United States Patent [19]

Chatterjee

[11] **3,858,585**

[45] **Jan. 7, 1975**

[54] **FLUID ABSORPTION AND RETENTION PRODUCTS AND METHODS OF MAKING THE SAME**

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[22] Filed: **Jan. 15, 1973**

[21] Appl. No.: **323,598**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 126,743, March 22, 1971, Pat. No. 3,731,686, which is a continuation-in-part of Ser. No. 797,791, Feb. 10, 1969, abandoned.

[52] **U.S. Cl.** ..... **128/290 R,** 128/287, 128/296

[51] **Int. Cl.** **A61f 13/16**

[58] **Field of Search** ..... 128/284, 287, 290 R, 296, 128/284 R

[56] **References Cited**

UNITED STATES PATENTS

2,486,805	11/1949	Seymour et al.	128/287
2,952,259	9/1960	Burgeni	128/290 R
2,952,260	9/1960	Burgeni	128/290 R
3,005,456	10/1961	Graham, Jr.	128/290 R
3,525,735	8/1970	Miller	128/296
3,589,364	6/1971	Dean et al.	128/296
3,731,686	5/1973	Chatterjee	128/290 R

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[57] **ABSTRACT**

An absorbent dressing is provided having improved fluid absorptive properties by including therein a substantially uncompressed body comprising absorbent fibers of an alkali metal salt of carboxyalkyl cellulose. The absorbent carboxyalkyl cellulose fibers are heat-treated so as to become insoluble but swellable in water at room temperatures and by virtue of this heat treatment, derive the improved fluid absorptive properties of this invention.

6 Claims, 5 Drawing Figures

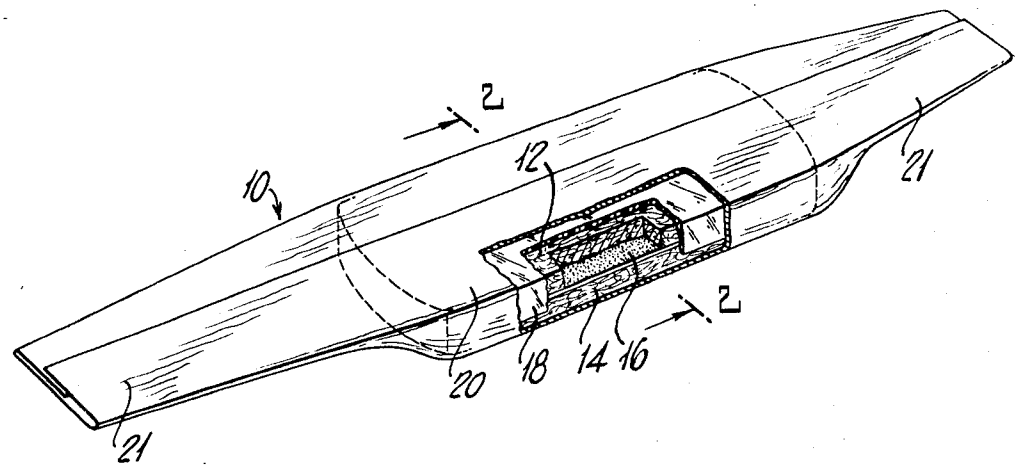


Fig. 1.

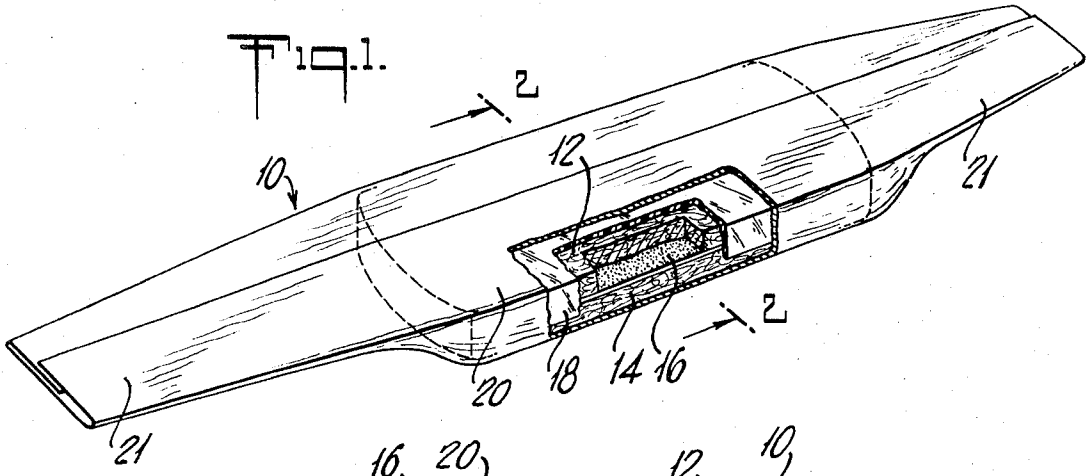


Fig. 2.

