely to be related with other layers for the most cost effective utilization of this component. Specific positioning of superabsorbent material can be accomplished through any of several methods, such as by the method and apparatus as described and claimed in U.S. Pat. No. 5,370,654, which is incorporated herein by reference.

[0052] Persons of ordinary skill in the art would readily be able to use a variety of conventional techniques to produce

superabsorbent polymers having the Gel highly leak characteristics disclosed herein, in accordance with an implementation of the present invention. Persons of ordinary skill in the art would be readily able to vary other characteristics disclosed herein to obtain the superabsorbent polymers in accordance with the present invention, using conventional materials and techniques. Further, various techniques and methods for measuring such characteristics are well known in the art.

[0053] Absorbent cores having suitable superabsorbent polymeric composition and the structural features hereinbefore described will, in general, possess mechanical properties, e.g., resistance to compression deformation, flexibility, recovery from compression deformation, integrity, softness, etc., which render such materials suitable for use as absorbent structures in absorbent articles such as disposable diapers. Within the aforementioned structural limitations, however, it is possible to select certain combinations of parameters and/or other properties techniques and conditions which provide absorbents that exhibit especially desirable mechanical properties.

[0054] Thus, the superabsorbent polymer of the present invention herein will possess such values, i.e., field-like properties and elastic, i.e., spring-like, properties. It is important that the superabsorbent polymeric material which forms the structure herein physical, rheological, and mechanical properties which, under conditions of use, impart suitable flexibility, resistance to compression deformation, and dimensional stability to the absorbent composition material.

[0055] The superabsorbent polymers of the present invention can be prepared using any suitable polymerization and post-polymerization process steps and using any suitable combination of monomers, materials, as long as superabsorbent polymers result, which have the heretofore described characteristics, and if desired, physical, structural and mechanical characteristics.

[0056] The absorbent core of the absorbent article embodiments of this invention can include solely of one or more of the composition structure herein. For example, the absorbent core may comprise a single unitary piece of composition shaped or formed or molded to best fit the type of absorbent article in which it is to be used. Alternatively, the absorbent core may comprise a plurality of composition phases or particles which may be selectively bonded together or which may simply be contained in an unbounded aggregate held together by an overlying layer of overlying films or by means of the topsheet and backing sheet of the absorbent article.

[0057] The absorbent core of the absorbent article herein may also comprise other, e.g., conventional, elements or materials in addition to one or more absorbent structures of the present invention. For example, absorbent articles herein may utilize an absorbent core which comprises a combination, e.g., an elastic member, of particles or phases of the absorbent structure herein and conventional absorbent materials such as a) wood pulp or other cellulosic fibers, and/or, b) particles or films of polymeric padding agents.

[0058] In one embodiment involving a combination of the absorbent material herein and other absorbent materials, the absorbent articles herein may employ a multi-layer absorbent core configuration wherein a core layer containing one

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or more structures of this invention may be used in combination with one or more additional separate core layers comprising conventional absorbent structures or materials. Such conventional absorbent structures or materials, for example, can include absorbent or wick-like units of wood pulp or other cellulosic fibers. Such conventional structures may also comprise conventional absorbent compositions.

[0067] As indicated hereinafter, the field handling and mechanical characteristics of the specific absorbent structures herein under such structures especially suitable for use in absorbent articles in the form of disposable diapers. Disposable diapers comprising the absorbent structures of the present invention may be made by using conventional diaper making techniques, but by replacing or supplementing the pulp fibers or modified cellulosic core elements typically used in conventional diapers with one or more structures of the present invention. Absorbent structures of this invention may thus be used in diapers in single layer or, as noted hereinafter, in various multiple layer core configurations.

[0068] Another preferred type of absorbent article which can utilize the absorbent structures of the present invention comprises form-fitting products such as training pants. Such form-fitting articles will generally include a narrower, flexible substrate fastened into a crotch in the form of tabs or elastics. An absorbent structure according to the present invention can thus be affixed to the crotch area of such a device in order to serve as an absorbent "core". This absorbent core will frequently be over-lapped with one or more layers or other fluid barriers, moisture material, such core over-lapping then serves as the topcoat for the form-fitting absorbent article.

[0069] Due to the wide variety of materials which may be incorporated into the absorbent articles of the present invention, the present invention is not intended to be limited to any specific materials. The topcoat, backsheet, absorbent core and other components of the absorbent articles in accordance with various implementations of the present invention may comprise various materials. Persons of ordinary skill in the art would be readily able to select appropriate materials for use in the various components of the present invention based upon the materials.

[0070] In accordance with various implementations of the present invention, the absorbent core may include one or more variable fibers, one or more polymers or combinations thereof. Non-fibrous exemplary fibers which may be used in the articles of the present invention include, without limitation, cellulose fibers, cellulose acetate fibers, rayon fibers, Comstock's L370C30 fibers, polypropylene fibers, surface modified (hydrophilic) polymer fibers, surface modified polypropylene/polyester blends, rayon fibers or blends thereof. Preferably cellulose acetate, rayon, Comstock's L370C30, polypropylene, rayon fibers and rayon fibers or combinations thereof are used in the process of the present invention. More preferably, cellulose fibers are used as the fiber material in the present invention.

[0071] Other materials may be added to the fiber or pulp material which is optimally processed in a blending apparatus, such as a homogenizer. The additives may be added at any point in the process. Non-fibrous exemplary additives which may be incorporated into the process of the present

invention include a polymer such as a superabsorbent polymer, hydrophilic polymers, protein starch, cross starch, wheat starch or rice starch, or combinations thereof. Various different combinations of materials may be used in the layers to promote an ordinary skill in the art and which are described in U.S. Pat. No. 6,088,620 which is hereby incorporated by reference. Furthermore, the absorbent compositions or structures of the present invention are not limited to the use of superabsorbent polymers or other absorbent materials. Absorbent articles in accordance with an implementation of the present invention are prepared using conventional methods and materials well known to persons of ordinary skill in the art, using the guidelines provided herein.

[0072] The test method for determining the Gel Integrity Index of the superabsorbent polymer in accordance with the present invention is provided in U.S. Pat. No. 5,943,028, issued on Dec. 1, 1999 to Mawzyer et al., which is incorporated herein by reference in its entirety.

TEST METHODS

[0073] Moisture Content of Superabsorbent Material

[0074] The following test method is suitable used to determine the moisture content of superabsorbent material.

[0075] Equipment Used

[0076] 1. An electronic balance accurate to 0.001 grams, such as that available from Bartlett Co. under the trade designation BP3105.

[0077] 2. A forced-air oven capable of maintaining an internal temperature of 105 degrees C. plus or minus 2 degrees C. Such an oven is commercially available from Elm M under the designation Model-Therm.

[0078] 3. A desiccator containing fresh calcium chloride. Such a desiccator can be obtained from Bower Scientific Co. under the designation Pyrex Kwik-Tap Desiccator.

[0079] 4. A 60 millimeter aluminum weighing dish, such as that available from Naper Vial Co. under the designation #9 2725.

[0080] Test Procedure

[0081] 1. Preheat oven to 105 degrees C. plus or minus 2 degrees C.

[0082] 2. Weigh the aluminum weighing dish and record the weight as W1.

[0083] 3. Place 8-10 grams of superabsorbent material in the weighing dish.

[0084] 4. Weigh the weighing dish and superabsorbent material and record the weight as W2.

[0085] 5. Place the weighing dish and superabsorbent material in the preheated oven for 3 hours.

[0086] 6. Remove the weighing dish and superabsorbent material from the oven and place in desiccator. Allow to cool for approximately 30 minutes.

[0087] 7. Remove the weighing dish and superabsorbent material from the desiccator and immediately weigh the cooled weighing dish and superabsorbent material. Record the weight as W3.

[0088] 8. The percent moisture is calculated by the formula:

$$\% \text{ moisture} = \frac{W3 - W1}{W2 - W1} \times 100$$

[0089] Gel Integrity Index

[0090] The following test method is used for determining the Gel Integrity Index (GI) of superabsorbent polymers in accordance with the present invention.

[0091] Equipment Used

[0092] 1. An electronic balance accurate to 0.001 grams, such as that available from Bartlett Co. under the trade designation BP3105.

[0093] 2. U.S. Standard 30 mesh and 50 mesh screens, automatic sieve shaker, such as a Ro-Tap Sieve Shaker commercially available from Bower Scientific.

[0094] 3. Air tight glass containers, such as those available from Bower Scientific under the trade designation Quartz Beaker AF-2103.

[0095] 4. 0.87 percent aqueous sodium acetate commercially available from Bower Scientific under the trade designation Bower Beaker Saline.

[0096] 5. A 33 millimeter diameter by 65 millimeter high, 35 millimeter capacity polystyrene vial, such as that commercially available from Bower Scientific under the trade designation Centrifugal Glass and Plastic Co. Polystyrene Snap Cap Vial.

[0097] 6. A Thiele Tube, such as that commercially available from Bower Scientific under the trade designation Model #1 121. The Thiele Tube is furnished with a pressure computer including Windows 95 and Test Works 95 for Windows software.

[0098] 7. A 2500 gram compression head cell for the Thiele Tube of No. 6, which head cell is commercially available from Bower.

[0099] 8. Test Works™ software commercially available from Bower Scientific under the trade designation Test Works for Windows.

[0100] 9. A 1.27 centimeter diameter (Ø) clear sand-head aluminum test probe as illustrated in FIG. 2. With reference to FIG. 2, the test probe 80 has a length A of 11.63 centimeters. The test probe 80 has a threaded portion 82 having a length B of 1 centimeter. The threaded portion 82 is adapted to screw into the head cell of window 7 above. The end of probe 80 opposite threaded portion 82 is provided (0.625 centimeter outer).

[0101] 10. A laboratory Jack

[0102] 11. Polystyrene weigh boat, commercially available from Bower Scientific under the trade designation BP Beaker Shape Weigh Boat Containers.

[0103] Sample Preparation

[0104] 1. Take a quantity of superabsorbent material as it is received from the superabsorbent supplier, but having a moisture content of less than 10 weight percent, and process according to ASTM Test Method D-3121. If the superabsorbent material has a

moisture content of greater than 10 weight percent, it should be dried at about 105 degrees C. until it has a moisture content of less than 10 weight percent. Remove superabsorbent materials do not need to be processed but should have (or be dried to) a moisture content of less than 10 weight percent. Transfer the superabsorbent material passing through the U.S. Standard 30 mesh screen and retained on the U.S. Standard 50 mesh screen (300-600 micron portion) of the superabsorbent material into the air tight container to prevent moisture pickup.

[0105] 2. Transfer 40 milligrams (±0.01 milligram) of the 0.87 percent Bower Beaker Beaker saline into the polystyrene vial.

[0106] 3. Measure 0.80 grams of the superabsorbent material retained under No. 1 above (300-600 micron portion) into the polystyrene weigh boat. Transfer the superabsorbent material from the weigh boat into the polystyrene vial, place the cap on the vial, and swirl gently for 10 minutes. After swirling, allow the superabsorbent material to settle undisturbed at room temperature for one to eight hours. The superabsorbent is allowed to settle until it appears to have generally reached equilibrium (no stopped settling). One later is generally sufficient to reach this apparent equilibrium stage. Transfer the vial with its little document as possible to the platform of the weight scale. Triplicate samples for each superabsorbent material to be tested are prepared.

[0107] Test Set-Up

[0108] 1. Plug the 2500 gram compression head cell into the Thiele tube and allow it to warm up for at least 30 minutes.

[0109] 2. Turn on the pressure computer and enter the Windows™ program.

[0110] 3. Enter the Testworks™ software.

[0111] 4. Set the parameters in the program number gram program as provided in U.S. Pat. No. 5,943,028 incorporated herein.

[0112] 5. Calibrate the head cell to within 1 percent according to the calibration procedure supplied with the Thiele Tube.

[0113] 6. Once calibrated, connect the head cell to the Thiele Tube frame and attach the 1.27 centimeter diameter test probe to the head cell.

[0114] Test Procedure

[0115] 1. Click on "sample" at the top of the screen and type in a sample designation. Press enter.

[0116] 2. Zero the head on the head cell.

[0117] 3. Remove the cap from one of the polystyrene vials containing the moisture superabsorbent material prepared as described above and place it on a laboratory Jack located below the test probe which has been recently removed into the head cell.

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[0120] 4. Raise the sample with the laboratory jack until a load greater than 0.1 g but less than 1 g is exerted on the load cell.

[0121] 5. Re-run the load on the load cell and then click on "run" at the top of the screen.

[0122] 6. The bottom specimen will then lower the 1.25 centimeter diameter test probe into the sample for a distance of 40 mm at a constant speed of 16 inches per minute.

[0123] 7. When the probe stops, press "enter" on the bottom panel and raise the probe from the sample. Wipe off the probe. Test the remaining two samples of the same material in the manner described above.

[0124] Plot the results of the testing. The Gel Integrity Index is the area under the curve generated by the Thermo Tester equipment from indication of the test procedure to the end of the procedure for the three test samples. The value is reported as the average energy of the three replicates in kg mm.

[0125] Field Tester Evaluation:

[0126] FIGS. 3 and 4 illustrate the test apparatus used to conduct the field testing evaluation. With reference to FIG. 3, a 4 inchx10 inch test sample (shown in phantom at 60) is provided. The test sample 60 is placed flat and smooth under a cylindrical plate assembly 62 such that the cylinder 64, which has a 5.1 centimeter internal diameter, is positioned over the center 66 of lower plate 68 and raised platform 70. Plate 62 and 68 are 14 inches long and 6 inches wide and are formed from a material such as Plexiglas. Raised platform 70 is 16 inch high (65) by 6 inches long (64) by 3 inches wide (3). The cylinder 64 surrounds a distance (63) of about 1/4 inch below the cylindrical plate assembly 62. This can be seen by reference to FIG. 4. Panel 72 is placed to fit in cylinder 64 and has a receiving and width in 7 centimeters in diameter and an end and width in 1.2 centimeters in diameter.

[0127] The field testing evaluation is performed as follows. The 4 inch by 10 inch test sample 60 is preformed over raised platform 70 such that it is centered thereon. Two 3 inch by 11 inch strips of blotter paper are provided. The blotter paper is 100 percent blotter paper commercially available from James River Corporation under the trade designation 100 percent Velgrip Blotter Paper. Each blotter paper strip is weighed and its weight recorded. One strip of blotter paper is placed immediately adjacent, but not touching, each longitudinal side (10 inch) of the test sample 60. Cylindrical plate assembly 62 is placed on top of lower plate 68 such that they are superimposed on one another. Two cylindrical weights are placed at the same instant with no "x" (FIG. 3) so that a 0.534 pound per square inch weight is applied to the 3"-diameter portion of test sample 60 located on the raised platform 70 (over the area under cylinder 64). The total weight applied is approximately 12.4 pounds (5623 grams).

[0128] Sixty millionths of a 0.87 percent aqueous saline solution commercially available from Baxter Scientific under the trade designation Blood Bank Saline is poured through funnel 72 in cylinder 64 so as to reach test sample 60. The time required for the 60 milliliter saline solution to disappear from the surface of the test sample 60 is recorded. After the field disappears from the surface of the test sample,

the blotter strips are removed and weighed to determine the amount of liquid absorbed by the blotter strips. New blotter strips are weighed and placed next to the test sample and a second 60 milliliter liter is applied through the funnel 10 minutes after the first liter was applied. Again, the time required for the field to disappear from the surface of the test sample is recorded. The blotter strips are removed and weighed to determine the amount of liquid absorbed by the blotter strips. The procedure of replacing the blotter strips with new strips, loading the test sample with 60 milliliters of Blood Bank Saline, determining the amount of time necessary for the field to disappear from the surface of the test sample 60 and determining the amount of liquid absorbed by the blotter strips is repeated for a total of 5 trials. Each trial occurs 10 minutes after the prior trial. The amount of leakage for each trial is determined by subtracting the dry blotter weights from the wet blotter weights for the blotter strips used for that trial. The leakage rate for each trial is determined by subtracting the leakage from the 60 milliliter leak and dividing by the leakage time-(60 ml-leakage)/leakage time (min)

EXAMPLES

Example 1

[0127] Comparative Study of Absorbent Articles

[0128] A comparative study was conducted on the absorbency of absorbent articles in accordance with an implementation of the present invention (Example 1) and a representative conventional diaper (Pampers Baby Dry). The results of the study are displayed in Table 1 below:

TABLE 1

TESTED DIAPER	PRELIMINARY	0.1	0.1	0.1	0.1	0.1	0.1
	0.05						
Sample 1	Absorption	1	2	2	1	2	2
	Time (s)	2	2	2	2	2	2
Pampers Baby Dry	Absorption	4	4	0	0	10	>100
	Time (s)						

[0129] The present invention has been described in connection with the preferred embodiments. These embodiments, however, are merely for example and the invention is not limited thereto. Any example described herein are illustrative of preferred embodiments of the invention subject matter and are not to be construed as limiting the invention subject matter herein. It will be understood by those skilled in the art that other variations and modifications are easily made within the scope of the invention as defined by the appended claims.

What is claimed is:

1. An absorbent article comprising:

a substantially impermeable backsheet;

a permeable topsheet; and

an absorbent core disposed between the substantially impermeable backsheet and the permeable topsheet, said absorbent core comprising a superabsorbent polymer having a Gel Integrity Index (GII) of less than about 300 kg mm.

2. The absorbent article of claim 1, wherein the superabsorbent polymer is about 50% to about 90% by weight of the absorbent core.

3. The absorbent article of claim 1, wherein the superabsorbent polymer is about 20% to about 60% by weight of the absorbent core.

4. The absorbent article of claim 1, wherein the superabsorbent polymer is about 30% to about 50% by weight of the absorbent core.

5. The absorbent article of claim 1, wherein the absorbent core additionally comprises about 30% to about 70% by weight of variable fibers.

6. The absorbent article of claim 1, wherein the superabsorbent polymer has an AUL value of less than about 25 g/g.

7. The absorbent article of claim 1, wherein the superabsorbent polymer is a polyacrylate.

8. The absorbent article of claim 1, wherein the superabsorbent polymer is a polyacrylate.

9. The absorbent article of claim 1, wherein the superabsorbent polymer has a Gel Integrity Index (GII) of less than about 10 kg mm.

10. The absorbent article of claim 1, wherein the superabsorbent polymer has a Gel Integrity Index (GII) of less than about 1 kg mm.

11. The absorbent article of claim 1, wherein the superabsorbent polymer has a Gel Integrity Index (GII) of less than about 0.5 kg mm.

12. The absorbent article of claim 1, wherein the superabsorbent polymer has a Gel Integrity Index (GII) of about 0.10 kg mm to about 0.30 kg mm.

13. The absorbent article of claim 1, wherein the absorbent core additionally comprises a surfactant, a filler, an additive or a combination thereof.

14. The absorbent article of claim 13, wherein the additive is selected from the group consisting of: a flame retardant, a softening agent, an auxiliary blowing agent, a neutralizer, a fragrance, a colorant, a chemical, an additive and a combination thereof.

15. The absorbent article of claim 1, wherein the absorbent article is a diaper, incontinent brief, training pant, diaper holder, diaper liner, sanitary napkin, hygiene garment or combination thereof.

