This invention relates to absorbent products and more particularly to absorbent products having improved liquid flow and liquid absorbency characteristics.

Absorbent products, such as sanitary napkins, usually contain a barrier sheet or layer of liquid repellent material to minimize or prevent absorbed liquid from striking through the product and also to obtain lateral spreading of absorbed liquid so that the absorbing capacity of the product will be utilized more effectively. The liquid repellent barriers which have been used heretofore in such products include sheets or films of plastic materials, such as polyethylene films, coated or sized papers, and the like. Polyethylene films and similar plastic films have been found especially suitable because they are practically completely liquid repellent.

In sanitary napkins, which are divided generally into two types, a so-called one-way napkin and a two-way napkin, the liquid repellent barrier is so positioned with respect to the other components of the napkin to provide the result desired. One-way napkins are so designed and constructed that only one surface is placed against the body whereas two-way napkins are so designed and constructed that, although one side is preferably placed against the body of the user, the opposite side may also be used.

In the one-way napkin, the liquid repellent barrier is placed at or adjacent the bottom of the napkin opposite the surface which is placed against the body. When liquid, such as menstrual fluid, is applied to the surface of the napkin, it penetrates downwardly at the point of application to the liquid repellent barrier whereupon it is caused to spread laterally of the napkin. Therefore, to function properly, one-way napkins must be placed with the correct surface against the body. However, in the case of a two-way napkin, which, as noted above, is so designed that either surface may be placed against the body, the liquid repellent barrier is placed in the interior of the napkin intermediate the layers of absorbent material used to make the napkin. The construction is, in principle, similar to placing two one-way napkins back to back with the liquid repellent barrier in the center.

Since the liquid repellent barriers used heretofore do not permit the absorbed liquid to pass through, the lower absorbent components of the two-way napkin are not used effectively, and for all practical purposes, are wasted. In addition, such conventional liquid repellent barriers are not absorbent and do not increase the absorbing capacity of the napkin; they also present disposability problems.

In accordance with the present invention, there is provided an absorbent product which contains a barrier which is initially liquid repellent, but which subsequently, upon absorption of liquid, solubilizes in the liquid to permit the liquid to penetrate through to the absorbent layers below, thereby utilizing their absorbing capacity. Further, the liquid repellent barrier may combine with the absorbed fluid to form a hydrate or gel to increase the absorbent capacity of the product. This feature is useful not only in the two-way napkins, but also in the oneway napkins. The repellent barrier characterizing this invention spreads absorbed liquid transversely of the napkin so that the absorbent capacity of the absorbent layers in the top part of the napkin which is placed against the body will be effectively utilized. Upon continued contact with liquid, the barrier then loses its repellent characteristics so that liquid can penetrate to the bottom parts of the napkin. The invention is of particular application to two-way sanitary napkins and will be disclosed in connection therewith. It is to be understood, however, that such disclosure is not by way of limitation and that it has application to other type of products, including one-way napkins.

A napkin incorporating the invention is particularly useful when menstrual flow is heavy. In napkins containing conventional barrier sheets or layers, heavy menstrual flow, especially when not anticipated, causes side spread failure of the napkin. Such napkins contain no reserve absorbing capacity. The napkin of the present invention due to its novel construction, provides an extra margin of absorbing capacity as a safety factor when menstrual flow is heavy.

The above mentioned advantages may be accomplished in accordance with the present invention by providing in an absorbent product, such as a sanitary napkin, a liquid repellent barrier layer which is, from the viewpoint of function, initially in the form of a continuous film or layer of a material which is soluble in menstrual fluid and which preferably forms a gel or a hydrate upon contact therewith. Upon initial contact with menstrual fluid, the film or layer acts as a repellent to the fluid, causing it to spread along the surface of the film. Upon continued contact with fluid, the film loses its predominantly repellent characteristics and solubilizes in the fluid, whereupon excess fluid can penetrate through to the layers of absorbent material below. The layer or film of liquid repellent material itself contributes to the absorbing capacity of the napkin by combining with the menstrual fluid to form a gel or a hydrate.

