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ABSORBENT STRUCTURE

This disclosure relates to an absorbent structure such as may be used in a disposable diaper.

Disposable diapers generally include an inner liquid permeable liner that lies closest to the wearer's skin. An outer, liquid impermeable cover is disposed at the outside of the diaper, furthest away from the wearer. In between the liner and the cover is a fibrous liquid absorbent material or batt.

In general, the most economical liquid absorbent material for use in disposable diapers is cellulosic fibers such as comminuted wood pulp, commonly known in the art as "fluff pulp", or simple "fluff". Batts made from these fibers have a low density and a high capacity for absorbing fluids, but their wicking ability is very poor. Thus, the low central crotch portion of the diaper as worn tends to become very wet when waste fluids are released thereupon, while the fluff included in the higher portions of the diaper (as worn) can remain dry with its absorbent capacity unused.

Several problems are posed by this. First, it is uneconomical to line a diaper with fluff, the majority of which will be wasted. Further, there can be leakage from the liquid saturated central portion of the diaper. Still further, this concentration of liquid localized in one region of the diaper can cause discomfort to the wearer of the diaper.

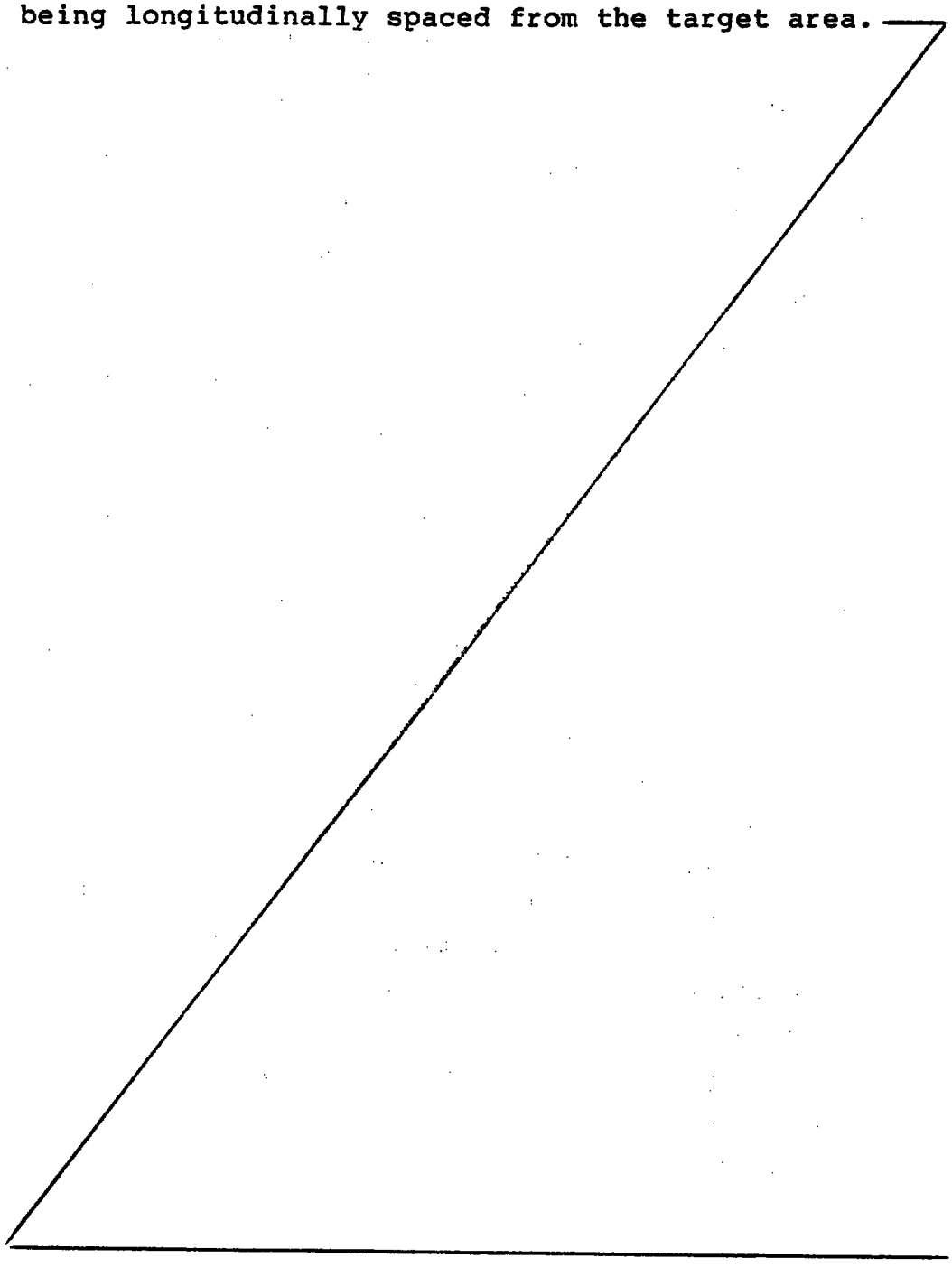
One prior art approach disclosed in U.S. Patent No. 4,213,459 to avoid some of these problems is to decrease the pore size such that the improved capillary action of the pores overcomes the force

