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[54] FLUSHABLE WRAPPER FOR ABSORBENT PADS

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[58] **Field of Search** .....128/284, 287, 290, 296; 117/140 A, 161 UE, 139.5 A

[56] **References Cited**

UNITED STATES PATENTS

2,251,296	8/1941	Shipp	117/161 UE
2,300,074	10/1942	Strain	117/161 UE
2,439,108	4/1948	Staehle	117/161 UE
2,607,765	8/1952	Czerwin et al.	117/161 UE
3,288,631	11/1966	Jorder	117/140 A
3,438,808	4/1969	Hawkins et al.	117/161 UE
3,480,016	11/1969	Constanza et al.	128/284
3,561,447	2/1971	Alexander	128/290 W

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[57] **ABSTRACT**

A flushable wrapper for sanitary napkins and other absorbent pads. The wrapper comprises a non-woven fiber web bonded by cold-water soluble polyvinyl alcohol and subsequently treated with an insolubilizing agent which renders the polyvinyl alcohol resistant to solubilization in a moisture laden environment. A web thus bonded has enough wet strength and abrasion resistance to perform satisfactorily at moisture levels encountered during normal use, yet disintegrates sufficiently fast after soaking in excess water to permit disposal by flushing.

10 Claims, No Drawings

FLUSHABLE WRAPPER FOR ABSORBENT PADS

BACKGROUND OF THE INVENTION

Many attempts have been made to produce sanitary napkins and other absorbent pads which for disposal purposes may be flushed away safely in conventional toilets. While the individual absorbent components of a sanitary napkin, i.e. wood fluff, absorbent cotton batts, cellulose wadding and the like, are of such construction that they easily disintegrate when agitated in water, the necessary strength requirements for the fluid-pervious wrapper enclosing such components is usually such that it will not disintegrate even after extended exposure to water. Therefore, such wrapper elements must first be removed by the user when an attempt is made to dispose of the napkin in a toilet, otherwise the absorbent components will not disintegrate because they cannot escape the confines of the wrapper. Since such napkins will retain most of their bulk form if retained in the wrappers, they frequently cause stoppages in the disposal system when attempts at disposal are made, either accidentally or intentionally, without first removing the wrapper. The wrapper, of course, can be stripped off, but this procedure is extremely inconvenient and unsanitary, and for that reason the user usually prefers not to go to that trouble, and instead, will dispose of the used napkin in a disposal bag or other container for solid wastes.

Accordingly, there is a need to provide sanitary napkins and similar absorbent pads with a wrapper which is strong enough to perform its support and pad-retaining function and yet which will disintegrate readily after a short time exposure in flowing water. Non-woven fiber webs bonded by cold-water soluble adhesives such as polyvinyl alcohol, polyvinyl methylether, glycol cellulose, cellulose glycolate, methyl cellulose, and the like, have been tried as sanitary pad wrappers and found to be readily disintegratable in excesses of water. However, while the latter characteristic was easily achieved, it was also found that these water-soluble adhesives tended to soften and dissolve prematurely in the presence of body moisture generated by perspiration and discharged body fluids with the undesirable result that the wrapper often weakened and ruptured while worn. Accordingly, such wrappers were considered unsatisfactory for general use.

The present invention is directed to a non-woven napkin wrapper which disintegrates in excess water after a short period, but which also has sufficient wet strength to retain its integrity in use when exposed to the moist environment of the body.