Referring to the drawings:

FIG. 1 is a plan view of a so-called two-way type sanitary napkin incorporating the invention; and

FIG. 2 is a section of FIG. 1 taken along line 2-2 and discloses layers of absorbent material with the temporary barrier in between.

Referring now to FIG. 1, a sanitary napkin incorporating the invention is shown completely assembled but broken away to expose the interior components. The napkin comprises an absorbent core covered with an outer wrapper 10, which may be of conventional material used as covers for napkins including woven and non-woven fabrics of rayon, cotton or other suitable fibers. Within the cover, there is the absorbent core formed of two relatively thick layers 12 and 14 of absorbent material, such as cotton or comminuted wood pulp, the confronting faces of these two layers being lined, if desired, with thin sheets of tissue 16. The two absorbent layers are separated by a thin film or layer 18 which forms the temporary barrier characterizing the present invention. The whole assembly is held together by the outside cover which has tabs 20 extending beyond the ends of the absorbent core for securing the napkin in position on the body of the wearer.

In the drawings, the absorbent layer 12 is shown on top and the absorbent layer 14 at the bottom of the napkin, thus forming a two-way napkin so that either the top or bottom surface may be placed against the body. One of the layers e.g., layer 12, is utilized to the limit of its effective absorbing capacity and then, due to the concentration of fluid in said layer, the temporary barrier 18 is solubilized and the fluid is thereby allowed to pass through the barrier to the absorbent layer 14 below. In this solubilizing, the temporary barrier 18 forms hydrates with the absorbed menstrual fluid.

Various materials may be used as the liquid repellent barrier including organic film-forming water soluble
resins of the synthetic type, such as polymers of ethylene oxide, methyl cellulose, polyvinyl alcohol, and natural film-forming water soluble organic resins, such as gum tragacanth and the alginates which form hydrates with water to form a gel. These materials may be used in the form of a continuous film, as coatings on paper, or on layers of absorbent material, or in other forms. Barriers made from synthetic materials are preferred in view of the control, particularly as to thickness, which may be exercised in their manufacture. "Polyox," a water soluble ethylene oxide polymer made by Union Carbide Chemical Company is particularly suitable.

Since the rate at which the barrier layer solubilizes upon contact with liquid depends upon the amount and type of liquid to be absorbed, and the material used, and since the rate of penetration of absorbed liquid through the barrier layer is dependent upon the thickness of the layer, it is apparent that the types of materials used and the thicknesses of the materials may be varied. To obtain optimum results, the type and thickness of the particular material used to form the barrier layer is so selected as to obtain the desired lateral spreading of liquid throughout the absorbent components in the upper part of the napkin until such time as the absorbing effectiveness of the upper portions thereon have then effectively used and then become solubilized in the liquid to permit the liquid to penetrate the barrier before the liquid has spread beyond the side edges of the napkin. The thickness of the barrier layer, when it is in the form of a continuous film, may suitably vary, by way of example, from about 0.2 mil to about 2 mils, depending upon the particular material used. A film about 0.4 mil thick formed of the ethylene oxide polymer, the "Polyox" referred to above, has been found to give satisfactory results. The film is of sufficient thickness so that under normal conditions of use in a sanitary napkin, it acts as an effective repellent for sufficient time to obtain spreading of the liquid in the upper layers of the napkin and then forms a hydrate or gel with liquid whereupon the liquid may be absorbed by the absorbent layers below.

Tests were conducted to compare the absorbing effectiveness of sanitary napkins incorporating the invention with sanitary napkins containing conventional repellent barrier sheets. A number of test napkins were prepared, each of the same construction and containing as the absorbent core portion, layers of comminuted wood pulp fibers, and differing only in the repellent barrier sheet incorporated into the napkin. Some of the napkins contained barrier sheets positioned between the layers of the comminuted wood pulp of the napkin, 1.5 mils thick, methyl-cellulose 1 mil thick and ½ mil thick and ethyl oxide polymer 4 mils thick, 2 mils and 0.4 mil thick. The reference napkin contained a conventional barrier layer consisting of two plies of repellent tissue paper each weighing 7.6 grams and impregnated with a resin size.