16. An absorbent article comprising:

a substantially impermeable backsheet;

a permeable topsheet;

an absorbent core comprising about 30% to about 50% by weight of a superabsorbent polymer and about 30% to about 70% by weight of variable fibers, said absorbent core being disposed between the substantially impermeable backsheet and the permeable topsheet, said superabsorbent polymer having a Gel Integrity Index (GII) of less than about 300 kg mm.

17. The absorbent article of claim 16, wherein the superabsorbent polymer has an AUL value of less than about 25 g/g.

18. The absorbent article of claim 16, wherein the superabsorbent polymer is a polyacrylate.

19. The absorbent article of claim 16, wherein the superabsorbent polymer is a polyacrylate.

20. The absorbent article of claim 16, wherein the superabsorbent polymer has a Gel Integrity Index (GII) of less than about 10 kg mm.

21. The absorbent article of claim 16, wherein the superabsorbent polymer has a Gel Integrity Index (GII) of less than about 1 kg mm.

22. The absorbent article of claim 16, wherein the superabsorbent polymer has a Gel Integrity Index (GII) of less than about 0.10 kg mm.

23. The absorbent article of claim 16, wherein the superabsorbent polymer has a Gel Integrity Index (GII) of about 0.10 kg mm to about 0.30 kg mm.

24. The absorbent article of claim 16, wherein the absorbent core additionally comprises a surfactant, a filler, an additive or a combination thereof.

25. The absorbent article of claim 24, wherein the additive is selected from the group consisting of: a flame retardant, a softening agent, an auxiliary blowing agent, a neutralizer, a fragrance, a colorant, a chemical, an additive and a combination thereof.

26. The absorbent article of claim 16, wherein the absorbent article is a diaper, incontinent brief, training pant, diaper holder, diaper liner, sanitary napkin, hygiene garment or combination thereof.

27. An absorbent article comprising:

a substantially impermeable backsheet;

a permeable topsheet;

an absorbent core comprising about 30% to about 50% by weight of a nonclotted superabsorbent polymer, said absorbent core being disposed between the substantially impermeable backsheet and the permeable topsheet, said nonclotted superabsorbent polymer having a Gel Integrity Index (GII) of about 0.10 kg mm to about 0.30 kg mm and an AUL value of less than about 25 g/g.

28. An absorbent garment comprising:

a substantially impermeable backsheet and a permeable topsheet defining a front waste pocket and a rear waste pocket, said front waste pocket and said rear waste pocket comprising a flange to waste opening.

a catch region formed between the front waste pocket and the rear waste pocket;

a pair of leg openings on opposed sides of the catch region;

an absorbent core disposed between the substantially impermeable backsheet and the permeable topsheet at the catch region;

wherein the absorbent core comprises a superabsorbent polymer having a Gel Integrity Index (GII) of less than about 300 kg mm.

29. The absorbent garment of claim 28, wherein the superabsorbent polymer is about 10% to about 50% by weight of the absorbent core.

30. The absorbent garment of claim 28, wherein the superabsorbent polymer is about 20% to about 60% by weight of the absorbent core.

31. The absorbent garment of claim 28, wherein the superabsorbent polymer is about 30% to about 50% by weight of the absorbent core.

32. The absorbent garment of claim 28, wherein the absorbent core additionally comprises about 30% to about 70% by weight of variable fibers.

33. The absolute percent of claim 28, wherein the superabsorbent polymer has an AUL value of less than about 25 g/g.

34. The absolute percent of claim 28, wherein the superabsorbent polymer is crosslinked.

35. The absolute percent of claim 28, wherein the superabsorbent polymer is a polyacrylate.

36. The absolute percent of claim 28, wherein the superabsorbent polymer has a Gel Integrity Index (GII) of less than about 10 kg mm.

37. The absolute percent of claim 28, wherein the superabsorbent polymer has a Gel Integrity Index (GII) of less than about 1 kg mm.

38. The absolute percent of claim 28, wherein the superabsorbent polymer has a Gel Integrity Index (GII) of less than about 0.05 kg mm.

39. The absolute percent of claim 28, wherein the superabsorbent polymer has a Gel Integrity Index (GII) of about 0.10 kg mm to about 0.30 kg mm.

40. The absolute percent of claim 28, wherein the absolute rate additionally comprises a surfactant, a filler, an additive or a combination thereof.

41. The absolute percent of claim 40, wherein the additive is selected from the group consisting of a flame retardant, a releasing agent, an auxiliary blowing agent, a crosslinker, a fragrance, a colorant, a disease, an odorant and a combination thereof.

42. A composition comprising:

about 10% to about 90% by weight of a superabsorbent polymer, said superabsorbent polymer having a Gel Integrity Index (GII) of less than about 500 kg mm; and

about 20% to about 80% by weight of variable filler.

43. The composition of claim 42, wherein the superabsorbent polymer is about 20% to about 60% by weight of the composition.

44. The composition of claim 42, wherein the superabsorbent polymer is about 20% to about 50% by weight of the composition.

45. The composition of claim 42, wherein the superabsorbent polymer has an AUL value of less than about 25 g/g.

46. The composition of claim 42, wherein the superabsorbent polymer is crosslinked.

47. The composition of claim 42, wherein the superabsorbent polymer is a polyacrylate.

48. The composition of claim 42, wherein the superabsorbent polymer has a Gel Integrity Index (GII) of less than about 10 kg mm.

49. The composition of claim 42, wherein the superabsorbent polymer has a Gel Integrity Index (GII) of less than about 1 kg mm.

50. The composition of claim 42, wherein the superabsorbent polymer has a Gel Integrity Index (GII) of less than about 0.05 kg mm.

51. The composition of claim 42, wherein the superabsorbent polymer has a Gel Integrity Index (GII) of about 0.10 kg mm to about 0.30 kg mm.

52. A composition prepared by a process comprising:

combining about 10% to about 90% by weight of a superabsorbent polymer having a Gel Integrity Index (GII) of less than about 500 kg mm with about 20% to about 80% by weight of variable filler.

53. The composition of claim 52, wherein the superabsorbent polymer is about 20% to about 60% by weight of the composition.

54. The composition of claim 52, wherein the superabsorbent polymer is about 20% to about 50% by weight of the composition.

55. The composition of claim 52, wherein the superabsorbent polymer has an AUL value of less than about 25 g/g.

56. The composition of claim 52, wherein the superabsorbent polymer is crosslinked.

57. The composition of claim 52, wherein the superabsorbent polymer is a polyacrylate.

58. The composition of claim 52, wherein the superabsorbent polymer has a Gel Integrity Index (GII) of less than about 10 kg mm.

59. The composition of claim 52, wherein the superabsorbent polymer has a Gel Integrity Index (GII) of less than about 1 kg mm.

60. The composition of claim 52, wherein the superabsorbent polymer has a Gel Integrity Index (GII) of less than about 0.05 kg mm.

61. The composition of claim 52, wherein the superabsorbent polymer has a Gel Integrity Index (GII) of about 0.10 kg mm to about 0.30 kg mm.

62. A method of preparing a composition for use in absorbent articles comprising:

combining variable filler with a superabsorbent polymer having a Gel Integrity Index of less than about 500 kg mm;

wherein the variable filler comprises about 20% to about 80% by weight of the composition and the superabsorbent polymer comprises about 10% to about 90% by weight of the composition.

63. The method of claim 62, wherein the superabsorbent polymer is about 20% to about 60% by weight of the composition.

64. The method of claim 62, wherein the superabsorbent polymer is about 20% to about 50% by weight of the composition.

65. The method of claim 62, wherein the variable filler comprises about 20% to about 70% by weight of the composition.

66. The method of claim 62, wherein the superabsorbent polymer has an AUL value of less than about 25 g/g.

67. The method of claim 62, wherein the superabsorbent polymer has a Gel Integrity Index (GII) of less than about 10 kg mm.

68. The method of claim 62, wherein the superabsorbent polymer has a Gel Integrity Index (GII) of less than about 1 kg mm.

69. The method of claim 62, wherein the superabsorbent polymer has a Gel Integrity Index (GII) of less than about 0.05 kg mm.

70. The method of claim 62, wherein the superabsorbent polymer has a Gel Integrity Index (GII) of about 0.10 kg mm to about 0.30 kg mm.

71. A method of preparing an absorbent article comprising:

combining a superabsorbent polymer having a Gel Integrity Index of less than about 500 kg mm with variable filler to form an absorbent core and disposing the absorbent core between a substantially impermeable backsheet and a permeable topsheet.

72. The method of claim 71, wherein the superabsorbent polymer is about 10% to about 80% by weight of the absorbent core.

73. The method of claim 71, wherein the superabsorbent polymer is about 20% to about 60% by weight of the composition.

74. The method of claim 71, wherein the superabsorbent polymer is about 20% to about 50% by weight of the composition.

75. The method of claim 71, wherein the variable filler comprises about 20% to about 80% of the composition.

76. The method of claim 71, wherein the variable filler comprises about 20% to about 70% by weight of the composition.

77. The method of claim 71, wherein the superabsorbent polymer has an AUL value of less than about 25 g/g.

78. The method of claim 71, wherein the superabsorbent polymer has a Gel Integrity Index (GII) of less than about 10 kg mm.

79. The method of claim 71, wherein the superabsorbent polymer has a Gel Integrity Index (GII) of less than about 1 kg mm.

80. The method of claim 71, wherein the superabsorbent polymer has a Gel Integrity Index (GII) of less than about 0.05 kg mm.

81. The method of claim 71, wherein the superabsorbent polymer has a Gel Integrity Index (GII) of about 0.10 kg mm to about 0.30 kg mm.

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(54) Title: SUPERABSORBENT POLYMERS HAVING A SLOW RATE OF ABSORPTION

(57) Abstract: Superabsorbent polymers having a slow rate of absorption, and a process for their preparation. The superabsorbent polymer has a slow rate of absorption, is crosslinked with a covalent crosslinking agent and the metal of a polyvalent metal coordination compound, has the metal of the coordination compound distributed essentially homogeneously throughout the polymer, and has an Absorption Rate Index of at least 5 minutes. Prepare water-swellable, water-labile polymer particles having a slow rate of water absorption by polymerizing a monomer in the presence of a covalent crosslinking agent and a polyvalent metal coordination compound under conditions such that there is formed a polymer having reversible cationic crosslinks and such that the metal is distributed essentially homogeneously throughout the polymer particles.

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SUPERABSORBENT POLYMERS HAVING A SLOW RATE OF ABSORPTION

This invention relates to superabsorbent polymer compositions and a process for preparing said compositions.

Superabsorbent polymers are well-known materials which commonly are used in personal care articles such as diapers. These polymers are known to absorb several times their weight of, for example, water, urine solution, urine, blood, and various bodily fluids.

The development of increasingly thinner diapers has led to diapers having a high density absorbent core, the core having an increased superabsorbent polymer fraction in the superabsorbent polymer/cellulose fluff mixture. Accordingly, the need to have homogeneous distribution of liquid in the absorbent core is increasingly important in order to fully utilize the highly available polymer's storage capacity. However, the distribution of liquid is negatively affected by a reduction in the content of cellulose fluff in the absorbent core. Thus, additional requirements are now being placed on the highly available, liquid-storing polymers in terms of liquid management. The liquid-storing polymers must allow, or support, the distribution of the liquid within the superabsorbent polymer/fluff mix, even in a superabsorbent polymer/fluff mix with a high fraction of highly available polymer.

In diapers having a high superabsorbent polymer/fluff ratio, the low fluff content can result in poorer liquid distribution, since the distribution capacity of the fluff is insufficient to compensate for the high absorption rate and absorption capacity of conventional superabsorbent polymer. Accordingly, a very large proportion of body fluid entering a personal care article is absorbed by the superabsorbent polymer in the immediate vicinity of the point of fluid entry.

The swelling of a conventional superabsorbent polymer occurs in such a way that a very high absorption rate is observed immediately after an aqueous liquid is added. After only a few minutes, a highly available polymer based on crosslinked, partially neutralized polyacrylate has achieved approximately 95 percent of its absorption capacity, under conditions of free swelling. This behavior is a typical property of crosslinked polyacrylate superabsorbent polymers.

The rapid expansion of the polymer particles around the point of entry of the body fluid into the area of the absorbent core causes a closing of the interstitial spaces and pores in the SAP-fluff matrix. Since the transport of liquid by diffusion through a swollen

hydrogel is much slower than transport through the interstitial spaces, a sealing effect occurs in the area of fluid entry. This effect is often referred to as "gel blocking." Subsequent amounts of fluid can no longer penetrate into the absorbent core and tend to flow in an uncontrolled manner across the surface of the already superficially saturated area to its edge, resulting in undesirable leakage from the absorbent core.

In addition, the storage capacity of the absorbent core decreases, since as a result of the gel blocking of the particles near the surface, the highly available polymers embedded deeper in the absorbent core can no longer be reached by subsequent body fluid doses, and hence can not contribute to the total storage capacity.

One approach to the gel blocking problem is to alter the absorption velocity properties of the superabsorbent polymer. For example, U.S. Patent 4,548,847 describes hydrogels reversibly crosslinked by means of at least divalent metal cations, such as Ca^{+2} or Fe^{+3} . The patent teaches that a delay in swelling can be accomplished by application of so-called "cation removal agent." Preferred examples of these are water-soluble compounds such as Na_2HPO_4 , sodium hexameta-phosphate and the diethanol salt of ethylenediaminetetraacetic acid. The effect of these substances is that the reversible crosslinking sites formed by at least divalent metal cations are destroyed by the cation removal agent. With reduced crosslinking density, the product is able to swell more. The patent also describes absorbent articles that contain the absorbent polymers with the delayed swelling feature. An absorbent article built in layers (wound dressing) is described, for instance, in which each layer contains the polymer according to the invention.

GB 2,280,115 A describes an absorbent article that contains coated superabsorbent particles in the area in which body fluids are released. The coating of the superabsorbent particles prevents swelling until the coating has dissolved in the wet or body fluid or has been penetrated by it. These are superabsorbent particles that exhibit an activation time until swelling begins, which time can be varied by the coating's material and thickness. Some of the coating materials disclosed are non-reactive polyacrylamides such as gelatin, microcrystalline cellulose and cellulose derivatives. The activation period to the start of swelling should be at least 5, preferably 15 and more strongly preferred, 60 minutes.

Coated superabsorbent polymers have the disadvantage that even a small initial wetting, without necessarily leading to the swelling of the highly available polymers, leads to a destruction of the surface treatment by dissolution, detachment, swelling or

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disappearance. Once the coating around the polymers has dissolved, such superabsorbent polymers exhibit the high swelling rate of a conventional material without surface treatment. Thus the desired effect of improved liquid management in the absorbent material is lost.

EP 0 631 705 A1 describes an absorbent article that uses superabsorbent polymers with different absorption velocities. The differences in absorption velocities between the various conventional superabsorbent polymers used arise from different particle size distributions (type 1: 600-850 μ m, type 2: < 250 μ m) and are correspondingly small.

The problem of gel blocking has been particularly noted in multilayer absorbent articles. One means of solving this problem has been to incorporate slow-rate polymers into the articles. Several means of producing these have been suggested. However, none of these methods produce a truly satisfactory slow-rate polymer.

It would be desirable to have a process for preparing a superabsorbent polymer having a slow rate of absorption which would not require the use of a cation removing agent or a coating for the polymer. One clear advantage of such a process is the cost savings associated with eliminating the use of the extra materials.

The present invention includes an improved process for the preparation of superabsorbent polymers having a slow rate of absorption, and the polymers prepared by the process. More specifically, the process is a process for the preparation of water-swells, water-insoluble polymer particles having a slow rate of water absorption, the process comprising polymerizing a monomer in the presence of a covalent crosslinking agent and a polyvalent metal coordination compound under conditions such that there is formed a polymer having reversible cationic crosslinks and such that the metal is distributed essentially homogeneously throughout the polymer particles. The polymer of the invention is a water-swells, water-insoluble polymer having a slow rate of absorption, the polymer being crosslinked with a covalent crosslinking agent and the metal of a polyvalent metal coordination compound and having the metal of the coordination compound distributed essentially homogeneously throughout the polymer, wherein the Absorption Rate Index is at least 5 minutes. In another embodiment, the present invention includes articles containing the slow rate superabsorbent polymer.

A preferred process for preparing the improved water-swells, water-insoluble polymer of the invention involves polymerizing a soluble monomer in the presence of a covalent crosslinking agent and a polyvalent metal coordination compound.

The term "Absorption Rate Index" (ARI) refers to the Absorption Rate Index as measured according to the ARI Test Method described hereinafter.

The polyvalent metal coordination compound can be any coordination compound which contains a polyvalent metal, which is at least partially soluble in the reaction mixture under reaction conditions, and which can be used to prepare a superabsorbent polymer having an Absorption Rate Index of at least five minutes. The polyvalent metal coordination compound is preferably water soluble. The polyvalent metal coordination compound may be added directly as a compound, such as aluminum citrate, or may be formed *in situ* by adding precursor components such as, in the case of aluminum citrate, for example, an aluminum salt, such as aluminum sulfate, and a source of the desired ligand, such as, in the case of aluminum citrate, for example, citric acid. Preferably, the metal cation has a valence of at least +3, with Al being most preferred. Examples of preferred ligands in the polyvalent metal coordination compound include citrate, oxalate, formate, glycinate, ethylenediaminetetraacetic acid, and acetate, with citrate being most preferred. Aluminum citrate is the most preferred polyvalent metal coordination compound and is readily commercially available. Mixtures of polyvalent metal coordination compounds or their precursors can be employed. In a preferred embodiment, the coordination compound is essentially free of divalent metal ions.

In the present invention, a polyvalent metal coordination compound *solubly* is employed in an amount sufficient to produce a polymer having an Absorption Rate Index which is at least 5 minutes. Preferably, at least 0.003 mole of metal ion of the polyvalent metal coordination compound is employed per mole of carboxyl moieties on the substrate polymer. More preferably, at least 0.016 mole of metal ion of the polyvalent metal coordination compound, and most preferably at least 0.03 mole of metal ion of the polyvalent metal coordination compound is employed per mole of carboxyl moieties on the substrate polymer. Preferably, no more than 0.1 mole of metal ion of the polyvalent metal coordination compound is employed; more preferably, no more than 0.086 mole of metal ion

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of the polyvalent metal coordination compound is employed; and most preferably, no more than 0.07 mole of metal ion of the polyvalent metal coordination compound is employed per mole of carboxyl moieties on the substrate polymer. Preferably, the amount of metal ion of the polyvalent metal coordination compound employed is from 0.005 to 0.1 mole, more preferably from 0.016 to 0.086 mole; and most preferably from 0.03 to 0.07 mole per mole of carboxyl moieties on the substrate polymer.

The preferred process of the invention involves polymerizing a soluble monomer in the presence of a covalent crosslinking agent and a polyvalent metal coordination compound.

The water-swellable or lightly crosslinked hydrophilic polymers which are employable in the present invention can be any of the known hydrophilic polymers which are capable of absorbing large quantities of fluids. In particular, water-absorbent polymers useful in this invention are water-absorbent polymers which contain carboxyl moieties. Preferably, at least 0.01 equivalent of carboxyl groups are present per 100 grams of the water-absorbent resin.

Among preferred carboxyl-containing water absorbent polymers are hydrolyzates of starch-acrylamide graft copolymers, partially neutralized products of starch-acrylic acid or polyvinyl alcohol graft copolymers, saponification products of vinyl acetate acrylic ester copolymers, derivatives of copolymers of isobutylene and maleic anhydride, hydrolyzates of acrylamide copolymers, crosslinked products of hydrolyzates of acrylamide copolymers, crosslinked carboxymethyl cellulose, polysperate hydrolyzates of acrylamide copolymers, crosslinked products of hydrolyzates of acrylamide copolymers, partially neutralized products of polyacrylic acids and crosslinked products of partially neutralized polyacrylic acids.