SUMMARY OF THE INVENTION

In accordance with this invention, a flushable nonwoven fabric, suitable for use as a wrapper for sanitary napkins and other absorbent pads, is provided by first applying to a web of fibers a cold water soluble polyvinyl alcohol binder, such as by spraying, impregnating, or printing. Before the polyvinyl alcohol treated web is dried to set the binder, it is oversprayed with a solution of a gelling or insolubilizing agent, such as borax. This agent, when applied to the polyvinyl alcohol treated web before the polymer has set to a film, reacts with the binder to cross-link at least the exposed surface areas of the polymer sufficiently to render the reacted binder somewhat water resistant after the web is dried. Webs treated in this manner are found to retain much greater strengths at the intermediate moisture levels normally encountered during use, than webs bonded by untreated or unmodified polyvinyl alcohol. Yet in large excesses of water, the insoluble nature of the treated binder is nullified, and the web bonded with borax treated binder disintegrates almost as fast as a web bonded by a polyvinyl alcohol which is untreated. The large excess of water is instrumental in leaching out the borax to destroy enough of the cross-links in the polymer to reduce water-resistance to a non-effective level.

Accordingly, it is an object of the present invention to provide an improved fluid-pervious wrapper for sanitary napkins and other absorbent pads, which wrapper retains sufficient strength to retain its integrity during normal use in the presence of body moisture, but disintegrates readily after a short time when deposited in excess water such as in a toilet bowl, and when agitated in its course through a sewer line.

Another object is to provide a sanitary napkin or the like in which all the structural components, including the wrapper, will break down to flushable size after a relatively short time when deposited in the excess water found in conventional toilet systems.

These and other objects will become apparent by reference to the following specification wherein various selected embodiments of the invention are described.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A carded web composed of 1.5 denier rayon fibers having an average length of 1 9/16 inch and weighing approximately 14 grams per square yard was sprayed with a 3 percent solution of cold water soluble polyvinyl alcohol, to provide a solids pickup of about 10 percent based on the web weight. The wet web was immediately oversprayed with a 2 percent solution of borax to provide about 0.5 percent salt pickup based on the web weight and dried at about 90° C. for about 20 minutes.

Another base web of the type described above was sprayed with the same amount of polyvinyl alcohol in the manner indicated and then oversprayed with a 2 percent solution of borax to provide about 1.0 percent salt pickup based on the web weight, and then dried.

A third web was treated in the same way, but with about 2.0 percent salt pickup.

As a base for comparison, still another web of the same type was prepared by bonding it with 10 percent by weight of polyvinyl alcohol as indicated above while omitting the borax treatment completely before drying.

Each of these webs was then tested for burst strength with the following results:

BURST STRENGTH IN g./cm.²

Sample	Air Dry	100% Moisture	500% Moisture	After Soaking In Excess Water ½ Min.	1 Min.	2 Min.
10% PVA alone	173	28.6	10.5	0.0	0.0	0.0
10% PVA-0.5% borax	122	51.0	15.1	1.7	0.0	0.0
10% PVA-1.0% borax	135	53.5	33.0	24.2	8.3	<1.6
10% PVA-2.0% borax	153	73.5	38.5	37.0	16.0	7.9

Percent moisture is calculated by spraying a web of known weight with a predetermined amount of water.

Wet burst is measured by a simplified penetration tester. A 6-inch square piece of the dry web, or the moistened web containing the specified amount of moisture or soaked for the specified time, is clamped between two 6-inch square plates of clear acrylic plastic having a 5-inch diameter aperture in the center. The inner surface of each plastic plate is covered with rubber to increase its frictional grip on the clamped web. The plates are suspended from blocks of wood so that the exposed area of web in the center of the plates is disposed parallel to the surface of the laboratory counter at a distance of about 3 ½ inches. A 400 ml. stainless steel beaker with a bottom surface area of 38.15 cm² is placed in the center of the suspended web and loaded with lead shot until the beaker breaks through the web. The beaker plus shot is then weighed and the weight divided by the area of the bottom surface of the beaker to give the burst strength in grams per square centimeter.

As indicated above, at each of the moisture levels shown, the borax treated webs, while lower in dry strength, had significantly higher wet burst strengths than the same web

treated with polyvinyl alcohol alone. The figures also indicate that as the amount of borax picked up by, and reacting with, the binder in the web is increased, the wet burst strength figures also increase. The additional wet strength may be accounted for by either a larger cross-linked surface area of the polymer, or a deeper penetration of the borax into the polymer to give more interior cross-linking.