The napkins so prepared were then tested for their absorbing effectiveness and capacity in the following manner. Each napkin was folded lengthwise into the form of an inverted U to simulate the form assumed by the napkin when it is worn. The napkin was then positioned with its length horizontal and with the folded portion, or the top of the U, facing upwards. A measured menstrual fluid consisting of water containing a thickening agent to provide a liquid having at 20°C, a viscosity of 5.2 to 6.1 centipoises, a specific gravity of 1.060 to 1.075 and a surface tension of 44 to 50 dynes/cm, and colored with a dye to aid in visual observation, was fed from a burette in a dropwise manner to the top center fold of each of the test napkins. The rate of feed in each instance was so adjusted that the napkin absorbed the fluid as it was applied and no collecting or puddling of the fluid on the surface of the napkin occurred. The liquid was fed to the surface of the napkin until the liquid struck through the bottom of the napkin or had spread to the sides of the napkin. When this occurred, the amount of liquid fed from the burette was read. The fluid capacity of each napkin was recorded as the number of milliliters of liquid fed from the burette until failure occurred.

The absorbing capacities of each of the napkins tested are listed in the table below. In the napkin containing the 0.4 mil film of the ethylene oxide polymer as the barrier layer, the fluid penetrated the film and struck through to the bottom of the napkin before reaching the sides. In the remaining napkins tested, the fluid reached the sides of the napkin before striking through to the bottom. In each case there was penetration of the barrier layer by the fluid into the absorbent layer below. The results demonstrate that the various barrier layers cause absorbed fluid to spread laterally of the napkin in the intended manner and are also penetrated by the fluid. The results also demonstrate that the thickness of a film of a particular material is desirably so selected that fluid will penetrate the film and be absorbed by lower parts of the napkin before the fluid has spread to the sides of the napkin. The results also show that where the thickness of the film is such that penetration of the fluid through the film is not sufficiently rapid or extensive that the lower parts of the napkin will be fully utilized before the fluid reached the sides of the napkin. There is nevertheless an increase in absorbing capacity of the napkin due to the partial penetration of fluid and to the formation of a gel between the film and absorbed fluid.

Liquid repellent barriers of such materials as polyvinyl alcohol, methylcellulose and ethyl oxide polymers, although considered water soluble materials, do not ordinarily dissolve completely in menstrual fluid under ordinary conditions of use when incorporated into a sanitary napkin. Usually films of such materials form gels, such as hydrates, with menstrual fluid and in this respect the films not only act as a temporary barrier to the flow of menstrual fluid but also retain absorbed fluid in the napkin. Sufficient data to determine the absorbing capacity of the napkin at the point of application of the liquid until it contacts the temporary barrier at "B." The part of the absorbent layer 12 at or adjacent the point of application of liquid becomes saturated with the liquid while the remaining portions remain substantially dry. When the liquid contacts barrier 18, it is caused to spread transversely and longitudinally of the napkin along the surface of the barrier, as indicated at "C." In spreading, the liquid is brought into contact with the relatively dry portions of the absorbent layer 12 which are adjacent or in contact with the surface of the barrier layer and is then absorbed by such dry portions.

As these portions become saturated with liquid, the liquid spreads further over the surface of the barrier sheet to other unsaturated portions of the absorbent layer 12. At the same time, the absorbed liquid also begins to solubilize the barrier layer 18 with which it is in contact, first at the surface and then progressively deeper. Complete solubilization does not occur directly
upon contact by liquid but instead is delayed because the liquid is also being spread transversely of the napkin to the adjacent portions of the absorbent layer 12. As additional absorbed liquid is applied, more complete solubilization of the barrier layer occurs until such time as solubilization through the layer results and the liquid begins to penetrate the layer, as indicated at "D." At this time, the absorbent layer 14 begins to pick up the liquid which has penetrated the barrier layer by a wicking action or capillarity. As a result, absorbed liquid is removed from the solubilized barrier layer by the lower absorbent layer 14 thereby delaying such solubilization of the barrier layer upon immediate contact with the fluid that would result in direct strike through. Instead, there usually results the formation of a gel of the barrier layer in the absorbed fluid. The gel formation occurs first on the top surface of the layer and then continues through the layer as additional liquid contacts the layer. Although absorbed liquid can penetrate the gel, its formation provides, to some extent, a continuing barrier to the flow of fluid through the layer. The lower absorbent layer 14 thus desirably functions to deter solubilization of the barrier layer in contact with absorbed liquid by removing, through absorption, excess absorbed fluid which contacts the layer.