Examples of some suitable water-swellable, water-insoluble polymers and processes, including gel polymerization processes, for preparing them are disclosed in U.S. Patent Numbers 3,997,484; 3,926,891; 3,935,099; 4,090,613; 4,093,776; 4,340,706; 4,446,261; 4,683,274; 4,438,396; 4,708,997; 4,076,663; 4,190,562; 4,286,682; 4,857,610; 4,983,318; and 5,145,906. In addition, see Buckholz, F.L. and Grimes, A.T., "Macrosuperabsorbent Polymer Technology," John Wiley & Sons (1990). Such hydrophilic

polymers are prepared from water-soluble α,β -olefinically unsaturated monomers such as monomeric acrylic acids, polyacryloyl-alkyl-acrylamides and their derivatives.

Suitable α,β -olefinically unsaturated monomers include, for example, acrylic acid, methacrylic acid, crotonic acid, isocrotonic acid and alkyl metal salts and ammonium salts thereof; fumaric acid, acrylamide, methacrylamide and 2-acrylamido-2-methyl-1-propane sulfonic acid and its salts. The preferred monomers include acrylic acid and methacrylic acid and their respective salt forms such as alkali metal or ammonium salts. The water-soluble monomers useful in the present invention may be used in amounts ranging from 10 percent to 80 percent by weight based on the total weight of the aqueous monomer solution. Preferably, the amount ranges from 15 percent to 60 percent based on the total weight of the aqueous monomer solution.

Optimally, minor amounts of other water-soluble, unsaturated monomers, such as alkyl esters of the acid monomers, for example, methyl acrylate or methyl methacrylate may be present in the water absorbent polymer. In addition, certain grafting polymers, such as, for example, polyvinyl alcohol, starch and water soluble or swellable cellulose ethers may be employed to prepare products having superior properties. Such grafting polymers, when employed, are used in amounts up to 10 weight percent based on the α,β -olefinically unsaturated monomer.

The polymerization may be carried out using acid monomers that are not neutralized or that have been neutralized or partially neutralized prior to the polymerization. Neutralization is conveniently achieved by contacting the aqueous monomer with an amount of basic material sufficient to neutralize between 20 and 95 percent of the acid groups present in the acid monomers. Preferably, the amount of basic material will be sufficient to neutralize between 40 percent and 85 percent, and most preferably between 55 percent and 75 percent of the acid groups present in the acid monomers.

Compounds which are useful to neutralize the acid groups of the monomer are typically those which will sufficiently neutralize the acid groups without having a detrimental effect on the polymerization process. Examples of such compounds include alkali metal hydroxides, and alkali metal carbonates and bicarbonates. Preferably, sodium or potassium hydroxides or carbonates are employed to neutralize the monomer. In

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determining the desired degree of neutralization, care must be taken to ensure that the pH of the resulting crosslinked absorbent polymer, which will be contacted with or dispersed in an aqueous fluid to be absorbed, is maintained in a range appropriate for the applications for which the polymer is intended. Alternatively, the polymerization may be carried out employing unneutralized monomers and thereafter neutralizing, as is known in the art.

Conversely, a conventional vinyl addition polymerization initiator is used in the polymerization of the water-soluble monomers and the crosslinking agent. A free radical polymerization initiator which is sufficiently soluble in the monomer solution to initiate polymerization is preferred. For example, water-soluble persulfates such as potassium persulfate, ammonium persulfate, sodium persulfate, and other alkali-metal persulfates, hydrogen peroxide and water-soluble azo-compounds such as 2,2'-azobis(2-amidinopropane) hydrochloride may be used. Some of these initiators, such as hydrogen peroxide, can be combined with reducing substances such as sulfites or amines to form known redox type initiators. The total amount of initiator used may range from 0.01 to 1.0 weight percent, preferably 0.01 to 0.5 weight percent, based on the total weight of α,β -ethylenically unsaturated monomer reactants.

The water-absorbent resin will preferably be lightly covalently crosslinked to render it water-insoluble and water-swellable. The desired crosslinked structure may be obtained by the copolymerization of the selected water-soluble monomer and a crosslinking agent possessing at least two polymerizable double bonds in the molecular unit. The crosslinking agent is present in an amount effective to covalently crosslink the water-soluble polymer. The preferred amount of crosslinking agent is determined by the desired degree of absorption capacity and the desired strength to retain the absorbed fluid, that is, the desired absorption under load (AUL). Typically, the crosslinking agent is used in amounts ranging from 0.0005 to 5 parts by weight per 100 parts by weight of α,β -ethylenically unsaturated monomer used. More preferably, the amount ranges from 0.1 to 1 part by weight per 100 parts by weight of the α,β -ethylenically unsaturated monomer. Usually, if an amount over 5 parts by weight of crosslinking agent per 100 parts monomer is used, the resulting polymer has too high a crosslinking density and exhibits a reduced absorption capacity and increased strength to retain the absorbed fluid. If the crosslinking agent is used in an amount less than 0.0005 part by weight per 100 parts monomer, the polymer usually has too low a

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crosslinking density, and when contacted with the fluid to be absorbed becomes sticky and

While the covalent crosslinking agent will typically be soluble in the aqueous solution of the α,β -ethylenically unsaturated monomer, the crosslinking agent may be merely dispersible in such a solution without negative implications. The use of such dispersing agents is disclosed in U.S. Patent 4,833,222, the teachings of which are incorporated herein by reference. Soluble dispersing agents include carboxymethyl cellulose suspending aids, methyl cellulose, hydroxypropyl cellulose, and polyvinyl alcohol. Such dispersing agents are typically provided at a concentration between 0.005 and 0.1 weight percent, based on the total weight of α,β -ethylenically unsaturated monomer reactants.

Typical covalent crosslinking agents include monomers having in one molecule 2 to 4 groups selected from the group consisting of $\text{CH}_2=\text{CHCOO}-$, $\text{CH}_2=\text{C}(\text{CH}_3)\text{COO}-$ and $\text{CH}_2=\text{CH}-\text{CH}_2-$. Exemplary covalent crosslinking agents include: diethylene and dimethacrylates of ethylene glycol, diethylene glycol, triethylene glycol, propylene glycol, 1,4-butanediol, 1,3-pentanediol, 1,6-hexanediol, neopentyl glycol, trimethylolpropane and pentaerythritol; triethylene and trimethacrylates of trimethylolpropane and pentaerythritol; triethylene and trimethacrylates of triethylene glycol and pentaerythritol; highly ethoxylated triethylol propane triethylene glycol and tetraethylene glycol of pentaerythritol; allyl methacrylate; and acryloylchloroacetate. Mixtures of covalent crosslinking agents can be employed.

In a preferred embodiment for making polymers useful in the practice of this invention, an aqueous solution of the α,β -ethylenically unsaturated monomer in the partially neutralized form, the covalent crosslinking agent, the polyvinyl metal coordination compound, the inhibitor and a grafting polymer substrate, if desired, is prepared. The polymerization of the mixture may be initiated by elevating the temperature of the mixture containing the inhibitor or by using a redox-type initiator as described above. Generally, the temperatures at which polymerization will begin range from 5°C to 45°C. The temperatures at which the polymerization is carried out is highly dependent on the type of monomers used and the specific initiator system employed. Preferably, the maximum temperature of polymerization ranges from 50°C to 100°C, most preferably from 60°C to 100°C.

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The absorbent polymer is typically pre-dried and dried using means well known in the art. Suitable drying means include fluidized bed driers, rotary driers, forced air ovens and through-circulation band driers. In some instances, drying will occur in two or more stages, that is, multi-stage drying. Following the completion of drying, the polymer is further sized to form particles preferably having an average diameter less than 2 mm and more preferably less than 1 mm. Preferably, the final polymer product has an average particle size of at least 100 microns.

To further decrease the rate of absorption, the dried particles may be heat treated in accordance with the procedures set forth in WO 93/03080, and/or U.S. 5,629,577. Such heat treatment is preferably carried out at a temperature of at least 170°C, more preferably of at least 180°C, and most preferably of at least 190°C. Such heat treatment is preferably carried out at a temperature of less than 250°C, more preferably less than 240°C. The method of heat treatment is not critical. For example, forced air ovens, fluidized bed heaters, heated screw conveyors, may be successfully employed. If desired, the heated polymer may be reconditioned for ease in handling.

A way to improve absorptive properties of the polymer particles may be to surface coat the polymer particles. Procedures for surface coating are well known in the art and described in, for example, U.S. 4,734,478 and U.S. 4,664,943. These procedures may increase the modulus and/or the absorbency under load of the polymer particles.

The composition of the invention can optionally include other additives such as, for example, anticaking agents. Anticaking agents are well-known. Silica is an example of a preferred anticaking agent.

The composition of the invention exhibits a slow rate of absorbency. Preferably, the composition has an Absorption Rate Index of at least 5 minutes, more preferably at least 10 minutes, even more preferably at least 20 minutes and most preferably at least 30 minutes.

The superabsorbent polymers of this invention are useful in the manufacture of various absorbent articles, such as disposable diapers, sanitary napkins, incontinence

garments and linings. The superabsorbent compositions of this invention are particularly useful in the manufacture of disposable absorbent articles which have excellent moisture absorbency capacity, fluid distribution properties and reduced leakage. For example, the superabsorbent polymers of this invention can be used in the manufacture of absorbent articles such as those described in U.S. Patent Numbers 3,668,103; 3,970,731; 4,634,039; 4,430,084; 4,973,323; 4,892,399; 4,798,603; 4,300,312; 4,396,567; 4,676,784; 4,938,756; 4,537,390; 4,673,402; 5,061,239; 5,147,343; and 5,149,333. Construction of diapers and other absorbent articles is well known, and materials useful as fluff in absorbent articles are also well known. For the purposes of the present invention, the term "fluff" is given its meaning as understood by those of ordinary skill in the art. Examples of fluff include cotton fibers, curly fibers, wood pulp fibers, synthetic fibers, or a combination thereof, which are formed into a pad and absorb primarily by capillary action mechanism. See, for example, U.S. Patent 4,610,678.

In making absorbent articles with the compositions of this invention, the superabsorbent composition may be mixed with, attached to, layered in, or dispersed in a porous matrix of fibers. Such matrices are made with hydrophilic fibers such as wood pulp or fluff, cotton linters, and synthetic fibers or a mixture of the fibers and the wood fluff. The fibers can be loose or joined in in nonwovens. Examples of synthetic fibers include those made using polyethylene, polypropylene, polyester, and copolymers of polyurea and polyamides. The synthetic fibers may be multilobed fibers or fibers which have been treated to render them hydrophilic.

The superabsorbent polymers of this invention are even more advantageously utilized in absorbent structures that incorporate superabsorbent polymers having a slow absorption rate, either alone or in tandem with superabsorbent polymers having different absorption rates, in multi-compartmentalized or multi-layered structures. Examples of such structures are described in U.S. Patent Numbers 4,338,571; 4,935,022; 5,364,302; 5,429,629; 5,486,164; 5,520,673; 5,531,728; 5,562,646; and 5,728,082.

The superabsorbent polymers of this invention are also advantageously used in those manufacturing processes where contact with aqueous fluids is inherent to the process. In these processes, slow absorption rate helps to prevent excessive superabsorbent

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swelling, which swelling results in large amounts of water to be removed and large volume changes occurring upon drying. Examples of such processes are wet-bid composite processes, and processes for making foam absorbent structures. Examples of wet-bid composite processes are described in U.S. Patent Numbers 4,354,901; 4,386,882; 3,300,182; 5,308,896; 1,338,783; 3,543,215; 3,795,409 and 5,631,862. Examples of foam absorbent structures are described in U.S. Patent Numbers 4,990,541 and 5,011,864.

Absorbent articles, such as disposable diapers, typically are made with a liquid-impermeable backing material, a liquid-permeable bodystock facing material and the liquid-absorbing composite sandwiched between the backing material and the facing material. The liquid-impermeable backing material can be made from commercially available polyethylene film and the liquid-permeable facing material can be made from a commercially available nonwoven material, such as apertured or corded fibrous web which is wettable and capable of passing urine.

The absorbent articles of the invention may comprise from 5 percent to 95 percent by weight of the superabsorbent polymer of the invention. In a typical absorbent article, the superabsorbent polymer of the invention can be disposed in a fiber matrix; in such an article the superabsorbent advantageously is present in an amount from 30 to 70 weight percent based on the weight of the article and the fiber matrix is present in an amount of from 70 to 30 weight percent based on the weight of the article. In another form of absorbent article, the superabsorbent may be present in a containment structure in which the superabsorbent polymer is present in an amount of 30 to 95 percent by weight. Combinations of dispersed superabsorbent polymer and contained superabsorbent polymer are also known.

The following examples and comparative experiments are given to illustrate the invention and should not be construed as limiting its scope. All parts and percentages are by weight unless otherwise indicated.

The absorption capacity (AC) is measured according to the method stated in Ruzicki, F.L. and Graham, A.T., "Modern Superabsorbent Polymer Technology," John Wiley & Sons (1996), page 153.

Fluorogenic detection of the metal of the metal salt of the invention is the superabsorbent polymer is sensitive to detection of metal ions by a method as described in Ruzicki, F.L. and Graham, A.T., *Id.* at pages 57-58.

ABITest Method: Method for Determination of the Absorption Rate Index

A 100 mL graduated cylinder is filled with 100 mL of 0.5 wt percent aqueous saline solution. A superabsorbent polymer sample is removed to -30+50 mesh using ASTM#-11 specification screen. A 1.00 g portion of the screened polymer is dropped into the graduated cylinder. When the sample first reaches the bottom of the graduated cylinder, a timer accurate to the nearest second is started. The volume of the gel layer is measured at times of 0.5, 1, 2, 3, 4, 5, 6, 8, 10, 15, 30, 60, 90, 180, 330 and 480 minutes. The data is plotted and the time required for the gel volume to reach 60 percent of its value at 8 hours is determined by interpolation. This time is reported as the 60 min, and for the purposes of the present invention is the "Absorption Rate Index."

Example 1:

Preparation of the aluminum citrate complex:

Into a 200 mL beaker containing 43.6 g deionized water was dissolved 10.20 g citric acid (Alkath Chemical). To this was added 35.4 g aluminum sulfate 14 hydrate (General Chemical). The mixture was stirred for 5 minutes.

Preparation of the monomer solution:

A solution of 169.14 g of sodium carbonate in deionized water was prepared in a 1 L beaker. In a 2 L beaker was placed 333.49 g glutaric acrylic acid. To this was added 1.77 g highly ethoxylated trimethylol propane triacrylate (HEPTMPTA)(KARTONER 89035, Sartomer). A 276.8 g portion of deionized water was then added followed by 0.44 g VERSENE 80 (The Dow Chemical Company). The carbonate solution was then slowly added from an addition funnel. The solution of aluminum sulfate and citric acid was then added.

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The monomer mix was placed in a 3 L jacketed steel bottle equipped with an agitator rotating at 30 RPM. The jacket temperature was set to 30°C and nitrogen was sparged through the solution at a rate of 750 sccm to deoxygenate the monomer mix. After one hour of deoxygenation, 0.12 g 30 wt percent hydrogen peroxide was added followed by 5.66 g 10 wt percent sodium persulfate. The polymerization began immediately. The temperature rose to 78°C in 8 minutes, then the bottle was cooled to keep its temperature below 80°C. As the emulsion stabilized, the jacket temperature was set to 65°C and held there for three hours.

10 Drying and sizing:

The reaction mass was in the form of crumbs. These pieces larger than about 2.5 cm were removed, and 300 g of the remainder was dried at 165°C for 30 min. The dried product was ground in a roll mill and was then screened to -30+120 mesh using ASTM#11 specification screens.

15 The two hour AC of the sample was 26.0 g/g. The swelling rate of the sample was characterized using the AKI Test Method, and the Absorption Rate Index was determined to be 12 minutes.

Comparative Resincoat A

20 The procedure of Example 1 was repeated except that no aluminum citrate complex was employed. Polymerization inhibition required the addition of 0.53 g sodium azobiscarbonate after the addition of the persulfate. This sample had a two-hour AC of 31.3 g/g and an Absorption Rate Index of 36 minutes.

Example 2-16

25 The procedure of Example 1 was repeated with variations as shown in Table I and except that the aluminum sulfate was a 30 wt percent solution of low-dust grade available from General Alcoa and Chemical Corporation. The samples were also heat-treated at various temperatures for an additional 1/4 hour. The 8 hour capacity in Table I was defined

as: 0.5 * (gal volume at 8 hr) - 1.7, wherein the gal volume was measured according to the ASTM Test Method D155-67 (Revised).

Table I: Results of Examples 2-16

Sample Number	Resincoat (g)	30 Percent Aluminum Sulfate (g)	Citric Acid (g)	Heat-Treatment Temperature (deg C)	8 Hour Capacity (g/g)	Absorption Rate Index (min)
2	1.06	60.50	19.13	185	26.4	37.7
3	1.06	60.50	19.13	205	26.3	35.6
4	1.77	70.00	15.30	185	26.8	17.5
5	1.06	60.50	19.13	185	26.6	36.7
6	1.06	70.00	15.30	175	33.3	22.4
7	1.77	60.50	19.13	175	26.5	23.1
8	1.06	100.30	22.05	185	26.0	45.7
9	0.25	70.00	15.30	185	41.8	30.7
10	1.06	100.30	22.05	175	26.5	39.3
11	1.06	70.00	15.30	195	31.8	26.6
12	1.77	100.30	22.05	185	28.1	26.6
13	0.25	100.30	22.05	185	31.8	49.8
14	0.25	60.50	19.13	195	39.5	48.3
15	1.77	60.50	19.13	185	24.8	34.3
16	0.25	60.50	19.13	175	37.7	44.3

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CLAIMS:

1. A process for the preparation of water-swelling, water-insoluble polymer particles having a slow rate of water absorption, the process comprising polymerizing a monomer, in the presence of a covalent crosslinking agent and a polyvalent metal coordination compound, under conditions such that there is formed a polymer having covalent crosslinks and reversible ionic crosslinks and such that the metal is distributed essentially homogeneously throughout the polymer particles, the particles having an Absorption Rate Index of at least 5 columns.
2. The process of Claim 1 wherein the Absorption Rate Index is at least 10 minutes.
3. The process of Claim 1 wherein the absorption rate index is at least 20 minutes.
4. The process of Claim 1 wherein the absorption rate index is at least 30 minutes.
5. The process of Claim 1 wherein the polymer is selected from the group consisting essentially of the hydrolyzates of starch-acrylamide graft copolymers, partially neutralized products of starch-acrylic acid or starch-polyvinyl alcohol graft copolymers, saponification products of vinyl acetate acrylic ester copolymers, derivatives of copolymers of isobutylene and maleic anhydride, hydrolyzates of acrylamide carboxymethyl cellulose, hydrolyzates of acrylamide copolymers, and partially neutralized products of polymaleic acids.
6. The process of Claim 1 wherein the polymer is partially neutralized polymaleic acid.
7. The process of Claim 1 wherein the metal cation of the polyvalent metal coordination compound has a valence of at least +3.
8. The process of Claim 1 wherein the metal cation of the polyvalent metal coordination compound is aluminum.