of gravity sufficiently to cause the waste liquid to move upwardly in the diaper. However, it has been noted that the total absorption capacity is reduced by reducing the average pore size. Nevertheless, the use of this approach to achieve a better distribution of fluid throughout the available area in the diaper has generally been the approach of choice despite the resulting loss in absorption capacity.

A further step was taken towards the solution of these problems in U.S. Patent No. 4,213,459, which discloses providing a localized area of increased density fluff in the batt for wicking waste fluid to a higher portion of the diaper. Although this presents an advance in the art, it is not without drawbacks. First, the surface of the diaper nearest the wearer's skin directly beneath the lining becomes soaked. Further, the only places where liquid can be transferred from the lower density material to the higher density material are at the borders or edges where the lower density material adjoins the higher density material. Thus, it is suggested in US 4213459 that the areas around the densified region of the batt should remain undensified.

According to the invention there is provided a disposable garment comprising an absorbent structure having opposed longitudinal ends and including a liquid permeable liner to face the body of a user, an outer liquid impermeable cover, and liquid absorbing material therebetween, the liquid absorbing material including a body of cellulosic fibres wherein the structure further comprises superabsorbent material, such superabsorbent material being arranged to be disposed in use wholly between one longitudinal end of the structure and the target area where liquid initially accumulates on the garment, the superabsorbent material being mounted in liquid

transfer contact with said body of cellulosic fibres, and the body of cellulosic fibres being effective in use to draw some of the liquid accumulating on the target area from said target area to said superabsorbent material so that the superabsorbent material provides an additional reservoir for liquid absorbed by the garment, such additional reservoir being longitudinally spaced from the target area.



Several embodiments of this invention are described below by way of example with reference to the accompanying drawings in which,

Fig. 1 is a perspective plan view of a first embodiment without superabsorbent material included therein.

Fig. 2 is a longitudinal cross-sectional view taken along line 2-2 of Fig. 1.

Fig. 3 is a perspective plan view of a second embodiment without superabsorbent material included therein.

Fig. 4 is a longitudinal cross-sectional view taken along line 4-4 of Fig. 3.

Fig. 5 is a perspective plan view with several cutaway portions of a third embodiment without superabsorbent material included therein.

Fig. 6 is a perspective plan view of a fourth preferred embodiment including a portion of superabsorbent material incorporated therein.

Fig. 7 is a longitudinal cross-sectional view taken along line 7-7 of Fig. 6.

Fig. 8 is a perspective plan view of a fifth preferred embodiment including a portion of superabsorbent material incorporated therein.

Fig. 9 is a longitudinal cross-sectional view taken along line 9-9 of Fig. 8.

Fig. 10 is an absorbency profile for the control diaper tested in Example 1.

Fig. 11 is an absorbency profile for the diaper containing one ply of compressed fluff in addition to the regular fluff component as discussed in Example 1.

Fig. 12 is an absorbency profile for the diaper containing two plies of a compressed fluff in addition to the regular fluff component as discussed in Example 1.

Fig. 13 is the absorbency profile for the diaper containing three plies of compressed fluff in addition to the regular fluff component as described in Example 1.

Fig. 14 is the absorbency profile for the diaper containing two plies of compressed fluff plus a portion of superabsorbent material as described in Example 1.

Referring now to the drawings, a disposable diaper 1 comprises generally a body facing, liquid permeable liner 2, an outer liquid impermeable cover 3, and a liquid absorbing material indicated generally as 4 therebetween. The liquid absorbing material 4 comprises a first, lower density layer 5 of cellulosic fibers such as communited wood pulp (fluff) which lies beneath the inner liner 2. A second, higher density layer 6 of fluff lies beneath at least a portion of the first lower density layer 5 such that waste fluid can be transferred from the lower density layer 5 to the higher density layer 6. Thus, a lower surface 15 of the lower density layer 5 should be contiguous with at least a portion of an upper surface 16 of the higher density layer 6. However, a tissue layer can be placed between the layers 5 and 6 without departing from the broad aspects of this disclosure.