From the foregoing, it will be seen that the constructions employed in the present invention will overcome one of the major problems that now exist in the conventional sanitary napkins containing a centrally or nearly centrally located nonsoluble barrier. The nonsoluble barrier of conventional napkins permits the use of the absorbent material next to the body only and failure of the sanitary napkin is caused by the liquid flooding over the sides while the absorbent property of the outside or secondary layer of the napkin is not used.

The advantages of the new type of product disclosed herein are threefold. The first is that the solubility of the barrier layer may be closely controlled by appropriate selection of the type of polymers used or by the thickness of the film or a combination of both. As a result of this major advantage, the passage of the menstrual fluid to the lower absorbent layer immediately prior to the usual over-the-edge failure is controlled entirely by the amount of fluid deposited on the top layer, thus practically doubling the effective absorption capacity of the product. The second is that the materials used for the barrier layer will form hydrates or gels with water and fluids and thus tend to act as additional absorbent material. The third is that the product becomes more easily disposable due to the fact that all components (cover, absorbent layers and barrier) disintegrate in water readily and hence may be flushed away in a disposal system.

It is evident from the foregoing disclosures that products, such as sanitary napkins, made in accordance with this invention will have many advantages. The described embodiment is merely illustrative and may be varied and modified without departing from the spirit of the invention.

What is claimed is:
1. An absorbent product for absorbing body fluids comprising a plurality of layers of absorbent material, and a fluid barrier layer between said absorbent layers, said barrier layer temporarily barring the passage of said fluid through said barrier layer upon initial contact with said fluid, and then solubilizing upon continued contact with said fluid whereupon said fluid may penetrate said barrier layer.
2. An absorbent product for absorbing body fluids comprising a plurality of layers of absorbent material, and a fluid forming barrier layer between said absorbent layers, said barrier layer temporarily barring the passage of said fluid through said barrier layer upon initial contact with said fluid, and then solubilizing and forming a gel upon continued contact with said fluid whereupon said fluid may penetrate said barrier layer.
3. An absorbent product for absorbing body fluids comprising a plurality of layers of absorbent material, and a film forming water-soluble organic resin fluid barrier layer between said absorbent layers, said barrier layer temporarily barring the passage of said fluid through said barrier layer upon initial contact with said fluid, and then solubilizing upon continued contact with said fluid whereupon said fluid may penetrate said barrier layer.
4. An absorbent product for absorbing body fluids comprising a plurality of layers of absorbent material, and a water-soluble organic resin film fluid barrier between said absorbent layers, said film ranging in thickness from about 0.2 to about 2 mils, said film temporarily barring the passage of said fluid through said film upon initial contact with said fluid, and then solubilizing upon continued contact with said fluid whereupon said fluid may penetrate said film.
5. An absorbent product for absorbing body fluids comprising a plurality of layers of absorbent material, and a fluid barrier film of a water-soluble ethylene oxide polymer between said absorbent layers, said barrier film temporarily barring the passage of said fluid through said barrier film upon initial contact with said fluid, and then solubilizing upon continued contact with said fluid whereupon said fluid may penetrate said barrier film.
6. An absorbent product for absorbing body fluids comprising a plurality of layers of absorbent material, and a fluid barrier film of a water-soluble ethylene oxide polymer ranging from about 0.2 to about 1.5 mils in thickness, between said absorbent layers, said barrier film temporarily barring the passage of said fluid through said barrier film upon initial contact with said fluid, and then solubilizing upon continued contact with said fluid whereupon said fluid may penetrate said barrier film.
7. A sanitary napkin comprising an absorbent core and a cover for said core, said core including a plurality of layers of absorbent material, and a water-soluble organic film fluid barrier between said absorbent layers, said barrier film temporarily barring the passage of said fluid through said barrier film upon initial contact with said fluid, and then solubilizing upon continued contact with said fluid whereupon said fluid may penetrate said barrier film.

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