In any event, after depositing each of the wrappers in excess water to subject it to a short soaking period the following results were noted. Strengths of the webs bonded with 10% PVA alone and with 10% PVA–0.5% borax were reduced to zero after 1 minute soaking so that each of these wrappers readily disintegrated. The web bonded with 10% polyvinyl alcohol crosslinked with 1% borax had a much improved air dry strength and wet burst strength at 100 percent and 500 percent moisture, but nevertheless was reduced to a wet burst strength of less than 1.6 g/cm² after soaking for 2 minutes. However, the web bonded with 10% PVA–2.0% borax did not degrade sufficiently after even a 2 minute soak to disintegrate readily. For comparison purposes, and as a basis for evaluating these strength figures, it is noted that a bonded non-woven wrapper with a wet burst strength of less than about 2 gm/cm² is generally weak enough to disintegrate sufficiently to be considered flushable. Accordingly when borax substantially in excess of 1.0 percent based on the weight of the web, (or 10 percent of the weight of the polyvinyl alcohol) is applied to the polyvinyl alcohol bonded web, wet strength is too high for the intended purpose.

In additional trials, sanitary napkins utilizing covers comprised of the first three samples identified above were prepared and tested in actual use. The users found that the wrappers bonded with the PVA-borax treated binders held up well in contact with body moisture and menstrual fluid, while a large number of the wrappers bonded with untreated PVA failed. When the used napkins were placed in a toilet bowl and allowed to soak for 30 seconds to 2 minutes, the binder in wrappers of both the treated and untreated types dissolved sufficiently to allow the entire napkin to disintegrate upon flushing.

Limited trials of napkins wrapped with webs bonded with the 10% PVA–2.0% borax binder found that wrappers bonded with this less soluble binder did not disintegrate sufficiently fast after soaking a suitable period to be considered satisfactory for toilet disposal.

The polyvinyl alcohol employed in the above-described tests was of a type which was about 79–82% hydrolyzed, had a viscosity of about 22 cps (4 percent solution at 20° C.), and was readily soluble in cold water. Other polyvinyl alcohols were also found to perform well as long as they were cold-water soluble. For example, polyvinyl alcohols having a percent hydrolysis in the range of 74 to about 98 are generally cold-water soluble and are suitable for the described use. While a wide range of viscosities may be used with various degrees of success, viscosities of about 21 to about 28 (4 percent solution at 20° C.) are preferred.

When using cold-water soluble polyvinyl alcohols with the degree of hydrolysis indicated above, the borax treatment was found to give the bonded web a better burst strength at high moistures than webs bonded with untreated polyvinyl alcohol binder of the same degree of hydrolysis, while not substantially inhibiting ultimate solution of the binder in excess water.

Functional wrappers were prepared using from 5% to 15% polyvinyl alcohol by weight of fibers, and from 2% to 10% borax based on the weight of the PVA (i.e. 0.1% to 1.5% borax on the weight of the fibers). Below about 2% borax there was not sufficient cross-linking to affect the wet strength. Above 10% the resulting amount of crosslinking provided too much wet strength.

With regard to the amount of polyvinyl alcohol used to bind the web, the following was noted; as the amount used was decreased below 5% the web became too weak for practical use, and when the amount used was increased above 15% the web tended to become too sticky when moist to be of practical use. It was also found that as the amount of adhesive is increased over 10 percent the degree of strength added per unit of adhesive declines, so that the 10 percent level appears to be the most economical use of adhesive for strength desired.

In addition to the rayon fibers of textile length described in the specific examples, other synthetic textile fibers especially other types of regenerated cellulose may be suitably used in the non-woven wrapper, as well as natural cellulose fibers and various mixtures of synthetic and natural fibers.