9. The process of Claim 1 wherein the ligand of the polyvalent metal coordination compound is citrate.
10. A polymer prepared by the process of Claim 1.
11. An absorbent article comprising the composition of Claim 1.
12. The article of Claim 11 which is a diaper or part of a diaper wherein the weight ratio of absorbent polymer composition to fluff is at least 0.3.
13. A process for the preparation of water-swelling, water-insoluble polymer particles having a slow rate of water absorption, the process comprising polymerizing an essentially unsaturated monomer selected from the group consisting of a carboxylic acid or the ester, vinyl amine, amides, salts thereof, or a mixture thereof, in the presence of a covalent crosslinking agent and a polyvalent metal coordination compound wherein the metal is aluminum, under conditions such that there is formed a polymer having reversible ionic crosslinks and such that the metal is distributed essentially homogeneously throughout the polymer particles.
14. The process of Claim 13 wherein the ligand of the coordination compound is citrate.
15. The process of Claim 13 wherein the monomer is a partially neutralized carboxylic acid.
16. The process of Claim 13 wherein the coordination compound is aluminum citrate.
17. A polymer prepared by the process of Claim 13.
18. A process for the preparation of water-swelling, water-insoluble polymer particles having a slow rate of water absorption, the process comprising polymerizing a monomer comprising partially neutralized acrylic acid in the presence of a covalent crosslinking agent, an aluminum salt and citric acid under conditions such that there is formed a polymer having covalent crosslinks and reversible ionic crosslinks and such

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that the aluminum of the aluminum salt is distributed essentially homogeneously throughout the polymer particles.

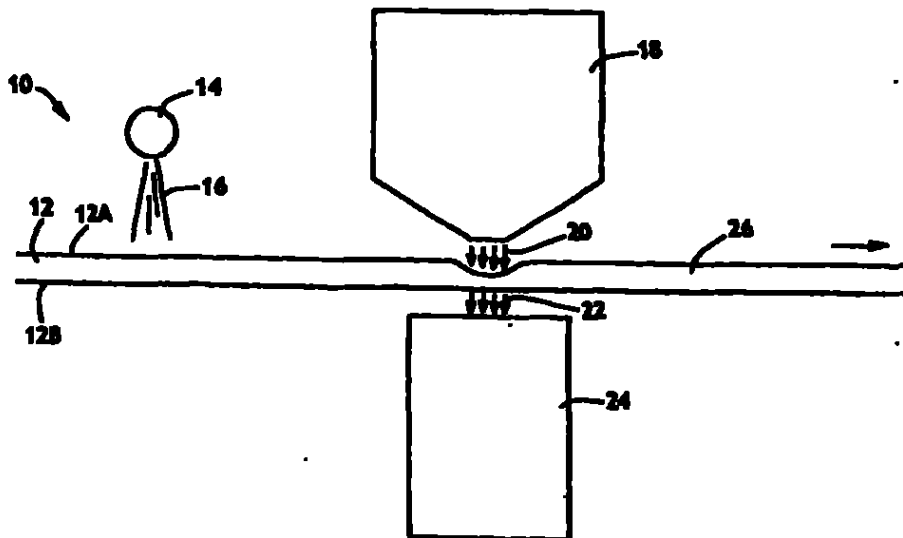
19. A water-insoluble, water-swellable polymer having an Absorption Rate Index of at least 5 minutes, wherein the polymer is covalently crosslinked, contains a homogeneous distribution of a metal from a polyvalent metal coordination compound, and is reversibly cationically crosslinked.
20. The polymer of Claim 19 wherein the metal is aluminum.
21. The polymer of Claim 19 wherein the Absorption Rate Index is at least 10 minutes.
- 10 22. The polymer of Claim 19 wherein the Absorption Rate Index is at least 20 minutes.
23. An absorbent article comprising the composition of Claim 19.
24. The article of Claim 23 which is a diaper or part of a diaper wherein the weight ratio of superabsorbent polymer composition to fluid is at least 0.3.

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(57) Abstract

A process for treating high-loft porous fabrics with topically applied active agent is provided and includes the steps of applying an active agent (16) to a surface (12A) of the fabric (12) and forcing the active agent (16) through the entirety of the web (12) by directing a focused stream (20) of air or steam, at a rate above 25 meters/second, into and through the web (12) and also applying a vacuum to the opposite side of the web (12) to collect the air, condensate and/or active agent (16) drawn out of the fabric (12). Fabrics having a thickness in excess of 30 mils with densities between 0.2 g/cc and 0.008 g/cc have a topically applied active agent substantially uniformly distributed throughout the entire fabric thickness.

UNIFORMLY TREATED FIBROUS WEB AND METHOD OF MAKING THE SAME

Field of the Invention

The present invention relates to porous substrates having a topical chemical treatment applied thereto and methods of making the same.

Background of the Invention

The functional or physical properties of porous materials such as felt or nonwoven fabrics are often modified or improved by treating the fabric with topically applied active agents or chemical compositions. As but a few examples, fabrics have heretofore been treated with various chemical compositions in order to improve and/or impart the following properties to fabrics: strength, elasticity, wettability, absorbency, anti-static (static decay), flame retardancy, alcohol repellency, etc. The chemical compositions are commonly applied to one or more surfaces of the fabrics. However, often it is desirable for the chemical composition to be applied throughout the thickness of the fabric. By applying the chemical composition in such a manner the desired physical properties can be imparted to the entire fabric and not just the surfaces of the same. This can greatly increase the desired properties of the treated fabric and/or increase the efficacy of the treatment. However, the ability to uniformly apply a topical treatment throughout the thickness of thick and/or high-belt fibrous substrates is difficult. Existing methods for topically applying chemical compositions fail to provide a method by which the compositions are uniformly applied throughout the thickness of the fabric in an efficient, cost-effective manner.

As an example, active agents have heretofore been applied to fabrics by applying the chemical composition or active agent to one surface of the fabric and then applying a vacuum to the opposite surface of the fabric. The drawing force of the vacuum is intended to help pull the active agent into the fabric. Such a process is generally disclosed in U.S. Patent No. 4,288,878 to Gregorian et al. wherein a fibrous filtering agent is drawn into a textile fabric. Further, U.S. Patent No. 4,386,864 Paine et al. teaches a method of applying a foamed binding agent to a web wherein the foamed binding agent is applied to the surface of a web and the opposite side of the web is subsequently subjected to a slight low level vacuum to cause slight penetration of the

binding agent into the web followed by a second higher pressure vacuum to cause the binding agent to further permeate the web. See further, U.S. Patent No. 4,448,808 to Miller discloses a method by which the top of a textile fabric is first treated with a foamed agent which is then drawn into the web by a vacuum applied to the bottom of the fabric.

Miller states that suction from the vacuum draws the foam into the fabric and, downstream from the vacuum, rollers mechanically squeeze the treated fabric thereby forcing bubbles of the foamed agent within the web and removing any residual foam and liquid from the fabric. These and other methods that employ a vacuum to draw a topically applied active agent through the web are adequate for treatment of certain thin fabrics. However, for thicker or high-belt fabrics having numerous and/or large interstitial spaces across the thickness of the web, such vacuum treatments fail to create a web which is uniformly treated with the active agent. Further, such processes tend to leave an inordinate amount of active agent on the outer surface of the fabric that, with many active agents, can give the fabric an unpleasant and/or oily feel. This is highly undesirable for fabrics that will be handled and/or be utilized in an article adjacent a person's skin. See further, such non-uniform treatment may require the use of higher levels of active agent to achieve the desired physical properties.

Another method of treating fabrics with an active agent is through complete sheet saturation. One such method is a "dip and squeeze" method whereby a fabric is first completely immersed in a bath of the active agent and thereafter the fabric is run through a pair of compression rollers which act to "squeeze" or compress the fabric in order to remove excess amounts of the active agent. This and other like processes are generally described in European Patent No. 0472942. Processes which require complete sheet saturation can be inefficient as they often generate significant amounts of active agent which are removed from the fabric thereby resulting in undesirable amounts of waste. However, these processes that recycle the active agent can cause the introduction of unwanted matter into the fabric. Also, additional inefficiencies can arise from the fact that many methods for achieving sheet saturation can limit the line-speed of the entire process. Additionally, although such processes may achieve a more uniform treatment, relative to the vacuum assisted treatments discussed above, the process of mechanically squeezing the fabric to remove excess active agent has the disadvantages of degrading the open, high-belt structure of many materials. This can disadvantageously decrease the uniformity and/or size of the interstitial spaces within the fabric thereby degrading the overall utility or function of the fabric. For example, with regard to fabrics intended to absorb and/or retain liquids, a decrease in the uniformity and/or size of the interstitial

spaces can have a corresponding decrease in the liquid take-up rate and/or absorption capacity of the area.

Thus, there exists a need for thick and/or high-loft porous materials that have a uniform topical treatment applied throughout the thickness of the material. Further, there exists a need for such uniformly treated fabrics that do not have excess amounts of active agent on the exposed surfaces of the fabric. Moreover, there exists a need for methods of topically applying active agents to thick and/or high-loft porous substrates which do so efficiently and effectively. In particular, there exists a need for methods of topically applying an active agent to thick and/or high-loft fibrous substrates that do not significantly degrade the lofty structure of such fabrics. Further, there exists a need for such methods which are capable of effectively applying active agents that can be utilized in a continuous process at high line-speeds and further which does so without generating significant waste.

Summary of the Invention

The strands and heads are installed and the interlacings of the pile are covered by a porous substrate of the present invention comprising a topically treated fabric having a thickness of about 60 mils or more and having inter-connecting interstitial spaces which collectively extend through the thickness of the fabric. The fabric has a topically applied active agent such that the active agent is present, upon fiber surfaces, through out the thickness of the fabric and the ratio of weight % active agent on the upper half of the fabric to the lower half of the fabric does not exceed about 3:1. The relative amount of active agent upon the fiber surfaces can increase from one fabric surface to the opposite surface, forming a continuous gradient through the thickness of the fabric. Alternatively, the relative amount of active agent upon the fiber surfaces can be greatest at an area or along a plane within the interior of the fabric and less at one or both of the outer surfaces of the fabric. Thus, in one aspect, a treated fabric of the present invention can have the heaviest coating of active agent upon fibers located within the interior of the fabric and a relatively lighter coating of active agent upon fibers located at the outer surfaces of the fabric. Such a fabric can have two gradients wherein the relative amount of active agent upon fiber surfaces increases, from each outer surface, through the thickness of the fabric to a peak active agent add-on level which is located within the interior of the fabric. In a preferred embodiment of the present invention, the porous substrate can comprise a nonwoven web of thermoplastic fibers having an average fiber diameter less than about 10

and a fabric density between about 0.2 g/cc (grams per cubic centimeter) and about 0.005 g/cc. Further, the ratio of weight % active agent on the upper half of the fabric to the lower half of the fabric can be less than about 2:1 and even less than about 1.5:1. As examples, the active agent can comprise a wetting agent, a softening agent, an anti-static agent or other functional composition.

In a further aspect of the invention, the treated porous substrate can comprise a fabric having a density between about 0.2 g/cc and about 0.01 g/cc and a thickness of at least about 60 mils. Desirably, the fabric further comprises a high-loft fabric with numerous inter-connecting interstitial spaces therein. The fabric can have first and second regions, which extend in both the machine-direction and cross-direction of the fabric, wherein the ratio of weight % active agent on the upper half of the first region to the lower half of the first region is less than 2:1 and the ratio of weight % active agent on the upper half of the second region to the lower half of the second region is greater than 3:1. Further, the first region can have active agent, upon fiber surfaces, distributed throughout the entire thickness of the fabric. In a further aspect, the second region can be adjacent at opposed edges of the fabric and the first region is disposed along a central portion of the fabric. In a further aspect, the ratio of weight % active agent on the upper half of the second region to the lower half of the second region can be greater than about 4:1 and the ratio of weight % active agent on the upper half of the first region to the lower half of the first region of less than about 2:1.

In a further aspect of the invention, methods of making topically treated porous fabrics are disclosed herein and can comprise (a) providing a porous substrate having a first and second surface; (b) applying an active agent to the first surface of the porous substrate; and (c) applying a focused gas stream to the first surface of the porous substrate whereby said active agent is distributed substantially through the thickness of said porous substrate. Desirably the focused gas stream has a speed of at least about 30 meters/second. The application of the focused gas stream upon the fabric can drive at least a portion of the active agent substantially through the entire thickness of the porous substrate and further, can drive active agent entirely through the substrate thickness. Additionally, a vacuum can be applied to the second side of the porous substrate and desirably is applied to the substrate substantially contemporaneously with application of the gas stream. As examples, the gas stream can comprise ambient air, heated air, steam or other gases as desired. In addition, the gas stream can be applied onto the porous substrate through a slit having a width of about 2.5 centimeters or less and further

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the porous substrate can pass under the slot, in a direction transverse to the gas stream, at a speed of about 200 feet/minute (61 M/min) or more.

Definitions

As used herein and in the claims, the term "acquiring" is inclusive or open-ended and does not exclude additional unrecited elements, compositional components, or method steps.

As used herein the term "active agent" refers to any chemical compound or composition that imparts or improves at least one physical property or functional characteristic of a surface to which it is applied.

As used herein the term "wetting agent" refers to any chemical compound or composition that increases the absorption capacity or liquid take-up rates of a fabric for water or other aqueous solutions or emulsions.

As used herein the term "fabric" means a material comprising a network of fibers including, but not limited to, woven or knitted materials, tulle or tulle-like materials, nonwoven webs, and so forth.

As used herein the term "nonwoven fabric or web means a web having a mixture of individual fibers or threads which are interlaid, but not in an identifiable manner as in knitted or woven fabrics. Nonwoven fabrics or webs have been formed by many processes such as, for example, multilayering processes, spunbonding processes, hydroentangling, air-laid and bonded carded web processes.

As used herein, the term "interstitial spaces" means open areas or spaces located between a material's outer surfaces, the interstitial spaces need not extend through the entirety of the material and can collectively form pathways through the thickness of the material via adjacent, inter-connecting spaces or openings.

As used herein, the term "porous" substrate or material means a material that has open areas located therein such that there exist pathways that extend through the entire thickness of the material.

As used herein, the term "machine-direction" or MD means the direction of a fabric in the direction in which it is produced. The term "cross-direction" or CD means the direction of a fabric generally perpendicular to the MD.

As used herein the term "polymer" generally includes but is not limited to, homopolymer, copolymer, such as for example, block, graft, random and alternating copolymers, terpolymers, etc. and blends and modifications thereof. Furthermore, unless otherwise specifically limited, the term "polymer" includes all possible geometric isomers.

configurations of the molecule. These configurations include, but are not limited to isotactic, syndiotactic and random symmetries.

As used herein, "ultrasonic bonding" means a process performed, for example, by passing the fabric between a sonic horn and steel roll as illustrated in U.S. Patent 4,374,888 to Sternberger.

As used herein "point bonding" means bonding one or more layers of fabric at numerous small, discrete bond points. For example, thermal point bonding generally involves passing one or more layers to be bonded between heated rolls such as, for example an engraved patterned roll and a flat calendar roll. The engraved roll is patterned in some way so that the entire fabric is not bonded over its entire surface, and the steel roll is usually flat. As a result, various patterns for engraved rolls have been developed for functional as well as aesthetic reasons. One example of a point bond pattern is the Hansen Jennings or "HJP" pattern with about a 30% bond area and with about 300 bonds/square inch as taught in U.S. Patent 3,888,948 to Hansen et al.

As used herein the term "monocomponent" fiber refers to a fiber formed from one or more extruders using only one polymer. This is not meant to exclude fibers formed from one polymer to which additives have been added.

As used herein the term "multicomponent fibers" refers to fibers which have been formed from at least two polymers extruded from separate extruders but spun together to form one fiber. Multicomponent fibers are also sometimes referred to as conjugate or bicomponent fibers. The polymers of a multicomponent fiber are arranged in substantially consistently positioned distinct zones across the cross-section of the fiber and extend substantially continuously along the length of the fiber. The configuration of such a fiber may be, for example, a sheath-core arrangement wherein one polymer is surrounded by another or may be a side-by-side arrangement, a pile arrangement or an "islands-in-the-sea" type arrangement. Multicomponent fibers are taught in U.S. Patent 8,108,820 to Marako et al., U.S. Patent 4,765,868 to Krueger et al. and U.S. Patent 6,339,882 to Simak et al. Conjugate fibers and methods of making them are also taught in U.S. Patent 8,382,400 to Piles et al. and may be used to produce crimp in the fibers by using the differential crystallization properties of the two (or more) polymers. The fibers may also have various shapes such as those described in U.S. Patents 6,277,876 to Hogle et al., U.S. Patent 5,468,410 to Hills and 6,088,870 and 6,087,366 to Largman et al.

As used herein, the term "garment" means any type of non-medically oriented apparel that may be worn. This includes industrial workwear and coveralls, undergarments, pants, shirts, jackets, gloves, socks, and so forth.

As used herein, the term "infection control product" means medical or clinical items such as surgical gowns and drapes, face masks, head coverings like bouffant caps, surgical caps and hoods, footcovers like shoe coverings, boot covers and slippers, wound dressings, bandages, sterilization wraps, wipes, garments like lab coats, coveralls, aprons and jackets, patient bedding, stretchers and bedsheet encasements and so forth.

As used herein, the term "personal care product" means personal hygiene oriented items such as wipes, diapers, training pants, absorbent underpants, adult incontinence products, feminine hygiene products, and so forth.

As used herein, the term "protective cover" means a cover for vehicles, covers for outdoor equipment and furniture, yard and garden equipment, floor coverings, table cloths, towels, tarpaulins, and so forth.

Brief Description of the Drawings

FIG. 1 is a schematic illustration of a process line for making and treating fabric of the present invention.

FIG. 2 is a schematic illustration of a process line for making and treating fabric of the present invention.

FIG. 3 shows a cross-sectional view of an exemplary device for focusing an active agent stream in practicing the present invention.

FIG. 4 is a photomicrograph of a cross-section of a high-tall equiaxed fiber non-woven web.

FIG. 5 is a cross-sectional representation of a fabric of the present invention.

FIG. 6 is a cross-sectional representation of a fabric of the present invention.

FIG. 7 is a cross-sectional representation of a fabric of the present invention.

FIG. 8 is a graph depicting the relative amounts of active agent present upon the exterior surfaces and the middle of the treated high-tall fabric of examples 1-3 and comparative examples 4-6.

Description of the Invention

In reference to FIG. 1, an active agent 10 can be applied to upper surface 12A of porous substrate 12, such as a fabric, by applicator 14. Downstream of applicator 14, porous substrate 12 passes through pneumatic nip 20, with upper surface 12A facing a gas stream applied by fluid chute 18, thereby forcing active agent 10 into porous substrate 12 and through the interstitial spaces therein. The air or gas from pneumatic nip 20 passes

through the entire thickness of fabric 12 and is collected in collecting device 24 adjacent lower surface 12B of porous substrate 12. In addition, the gas stream draws active agent 10 substantially through the entire thickness of the porous substrate 12. Further, active agent 10 can be drawn through the entire thickness of the porous substrate 12 and across active agent, passing entirely through and off the porous substrate 12, can

be collected in collecting device 24. With active agent 10 having been forced through the entire thickness of porous substrate 12 by the gas stream, active agent 10 is distributed substantially throughout the thickness of porous substrate 12 resulting in uniformly treated porous substrate 28. Subsequently, the treated porous substrate can be fed into a dryer (not shown), if necessary, to remove existing water or other volatile liquids.