Predominantly softwood pulp fluff can be used for each of the layers 5 and 6. Alternatively, a layer of predominantly softwood fluff can be used for the layer 5 and a layer of preponderantly hardwood fluff can be used for the layer 6, in which case it is the average pore size and not necessarily the density that varies between the layers 5 and 6, as will shortly be explained. For the purposes of this disclosure and the accompanying claims, "predominantly" is intended to mean at least about 80% while "preponderantly" is intended to mean at least about 50%.

In the first embodiment shown in Figs. 1 and 2, the higher density layer 6 is formed as a strip extending from a target area 7, where liquid waste will initially accumulate, to an upper edge 8 towards the back of the diaper. The higher density layer 6 draws waste fluid from the lower density layer 5 in the target area 7 upwardly towards the edge 8 at the back of the diaper 1. Further, along upper regions 18 of the higher density layer 6 towards the upper edge 8 there is, surprisingly, substantial fluid transfer back from the higher density layer 6 to the lower density layer 5. It is important to note that although this flowback occurs from the higher density layer 6 to the lower density layer 5, the lower density layer 5 only draws sufficient fluid to satisfy its unsaturated capillary forces proximate to the higher density layer 6, where there is an overlap in pore sizes such that the smallest pores in the lower density layer 5 are smaller than the largest pores in the higher density layer 6. The lower density layer 5 drains fluid from the higher density layer 6 but does not become soaked, with the advantage that the wearer's comfort is maintained while a signficant proportion of the absorption capacity of the lower density layer 5 is utilized.

Alternative embodiments are shown in Figs. 3 through 5. In the second embodiment in Figs. 3 and 4, the higher density layer 6 extends as a strip along the entire length of the diaper. In the third embodiment shown in Fig. 5, the higher density layer 6 is coextensive with the entire lower density layer 5.

Yet another alternative to each of the embodiments described above is that of varying the pore size without necessarily varying the density. For example, it has been discovered that the fine

fiber dimensions of hardwood fluff can be utilized to advantage by substituting at least about 50%, and preferably about 80% to 100%, hardwood fluff fibers of approximatley the same density as the lower density softwood fluff fiber layer 5 for the higher density softwood fluff fiber layer 6. This can be done because the hardwood fluff has a smaller pore size than the softwood fluff material. As a result, if hardwood fluff fibers are used as a replacement for the higher density softwood fluff fibers, two different pore size distributions will still be obtained even if the density of each layer is the same. Thus, for example, a two component fluff sandwich comprising a coarse pore structure in the upper layer 5 obtained from a predominantly softwood fluff pulp and a fine pore structure in the lower layer 6 comprised of a preponderantly hardwood fluff pulp fluff, densified throughout to one density (preferably approximately 0.1 g/cm^3) can successfully be used with similar results to those obtained according to the embodiments described.

In the present invention a portion of superabsorbent material (SAM) is included as part of the liquid absorbing material. The term "superabsorbent material" as used herein refers to one or more hydrocolloid materials capable of absorbing many times its own weight of water or aqueous fluid. These materials are generally prepared by polymerizing one or more monomers which, if homopolymerized by conventional methods, would form water soluble polymers. To render them water-insoluble and suitable for use in diapers, these polymers or mixture of polymers are typically reacted, frequently with a crosslinking agent, to form crosslinked polymers, thereby introducing a limited water-insolubility while retaining susceptibility to swelling in water and water-containing fluids. Pseudocrosslinking

may also be achieved by chain entanglement of high-molecular weight polymers, thus effecting water insolubility (see, e.g., U.S. Patent No. 4,340,706). Typically, these hydrocolloids are salts of polyacrylic acid and variations thereof, such as methacrylic acid. Commercially they are available under the trademarks WATER LOCK J-500 from Grain Processing Co.; ABASORB 720 from Arakawa Chemical, (U.S.A.) Inc.; and Aqualic-CA from Mitsui Co. Alternative superabsorbents also may include hydrophilic polymer grafts onto starch or cellulose backbones and cross-linked carboxylated celluloses.

In Figs. 6 and 7 a preferred embodiment is shown wherein the superabsorbent material 9 is sandwiched between a first higher density component 10 and a second higher density component 11. These first and second higher density components 10, 11 are disposed in an equivalent position to the higher density layer 6 in the three embodiments discussed above. However, it is generally preferred that the superabsorbent material 9 is localized in an area 17 slightly above a region midway between the target area 7 and the upper edge 8. Thus, the superabsorbent material 9 provides an additional reservoir for liquid waste that has been drawn up the diaper by the higher density layer 6.