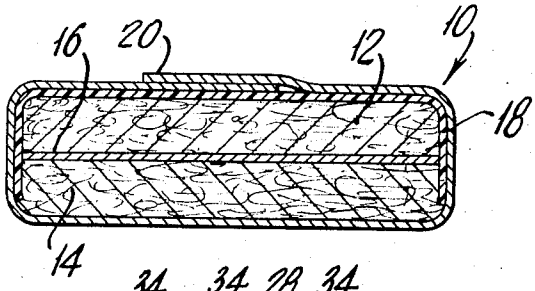


Fig. 3.

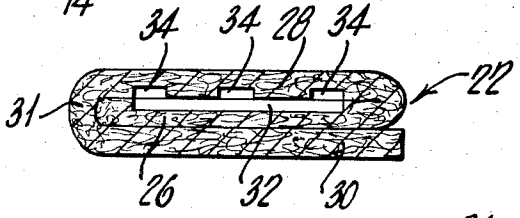


Fig. 4.

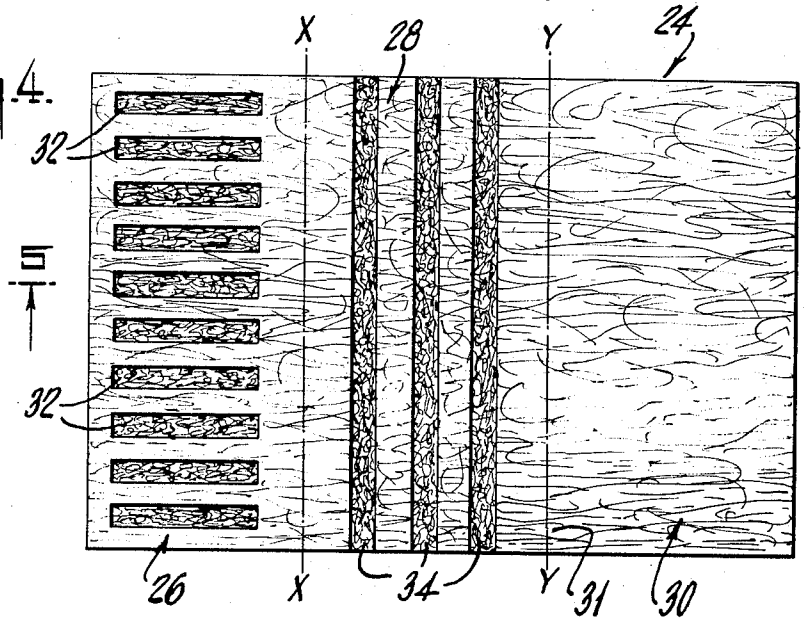
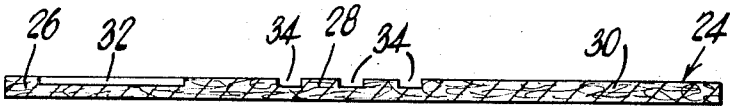


Fig. 5.



FLUID ABSORPTION AND RETENTION PRODUCTS AND METHODS OF MAKING THE SAME

This application is a continuation-in-part of my co-pending U.S. application, Ser. No. 126,743, filed on Mar. 22, 1971, now U.S. Pat. No. 3,731,686, which is a continuation-in-part of U.S. application, Ser. No. 797,791, filed on Feb. 10, 1969 and now abandoned.

BACKGROUND OF THE INVENTION

The present invention relates to absorbent products and more particularly to absorbent dressings and articles of manufacture having improved fluid absorption and retention properties and methods of making the same. More specifically, the present invention relates to such articles of manufacture as sanitary napkins, diapers, surgical dressings, hospital underpads, sponges and bandages as well as other intra- and extracorporeal body exudate and fluid absorption and retention materials.