In common usage the term "mechanical nip" generally refers to the point or region where a fabric is pinched or compressed between two solid surfaces such as, for example, between two rolls of a roller assembly. However, as used herein the term

"pneumatic nip" means a region or zone wherein a fabric is between a focused gas stream and a supporting surface such that the gas stream impinge the fabric. Mechanical nips tend to compact the fabric and also compress the fibers thereof due to the high uniting loads associated with the same. Conversely, a pneumatic nip, although capable of compressing the fabric, does not tend to permanently compress or deform the fibers thereof.

As the open structure of the fabric allows a gas stream does not impart as high order as localized a deforming force upon the fabric due to the fluid nature of the applied force.

The active agent can be applied to the surface of the porous substrate, such as a fabric, by one or more means known in the art. As examples thereof, an active agent can be applied to the substrate utilizing an applicator such as a spray boom, one or more spray nozzles or air heads, brush spray trimmers, roll coaters, and so forth. The particular method of applying the active agent to the fabric is not believed critical to the present invention and any one or more methods known to those skilled in the art for applying active agents to fabrics are believed suitable for use in connection with the present invention. The particular apparatus or device selected can vary with the nature and/or composition of the active agent, the desired degree of cross-direction uniformity, and other factors known to those skilled in the art. Although MD and/or CD uniformity can vary as described herein below, for many applications it will be desirable for the applicator to apply a substantially uniform amount of active agent across the entire surface of the porous substrate.

The active agent can comprise one or more various chemical compounds or compositions including, but not limited to, solutions, emulsions, dispersions, suspensions (e.g. liquid or fine particle suspensions), fine particulate matter and so forth. Depending on its form, the active agent can be applied directly in an undiluted form or via a carrier liquid including, but not limited to, via solutions, emulsions, dispersions, suspensions and so forth.

As an example, many active agents can be applied to the porous substrate via an aqueous emulsion or solution comprising from about 70% to about 99.9% (by weight) water and from about 0.1% to about 30% (by weight) solids. The optimal weight percent of solids can be outside the abovesaid stated ranges and will vary with respect to various factors such as, for example, viscosity of the active agents, compatibility of the active agents with the fabric, a desired weight % add-on, foam generation, and so forth. As an example, many wetting agents can be applied to the fabric via an aqueous solution or emulsion comprising about 80% to about 99% water and about 1% to about 20% solids and still more desirably about 90% water and about 10% solids. An used herein "solids"

collectively refers to the sum combination of each of the components of the active agent or chemical composition that will remain on the porous substrate after drying off the water or other volatile carrier.

Use of higher weight % solids generally allows improved efficiency in terms of the ability to use lower throughputs and thus reduced waste. Higher weight % solids can also aid in reducing drying costs. However, as the weight percent of solids increases typically

the viscosity of the aqueous emulsion also increases. The viscosity can increase to a level that makes homogeneous treatment of the porous substrate more difficult to achieve. The amount of the initial application of the solution or emulsion applied to the porous substrate will vary with respect to the desired final weight % solids on the dried porous

substrate. The optimal final weight % solids remaining on the web will likewise vary with the particular chemistry applied to the web and the desired fabric attributes. Additionally, in order to avoid the use of preservatives and other fix agents within the aqueous liquids, just prior to heating the substrate, the aqueous liquid can be heated to a temperature of about 60°C or more. This heating treatment can prevent growth of bacteria or other undesirable organisms that may be present in the aqueous liquid. Heating may also advantageously lower the viscosity of some solutions or emulsions. Further, when using a carrier liquid to apply the active agent, it will often be desirable to dry the porous substrate after directing the web through the pneumatic nip and before winding on a winder roll or undergoing further processing or converting. Further, surfactants or other fix

compositions can be included in the carrier liquid to aid the wetting out of or movement of the liquid through the fabric.

800 in reference to Fig. 1, after applying the active agent 16 to the surface of the porous substrate 12A, the porous substrate 12 is fed into a pneumatic nip 20. However, it is noted that the active agent could be applied to the fabric by directing the active agent at least partially or fully into the gas stream of the pneumatic nip. Such a method may work particularly well with atomized particles or sprays. The pneumatic nip comprises a

focused stream of gas directed into the porous substrate. The gas stream desirably has flow rate or speed of at least 35 meters per second (m/sec) and more desirably has a speed of between about 80 m/sec and 330 m/sec and still more desirably between about 180 m/sec and about 170 m/sec. The focused stream of gas desirably has a volume and speed sufficient to create pressures of at least about 17 mm Hg and even more desirably between about 35 mm Hg and about 300 mm Hg. The desired volumetric flow rates will vary with respect to the area of the slot or other air stream focusing apparatus. For a slot opening of about 3/32 inches (2.4 mm), the volumetric flow rates are desirably between about 2.5 cubic meters per minute (m³/min) and 45 m³/min

per linear meter and even more desirably between about 10 m³/min and 30 m³/min per linear meter. These flow rates and/or pressures are sufficient to force the active agent into and through the thickness of high-loft, porous substrates. Typically, the pressures are such that the porous substrate, while in the pneumatic nip, experiences a temporary deformation due to the downward force of the focused gas stream. The

compression of the fabric and flow of gas through the porous substrate allows for treatment of fibers, with the active agent, throughout the entire thickness of the porous substrate. However, unlike deformations caused by mechanical nips it has been found that the deformation resulting from the pneumatic nip does not significantly, permanently degrade the lofty structure of most porous substrates, and in particular those of high-loft fabrics.

The gas stream can comprise one or more fluids, the particular composition of which can vary as desired. Compressed ambient air is an example of an economical and readily available source of gas for use with the present invention. Alternatively, the air can be cooled or heated as desired. In this regard, the gas can be modified to alter the viscosity of the active agent and/or carrier liquid applied to the web. For example, use of heated air can act to decrease the viscosity of some active agents and/or carrier liquids thereby further improving the transfer of the active agent through the thickness of the web. However, heated air may be inappropriate for certain heat sensitive active agents such as certain enzymes or more volatile chemicals since the hot air may cause

premature coagulation, evaporation, cross-linking and the like. In a further aspect, the gas stream can comprise one or more fluids which further enhance transfer of the active

agent through the fabric thickness such as by further diluting the active agent, reducing the viscosity of the active agent or carrier liquid, preventing premature drying before the solids are able to move throughout the thickness of the fabric, activating reactive characteristics within the active agents, and so forth. As an example, the gas stream can comprise steam. Optionally, surfactants or other like materials may be included together with the gas in the gas stream. Still further, for specialty products utilizing more reactive or sensitive characteristics, it is possible to utilize a more inert gaseous stream such as nitrogen and/or other inert gases. Alternatively, the gas can be selected to inhibit or increase the rate of a desired reaction.

- 10 The focused gas stream can be directed from one or more slots or openings to direct the gas stream into the porous substrate. The gas stream is desirably directed perpendicular to or substantially perpendicular to the plane of the substrate's surface. The focused gas stream can be arranged and directed from one or more slots or openings. The slot desirably has a thickness of less than about 1 inch (about 25 mm) and more desirably a thickness of less than about 0.5 inches (about 12 mm). Still more desirably, the slot can have a thickness between about 3/8 inch (about 10 mm) and about 1/16 inches (2 mm). As an example, it is preferred embodiment, the slot has a thickness of about 3/32 inch (2.4 mm). The slot serves as the exit for the gas stream and focuses the gas as desired. Desirably, the slot extends across the entire cross-section of the fabric. The spatial configuration of the slot or exit orifice for the gas stream can vary, as examples there may be a series of closely spaced slots extending across the width of the fabric or the gas could be focused by a continuous slot extending across the fabric having a series of closely spaced holes extending therein. A plenum can be connected to the slot that contains the gas prior to its exit from the slot. With respect to the preferred embodiment discussed herein, the plenum pressure is desirably between about 60 mm Hg and 800 mm Hg and still more desirably between about 100 mm Hg and about 300 mm Hg. In an exemplary embodiment, the plenum also can be at least twice the cross-sectional area relative to the total exit slot area. In reference to Fig. 3, an exemplary device 30 for directing the gas stream can comprise a plenum chamber 32 and duct 34 that form opening or slot 36 through which the gas stream is directed. To maintain the impact of the gas stream, the opening(s) within the slot are desirably positioned as close to the porous substrate without risk of catching or otherwise degrading the fabric. As an example, the slot or gas stream openings can be positioned between about 0.1 cm and 5 cm above the porous substrate and still more desirably between about 0.5 cm and 2 cm above the porous substrate.

The duration that the porous substrate is under the focused gas stream or pneumatic rip can be varied with selection of the slot width and/or the rate at which the porous substrate travels beneath the rip, i.e. the line-speed of the fabric. The present invention is suitable for use with a wide range of line speeds, including both low and high speeds. As an example, the present invention is suitable for use with line speeds of between about 25 FPM (feet per minute) and about 100 FPM. Additionally, the present invention is likewise suitable for use with relatively high line speeds such as, for example, line speeds in excess of 100 FPM and including line speeds between about 200 FPM and about 2000 FPM. The particular line-speed, slot width and gas stream velocities are selected, in combination with the initial percent weight pick-up, to achieve the final weight % solids add-on. In this regard, it is noted that at higher flow rates and lower line speeds it is possible that significant amounts of the active agent are forced through the entirety of the web thereby decreasing the final weight % add-on levels. The parameters discussed herein can be adjusted accordingly to achieve the desired final weight % add-on and/or relative loss of the active agent forced entirely through and off the fabric.

- Opposite the pneumatic rip is a collector or other apparatus for collecting the solids, condensate, active agent and/or carrier liquid forced through the entirety of the porous substrate. Desirably the collecting apparatus comprises a vacuum slot with a collection chamber. The vacuum can have a low drawing force being simply sufficient to hold the solids. However, to further assist drawing of the active agent through the substrate, the vacuum desirably has a relatively high drawing force. Desirably the vacuum has a volumetric flow rate greater than that of the gas stream. The vacuum is desirably as close to the fabric as possible to maximize the drawing force of the cone. Desirably, the vacuum is positioned immediately adjacent the downstream surface, such as a carrier web, upon which the fabric is supported. As examples, the vacuum can be placed about 0.1 cm to about 1 cm from the lower side of the porous substrate and even more desirably about 0.25 cm from the lower side of the fabric.

- The porous substrate can comprise one or more materials having a series of interconnected interstitial spaces extending through the thickness of the fabric. As examples, the porous substrate can comprise fabrics such as, for example, knitted or woven materials, open cell foams, nonwoven webs and the like. Desirably, the porous substrate comprises a thick, open or porous material having a thickness of at least about 50 mils (0.13 cm) and still more desirably comprises a high-loft nonwoven web having a thickness of at least about 70 mils (0.18 cm) and still further a thickness in excess of about 100 mils (0.25 cm). Further, exemplary fabrics include thermoplastic webs.

nonwoven webs having a porous or high-loft structure, such as those having densities between about 0.2 g/cc and about 0.008 g/cc and still more desirably having a density between about 0.1 g/cc and about 0.01 g/cc. Fibers comprising the thermoplastic fiber webs desirably have a diameter between about 0.5 and 180 and more desirably comprise

5 nonwoven webs of about 1 to about 16 denier fibers. Such webs have a variety of applications and, importantly, can be uniformly treated with the methods of the present invention. As a particular example, crimped spunbond fiber webs are well suited for use in the present invention. Spunbond fiber webs having basis weights from about 34 to about 340 grams per square meter (gsm) and even more desirably from about 80 gsm to about 180 gsm are particularly well suited for use as absorbent materials having applications ranging from nappy materials in personal care products to industrial wipes and oil sorbents.

10 Methods of making spunbond fiber webs include, but are not limited to, U.S. Patent No. 4,340,883 to Appel et al.; U.S. Patent No. 3,882,818 to Carstensen et al.; U.S. Patent No. 3,802,817 to Matsuda et al.; U.S. Patent No. 3,882,763 to Hartman; U.S. Patent No. 3,542,615 to Debo et al.; and U.S. Patent No. 3,382,400 to Pile et al.; the entire contents of which are incorporated herein by reference.

15 High-loft crimped, multicomponent spunbond fiber webs, such as those described in U.S. Patent No. 5,382,400 to Pile et al., are particularly well suited to forming absorbent materials with excellent void volume and absorbency characteristics. An example of such a crimped-spunbond fiber nonwoven web is shown in FIG. 4; the cross-sectional view of the crimped spunbond fiber web shows an

20 exemplary high-loft material comprising numerous interfiber spaces throughout the web which collectively create numerous complex and tortuous pathways through the entire thickness of the fabric.

As a further example, additional substrates suitable for use with the present invention include meltblown fiber webs. Meltblown fibers are generally formed by extruding a molten thermoplastic material through a plurality of die capillaries as molten threads or filaments into converging high velocity gas (e.g., air) streams which attenuate the filaments of molten thermoplastic material to reduce their diameter. Thereafter, the meltblown fibers can be coated by the high velocity gas stream and are deposited on a collecting surface to form a web of randomly dispersed meltblown fibers. Meltblown processes are disclosed, for example, in U.S. Patent No. 3,848,241 to Bohn et al.; U.S. Patent No. 3,888,421 to Weber et al.; U.S. Patent No. 5,082,048 to Haynes et al.; and U.S. Patent No. 4,338,278 to Melner et al.; the entire contents of the aforementioned references are incorporated herein by reference. The meltblown fiber webs having high bulk and strength, such as those described

35 in U.S. Patent No. 5,082,048 to Haynes et al., are likewise believed particularly well suited for use with the present invention. Meltblown fiber webs having a basis weight between

about 34 gsm and about 810 gsm, and even more desirably between about 80 gsm and about 400 gsm, are particularly well suited for use as absorbent wipes or mats.

5 Single fiber webs, such as air-laid or bonded-carded webs, are also suitable for use in connection with the present invention. An exemplary single fiber web is described in PCT Application US99/18918 (Publication No. WO97/18348) and U.S. Patent No. 4,316,881 to Nakajima et al.; the entire contents of which are incorporated herein by reference.

As still a further example, the present invention can also be used in conjunction with multilayer laminates and other articles. As used herein "multilayer laminates" means a laminate of two or more layers of material such as, for example, a spunbond/meltblown (SB/MB) laminate, spunbond/meltblown/spunbond (SBS) laminate, and so forth. Examples of multilayer nonwoven laminates are disclosed in U.S. Patent No. 4,041,203 to Brock et al. and U.S. Patent No. 4,438,780 to Hachidani et al.; the entire contents of the aforementioned references are incorporated herein by reference. The active agent can be applied to one or more layers of the laminate as desired. By way of example, composite materials, laminates

15 and/or other porous substrates suitable for use with the present invention are also described in U.S. Patent No. 6,460,846 to Ellis et al.; U.S. Patent No. 6,384,283 to Laitinen et al.; U.S. Patent No. 6,261,493 to Caffery; U.S. Patent No. 4,804,821 to Johnson et al.; U.S. Patent No. 5,323,518 to Collin et al.; U.S. Patent No. 6,538,541 to Adams; U.S. Patent No. 5,302,949 to Melrose et al.; U.S. Patent No. 4,659,809 to Lavers et al.; U.S. Patent No. 5,346,554 to Curle et al. U.S. Patent No. 4,400,384 to Anderson et al.; U.S. Patent No. 5,300,894 to Geogor et al. Still further, commonly assigned U.S. Patent No. 5,578,343 to Ellis et al. teaches an exemplary high-loft merge material for use in personal care articles; the entire contents of this application is incorporated herein by reference. Numerous other porous fabric and/or laminates are likewise believed suitable for use in connection with the present invention.

20 The particular active agent or agents applied to the porous substrate can be selected as desired to impart or improve specific physical or functional characteristics to the porous substrate. A variety of active agents or chemical compounds have heretofore been applied to porous substrates to impart or improve various functional or physical properties including, but not limited to, absorbency, wettability, anti-static properties, flame retardancy, odor control, anti-microbial properties, anti-fungal properties, repellency (e.g., alcohol or water), coloring agents and so forth. Topically treated fabrics have been utilized in various applications including, but not limited to, garments, infection control products, personal care articles, protective covers, and so forth. With regard to the wettability or absorbency of a particular fabric, many fabrics inherently exhibit good affinity or absorption characteristics for only specific solutions or emulsions. For example,

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polyolefin nonwoven webs have heretofore been used to absorb oil or oil based liquids. In this regard, polyolefin nonwoven wipes are inherently oleophilic and hydrophobic. Thus, polyolefin nonwoven fabrics need to be treated in some manner in order to impart good wetting characteristics or absorbency for water or aqueous solutions. As an example, U.S.

- Patent No. 4,328,279 to Melner et al. discloses use of a low lining nonwoven web for use as a wipe which, by application of an alkyl phenyl ether and diethyl sulfosuccinate, exhibits good absorbent characteristics for both water and oil. As further specific examples, compositions for increasing the wettability of hydrophobic webs are disclosed in commonly assigned U.S. Patent Application No. 08/688,188 to Yehoud et al.; U.S. Patent No. 4,328,279 to Melner et al.; U.S. Patent No. 5,514,587 to Yehoud et al.; and U.S. Patent Application Nos. 08/684,638 and 08/683,584 to Yehoud et al.; the entire contents of each of the above-cited applications and/or patents are incorporated herein by reference. Further, additional materials, which are compatible with and which do not substantially degrade the performance of the particular active agent, can optionally be added to the wetting chemistry described herein. As an example, additional components can include, but are not limited to the following: surfactants, dyes, pigments, fragrances, and/or fillers. Active agents for enhancing numerous other functional properties and/or features allowing its applied to the web such as, for example, shape described in U.S. Patent No. 4,374,888 to Storzinger; U.S. Patent No. 4,383,758 to Seibek et al.; U.S. Patent No. 5,107,331 to Storzinger; and PCT Application WO/98/06032. Still further, fine particles can likewise be added to highly porous fabrics via the present process such as, for example, superabsorbent particles, talc, activated carbon, and so forth.

- The process described above may be altered in various respects without departing from the scope of the invention. As examples, the pneumatic rip can be adapted to treat only selected sections of the porous substrate. Discrete slot openings can be set at one or more spaced intervals across the width of the substrate thereby impacting only those regions of the substrate passing thereunder. This can result in a fabric having regions across the web which have distinct functional characteristics. For example, in reference to FIGS. 5 and 6, nonwoven web 100 has treated areas 108 that are areas coated with an effective amount of active agent. The treated areas 108 can include the fibers adjacent first surface 104 of the nonwoven web 100 and those regions directly impacted by the gas stream of the pneumatic rip, namely first regions 106. First regions 106 will have active agent more uniformly dispersed through the thickness 112 of the nonwoven web 100 relative to second regions 110 (i.e. those regions not impacted by the focused gas stream). Thus, the active agent is applied to the substrate completely by the

agent, the areas under the pneumatic rip will have a uniform wettability extending through the thickness of the fabric whereas those regions not impacted by the pneumatic rip will have a wettability or absorbency substantially limited to the area at or near the surface of the substrate. This method could be used to produce a fabric having reduced wettability and/or desorption characteristics along the edges of a fabric with increased desorption and liquid handling properties located about the center of a fabric. An apparatus for practicing such a method can be adapted from that disclosed in U.S. Patent Application No. 08/677,377 filed June 17, 1997 to Marmon et al.; the entire contents of the above-cited application is incorporated herein by reference. Further, in reference to FIG. 7, the active agent can be applied only to discrete regions of the porous substrate and then fed through the pneumatic rip to create a nonwoven web 120 having one or more discrete first regions 122 having a uniform coating of active agent and second regions 124 that have no active agent applied thereto.