An important advantage of this diaper is that it assists in fluid distribution along the length of the superabsorbent material. Generally, superabsorbents 9 disposed in a fiber matrix enhance fluid distribution in the direction corresponding to the thickness of the liquid absorbing material 4. However, due to the swelling nature of the superabsorbent material 9, wicking in the plane of the fiber matrix bearing the superabsorbent 9 is severely hindered. In this diaper wicking across the entire length of the superabsorbent

material 9 is accomplished by sandwiching the superabsorbent material 9 between the first high density component 10 and the second high density component 11. Thus, the liquid waste is brought into contact across an upper surface 12 and a lower surface 13 of the superabsorbent material 9 rather than across a bottom edge 14 thereof. This is an improvement over border-to-border transfer of liquid waste, in much the same way as the diapers described in connection with Figs. 1-5, provides the improvement of surface to surface contact between the lower density layer 5, and the higher density layer 6.

Figs. 8 and 9 show an alternative embodiment wherein the superabsorbent material 9 is disposed adjacent the outer, liquid impermeable cover 3, and then covered with the single higher density layer 6 which is in turn covered with the lower density layer 5.

Of course, still further alternative embodiments are provided by using a softwood fluff pulp in the layer 5 and a hardwood fluff pulp in the layers 6 (Figs. 8 and 9), or 10 and 11 (Figs. 6 and 7), with uniform densification of all layers to about 0.1 g/cm^3, or in the range of 0.1 g/cm^3 to 0.15 g/cm^3. Yet further variations include using a softwood fluff pulp of a first density in combination with a hard wood fluff pulp of a second density, wherein the second density is preferably higher than the first density.

The term "density" as used herein refers to the density of the composite structure of the lower density layer 5 or the higher density layer 6, and not the actual fiber density. (The actual fiber density is about 1.5 g/cm^3.) The density of the lower density layer 5 should be in the range of 0.03 to 0.14 g/cm^3, with the preferred range, in light of considerations of integrity and bulk,

at 0.07 to 0.11 g/cm^3. The higher density layer 6 should have a density in the range of 0.16 to 0.22 g/cm^3 for providing the desired capillarity without excessive stiffness. The density for these preferred ranges is a density measured under a load of 0.2 psi (1.2 kPa). An important consideration in selecting suitable ranges for the higher density fluff and lower density fluff, when provided, is that although there should be two distinct pore size distributions, one for each of the respective layers of fluff, these pore size distributions should overlap because this will permit flowback from the high density layer back to the low density layer.

The densified layer 6 may be a multiple ply layer rather than merely a single ply layer, and the ply may increase in density across the width or length of the layer 6 within the specified range or can be of uniform density. The basis weight of the lower density layer 5 is preferably in the range of 150 to 500 g/m^2 to provide the desired aesthetic appearance and comfort of the diaper. The basis weight of the higher density layer 6 is preferably in the range of 150 to 1250 g/m^2.

It is preferred that the higher density layer 6 be substantially separately rather than integrally formed with the lower density layer 5, to achieve better moisture distribution therethrough. It should be noted, however, that the layers 5 and 6 are "substantially separately" formed even when formed in the same machine, one on top of the other, with some admixing at the interface. By the "substantial separate" terminology, it is intended only that two substantially discrete layers are formed, rather than a substantially single layer having a "skinned" surface, such as described in U.S. Patent Nos. 2,952,260, 2,955,641, 3,017,304, 3,060,936,

and 3,494,362. Thus, densification should be achieved uniformly through the higher density layer 6, and care should be taken to avoid substantial skinning, where such skinning is as described in the above patents or in U.S. Patent No. 4,103,062. Skinning produces undue stiffness in the fluff and results in low absorbent capacity in the bonded (skinned) layer. Skinning can be prevented by avoiding excess moisture and by maintaining both platens at approximately the same temperature to avoid condensation through the thickness of the material. It is desirable to avoid the densification of the fluff to the point of forming a skin layer so that the densified fluff layer 6 retains at least about 80% void volume, resulting in significant absorbent capacity.

The layer 6 is densified in a heated press, such as can be obtained by Dake, Grand Haven, Michigan, as a "Dake Laboratory Press", Model No. 44-148 which includes heated platen operated under suitable conditions of temperature and pressure as known in the art to achieve the desired density. Alternatively, a heated calender nip is suitable for use in the densification process, as known in the art.

Comminuted wood pulp (fluff) is preferred but other cellulose fibers such as cotton linters can be used. The preferred fluff is southern pine kraft wood pulp (i.e., made according to the sulfate process commonly known in the art) which has been bleached, such as can be purchased from ITT Rayoneer or International Paper Company. A suitable hardwood fluff pulp is southern hardwood kraft obtainable from Weyerhauser as "New Bern 309".

The superabsorbent material can be obtained from the Grain Processing Company of Muscatine, Iowa as their product Water Lock (TM) J-500 or A-100. Suitable inner liners 2 and outer covers 3 are easily obtained and well known in the art.