Cotton, rayon, wood pulp and similar natural and synthetic cellulosic materials have long been used extensively in the preparation of absorbent dressings and similar products and they have been found satisfactory for many purposes. However, many other materials have long been studied and have been considered as possible replacements or improvements for such cellulosic materials. Various carboxyalkyl ethers of cellulose, notably carboxymethyl cellulose, have been considered and in some areas have been suggested for fluid absorption and retention purposes. For example, U.S. Pat. No. 3,005,456 which issued Oct. 24, 1961, discloses the use of carboxyalkyl cellulose, notably carboxymethyl cellulose and carboxyethyl cellulose, particularly for catamenial tampons. However, it is to be noted that the use of such carboxyalkyl ethers of cellulose is normally limited to those having a maximum average degree of substitution (D.S.) of about 0.35 carboxyalkyl radicals per anhydroglucose unit in the cellulose. Beyond that degree of substitution, the carboxymethyl cellulose tends to become too water-soluble in its properties which is now believed to cause the fluid absorption and retention properties to fall off to an extremely low, undesirable value. It is believed that water-soluble carboxymethyl cellulose, having an average D.S. greater than 0.35, upon being contacted by fluid, quickly becomes surface-wetted, swells rapidly and agglomerates or cakes into a gel-like mass. This gelling is at the outermost surface portions of the carboxymethyl cellulose and delays or perhaps completely blocks further access of fluid to the innermost portions of the carboxymethyl cellulose whereby very little additional fluid absorption is accomplished in a reasonable period of time.

In my above referenced co-pending application, it was disclosed that if a water-soluble, carboxyalkyl ether of cellulose in fibrous form, such as carboxymethyl cellulose, is given a controlled heat treatment at selected elevated temperatures and for a specified duration of time, the carboxymethyl cellulose fiber is modified and becomes water-insoluble. It was also disclosed that when such heat-treated carboxymethyl cellulose fibers are used in a compressed state, as for example, in a compressed absorbent body which includes portions compressed to a density ranging from about 90 grains per cubic inch to about 215 grains per cubic inch, the resulting compressed body exhibits excellent fluid absorption and retention properties for all degrees of substitution without showing any tendency toward agglomerates, caking, gelling or blockage of wicking. Thus, the heat-treated fibers in compressed form are particularly useful in, for example, catamenial tampons, and compressed portions of sanitary napkins and other absorbent dressings.

SUMMARY OF THE INVENTION

The present invention is directed toward the use of heat treated fibers in uncompressed products. In accordance with this instant invention, it has been discovered that an absorbent dressing having improved fluid absorptive properties may be provided by including therein a substantially uncompressed body comprising absorbent fibers of an alkali metal salt of carboxyalkyl cellulose having an average degree of substitution greater than about 0.35 carboxyalkyl radicals per anhydroglucose residue in the cellulose, the absorbent alkali carboxyalkyl cellulose fibers being heat treated so as to become insoluble but swellable in water at room temperature. Thus, for example, the heat treated fibers of this invention may be used in the uncompressed portions of sanitary napkins, diapers and other absorbent products having both compressed and uncompressed portions of these products, as well as in such products which are entirely uncompressed. When so utilized, the heat treated fibers will provide such products with improved fluid absorptive properties. Stated in other words, an improvement in the absorptive properties of absorbent products may be realized by incorporating the fibers of this invention into bodies of absorbent fibers less dense than, for example, the 90 to 215 grain per cubic inch densities typical for catamenial tampons. The invention will be more clearly understood by reference to the accompanying drawings taken together with the detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

With reference to the accompanying drawings:

FIG. **1** is a perspective view of a sanitary napkin having an uncompressed absorbent body incorporating the present invention and partially cut away to reveal a representative inner construction;

FIG. **2** is a cross-sectional view of the napkin of FIG. **1** taken along line **2—2**;

FIG. **3** is a schematic cross-sectional view of a partially compressed absorbent body incorporating the present invention and useful in a sanitary napkin such as that of FIG. **1**;

FIG. **4** is a planar view of a single sheet of absorbent material which may be folded to result in the absorbent body of FIG. **3**; and

FIG. **5** is a cross-sectional view of the sheet of absorbent material shown in FIG. **4** and taken along line **5—5**.

DETAILED DESCRIPTION OF THE INVENTION

The invention will be herein described with special emphasis on carboxymethyl cellulose fibers as the fluid absorption and retention material in a specific product; namely, a sanitary napkin. It should be understood, however, that this is done for illustrative purposes and that the broader aspects of the invention are not to be construed as limited thereto but are to be considered equally applicable to other articles of manufacture

such as those mentioned herein, as well as to fibers of other ethers of cellulose, such as carboxyethyl cellulose, carboxymethyl hydroxyethyl, or other cellulose ethers containing the carboxyalkyl radical or, more precisely, as will be pointed out hereinafter, the sodium salts thereof.