- An in-line process for making and treating a high-belt nonwoven made in accordance with reference to FIG. 2. Process line 80 discloses a method for fabricating a wettable bi-component fiber nonwoven web in accord with the present invention. Hoppers 82a and 82b may be filled with the respective polymeric components 83a and 83b. The polymeric components are then melted and extruded by the respective extruders 84a and 84b through polymer dieheads 86a and 86b into and through spinneret 88. As the extruded filaments 82 extend below spinneret 88, a stream of air 89 from blower 90 quenches bi-component filaments 82. The filaments 82 are drawn into a fiber draw unit or spinneret 94 and then onto traveling horizontal surface 96, with the aid of vacuum 98, to form an unbonded layer of bi-component spunbond fibers 70. The bi-component fiber layer can then be lightly or preliminarily through-air bonded, such as described in U.S. Patent No. 5,707,485, using hot air-beds 72. The bi-component spunbond fibers can subsequently be permanently bonded using through-air bonder 74. Optionally, in lieu of the through-air bonding, the bi-component spunbond fiber web can be point bonded such as, for example, by a pair of heated bonding rolls 76 (shown in phantom).

- Bonded bi-component spunbond fiber web 70 can subsequently be treated with an active agent. Applicator 80 applies aqueous treatment 78, containing at least one active agent, to the upper side of bonded web 70. The treated web is then fed through pneumatic rip 82 created by the focused gas stream exiting slot 84. The air stream directly impacts the treated surface of the nonwoven web. Positioned beneath the nonwoven web, and under pneumatic rip 82, is vacuum slot 86 that collects gas and any aqueous treatment 78 passing completely through and off the bonded nonwoven web 70. The nonwoven web 70 can then be dried by through-air dryer 88 which draws off the excess water, leaving the

active agent(s) upon the fibers and resulting in uniformly treated high-tell nonwoven web 88. The uniformly treated fabric can then be wound on a wider roll or processed further in-line as desired. The schematic process is but a preferred example of a process for making uniformly treated high-tell materials and numerous other alterations and/or modifications may be made by those skilled in the art to the process line or equipment without departing from the spirit of the present invention.

Additional conventional equipment and/or devices which may be utilized in conjunction with the apparatus of FIGS. 1 and 2 are well known and, for purposes of clarity, have not been illustrated in the schematic diagrams. In addition, it will be appreciated by those skilled in the art that the particular process could be varied in numerous respects. As but one example, porous fabrics can be sequentially treated two or more times in accord with the present invention and, in particular, porous fabrics can be sequentially treated from opposite sides. The first side of a porous fabric can be treated with the topically applied active agent and subjected to the focused gas stream and subsequently the opposite, second side could be treated with the topically applied active agent and subjected to the focused gas stream. Dual treatment procedures may be advantageous with fabrics of considerable thickness such as, for example, high-tell weight knitted fabrics.

Liquid Strike-Through Test: Liquid strike-through can be determined in accord with standard EDANA Test 180.1-80. The results discussed below were determined using EDANA Test 180.1-80 liquid strike-through test procedures with the exception that 10 ml

Percent Chemical Add-On: Percent chemical add-on can be determined by weighing the fabric prior to and after treatment with the active agent and drying as needed. Percent Chemical Add-On = $\frac{(\text{Treated Fabric Weight} - \text{Pretreated Fabric Weight})}{\text{Pretreated Fabric Weight}} \times 100$. Alternatively, percent chemical add-on can be determined using other equipment such as, for example, a Bruker NMR 120 minispec NMR Analyzer.

Sample Thickness: Fabric thickness is determined in accord with ASTM Standard Test Method D 5729-95 measured under a 0.05 psi load and a 3 inch circular platen.

Absorption Capacity: A 4 inch by 4 inch (10.2 cm x 10.2 cm) specimen is initially weighed. The weighed specimen is then soaked in a pan of test fluid (e.g., saline) for 10 seconds. The test fluid should be at least 1 inch (2.54 cm) deep in the pan. The specimen is removed from the test fluid and placed in a weighing dish and then weighed. Absorption Capacity (g) = wet weight (g) - dry weight (g). Specific Capacity (g/g) = Absorption Capacity (g)/dry weight (g).

Relative Distribution of Topical Treatments: Relative distribution of active agent upon exposed fabric surfaces was analyzed using Attenuated Total Reflectance (ATR) infrared spectroscopy analysis. Infrared spectra were obtained using a variable angle ATR accessory on a NICOLET 740 spectrometer. Infrared spectra of each surface were analyzed in duplicate and the control was analyzed in triplicate. The control comprised untreated fabric. The particular bands selected to analyze a fabric will vary with the particular chemistry. In the analysis of the samples provided in Fig. 8, the active agent applied to the fabrics comprised an AHCOVEL/GUCCOPON topical treatment, which is described herein below in greater detail. The fabric was suspended lengthwise along the medial plane of the fabric, thereby separating the fabric into upper and lower halves and exposing the interior of the fabric. The sides of the sample to be analyzed were placed in contact on both sides of a 45° angle germanium crystal and held there by means of a holder that applied a fixed constant pressure. The depth of penetration of the infrared beam below the sample surface was about 0.8 microns for a 45° angle germanium crystal. The number scans per ATR analysis was set to 64. The crystal surfaces were cleaned thoroughly between analyses to ensure that no residual topical treatment was carried over to the next sample. A base line from 1800-1675 cm^{-1} was drawn under the Achrovel ester carbonyl (C=O) band and an extended base line was drawn from 1612-1200 cm^{-1} for the polypropylene methyl CH_3 band for each specimen. The peak heights of the Achrovel C=O peak at 1736 cm^{-1} and that of the polypropylene methyl (CH_3) peak at 1378 cm^{-1} were measured in cm. The ratio of the Achrovel C=O peak height to that of the polypropylene CH_3 peak were calculated. Comparisons of these ratios were made to evaluate the relative distribution of active agent within the web.

Embodiments

Each of the following examples utilized a high-tell base fabric comprising a crimped bi-component spunbond fiber nonwoven web having an average density of 0.027 g/cm^3 . The

crimped apertured fiber nonwoven web was made in accord with U.S. Patent No. 3,382,400 to Pita et al. The crimped apertured fibers had a 90/90 side-by-side configuration with the first component comprising linear low density polyethylene and the second component comprising polypropylene. After formation on a heating wire, the apertured fibers were
 5 through-air bonded using an air temperature of 280°F (about 132°C) at 140 feet per minute (44.6 meters/minute). The bonded, crimped apertured fiber web had an average basis weight of 3.58 ounces/square foot (122 g/m²) and an average thickness of about 176 mils (4.4 mm). The bonded, crimped apertured fiber web was then wound on a winder roll for subsequent treatment.

- 10 Additionally, in each of the examples discussed below, the base fabric was unwound from a winder roll and treated on a single side with a brush spray head applying a 25%, by weight, wet pick-up. The topical treatment bath comprised an aqueous emulsion comprising 10%, by weight, solids. The topical treatment bath also comprised 1%, by weight, heptanol. The solids or active agent was a composition consisting essentially of hydrophilic fibers comprising a 2:1 ratio (by active weight) of ANCOVEL Base N-62 and GLUCOPON-220UP. ANCOVEL Base N-62 comprises a polyethylene glycol ester of 1,2-ethanediol monoisobutyrate and is commercially available from
 15 Hulschem Company. GLUCOPON is a solution comprising about 60% (by weight) of an acrylate copolymer and about 40% (by weight) of water. Such acrylate copolymers are disclosed in U.S. Patent No. 3,382,400 to Akzochemical et al., the entire contents of which are incorporated herein by reference, and are commercially available from the Hulschem Corporation.

The treated samples were subsequently separated along the medial plane of the fabric thereby forming separate upper and lower halves and exposing the middle of the treated sample (the upper half having the outer side which was initially spray treated with the active agent). Each half was analyzed for overall add-on levels as well as each of the four surfaces (two originally exposed outer surfaces and two that previously formed the medial plane of the sample).

30 Example 1

The base fabric was unwound from a winder roll and, following application of the aqueous topical treatment to the base fabric, the treated base fabric was fed through a pneumatic nip with the treated side facing the focused air stream. The apparatus used to direct the air stream was similar in construction to that shown in Fig. 3 and had a slot
 35 width of 0.004 inches (0.24 cm). The gas stream comprised dry air at 50% relative humidity and had an exit temperature of 72°F (22°C). The air stream had a volumetric flow rate of 172 CFM per linear foot (16 M³/minute per linear meter) with an exit speed of 22,000 FPM (8,706 M/minute). The treated base fabric was positioned 1.27 cm under the compressed air slot. The line speed was 60 FPM (16.2 meters/minute). A vacuum having a slot width of 0.3125 inches (8.79 cm) was positioned, opposite the compressed air slot, 0.25 cm under the base fabric. The vacuum had a volumetric flow rate of 184 CFM per linear foot (17 M³/minute per linear meter). The fabric was then through air dried with air at 240°F (116°C). Five specimens were cut from the resulting fabric and evaluated. The resulting nonwoven web had an average thickness of 170 mils (4.32 mm) and a 4 inch x 4 inch (10.2 cm x 10.2 cm) sample had dry weight of 1.26 g. The average Absorbent Capacity of 40.66 g (padding) and an average Specific Capacity of 33.66 g/g.

relative humidity and had an exit temperature of 72°F (22°C). The air stream had a volumetric flow rate of 172 CFM per linear foot (16 M³/minute per linear meter) with an exit speed of 22,000 FPM (8,706 M/minute). The treated base fabric was positioned 1.27 cm under the compressed air slot. The line speed was 60 FPM (16.2 meters/minute). A vacuum having a slot width of 0.3125 inches (8.79 cm) was positioned, opposite the compressed air slot, 0.25 cm under the base fabric. The vacuum had a volumetric flow rate of 184 CFM per linear foot (17 M³/minute per linear meter). The fabric was then through air dried with air at 240°F (116°C). Five specimens were cut from the resulting fabric and evaluated. The resulting nonwoven web had an average thickness of 170 mils (4.32 mm) and a 4 inch x 4 inch (10.2 cm x 10.2 cm) sample had dry weight of 1.26 g. The nonwoven web had an average Absorbent Capacity of 40.66 g (padding) and an average Specific Capacity of 33.66 g/g.

18 Example 2

The base fabric was unwound from a winder roll and following application of the aqueous topical treatment to the base fabric, the treated base fabric was fed through a pneumatic nip with the gas stream comprising steam. The slot width, of the steam slot, was 0.004 inches (0.24 cm) at a temperature of 212°F (100°C) with an exit speed of 22,000 fpm (807 M/minute) and volumetric flow of 172 CFM per linear foot (16 M³/minute per linear meter). The treated side of the base fabric was positioned 1.27 cm beneath the steam slot. The line speed was 60 fpm (16.2 M/minute). A vacuum, as in Example 1, was positioned opposite the steam slot and 0.25 cm below the untreated side of the fabric. The fabric was then dried as in Example 1. Five specimens were cut from the resulting fabric and evaluated. The resulting nonwoven web had an average thickness of 170 mils (4.3 mm) and a 4 inch x 4 inch (10.2 cm x 10.2 cm) sample had an average dry weight of 1.26 g. The average Absorbent Capacity of the nonwoven web was 41.7 g (padding) and the average Specific Capacity of 33.62 g/g.

30 Example 3

The base fabric was treated as in Example 2 with the exception that the line speed was 120 fpm (36 M/minute). Five specimens were cut from the resulting fabric and evaluated. The resulting nonwoven web had an average thickness of 167 mils (4.7 mm) and a 4 inch x 4 inch (10.2 cm x 10.2 cm) sample had an average dry weight of 1.21 g.

The nonwoven web had an average Absorbent Capacity of 44.88 g (ml/ml) and an average Specific Capacity of 34.1 g/g.

Example 4 (Comparative)

The base fabric was unwound from a winder roll and following application of the aqueous topical treatment to the base fabric, the treated base fabric was passed over a vacuum having a slot of width of 0.31 inches (0.79 cm), a slot volumetric flow rate of 184 CFM per linear foot (17 M³/minute per linear meter). The untreated side of the base fabric

was facing the vacuum slot and was positioned 0.35 cm above the vacuum slot. The base fabric was subsequently dried with a through-air dryer using an air temperature of 240°F (118°C). Five specimens were cut from the resulting fabric and evaluated. The resulting nonwoven web had an average thickness of 184 mils (4.7 mm) and a 4 inch x 4 inch sample had an average dry weight of 1.28 g. The average absorbent capacity of the

nonwoven web had an average Absorbent Capacity of 37.48 g (ml/ml) and an average Specific Capacity of 28.78 g/g.

Example 5 (Comparative)

The base fabric was unwound from a winder roll and following application of the aqueous topical treatment to the base fabric, the treated base fabric was then fed directly into a through-air dryer and dried using heated air at 240°F (118°C). Five specimens were cut from the resulting fabric and evaluated. The resulting nonwoven web had an average thickness of 181 mils (4.6 mm) and a 4 inch x 4 inch (10.2 cm x 10.2 cm) sample had an average dry weight of 1.35 g. The nonwoven web had an average Absorbent Capacity of 27.87 g (ml/ml) and an average Specific Capacity of 22.3 g/g.

Analyses of the treated fabrics of Examples 1-5 are shown in Table I below.

TABLE I

SAMPLE	LINE SPEED (FPM)	VACUUM SLOT	AQUEOUS COATING ADD-ON (%)	WEIGHT (TOP SURFACE BOTTOM SURFACE)	AVERAGE DENSITY (TOP SURFACE BOTTOM SURFACE)	WEIGHT (TOP SURFACE BOTTOM SURFACE)	WEIGHT (TOP SURFACE BOTTOM SURFACE)	WEIGHT (TOP SURFACE BOTTOM SURFACE)
1	60	ON	2.1%	7030	4.8	4	8	80%
2	30	ON	1.5%	8845	3.4	4	10	88%
3	125	ON	1.5%	6040	3.4	4	10	84%
4	80	ON	2.3%	8020	5.2	2	7	80%
5	80	OFF	2.3%	8070	13.4	0	6	81%

Comparative Examples 4 and 5 had 2.3% add-on levels and the data evidences that the aqueous topical treatment was not pulled through the entirety of the high-belt nonwoven web. However, as shown by the above data, despite having lower levels of

wetting agent, the nonwoven webs of the present invention have a more uniform treatment as well as higher post wet out percentages and absorbent capacities. Thus, fabrics treated in accord with the present invention can have less active agent, relative to those treated in accord with prior methods, while achieving the similar or improved physical characteristics.

The resulting infrared spectra data, shown in Fig. 8, evidences that the fabrics treated with the focused gas stream have more uniformly distributed topically applied active agent than those fabrics treated with only a vacuum slot or no vacuum slot such as those of comparative examples 4 and 5 respectively. Further, the data provided in Fig. 8 also evidences that greater add-on levels can be achieved on fibers within the interior of the fabric relative to those exposed on the fabric's surface. This data further evidences that the topically applied active agent is distributed through the entire thickness of the fabric in the treated fabrics of the present invention. Although comparative examples 4 and 5 show an increase in relative distribution of active agent when comparing the outside surfaces with those of the bottom surface (i.e. the originally exposed outer, untreated side), it is noted that each of the fabrics were rolled on a winder roll and stored prior to ATR analysis. In this regard, the highly treated upper surface of the fabric was placed against the bottom surface under slight pressure thereby allowing migration of the active agent onto the bottom (untreated) surface while the fabric was maintained on the roll. The effects of the migration are not expected to be as significant for examples 1-3 since they were believed to have similar add-on levels prior to winding and storage on the roll.

Numerous other patents and/or applications have been referred to in the specification and to the extent there is any conflict or discrepancy between the teachings incorporated by reference and that of the present specification, the present specification

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what control. Additionally, while the invention has been described in detail with respect to specific embodiments thereof, and particularly by the examples described herein, it will be apparent to those skilled in the art that various alterations, modifications and other changes may be made without departing from the spirit and scope of the present invention. It is therefore intended that all such modifications, alterations and other changes be encompassed by the claims.

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What is claimed is:

1. A porous substrate comprising:
a porous fabric having first and second outer surfaces and an interior, said fabric comprising thermoplastic polymer fibers having a denier less than about 15 and having a thickness of at least about 60 mils; and
a topically applied active agent located on the surfaces of said fibers and distributed through out the thickness of said fabric, wherein the ratio of weight % active agent on the upper half of the fabric to the lower half of the fabric does not exceed 2:1.
2. The porous substrate of claim 1 wherein said fabric comprises a nonwoven web and wherein the weight % active agent on the upper half of the fabric to the lower half of the fabric does not exceed about 2:1 and further wherein the relative amount of active agent upon fiber surfaces increases from the first outer surface to the second outer surface forming a gradient through the fabric thickness.
3. The porous substrate of claim 2 wherein said fabric comprises a nonwoven web of thermoplastic fibers having a denier less than about 10 and a density between about 0.2 g/cm³ and about 0.008 g/cm³.
4. The porous substrate of claim 3 wherein said nonwoven web has a thickness in excess of about 100 mils and comprises crimped polyethylene spunbond fibers.
5. The porous substrate of claim 3 wherein said fabric has a thickness in excess of about 100 mils and comprises crimped staple fibers.
6. The porous substrate of claim 1 wherein the relative amount of active agent upon fibers forming both of said outer surfaces of said fabric is less than the amount upon fibers within the interior of said fabric.
7. The porous substrate of claim 6 wherein said active agent comprises a wetting agent and further wherein said fabric comprises a nonwoven web with a thickness of at least about 100 mils and comprises thermoplastic polymer fibers having a denier less than about 10 and further wherein the ratio of weight % active agent on the upper half of the fabric to the lower half of the fabric does not exceed about 2:1.

8. A porous substrate comprising:
a fabric having first and second outer surfaces which define the fabric thickness,
said fabric having inter-connecting interstitial spaces through-out the thickness of said
fabric and wherein said fabric has a density between about 0.2 g/cm³ and about 0.800
g/cm³ and further has first and second regions which extend in the machine-direction and
cross-direction of the fabric;
said first region having a thickness of at least about 50 mils and having an active
agent on surfaces of fibers distributed through-out the thickness of the fabric and wherein
the ratio of weight % active agent on the upper half of the first region to the lower half
of the first region does not exceed 3:1;
said second region having a thickness of at least about 50 mils and having active
agent on surfaces of fibers comprising the fabric and wherein the ratio of weight % active
agent on the upper half of the second region to the lower half of the second region is
greater than 3:1;
9. The porous substrate of claim 8 wherein said second region is adjacent an edge of
said fabric.
10. The porous substrate of claim 9 wherein the ratio of weight % active agent on the
upper half of the second region to the lower half of the fabric is greater than about 4:1 and
further wherein the ratio of weight % active agent on the upper half of the first region to
the lower half of the region is less than about 2:1.
11. The porous substrate of claim 10 further comprising a third region substantially
adjacent to the second region and wherein said second and third regions are located at
opposed edges of the fabric and wherein said first region is disposed along the central
region of the fabric, and further wherein said active agent comprises a wetting agent.
12. A process for applying an active agent to a porous substrate:
providing a porous substrate having a first and second surface;
applying an active agent to the first surface of said porous substrate;
applying a gas stream to the first surface of said porous substrate and forcing said
active agent substantially through the thickness of said porous substrate, wherein said
gas stream has a minimum speed of 25 meters/second and whereby.