The densified fluff layer 6 could also be used with other absorbents such as coformed (meltblown polymer fibers combined with wood pulp and/or stapel fibers) webs and the like, at a lower density. Further, the absorbent structures described herein have applications to embodiments other than diapers, such as to sanitary napkins or other hygienic media.

The advantages resulting from this disclosure will be understood further with respect to the following examples and test data.

Example 1

The high density fluff was prepared by running the fluff into a hot calender nip (steel on hard rubber) at 250°F (120°C) at a speed of 10 ft/min (3m/min). The nip pressure was sufficient to give a measured density on standing overnight of 0.15 g/cm^3. Alternatively the fluff could have been pressed in a blotter lined platen press heated to about 250°F (120°C) for about 5 seconds, with sufficient pressure to achieve the desired fluff density.

The lower density fluff was prepared by passing it through a calender nip at 250°F (120°C) at a speed of 10ft/min (3 m/min) and sufficient pressure to achieve a measured density on standing overnight of 0.1 g/cm^3.

In both cases the fluff was prepared from southern pine bleached kraft wood pulp, and was cut to dimensions such that the weight conditions set forth in Table I below were met. The combined low density fluff and high density fluff weight are given in the first column of Table I. The total absorbent weight was maintained at about 37 grams for each diaper, except for the one containing superabsorbent. The diaper with superabsorbent material located as shown in Fig. 8 contained an additional 7 grams of superabsorbent composite

consisting of about 3 grams of particulate superabsorbent (Water Loc (TM) A-100 from Grain Processing Co., Muscatine, Iowa); about 3 grams of polyolefin; and about 1 gram of porous nonwoven wrap. The composite was made in accordance with the teaching set forth in U.S. Patent No. 4,381,782. The diaper construction was completed by sandwiching the absorbent composite between a porous spunbonded polypropylene liner (23 g/yd^2, 24.5 g/m^2) and a polyethylene film outer cover, sealed together with adhesive at the diaper perimeter. Five types of diapers were constructed in this fashion, corresponding to the diaper description of Table I.

Each of the diapers was then subjected to a 15 minute vertical wicking test with synthetic urine, followed by 15 minutes of equilibration out of contact with the urine bath. The results of this testing are shown in Table I and Figs. 10-14.

In this test the preweighed diapers were mounted on a lucite plate (3/8" x 13" x 14") (0.95 x 33 x 35.5 cm) with the impervious poly backing adjacent the plate surface. The diaper was symmetrically wrapped around the edge of the plate with the longitudinal dimension of the diaper parallel to the long dimension of the plate. The waist line edges of the diaper were mounted on the plate with masking tape, the elastic leg bands being cut in 2 or 3 places to facilitate the mounting.

The plate was suspended vertically over a fluid bath contained in a glass tray with the longitudinal dimension of the diaper perpendicular to the fluid surface. The fluid was then brought into contact with the lower edge of the diaper so that the diaper edge was slightly immersed, and was maintained in this position for 15 minutes. The diaper was then removed from fluid contact and allowed to hang in the same vertical orientation

for 15 minutes equilibration. The fluid used for the diapers in Table I was a synthetic urine composed of by weight 1% urea, 0.01% Pluronic 10R8 surfactant to bring the surface tension to about 56 dynes/cm, and 0.04% sodium azide preservative.

After equiliberation the diapers were removed from the plate and weighed and the fluid pick up noted. The results are summarized in Table I and represent the average of seven measurements on each diaper design.

After weighing, the diapers were laid horizontally on a 3" x 15" (7.6 x 38.1 cm) cutting die which was segmented into 9, 1.7-inch (4.3 cm) zones with cutting edges across the die width as well as the outer perimeter. Several quick blows with a wooden mallet divided the 3-inch (7.6 cm) wide absorbent strip along the longitudinal axis of the diaper into 9 segments. The absorbent component in each segment was weighed, over dried and reweighed and the fluid pick up determined on a gram per gram of fiber basis (corrected for deposited solids from the fluid).

In the case of the diaper with the superabsorbent pouch, the synthetic urine composition was adjusted to more closely simulate the electrolyte composition of baby urine, namely: 0.31 g. $CaH_4(PO_4)_2\ H_2O$, 0.68 g. $K\ H_2PO_4$, 0.48 g. $MgSO_4\ 7H_2O$, 1.33 g. K_2SO_4, 1.24 g. $Na_3PO_4\ 12H_2O$, 4.4 g. NaCl, 3.16 g. KCl, 0.4 g. NaN_3, 8.56 g urea and 0.1 g. Pluronic 10R8 per liter, using distilled water as the solvent. The components were added to 900 mls of distilled water in the order given and each dissolved before the next component was added, and finally diluted to 1 liter.