Referring now to FIGS. **1** and **2,** there is shown a sanitary napkin **10** comprising an upper fluid absorption and retention pad **12** and a lower fluid absorption and retention pad **14** between which is positioned a sheet of fluid pervious tissue paper **16** provided to control the flow of liquid between the pads. The upper face of the napkin, i.e., the face used away from the body, is provided with a fluid impervious barrier sheet **18,** e.g., a sheet of polyethylene film, to preclude body fluid from wetting this face, i.e., to preclude fluid "strike through." As illustrated in the drawings, the barrier sheet **18** may be extended to protect the sides of the napkin as well. The entire construction is wrapped within an extended cover **20** made of a non-woven fabric or of a woven fabric, such as gauze, or even of a knitted fabric and, as is conventional, the cover extends beyond the ends of the pads to form the usual attachment tabs **21.** Such structure is exemplary of a form of sanitary napkin and is primarily employed to illustrate the incorporation of the invention in a sanitary napkin. It must be realized, however, that such structure is not limitative but is merely illustrative of one form of a napkin incorporating the present invention. For example, many napkins and other absorptive pads are formed without the usual attachment tabs. In some cases, the barrier sheet **18** or the tissue sheet **16** is dispensed with. In other variations, more or less than two pads are used or the cover **20** does not completely enclose the pads and the barrier sheet **18** is used to enclose the remaining portion. In any event, these variations are all susceptible to improvement by the present invention.

At least one of the pads **12** or **14** is comprised of fibers of this invention and is in the essentially uncompressed state. That is to say, unlike the absorbent bodies used in compressed catamenial tampons wherein the density is generally in the range of about 90 grains per cubic inch or higher, the fibers in the absorbent body, e.g., pad **12,** of the illustrated sanitary napkin are in the uncompressed state and are less than 90 grains per cubic inch. Typical uncompressed densities of such pads are, for example, about 2.5 to about 25 grains per cubic inch and more generally are about 5 to about 13 grains per cubic inch.

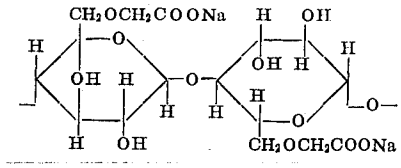
Referring now to FIGS. **3–5,** illustrated therein, is a second embodiment of an absorbent body utilizing the fibers of this invention and suitable as a substitute for one or both of the pads **12** or **14** illustrated in FIGS. **1** and **2.** FIG. **3** depicts, in schematical cross section, an absorbent body **22** folded, from the single sheet of absorbent material **24** shown in FIGS. **4** and **5,** to create a three plied pad. The sheet **24** is shown as being divided into three sections **26, 28** and **30,** respectively, by indicia lines X-X and Y-Y, said sections then corresponding to each of the three plies in the folded pad shown in FIG. **3.** Section **26** is provided with transverse embossed portions **32** and section **28** is provided with longitudinal embossed portions **34.** These embossed portions represent compressed areas of the absorbent material of sheet **24** and are useful, as is more fully described in U.S. Pat. No. 2,952,259 issued to Alfred A. Burgeni on Sept. 13, 1960, to control the flow of fluid through the pad **22** and to provide the pad with desirable structural stability and springiness. The pad **22** is thus comprised of portions of both high and low density, the embossed areas **26** and **28** having a density of the range of about **75** to about **126** grains per cubic inch and the unembossed areas such as unembossed section **30** or side section **31** having densities of about 2.5 to about 13 grains per cubic inch. As specific examples herein will more clearly show, the heat treated fibers of this invention, when incorporated in an uncompressed body of fibers, such as, for example, sections **30** and **31** of pad **22,** will result in improved fluid absorptive properties.

The absorbent fibers in the fluid absorption and retention bodies **12, 14** and **22** comprise fibrous carboxyalkyl cellulosic materials, preferably carboxymethyl cellulose, which have been heat-treated, modified, and improved by the methods of the present invention. The carboxymethyl cellulose is in fibrous form, such as is described in U.S. Pat. No. 3,005,456 issued on Oct. 24, 1961.

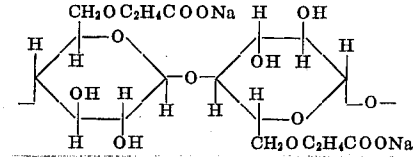
Although carboxymethyl cellulose is generally available commercially in degrees of substitution up to only about 1.4, methods are disclosed in the scientific literature for making carboxymethyl cellulose in fibrous form from cotton linters in a multi-stage carboxymethylation with degrees of substitution up to 2.50 and 2.77. Reference is made to Carbohydrate Chemistry, Vol. III (Cellulose), (1963) pages 322–327 for a disclosure of such methods.

The above literature reference describes the use of cotton linters as the basic starting raw material for making carboxymethyl cellulose. it is to be appreciated that other basic starting raw materials, notably rayon fibers and wood pulp, can always be used.