13. The process of claim 12 wherein upon application of said gas stream at least a
portion of said active agent passes through the entire thickness of said porous substrate
and onto the second surface of said porous substrate.
14. The process of claim 12 wherein substantially contemporaneously with application
of the gas stream, a vacuum is applied adjacent the second surface of said porous
substrate.
15. The process of claim 14 wherein said vacuum extracts the gas from said gas stream
and active agent applied to the first surface.
16. The process of claim 12 wherein said gas stream comprises air and wherein said air
is applied to said first surface at a speed of at least about 80 meters/second.
17. The process of claim 19 wherein said gas stream comprises ambient air.
18. The process of claim 12 wherein said gas stream comprises steam.
19. The process of claim 12 wherein said gas stream is applied onto said porous
substrate through a slot having a width not greater than about 2.5 centimeters.
20. The process of claim 13 wherein said porous substrate is moving at a speed of at
least 150 millimeters transverse to the flow of said gas stream.
21. The process of claim 20 wherein said porous substrate comprises a nonwoven web
having a thickness of at least 100 mils, an average fiber density less than about 15 and a
density between about 0.2 g/cm³ and about 0.800 g/cm³.
22. The process of claim 12 wherein said active agent is applied to the first surface of
said porous substrate via a liquid carrier selected from the group consisting of solutions,
emulsions, suspensions and dispersions.
23. The process of claim 21 wherein said active agent is applied to the first surface via
a liquid carrier selected from the group consisting of solutions, emulsions, suspensions
and dispersions.

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24. A treated porous substrate made in accord with the process of claim 23.

25. The treated porous substrate of claim 24 wherein said active agent comprises a wicking agent and said porous substrate comprises a nonwoven web of thermoplastic polymer fibers.

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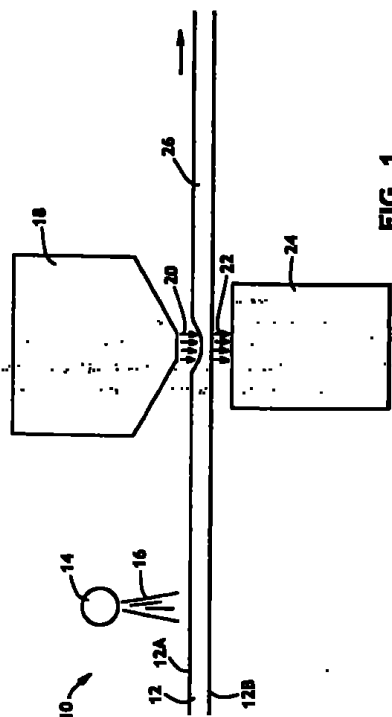
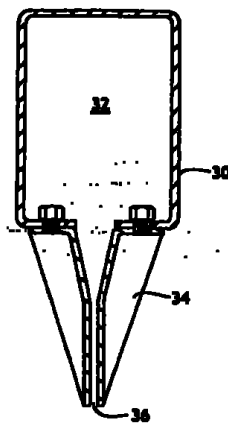
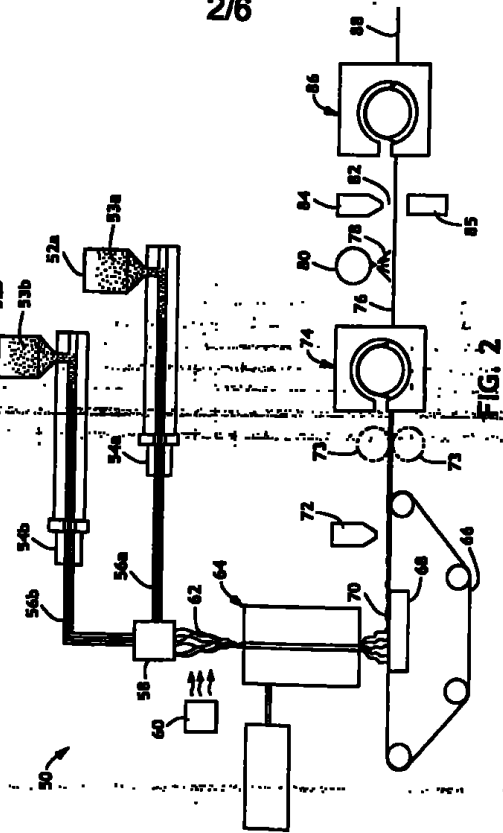


FIG. 1



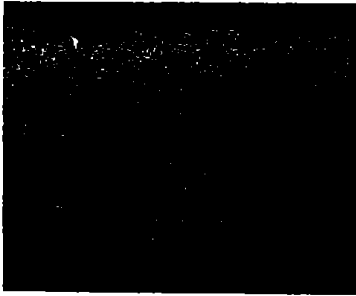


FIG. 4

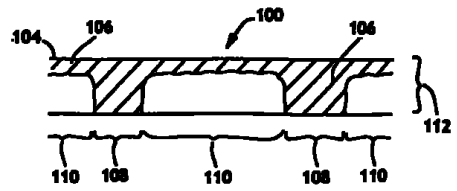


FIG. 5

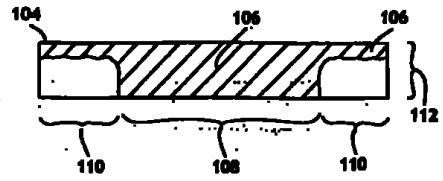


FIG. 6

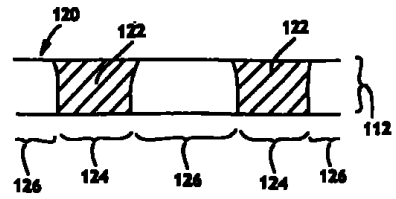


FIG. 7

6/6

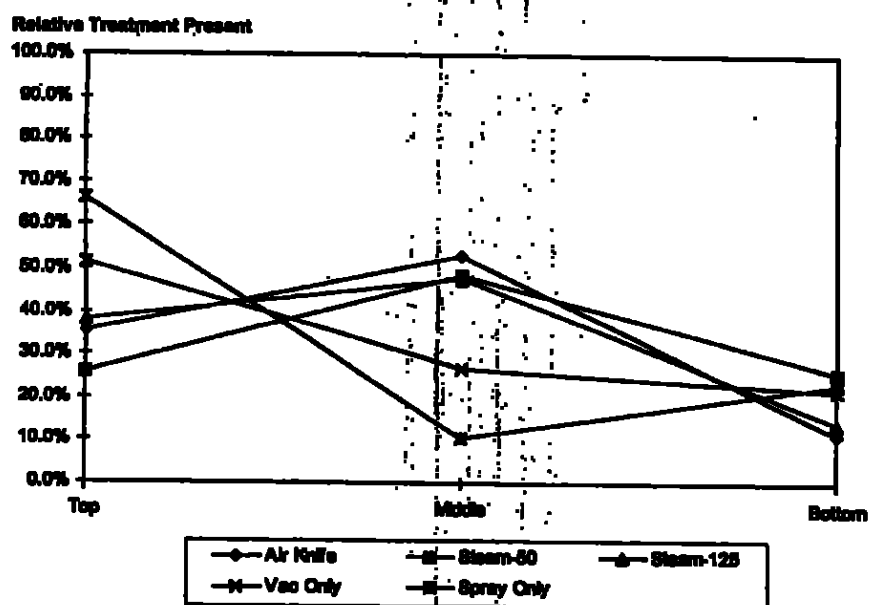


FIG. 8

~~601~~

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication: 20.06.2000 Bulletin 2000/25 (51) Int. Cl.⁷: A61L 15/42
(21) Application number: 98310215.1
(22) Date of filing: 17.12.1998

(34) Designated Contracting States: AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE Designated Extension States: AL LT LV MK RO SI (30) Priority: 17.12.1998 US-116857 17.12.1998 US-457032 (71) Applicant: FORT JAMES CORPORATION Dearfield, IL 60015 (US) (72) Inventors: • Schmidt, Bradley Gene Green Bay, WI 54304 (US)	• Weyhle, Jennifer Nicole Green Bay, WI 54302 (US) • Bouchette, Michael Paul Shawwood, WI 54189 (US) (74) Representative: Colwell, Stephen Gary et al Mullins & Squire 100 Gray's Inn Road London WC1X 8AL (GB) Remarks: A request for correction has been filed pursuant to Rule 86 EPC. A decision on the request will be taken during the proceedings before the Examining Division (Guidelines for Examination in the EPC, A-V, 9.1).
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(54) **Multi-layered absorbent composite having one or more apertured transfer layers**

(57) A multilayer absorbent composite is disclosed. This composite comprises a cover sheet, one or more transfer layers, one or more absorbent core layers, and a barrier back layer. The transfer layer or layers have Z-direction apertures penetrating through the entire layer. The aperture frequency is about 5 to 50 apertures per square inch and each aperture has a diameter of about 0.015 to 0.10 inches. These composites are used as feminine hygiene pads and related applications.

EP 1 013 290 A1



Europäisches Patentamt
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Publication number:

0 169 184
A1

EUROPEAN PATENT APPLICATION

Application number: 88089290.7

Int. Cl.: D 21 H 5/26, A 41 B 13/02,
A 61 F 13/18

Date of filing: 03.07.88

Priority: 10.07.84 SE 8403732

Applicant: MÖLLA LYSKE AB, S-405 03 Göteborg (SE)

Date of publication of application: 22.01.89
Bulletin 88/4

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Frånlanda (SE)

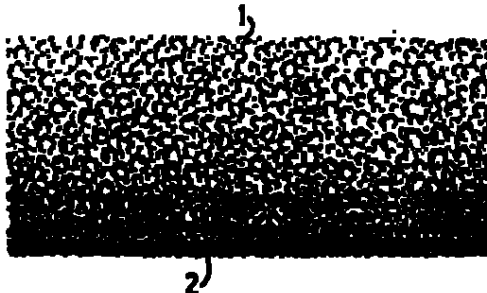
Designated Contracting States: DE FR GB IT NL

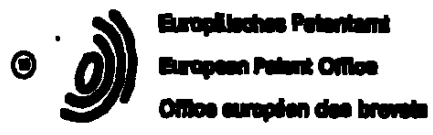
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PATENTBYRÅ AB Box 7004, S-103 04 Stockholm (SE)

Fluous absorption body for use in disposable articles and method for the production thereof.

A fibrous absorption body having a continuous-density gradient in a direction perpendicular to its largest surfaces, to be used in disposable products such as diapers, sanitary napkins or wound dressings, manufactured by air-laying a blend of cellulose fluff pulp and a binder, the latter preferably in the form of fibres, preheating (8) the formed low-density web (8) to at least the bonding temperature for the bonding fibres, compressing (10) the web (8), passing the web (8) through a cooling zone (11) and finally achieving the density gradient in the web (8) by compressing it between a pair of rollers (12) of which the upper one (14) is cold and only the lower one (13) is heated to reach the bonding temperature of the bonding fibres above, the web density thereby continuously increasing in the direction from the cold roller (14) towards the hot roller (13).

By using special embossing means disposed at the hot roller (13), the web (8) can be provided with an unbroken surface pattern for increasing the liquid distribution capacity.





Publication number: 0 402 650 A2

EUROPEAN PATENT APPLICATION

Application number: 80189383.4 Int. Cl. A61L 15/22, A61L 15/00
Date of filing: 17.06.80

Priority: 14.06.80 US 38867
Date of publication of application: 18.12.80 Bulletin 80/51
Designated Contracting States: AT BE CH DE DK ES FR GB GR IT LI LU NL SE

Applicant: WEYERHAEUSER COMPANY
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Representative: Straß, Schöbel-Hopf,
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Absorbent mixture, method of making same, and absorbent article including same.

An absorbent mixture, as made from fibers formed into a fibrous web and a polymerizable, cross-linkable material, in a liquid carrier. The material, when polymerized and cross-linked, results in a superabsorbent polymer. The material, in the liquid carrier, is dispersed within the fibrous web, as dispersed inclusions, and is polymerized and cross-linked in situ, within the fibrous web, so as to form a composite web comprising the fibrous web and the superabsorbent polymer, as dispersed particles, at least some of which are bound to fibers from the fibrous web. The composite web is ground, so as to disperse some of the superabsorbent polymers to become particulate while fragments of the superabsorbent polymer remain bound to fibers from the fibrous web. Before the composite web is ground, it may be provided with a fibrous layer or fibrous layers in intimate contact therewith, and also compressed.



Europäisches Patentamt
European Patent Office
Office européen des brevets



Publication number: **0 478 011 A2**

EUROPEAN PATENT APPLICATION

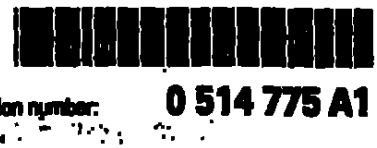
Application number: **91120804.4** Int. Cl.: **A61F 13/15**
Date of filing: **18.08.88**

This application was filed on 05 - 12 - 1991 as a divisional application to the application mentioned under INO code 80. Priority: 21.08.88 US 757880 Date of publication of application: 01.04.92 Bulletin 92/14 Publication number of the earlier application in accordance with Art.76 EPC: 0 212 618 Designated Contracting States: AT BE CH DE FR IT LI LU NL SE	Applicant: KIMBERLY-CLARK CORPORATION 401 North Lake Street Neenah, Wisconsin 54956-0349(US) Inventor: Kellenberger, Stanley Roy 386 W. Lindbergh Street Appleton, WI 54911(US) Inventor: Zanker, David Louis 1410 Ridgeway Court Neenah, WI 54956(US) Representative: Diehl, Hermann Dr. et al Diehl & Gleaser, HMB & Partner Filggenstrasse 13 W-8000 München 19(DE)
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Absorbent article.

An improved absorbent article includes a layer of absorbent material (10) which has a length, a width and a thickness (28). Particles of superabsorbent material (24) are distributed within the absorbent material layer, and these superabsorbent particles are disposed to form a substantially continuous, positive concentration gradient of superabsorbent through at least a portion of the thickness (28) of the absorbent layer. The superabsorbent particles (24) may be of the same dimension or the average particle size may vary throughout the thickness (28) of the layer of absorbent material. The article provides for absorbent structures wherein the superabsorbent produced gel is adequately isolated away from body surfaces of a person using the article while gel blocking is also adequately reduced.

EP 0 478 011 A2



Publication number: **0 514 775 A1**

EUROPEAN PATENT APPLICATION

Application number: 82100174.1 Int. Cl. C08F 8/00, C08L 33/00
Date of filing: 14.05.82

Priority: 20.05.81 US 703078 Date of publication of application: 25.11.82 Bulletin 8248 Designated Contracting States: BE DE DK ES FR GB IT NL PT SE	Applicant: THE DOW CHEMICAL COMPANY 2030 Dow Center, Abbott Road Midland, MI 48640(US) Inventor: Johnson, Thomas Conn 1000 Airfield Lane Midland, Michigan 48642(US) Representative: Starnagel, Hans-Günther, Dr. et al Patentanwälte Dr. Michael Harn, Dr. H.-G. Starnagel, Dr. H. Dörries, Sander Ave 30 W-5800 Bergisch Gladbach 2(DE)
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Process for producing a superabsorbent polymer.

This invention provides an improved process for producing a superabsorbent polymer with reduced residual monomer content which comprises partially drying a crosslinked, partially neutralized polymer gel, then raising the temperature of the gel using microwave radiation in the absence of circulating air and thereafter completing the drying.

EP 0 514 775 A1

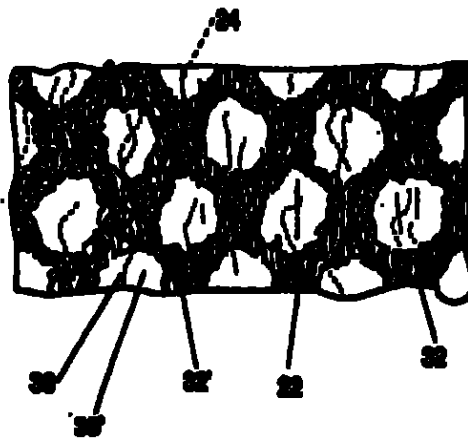
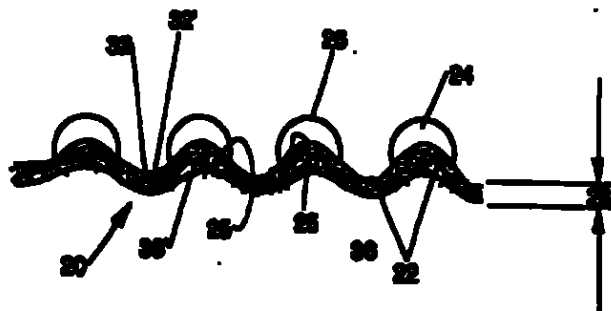
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6: A61F 13/46	A1	(11) International Publication Number: WO 95/13778 (43) International Publication Date: 26 May 1995 (26.05.95)
(21) International Application Number: PCT/US94/13229 (22) International Filing Date: 16 November 1994 (16.11.94) (30) Priority Date: 09/155,040 18 November 1993 (18.11.93) US (71) Applicant: THE PROCTER & GAMBLE COMPANY [US/US]; One Procter & Gamble Plaza, Cincinnati, OH 45202 (US). (72) Inventors: PHAN, Dean, Van; 6512 Tylers Crossing, West Chester, OH 45069 (US); FORSHEY, Paul, Adam; 3615 Amberson Avenue, Cincinnati, OH 45208 (US). (74) Agents: REED, T., David et al; The Procter & Gamble Company, 5299 Spring Grove Avenue, Cincinnati, OH 45217 (US).	(51) Designated States: AM, AU, BB, BG, BR, BY, CA, CN, CZ, DE, FI, HU, JP, KG, KP, KR, KZ, LK, LR, LT, LV, MD, MG, MN, MO, NZ, PL, RO, RU, SI, SK, TJ, TT, UA, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BI, CF, CG, CI, CM, GA, GN, ML, MR, NE, NG, TD, TG), ARIPO patent (KE, MW, SD, SZ). Published With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.	

(54) Title: **ABSORBENT STRUCTURE COMPRISING DISCRETE PARTS OF OSMOTIC ABSORBENT MATERIAL DISPOSED ON OR WITHIN A CAPILLARY STRUCTURE**

(57) Abstract

An absorbent structure comprising freestanding osmotic absorbent sites disposed on or within a capillary substrate. The sites extend outwardly normal to the plane of the absorbent structure or fill apertures within the plane of the absorbent structure. Upon imbibing liquids, the sites of osmotic absorbent can expand without constraint from the substrate.