Fig. 10 relates to a control diaper, and the dotted curve represents the equilibrium capacity for the low density fluff at the indicated hydrostatic

tensions as measured in a capillary tension cell. It is apparent that only at short wicking distances (4.5 cm) does the fluff reach its ultimate capacity. At the greater wicking heights (9-18 cms) it is well below its capacity.

Figures 11-13 demonstrate the ability of the densified fluff layer to pull the fluid up against the hydrostatic heads indicated. Comparison of the fluid level in the low density fluff in the back of the diaper with that in the same material in front at the corresponding head is a measure of the effectiveness of the high density fluff to improve the utilization of the low density material (e.g. 2.8 g/g back vs. 0.1 g/g front at 18 cms head, Fig. 13).

Fig. 14 shows the effectiveness of the densified layers in carrying and transferring fluid to the superabsorbent. The levels of fluid pickup in the superabsorbents are 12 and 22 g/g respectively at the 9 and 13.5 cm heads. Comparing this to Fig. 12 illustrates the effectiveness of the superabsorbent in diverting fluid from the fluff components at the highest heads.

It is apparent from these results that fluid distribution is greatly enhanced up the back of the diaper in the designs with densified fluff layers. The contrast with the fluid distribution in the front of the diaper, where densified fluff layer is absent, is very evident from the figures. Of course, better fluid distribution in the front as well as the back of the diapers would be obtained when the second and third embodiments are followed. However, the first embodiment was followed for the purposes of these tests because the diaper front tends to become fairly thoroughly wetted when the release of waste fluid occurs when the child wearing the diaper is lying on its stomach, for example when it is sleeping.

Moreover, the results demonstrate that the fluid distribution in the low density fluff areas is significant. This demonstrates the unexpected synergism obtainable in these designs.

In the instance of the superabsorbent diaper, which was made in accordance with the fourth embodiment set forth in this specification, the superabsorbent material drained substantial fluid from the higher regions of the diaper. However, these regions toward the upper edge 8 of the diaper provide surplus absorbing capacity if needed.

TABLE I

Whole Diaper Vertical Wicking Test*

Diaper Description	Absorbent Weight g.	Weight of Comp. Fluff	Amt. of Fluid Absorbed g.	Fluid Absorbed Over Control %
Control Diaper	36	0	140	--
Diaper containing 1 ply of compressed fluff	38	7	171	22
Diaper with 2 plies of compressed fluff	37	14	191	37
Diaper with 3 plies of compressed fluff	35	21	203	45
Diaper with 2 plies of compressed fluff & SAM	43**	14	215	54

* - Absorption time: 15 minutes followed by 15 minutes equilibration time.

** - Contains 7 g. of assembly containing 3 g. SAM.

Example 2

Similar results as with the higher density fluff can be achieved with finer fiber, hardwood pulp fluff but at normal density (0.1 g/cm^3). This discovery was made following the observation of a remarkable similarity in the pore volume distribution of 0.1 g/cm^3 density hardwood fluff and that of 0.2 g/cm^3 softwood fluff. The following tables compare the vertical wicking properties of softwood and hardwood fluff.

The vertical wicking test was somewhat similar to that conducted with whole diapers described above. This test was conducted on 3" x 15" (7.6 x 38.1 cm) strips of the absorbent material mounted on a 3/8" x 5" x 14" (0.95 x 12.7 x 33.5 cm) lucite plate in the same orientation and manner described for the diapers. A nylon mesh screen was used to support the fluff strip on the lucite (acrylic) plate. The plate and strip were then suspended from weight-sensing means such as a load cell in an Instron tensile tester. The synthetic urine (in these cases the second or salt-containing formulation) was then put in contact with the lower edge of the absorbent strip and the amount of fluid absorbed as a function of time is recorded at several time intervals for the 15 minute duration of the test. The amount absorbed was calculated as the grams per unit basis weight of 1 gm/cm^2 per unit width (1 inch, 2.5 cm). The vertical wicking capacity is defined as the amount absorbed in the defined units at the end of the 15 minute test. The reported rate was that measured from

the plot of amount absorbed/unit basis weight/unit width versus time$^{\frac{1}{2}}$ over the time interval of 7-21 seconds. The test was replicated six times and the results reported are averages of these six measurements.

Fluid distribution in this test was measured by die cutting the sample immediately following the completion of the test, the same manner described for the whole diapers. In this case zones corresponding to the same vertical heights were combined to give the results shown in Table III.