The idealized structural formula for carboxymethyl cellulose is as follows, showing a degree of 1.0:

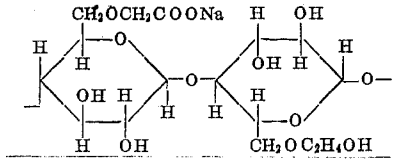


The idealized structural formula for carboxyethyl cellulose is as follows, showing a degree of substitution of 1.0:



Carboxyethyl cellulose is obtained by basically the same mechanism as is used for carboxymethyl cellulose except that monochloropropionic acid and sodium hydroxide are used rather than monochloroacetic acid and sodium hydroxide.

The structural formula for carboxymethyl hydroxyethyl cellulose is as follows, showing a degree of substitution of 0.5 for carboxymethyl and 0.5 for hydroxyethyl:



Carboxymethyl hydroxyethyl cellulose is prepared by carrying out the hydroxyethylation reaction first and then following with the carboxymethylation reaction second.

Consideration of the above structural formulas will indicate that, although the terms "carboxymethyl cellulose," "carboxyethyl cellulose" and "carboxymethyl hydroxyethyl cellulose" are used herein, a more precise but lengthier term should include a reference to the fact that they are commercially available and are normally used as the sodium salt of such chemical compounds. Other alkali metal salts which are not as commercially available but which are equally applicable are the potassium, lithium, rubidium and cesium salts.

The fibers of carboxymethyl, cellulose are modified according to the present invention by being heated at a temperature preferably of from about 120°C. (248°F.) to about 270°C. (338°F.) for a period of from about one hour to about 20 hours. The reaction is exothermic. Lower temperatures down to about 110°C. (230°F.) may be used but the duration of the heat treatment must then be prolonged to about 30 hours or more which is economically undesirable. In the same way, higher temperatures of about 200°C. (392°F.) or even approaching the browning temperature of about 226°C. (438°F.) may be employed for durations of heat treatments of only about 10 or 15 minutes or even less but such is a more delicate process, requiring much closer controls to avoid localized overheating or other damaging influences.

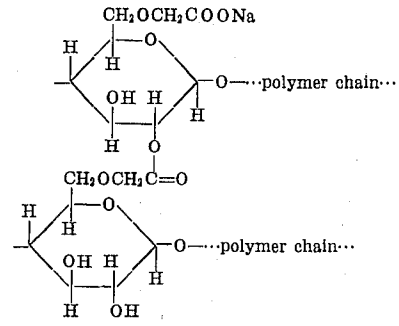
Pressure may be employed during the heat treatment whereby the temperature and time factors are decreased accordingly, as is well known in the art.

The most notable change is that the carboxymethyl cellulose fibers, subsequent to the heat treatment, become water-insoluble, and although they do swell in water several hundred per cent, they do so without developing the characteristic slippery feeling of wetted, untreated carboxymethyl cellulose. Both the untreated and heat-treated carboxymethyl cellulose fibers are soluble in six percent sodium hydroxide solution. The browning temperature of the heat-treated carboxymethyl cellulose fiber remains in the range of about 226°–228°C. and the charring temperature also is not materially changed from the original range of about 252°–253°C. for the untreated form. The specific gravity of the heat-treated carboxymethyl cellulose is about 1.59 grams/milliliter.

The resulting heat-treated fibers, in the uncompressed state, when treated with water at room temperature show tremendous water absorption and retention, along with excellent swelling, but are able to maintain their fibrous structural integrity. For example, when a heat treated fibrous carboxymethyl cellulose sample having a D.S. of 0.7 is used in the uncompressed state and treated with water at room temperature, both the quantity of water held at saturation and the quantity of water retained after water held in the interfiber capillaries is removed are both substantially higher than when an equivalent wood pulp sample is used. In contrast to this result, equivalent samples utilizing untreated 0.7 D.S. carboxymethyl cellulose fiber are soluble in water at room temperature, lose their fibrous structure, and are entirely unsuitable for use in an absorbent product as herein contemplated.

Although the exact mechanism of the modification of the carboxymethyl cellulose has not been completely proved beyond doubt, it is believed that there is some degree of internal esterification taking place between the carboxylic radicals of the carboxyalkyl group and the remaining unreacted hydroxyl groups of the main cellulose unit or anhydroglucose unit. As such, it may be generally classified as a crosslinking, internal esterification between adjacent chains of the repeating cellulose units or anhydroglucose units.