The polyvinyl alcohol may be applied by spraying, impregnation, printing or the like. However, a printing application can be better controlled and usually gives better softness and drying qualities.

The borax should be applied after the polyvinyl alcohol binder has been applied to the web, and preferably before the polyvinyl alcohol has set to a film form. Spraying or wetting the web with borax before applying the polyvinyl alcohol binder is not satisfactory, since it causes the polyvinyl alcohol to gel prematurely, making for a weaker bond, and causing the crosslinking to take place in an area remote from the area which is contacted first by the moisture during use, whereby it is less effective in producing the desired results.

Any suitable absorbent core which is disintegratable in water may be used for the pad filler in the sanitary napkin structure. Soluble or insoluble baffle members as found in various sanitary napkin structures may be used. While insoluble baffles such as thin sheets of polyethylene film will not disintegrate in water, such baffles are usually so thin, flexible and small that they will not cause stoppages in sewerage systems having standard diameter pipelines.

While the above described preferred embodiments relate particularly to sanitary napkins, it will readily be seen that the wrapper is equally applicable to other absorbent pads such as diapers, hospital pads, absorbent bandages and the like.

What is claimed is:

1. An improved wrapper especially for use with sanitary napkins and with pads for absorbing body fluids comprising a non-woven web of textile-length fibers bonded by a normally cold-water soluble polyvinyl alcohol, a portion of said polyvinyl alcohol being cross-linked with borax in an amount sufficient to render said polyvinyl alcohol water-resistant to an extent that under conditions wherein the web picks up moisture in excess of 500 percent by weight the cross-linked portion of said binder remains substantially insoluble, and under conditions wherein said web is soaked in excess water said borax is leached out to destroy said cross-links and to nullify substantially all of said water resistance.

2. The improved wrapper of claim 1 wherein said cross-linked portion comprises at least the exposed surface areas of said polyvinyl alcohol.

3. The improved wrapper of claim 1 wherein said polyvinyl alcohol is present in the amount of from about 5 percent to about 15 percent based on the weight of the fiber and the borax is present in the amount of from about 2 percent to about 10 percent based on the weight of the polyvinyl alcohol.

4. The improved wrapper of claim 1 wherein said polyvinyl alcohol has a percent hydrolysis in the range of about 74 to about 98 and in a 4 percent water solution at 20° C has a viscosity of about 21 to about 28.

5. The improved wrapper of claim 1 wherein said fibers are cellulosic.

6. The improved wrapper of claim 5 wherein said fibers are rayon.

7. A flushable sanitary napkin and the like comprising an absorbent core enwrapped in a fluid pervious wrapper capable of being readily disintegrated when soaked in excess water, said wrapper comprising a non-woven web of textile-length fibers bonded by a normally cold-water soluble polyvinyl alcohol, a portion of said polyvinyl alcohol being cross-linked with borax in an amount sufficient to render said polyvinyl alcohol water-resistant to an extent that under conditions wherein the web picks up moisture in excess of 500 percent by weight the crosslinked portion of said binder remains substan-

tially insoluble, and under conditions wherein said web is soaked in excess water said borax is leached out to destroy said crosslinks and to nullify substantially all of said water resistance, whereby the fibers in said web and in said napkin are free to disperse completely in said water.

8. The napkin of claim 7 wherein said cross-linked portion comprises at least the exposed surface areas of said polyvinyl alcohol.

9. The improved wrapper of claim 7 wherein said polyvinyl alcohol is present in the amount of from about 5 percent to about 15 percent based on the weight of the fiber and the borax is present in the amount of from about 2 percent to about 10 percent based on the weight of the polyvinyl alcohol.

10. The improved wrapper of claim 7 wherein said polyvinyl alcohol has a percent hydrolysis in the range of about 74 to about 98 and in a 4 percent water solution at 20° C. has a viscosity of about 21 to about 28.

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