As may be concluded from the results in Table II, the vertical wicking capacity of 0.1 g/cm^3 density hardwood fluff corresponds closely with that of 0.2 g/cm^3 density softwood fluff. The initial wicking rate of the hardwood fluff falls between the two softwood fuffs. The fluid distribution pattern in Table III also shows the similarity of the hardwood fluff and the 0.2 g/cm^3 density softwood fluff. These results imply a slightly larger average pore size for the former than the latter.

Hence, a combination of softwood and hardwood fluff at 0.1 g/cm^3 density should have similar fluid distribution properties to a two-density sandwich of softwood fluff, as previously described in this disclosure.

TABLE II

VERTICAL WICKING CAPACITY/RATE

(Showing similarity in capillarity of softwood kraft at 0.2 g/cm^3 and hardwood kraft at 0.1 g/cm^3 density)

Material	Density (g /cm^3)	*Vertical Capacity G/UBW/UW	Wicking Rate G/UBW/UW/SEC$^{\frac{1}{2}}$
Softwood Kraft Fluff	0.1	499	48
Softwood Kraft Fluff	0.2	573	36
Hardwood Kraft Fluff	0.1	580	42

* Units are grams per unit basis weight (1 g/cm^2) per unit width (1 inch, 2.5 cm)

TABLE III

FLUID DISTRIBUTION IN VERTICAL WICKING

	**Specific Absorbency (g/g) at Following Tensions				
	0cm	4.5cm	9cm	13.5cm	18cm
Softwood Kraft (0.1g/cm^3)	9.0	9.0	6.4	3.0	0.7
Softwood Kraft (0.2g/cm^3)	6.0	6.1	5.8	5.0	4.7
Hardwood Kraft (0.1g/cm^3)	8.2	8.1	7.2	5.3	3.3

** Tensions are measured as vertical distance from fluid source.

Example III

This example is directed to a double fluff layer of softwood fluff over hardwood fluff. The hardwood fluff was a bleached kraft, South American Eucalyptus hardwood pulp. The two-ply fluff contained equal weights of the softwood and hardwood pulp layers. After densifying the layers to 0.1 g/cm^3 density, the vertical wicking properties (same test procedure as for Example II) were as follows:

TABLE IV
VERTICAL WICKING PROPERTIES OF
SOFTWOOD/HARDWOOD LAYERED BATT

***Vertical Capacity	***Wicking Rate	***Specific Absorbency at Following Tensions				
		0cm	4.5cm	9 cm	13.5cm	18cm
544	46	7.8	7.8	6.1	4.3	3.0

*** Same units as in Tables II, III.

Comparing the distribution results for the double-layered fluff in Table IV with those for softwood kraft (Table III), it is apparent that the presence of the Eucalyptus layer greatly improves fluid wicking against the upper tow hydrostatic heads (i.e. in the 13.5 cm and 18 cm zones). This is particularly impressive since the Eucalyptus only represents 50% of the two-ply structure.

Example IV

A 40 g/m^2 web of meltblown polypropylene containing 40 percent by weight of superabsorbent (Waterlock J-500 from Grain Processing Company) was prepared. The superabsorbent was intermixed with the fine meltblown fibers (surface area about

1 m^2/g) containing enough surfactant (e.g., about 0.3-0.5 percent Triton X-102 from Rohm & Hass Company) to assure wetting of the fiber matrix, the composite being densified to 0.1 g/cm^3 during the manufacturing process.

When this web was subjected to the vertical wicking procedure described in Example II, the results presented in Table 5 were obtained. From these results it is apparent that the fluid wicks vertically 4.5 cms but then essentially stops, presumably because the swelling particles have restricted the fluid flow in the web by plugging the pores.

When this same web was placed beneath a softwood fluff layer, having a density of 0.2 g/cm^3, in a diaper construction, and the whole diaper was subjected to the vertical wicking test (described in Example I), the effect of the fluff layer as a fluid distributor for the superabsorbent was apparent. In Table 6, the fluid distribution is shown for the total absorbent composite, the fluff layer itself, and for the meltblown/superabsorbent web.

Comparing the vertical distribution for the meltblown/superabsorbent web from the diaper (Table 6) with the data in Table 5, it is apparent that the densified fluff acts to wick the fluid higher and improves the distribution to the superabsorbent (compare at 9 cm height, 11.6 g/g vs. 1.1 g/g; and at 13.5 cm height, 2.7 g/g vs. 0.1 g/g). Note that both tests were similarly run for 15 minutes. Furthermore, if the tests were allowed to proceed further, the height wicked in the diaper would continue to increase, whereas wicking in the superabsorbent web alone would virtually stop.