The structural formula for a typical unit of such a crosslinked internally esterified carboxymethyl cellulose (average D.S. = 1.0) is believed to be as follows, with each anhydroglucose unit illustrated being derived from separate chains.



Not to be ignored, however, is the lesser possiblity that there is an anhydride formation between adjacent carboxylic groups, leading to a crosslinking condensation reaction between adjacent chains. This however, is a less likely possiblity.

The invention will be described in greater detail by reference to the following examples and tables wherein specific embodiments of the invention are set forth for illustrative but not for limitative purposes.

EXAMPLE I

Three parts of uncompressed absorbent cellulosic fibers are prepared. The fibers of the first sample are southern pine, bleached kraft wood pulp fibers such as are conventionally used in absorbent products. The fibers of the second sample are conventional, unmodified sodium carboxymethyl cellulose fibers derived from wood pulp) having an average D.S. of 0.7. The fibers of the third sample are the same sodium carboxymethyl cellulose fibers having an average D.S. of 0.7 as those of the second sample but are, in accordance with this invention, heat-treated in an oven at 160°C. for four hours and then conditioned at room temperature and at a relative humidity of 50 percent for 18 hours. The three samples are then saturated with a solution of ersatz menstrual fluid by placing each of the samples in a beaker and covering them with excess fluid. The excess fluid is then drained off and the undissolved, saturated samples are weighed immediately to determine the weight of fluid absorbed. Each undissolved sample is then squeezed to remove fluid held in the interfiber capillaries and then reweighed to determine the fluid

retained. The results are reported in Table I below.

TABLE I

SAMPLE	DRY WEIGHT GM.	DENSITY GRAIN/ in^3	SATURATION CAPACITY (cc of fluid/ gm of fibers)	RETENTION CAPACITY (cc of fluid/ gm of fibers)
1. Wood Pulp	5	2.5	16	2
2. Unmodified Sodium Carboxymethyl Cellulose	5	2.5	soluble	—
3. Heat-treated Sodium Carboxymethyl Cellulose	5	2.5	45	18

As is evident from Table I, the unmodified sodium carboxymethyl cellulose fibers (Sample 2) are entirely unsuitable as a substitute for the conventional absorbent wood pulp in that, these fibers, having a D.S. of 0.7 are soluble in the ersatz menstrual fluid and lose their fibrous structural integrity. In contrast thereto, the heat-treated fibers of this invention (Sample 3) not only maintain their fibrous structure but in fact significantly surpass the absorbency and retention capacities of wood pulp.

EXAMPLE II

As in the previous examples, three pads of uncompressed absorbent cellulose fibers are prepared; the first sample consisting of southern pine bleached kraft wood pulp fibers, the second sample consisting of conventional, unmodified sodium carboxymethyl cellulose fibers derived from cotton and having an average D.S. of 0.7, and the third sample consisting of the same sodium carboxymethyl cellulose fibers as used in the second sample, however, these fibers being heat treated in an oven at 160°C. for 4 hours and then conditioned, at room temperature and at a relative humidity of 50 percent of 12 hours. The three samples were then tester in a Porous Plate Testing Apparatus for both maximum fluid capacity and for fluid retention. The Porous Plate test is described in detail in (Textile Res. J., 37, 356–366, 1967). Briefly, this test involves placing the sample in what is essentially a Buckner funnel having a porous bottom plate and holding the sample in place by applying a standard weight thereto to standardize the confining pressure. The porous plate is placed in contact with a reservoir of fluid and the sample is allowed to absorb fluid through the porous plate. The sample being essential at the level of the reservoir, the fluid absorbed is subjected to essentially a zero hydraulic level with respect to the reservoir. The apparatus is provided with means for directly measuring the volume of fluid absorbed from which the maximum capacity absorbed is calculated. To determine fluid retention values, the saturated sample is elevated with respect to the fluid reservoir, thereby imposing a hydraulic head upon the fluid absorbed which, in the case of the examples herein, is 36 inches of fluid The apparatus is provided with means for directly measuring the volume of fluid retained under this hydraulic head, from which the retention values are calculated. Portions of each sample are tested in three different water solutions of varying sodium chloride concentrations representing the range of sodium chloride concentrations of body fluids and exudates. The results are reported in Table II below. Table II clearly indicates that, at the lower saline composition there is a substantial difference in the total capacity and the retention values of the heat-treated sample (Sample 3) of this invention as compared to the conventional wood pulp fibers (Sample 1). As the saline concentration increases, the difference between total capacity values diminishes, however, there is still a large difference in the values obtained for retention. The unmodified sodium carboxymethyl cellulose (Sample 2) is clearly unsuitable because of its solubility in the test fluids. As the following examples will serve to illustrate, the performance of the fibers in an absorbent product, such as a sanitary napkin, is a complex function of both the capacity and the retention.