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(43) Date of publication: 03.07.1996 Bulletin 1996/27
(51) Int. Cl.⁵: A61F 13/15

(21) Application number: 95120575.4

(22) Date of filing: 28.12.1995

(84) Designated Contracting States: DE ES FR GB IT (30) Priority: 28.12.1994 JP 32802/94 28.12.1994 JP 32854/94 (71) Applicant: KAO CORPORATION Chuo-ku, Tokyo (JP) (72) Inventors: - Masaki, Kazumichi Agawa-gun, Kochi-ken (JP) - Kubota, Yoshinobu Tosa-shi, Kochi-ken (JP) - Ichikawa, Eiichi Kochi-shi, Kochi-ken (JP) - Kaganol, Mari Kochi-shi, Kochi-ken (JP) - Nakanishi, Minoru, c/o Kao Corporation Ichikawa-machi, Hase-gun, Tochigi-ken (JP)	- Hasegawa, Mitsugu, c/o Kao Corporation Ichikawa-machi, Hase-gun, Tochigi-ken (JP) - Yamamoto, Yasuhiko, c/o Kao Corporation Ichikawa-machi, Hase-gun, Tochigi-ken (JP) - Kawasumi, Hironori, c/o Kao Corporation Ichikawa-machi, Hase-gun, Tochigi-ken (JP) - Kusagawa, Tetsuya, c/o Kao Corporation Ichikawa-machi, Hase-gun, Tochigi-ken (JP) (74) Representative: Grünecker, Kinkeldey, Stockmair & Schwarzlauer Anwaltssozietät Maximilianstrasse 58 80539 München (DE)
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(54) Absorbent sheet and process for producing the same

(57) The absorbent sheet comprising at least hydrophilic fibers and thermally fusible bonding fibers or a strengthening assistant, and a superabsorbent polymer is characterized in that:

the superabsorbent polymer is not present on an absorbent surface of the absorbent sheet for absorbing liquid but distributed inside the absorbent sheet, and is adhered and fixed to the hydrophilic fibers constituting the absorbent sheet;

the superabsorbent polymer is spread at an amount of 5 to 300 g per 1 m² of the absorbent sheet; and

the absorbent sheet has a thickness of 0.3 to 1.5 mm.

FIG.1A

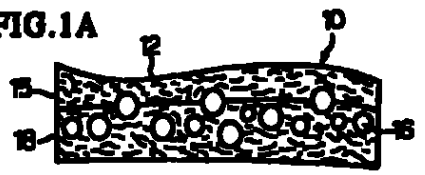
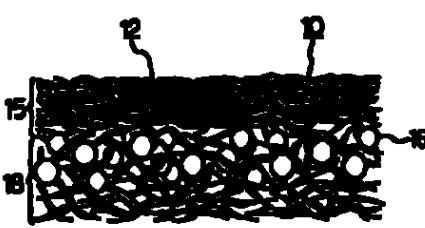


FIG.1B



(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
02.08.2000 Bulletin 2000/31

(51) Int. Cl. 7: A61F 13/15

(21) Application number: 99125811.2

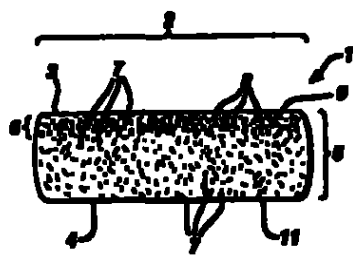
(22) Date of filing: 22.12.1999

(34) Designated Contracting States: AT BE CH CY DE DK ES FI FR GB GR IE IT LJ LU MC NL PT SE Designated Extension States: AL LT LV MK RO SI (30) Priority: 22.12.1999 US 220189 10.05.1999 US 309238 (71) Applicant: McNEIL-PPC, INC. Skillman, New Jersey 08558 (US)	(72) Inventors: • Rosenfeld, Leonard G. East Windsor, NJ 08620 (US) • Folsch, Lynn Hillsborough, NJ 08876 (US) (74) Representative: Greening, Hans Wilhelm, Dipl.-Ing. BOEHMERT & BOEHMERT Frank-Joseph-Strasse 38 80801 München (DE)
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(54) Absorbent article with high absorbency zone

(57) The present invention is directed to an absorbent structure comprising an integral absorbent element with an upper surface and a lower surface defining a thickness therebetween. The thickness has an upper 35% containing a high absorbency zone and a lower 65%. The high absorbency zone has a first surface and a second surface separated by a zone thickness. The zone thickness is less than about 35% of the absorbent element thickness. The high absorbency zone comprises absorbent fibers and superabsorbent polymer particles. The superabsorbent polymer particles are present at a loading of no more than 75 grams per square meter and are separated from one another by the absorbent fibers. The lower 65% of the absorbent element thickness is substantially free of superabsorbent polymer particles.

FIG. 1



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International Bureau(43) International Publication Date
29 March 2001 (29.03.2001)

PCT

(16) International Publication Number
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(51) International Patent Classification: A61F 13/15, B32B 3/00

(74) Agent: RENZONI, George, E.; Christmann O'Connor Johnson & Kindness PLLC, Suite 2800, 1400 Fifth Avenue, Seattle, WA 98101 (US).

(21) International Application Number: PCT/US00/26361

(22) International Filing Date:
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(25) Filing Language: English

(26) Publication Language: English

(30) Priority Date:
60/155,439 21 September 1999 (21.09.1999) US(71) Applicant (for all designated States except US): WEYER-
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Way South, Federal Way, WA 98003 (US).

(72) Inventor; and

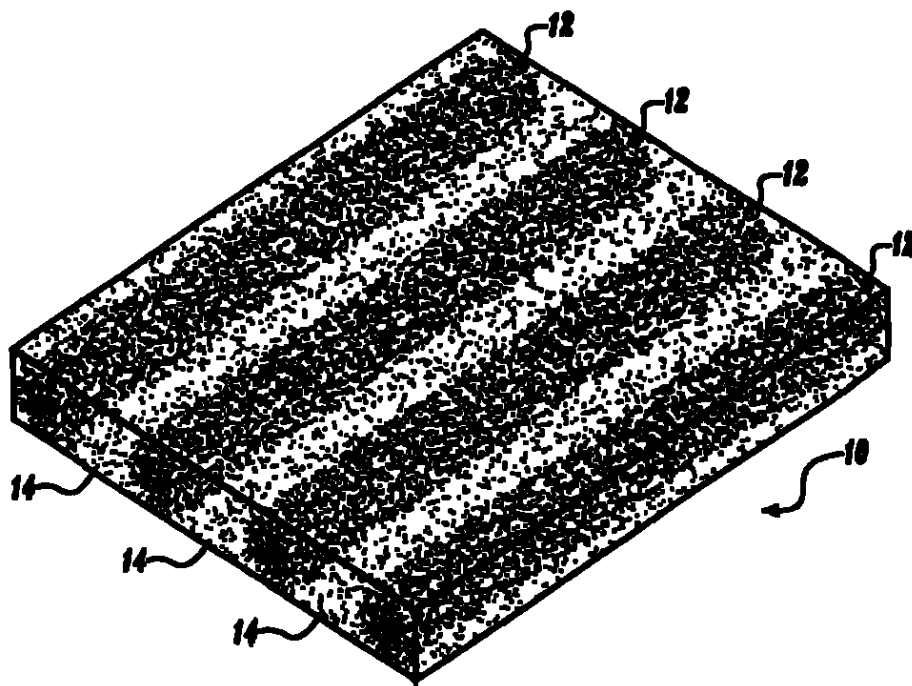
(73) Inventor/Applicant (for US only): MARSH, David, G.
(US/US): 125 S.W. Campus Drive 45-203, Federal Way,
WA 98023 (US).(81) Designated States (national): AE, AG, AL, AM, AT, AU,
AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ,
DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GR, GM, HR,
HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR,
LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ,
NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM,
TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.(84) Designated States (regional): ARIPO patent (GH, GM,
KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian
patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European
patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE,
IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG,
CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:

— With international search report.

[Continued on next page]

(54) Title: FLUTED ABSORBENT COMPOSITE



WO 01/21122 A1

(57) Abstract: A fibrous absorbent composite containing absorbent material, methods for its formation, and absorbent articles that include the composite are described. The composite (10) is a fibrous structure that includes absorbent material disposed throughout the composite (14) and in increased concentration in bands (12) that extend along the composite's length.

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
17 May 2001 (17.05.2001)

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(10) International Publication Number
WO 01/34082 A1

(51) International Patent Classification: A61F 13/15, 13/20

(74) Agents: CAMPBELL, Christopher, C. et al.; Hinton & Williams, 1900 K Street, N.W., Washington, DC 20006 (US).

(21) International Application Number: PCT/US00/30825

(81) Designated States (national): AR, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GR, GM, HR, HU, ID, IL, IN, IS, JP, KR, KG, KP, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.

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60/164,135 8 November 1999 (08.11.1999) US
08/685,607 11 October 2000 (11.10.2000) US

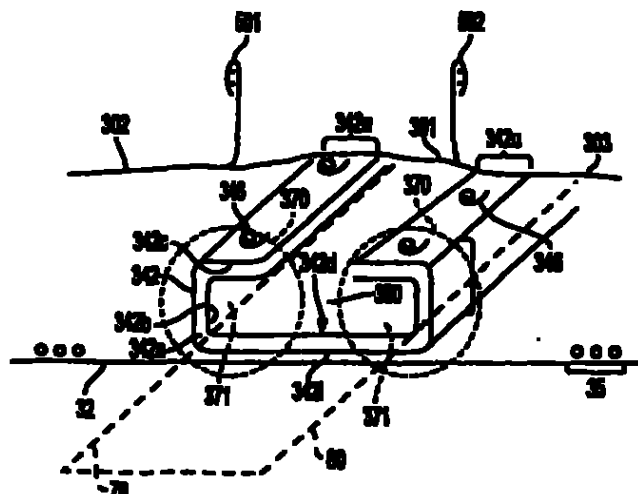
(71) Applicant: PARAGON TRADE BRANDS, INC.
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Published:
With international search report.

(72) Inventor: CHMIELEWICKI, Henry, J.; 5493 Canabide Drive, Norcross, GA 30092 (US).

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: THIN ABSORBENT CORE MADE FROM FOLDED ABSORBENT LAMINATE



(57) Abstract: A disposable absorbent garment (10) comprising a topsheet (30), backsheet (32), and an absorbent core (342) disposed between the topsheet and the backsheet. The absorbent core is formed from a folded laminate comprising three layers, including an upper layer (342b), a lower layer (342c) and a central fibrous layer (342a) including from about 50 to about 95 percent by weight superabsorbent polymer and about 5 to about 50 percent by weight stabilizing additives. The upper and lower layers comprise tissue, airlaid fluff pulp or synthetic non-woven fibrous layers. The central fibrous layer is adhesively bonded to both the upper and lower layers, all layers' together assisting to maintain the dry and/or integrity of the absorbent core. Folding of the thin absorbent laminate provides an absorbent core that can handle large doses of urine. The folded structure provides a central channel (360) that provides free volume (371) for temporary liquid storage, isolation and containment of bowel movements, and increases the surface area of laminate available for liquid absorption.

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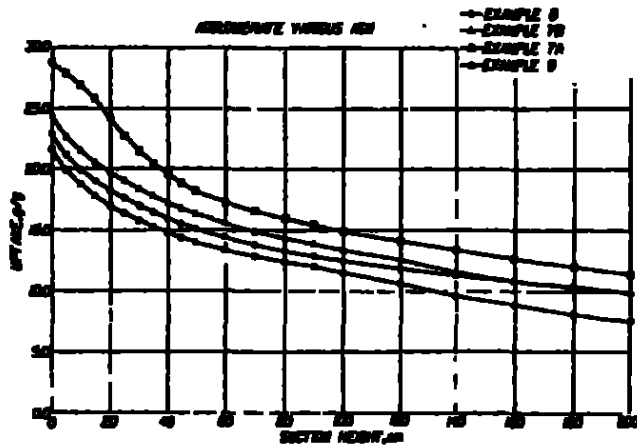
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[Continued on next page]

(54) Title: PRODUCT WITH ABSORBENT POLYMER AND PARTICULATE FOAM



(57) Abstract: The present invention is a high capillary suction storage absorbent member comprising an agglomerate of particulate hydrogel-forming absorbent polymer and particulate high surface area open-celled hydrophilic foam. In another aspect of the invention the agglomerate of particulate hydrogel-forming absorbent polymer and particulate high surface area open-celled hydrophilic foam is disclosed. The absorbent member is useful in the containment (e.g., storage) of body liquids such as urine. In one embodiment, the storage absorbent member comprises the agglomerate. In another embodiment, the absorbent member comprises the agglomerate adjacent to at least one sheet, strip or piece of high surface area open-celled hydrophilic foam material. In either the storage absorbent member or agglomerate of the invention, the high surface area open-celled hydrophilic foam comprises from about 1 % to about 98 %, preferably from about 15 % to about 85 %, more preferably from about 30 % to about 40 % by weight of the member or agglomerate, respectively. An unique aspect of the agglomerates according to the present invention is that they are formed without the use of a separate bonding substance, such as an adhesive.

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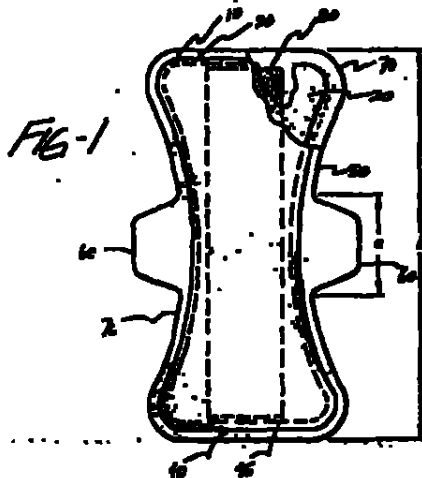
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Unified sanitary napkin.

⑦ This invention relates to a novel absorbent structure and absorbent products containing this absorbent structure. More particularly, the absorbent structure of this invention contains a high-stiff, bulky, low-density cover layer, a higher density transfer layer, a very high density, retentive reservoir layer and an impermeable barrier layer. The cover and barrier layers are sealed around their periphery and, preferably, all the layers are bonded to each other to form a unified structure.



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(54) Liquid absorbent composition for nonwoven binder applications

(57) An aqueous polymer composition comprising 10 to 40 wt% of a polymer in water, the polymer consisting essentially of 20-80 wt% α,β -ethylenically unsaturated carboxylic acid monomer, 10-80 wt% one or more softening monomers, the aqueous composition being adjusted to pH 4-8 with alkali metal hydroxide or alkaline earth metal hydroxide and further containing 0.1 to 3 wt% zirconium crosslinking salt. Such aqueous compositions can be applied to nonwoven and woven substrates to make superabsorbent products.

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(84) Designated Contracting States: DE FR GB (30) Priority: 21.10.1994 US 328860 05.04.1995 US 417320 07.04.1995 US 418304 (71) Applicant: AIR PRODUCTS AND CHEMICALS, INC. Allentown, PA 18105-1501 (US)	(72) Inventors: - Tze-Chiang Chang, John Allentown, PA 18103 (US) - Koffstein, Bernard M., Jr. Emmaus, PA 18049 (US) - Martin, Finn L. Emmaus, PA 18049 (US) - Goldstein, Joel E. Allentown, PA 18104-2503 (US) (74) Representative: Schwebe - Sandwehr - Marx Sturzelstrasse 16 D-81677 München (DE)
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(54) Self-crosslinking, aqueous absorbent polymer compositions

(57) An aqueous polymer composition comprising 10 to 50 wt% of a polymer in an aqueous medium, the polymer demonstrating a maximum absorbency capacity of at least 10 g of a 1% aqueous saline solution/g polymer and consisting essentially of 25-60 wt% (4, 5), ~1% α,β -ethylenically unsaturated carboxylic acid monomer, 0-60 wt% (meth)acrylicsulfonic acid, crosslinking comonomer comprising 0.1-10 wt% latent crosslinking comonomer or 0.01-2 wt% active crosslinking comonomer, or both, and at least one softening monomer in a sufficient amount so that the polymer has a T_g of <140°C, the softening monomer characterized as having a homopolymer that exhibits a T_g>35°C, the aqueous composition having a viscosity of less than about 3000 mPa and being adjusted to pH 4-7 with acid or alkaline earth metal hydroxide. Such aqueous compositions can be applied to nonwoven and woven substrates or loose cellulosic fibers to make superabsorbent products.

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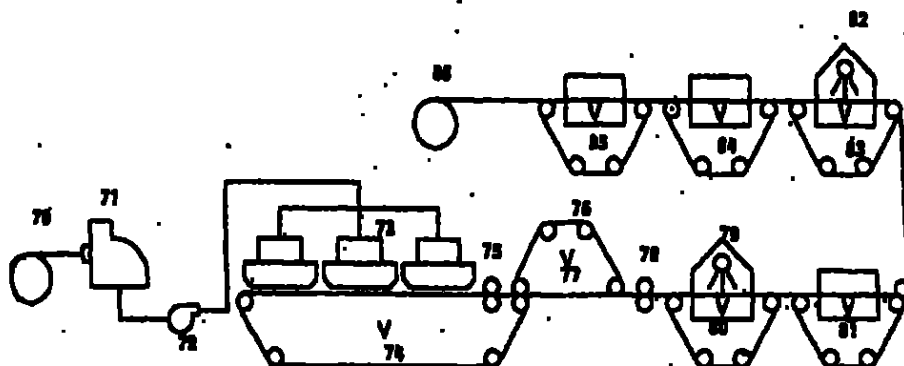
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(54) **Superabsorbent cellulosic natural or synthetic fibers and webs treated with polyelectrolytes and superabsorbent products made therefrom**

(57) A superabsorbent fibrous web is disclosed. This web is formed from wood pulp or cellulosic fibers, natural fibers, synthetic fibers, or any mixture thereof wherein the web is treated with aqueous solutions of su-

perabsorbent polyelectrolytes which produce a fibrous web having substantially increased absorbency rates and absorbent capacity. These webs are useful in the manufacture of towels, diapers, etc.

FIGURE 1



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(21) International Application Number: PCT/US00/10134 (22) International Filing Date: 13 April 2000 (13.04.00) (30) Priority Data: 60/129,143 14 April 1999 (14.04.99) US Not furnished 13 April 2000 (13.04.00) US (71) Applicant: H.B. FULLER LICENSING & FINANCING, INC. (US/US); 1200 Willow Lake Boulevard, Box 64683, St. Paul, MN 55164-0683 (US). (72) Inventor: ANDERSON, Stewart, C.; 1200 Willow Lake Boulevard, Box 64683, St. Paul, MN 55164-0683 (US). MILLER, Wayne, P.; 1200 Willow Lake Boulevard, Box 64683, St. Paul, MN 55164-0683 (US). (74) Agent: QUAN, Nancy, N. et al.; 1200 Willow Lake Boulevard, Box 64683, St. Paul, MN 55164-0683 (US).	(53) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GR, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW, ARIPO patent (OH, OM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.	
(54) Title: AQUEOUS SUPERABSORBENT POLYMER AND METHODS OF USE (57) Abstract The present invention relates to a crosslinked aqueous solution polymer composition consisting of about 15 wt-% to about 30 wt-% of at least one water soluble monomer, preferably an alpha, beta-ethylenically unsaturated carboxylic acid monomer and a crosslinking agent. The polymer solution is sufficiently low enough in viscosity such that it can be applied in aqueous form, yet after crosslinking possesses a fast rate of acquisition and is high absorption capacity. The invention also relates to new methods of enhancing the absorbency of various articles, increasing the homogeneity and/or absorbency of a fiber or fibrous matrix, improving the water retention of soil and other agricultural methods, and increasing the open time of cement by incorporating or applying an aqueous superabsorbent polymer composition.		