TABLE 5

VERTICAL WICKING TEST

MELTBLOWN/SUPERABSORBENT WEB

Description	Basis Weight g/m^2	Density g/cm^3	***Specific Absorbency at Following Tensions* 0.0cm	4.5cm	9.0cm	13.5cm	18.0cm
Meltblow Web with no Super-absorbent	93	0.1	7.9	7.7	2.4	0.0	0.0
Meltblow Web with 40% Super-absorbent	139	0.1	23.0	20.5	1.1	0.1	0.0

* Hydrostatic Tension in cm of water.
*** Same units as in Tables II and III.

TABLE 6

VERTICAL WICKING TEST

ON DIAPER CONTAINING

MELTBLOWN/SUPERABSORBENT WEB

Diaper Absorbent	Dry Absorbent Weight (g)	Absorbent Component	***Specific Absorbency at Following Tensions* 0.0cm	4.5cm	9.0cm	13.5cm	18.0cm
Fluff densified to 0.2 g/cm^3 over coextensive layer of Melt-blown Web with 40% Super-absorbent (basis weight 139g/m^2)	4.27	Fluff	7.5	7.2	4.5	2.5	1.5
		MB/SAM**	18.8	19.7	11.6	2.7	1.0
		Combined Absorbent	9.9	10.1	6.4	2.6	1.5

* Hydrostatic Tension, cms of water.
** Meltblown Web/Superabsorbent
*** Same units as in Tables II and III.

It is hereby stated that those embodiments discussed above and not including superabsorbent material are not embodiments of the present invention and are included for illustrative purposes only. However they are embodiments of the parent application, 8509580, which claims a disposable garment having a liquid liner to face the body of a user, an outer liquid impermeable cover and liquid absorbing material comprising a first layer of cellulosic fibres having a first average pore size and a second layer of cellulosic fibres having a second average pore size, said second average pore size being less than the first average pore size and said first layer being positioned between said second layer and said fluid permeable liner, wherein the respective pore size distribution of the two layers overlap so that the largest pore size of the second layer is greater than the smallest pore size of the first layer, so that in use the second layer draws fluid from a target area of the first layer and transfers the fluid to a position remote from the target area at which point at least a portion of the fluid is transferred back to the first layer.

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Claims:

1. A disposable garment comprising an absorbent structure having opposed longitudinal ends and including a liquid permeable liner to face the body of a user, an outer liquid impermeable cover, and liquid absorbing material therebetween, the liquid absorbing material including a body of cellulosic fibres wherein the structure further comprises superabsorbent material, such superabsorbent material being arranged to be disposed in use wholly between one longitudinal end of the structure and the target area where liquid initially accumulates on the garment, the superabsorbent material being mounted in liquid transfer contact with said body of cellulosic fibres, and the body of cellulosic fibres being effective in use to draw some of the liquid accumulating on the target area from said target area to said superabsorbent material so that the superabsorbent material provides an additional reservoir for liquid absorbed by the garment, such additional reservoir being longitudinally spaced from the target area.

2. A disposable garment as claimed in claim 1 wherein said body of cellulosic fibres has a substantially uniform density.

3. A disposable garment as claimed in claim 1 wherein said body of cellulosic fibres comprises a first layer of fibres having a first density located adjacent the permeable lining, and a second layer of fibres having a second density and being located between the first layer and the impermeable cover, said second desnity being greater than the first density.

4. A disposable garment as claimed in claim 3 wherein the first density is between 0.03 g/cc and 0.14 g/cc.

5. A disposable garment as claimed in claim 4 wherein the first density is between 0.07 and 0.11 g/cc.

6. A disposable garment as claimed in any of claims 3 to 5 wherein the second density is between 0.14 and 0.3 g/cc.

7. A disposable garment as claimed in claim 6 wherein the second density is between 0.16 and 0.22 g/cc.

8. A disposable garment as claimed in any preceding claim wherein said body of cellulosic fibres comprises softwood fluff.

9. A disposable garment as claimed in claim 8 wherein said body comprises preponderantly softwood fluff.

10. A disposable garment as claimed in claim 9 wherein said body comprises predominantly softwood fluff.

11. A disposable garment as claimed in any preceding claim wherein said superabsorbent material is interspersed in a web of fibres.

12. A disposable garment as claimed in claim 11 wherein said web comprises hydrophilic fibres.

13. A disposable garment as claimed in claim 11 or 12 wherein said web is in the form of a pouch.

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14. A disposable garment as claimed in claim 11, 12 or 13 wherein said web comprises meltblown fibres mixed with said superabsorbent material.

15. A disposable garment as claimed in any of claims 11 to 14 comprising a layer of cellulosic fibres, located between said superabsorbent material and said impermeable cover.

16. A disposable garment as claimed in claim 1 wherein said body of cellulosic fibres has a substantially uniform density of substantially 0.2 g/cc.