TABLE II

		ABSORBENCY (CC FLUID/GM FIBERS)					
		WATER		0.5% AQUEOUS Na Cl		1% AQUEOUS Na Cl	
SAMPLE	DENSITY (grains/Ca in)	Maximum* Capacity	Retention**	Maximum* Capacity	Retention**	Maximum* Capacity	Retention
1. Pulp	25	14	2	14	2	14	2
2. Unmodified Sodium Carboxymethyl Cellulose	25	Soluble	—	Soluble	—	Soluble	
3. Heat-Treated Sodium Carboxymethyl Cellulose	25	33	20	16	10	15	9

* Measured at zero hydraulic head and 1 gm/cm^2 confining pressure
** Measured at 36 inch hydraulic head and 1 gm/cm^2 confining pressure

EXAMPLE III

Two sanitary napkins were prepared having the construction shown in FIGS. 1 and 2 and utilizing a polyethylene barrier film and a tissue insert. The pads of the first napkin both consisted of 100 percent southern pine, bleached kraft wood pulp fibers. The pads of the second napkin both consisted of a uniformly distributed mixture of southern pine, bleached kraft wood pulp fibers and sodium carboxymethyl cellulose fibers (wood pulp derived) having a D.S. of 0.7 and having been heat treated in an oven at 160°C. for 4 hours and then conditioned for 12 hours at room temperature and

50 percent relative humidity. The fibers are in a weight ratio of wood pulp to heat-treated sodium methylcellulose of 90:10. Dynamic Form tests are performed by suspending each of the sample napkins across a rubber mold which simulates the female form. The form is set into motion by means of a set of gears, cans and rods and an ersatz menstrual fluid containing one percent NaCl, by weight, is allowed to drip onto the napkin to simulate in-use conditions. The fluid is applied at a rate of 0.2 c.c. per minute and the form is operated at a speed of 60 cycles per minute. The fluid capacity of the napkin under dynamic conditions is measured by the total volume of fluid applied at the time of failure, i.e., the time at which spotting is noted on the underside of the napkin. The results of this test is shown in Table III.

TABLE III

	SAMPLE	PAD		FLUID CAPACITY AT FAILURE
		Weight Grains	Density Grain/ cu.in.	
1.	100% Wood Pulp	200	10	12.2
2.	90:10 Wood Pulp: Modified CMC	200	10	20.5

EXAMPLE IV

Two sanitary napkins were prepared having the construction shown in FIGS. **1** and **2** but substituting for the pads and tissue insert of that construction, the embossed pad shown in FIGS. **3–5.** The first napkin pad consisted of 100 percent solution pine, bleached kraft wood pulp fibers. In the second napkin pad, a portion of the unembossed section 30 weighing 15 percent of the total weight of the filler was removed and replaced by fibers of sodium carboxymethyl cellulose having a D.S. of 0.7 and having been heat treated in an oven at 160°C. for four hours and then conditioned at room temperature and 50 percent relative humidity for twelve hours. In both napkins, the density of the unembossed portions of the pad was approximately ten and the density of the embossed portions was about 108 grains/cu. in.

The two napkins were tested for absorbency by utilizing a Burette Drip Test and the Dynamic Form Test, the latter test being described in the previous example. In the Burette Drip Test, the napkin to be tested is placed on a glass plate attached to ring stand and a 50 ml burette is positioned two inches above the napkin so as to release fluid dropwise onto the center of that face of the napkin normally used against the body. A mirror is placed below the glass plate to allow observation of the opposite face. The quantity of fluid released upon the napkin from the burette, at the time that napkin failure is observed, is recorded as the total absorbency. For this example, an ersatz menstrual fluid having a one percent, by weight, sodium chloride concentration was allowed to fall dropwise at a rate of 4 cc/min. The results of these tests are tabulated in Table IV below.

TABLE IV

	SAMPLE	Total Absorbency (cc) Burette Drip Test	Dynamic Form Test
1.	100% Wood Pulp	10.4*	10.7**
2.	15% Heat-Treated Na CMC 85% Wood Pulp	19.0*	23.6**

* Polyethylene Barrier Film Removed
** Polyethylene Barrier Film Included

EXAMPLE V

Two sample napkins were prepared in accordance with Example IV, with the exception, in that both samples, transverse embossing was provided on that portion of the pad designated for FIG. **3** as section **30** so that those portions embossed amounted to 15 percent of the total weight of one filler and the density of the embossed area was equal to 108 gr./cu. in. The unembossed area had a density of 10 gr./cu. in. The napkins are tested using the Burette Drip Test described above. The results are reported below in Table V.

TABLE V

	Napkin	Total Absorbency Burette Drip Test
1.	100% Wood Pulp	21.2
2	15% Heat-Treated Na CMC	39.2

EXAMPLE VI

Two sanitary napkins, identical to the first sample of the previous example was prepared. A quantity of sodium carboxymethyl cellulose fibers having a D.S. of 0.7 and heat-treated and conditioned as in the previous examples, was added to the first sample. The sodium carboxymethyl cellulose fibers were distributed on that portion of the pad designated in FIG. **3** by the numeral **31.** The density of this section was 10 gr./cu. in. A quantity equivalent to five percent by weight of the total pad weight was so distributed. In the second napkin, a quantity of additional wood pulp equivalent to five percent by weight was similarly distributed. The napkins were treated for total absorbency, using the Dynamic Form Test described above and using an ersatz menstrual fluid containing one percent Na Cl.

TABLE VI

	SAMPLE	ABSORBENCY (cc) DYNAMIC FORM TEST
1.	100% Wood Pulp	11.9**
2.	5% Heat-Treated Na CMC 95% Wood Pulp	20.5**

** Polyethylene Barrier

As the above examples indicate, the heat-treated carboxyalkyl cellulose fibers of this invention may be used wherein or in combination in the uncompressed state to improve the properties of absorbent products. In blending the fibers of this invention with other absorbent materials and fibers, a wide variety of such other materials and fibers may be included in percentages as low as about one percent by weight or as high as about 98 percent by weight, with preferred ranges from about 5 to about 50. Such other fibers may, for example, include cotton, rayon, wood pulp, comminuted tissue or other paper, etc.

If desired, other materials and other fibers, not necessarily fluid absorbent, may be added in similar percent-

ages by weight (as noted in the preceding paragraph) to obtain special characteristics and properties. Such other materials and other fibers include, for example, untreated carboxymethyl cellulose fibers, cellulose esters such as cellulose acetate, polyamide fibers such as nylon 6, nylon 6/6, nylon 12, etc., polyester fibers scuh as "Dacron," "Kodel," etc., acrylic fibers such as "Dynel," "Orlon," etc.

Although the present invention has been described with several examples and embodiments showing specific materials and specific products in specific arrangements and conformations, such is not to be considered limitative of the invention but merely illustrative thereof.

What is claimed is:

1. In an absorbent dressing including an uncompressed body comprised of absorbent fibers of an alkali metal salt of carboxyalkyl cellulose having an average degree of substitution greater than about 0.35 carboxyalkyl radicals per anhydroglucose residue in the cellulose, the improvement wherein said fibers have crosslinkages, said crosslinkages consisting of adjacent chains of repeating anhydrglucose units linked directly to each other by heat treating without the use of crosslinking agents.

2. The dressing of claim **1** wherein said linkages consist of internal esterification between adjacent chains of the repeating anhydroglucose units.

3. An absorbent dressing as defined in claim **1** wherein said uncompressed body includes portions having a density of less than 90 grains per cubic inch.

4. An absorbent dressing as described in claim **1** wherein said absorbent fibers of the alkali metal salt of carboxyalkyl cellulose and sodium carboxymethyl cellulose fibers.

5. An absorbent dressing as defined in claim **4** wherein said absorbent fibers of the alkali metal salt of the carboxyalkyl cellulose have an average degree of substitution in the range of greater than 0.35 and up to about 1.4.

6. An absorbent dressing as defined in claim **1** wherein the absorbent dressing is a catamenial device.

* * * * *

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,858,585 Dated January 7,1975

Inventor(s) Pronoy Kumar Chatterjee

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In Column 2, line 21, "being heat treated" should read --- being first heat treated ---.

In Column 4, line 33, "it is to be" should read --- It is to be ---

In Column 5, line 21, "carboxymethyl, cellulose" should read --- carboxymethyl cellulose ---.

In Column 5, line 24, "270°C." should read --- 170°C. ---

In Column 6,line 6, "carboxymethyl" should read --- carboxyalkyl ---.

In Column 6, line 53, "derived" should read --- (derived ---.

In Columns 7-8, Table 11, No.2, "Unmodified Sodium Carboxymethyl" should read --- Unmodified Sodium Carboxymethyl Cellulose, etc.---.

In Column 9, line 33, "solution pine" should read --- southern pine ---.

In Column 11, line 6, "scuh" should read --- such ---.

In Column 12, line 1, "anhydrglucose" should read --- anhydroglucose ---.

Signed and Sealed this

second Day of September 1975

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks