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TEXTILE FABRICS

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The present invention relates to textile fabrics, comprising open mesh textile sheet material having in intimate contact therewith a film of heterogeneously intermingled fibers which are bonded to the open mesh sheet material and to one another by the coalescent qualities of a portion of the fibers. These fabrics are particularly useful in the surgical and medical fields as they may be made to exhibit very desirable absorbent properties derived from high capillarity combined with large capacity for retaining liquids, particularly aqueous liquids, blood, lymph and the like. Such fabrics are also useful in many fields in which absorbency may or may not be of importance, for example, in the nursery, sanitary and coated products fields, in which these fabrics have been found to contribute desirable characteristics, for example, to such products as disposable diapers, waterproof-backed dressings and other coated or impregnated fabrics.

Woven surgical gauze is widely used in surgical dressings in which absorbency is a necessary characteristic, it being generally considered to be the safest absorbent material available for use in operative procedures although it is well recognized that it possesses certain disadvantages. Surgical gauze is an open mesh woven fabric composed basically of absorbent fibers tightly twisted into yarns. This physical arrangement of the absorbent fibers enhances the capillarity but reduced the total absorbent capacity originally possessed by the fibers when in a loosely associated state. Tests have shown that the total absorbent capacity of loosely associated fibers is several times the total capacity of the fibers when in the tightly twisted state. Furthermore, as an absorbent material gauze has the disadvantage of having its absorbent capacity non-uniformly distributed over an area because its yarns are relatively widely spaced. Thus, the absorbent fibers in the gauze are provided with very little opportunity to absorb liquid uniformly and rapidly from a field of operation. On the other hand, the use of the fibers in a loosely associated state is objectionable due to the tendency of individual fibers to become detached from the mass of fibers and to adhere to the wound and also because such a mass of fibers would be difficult for a surgeon or nurse to manipulate. Furthermore, the capillarity of a loosely associated mass of fibers is insufficient to cause absorbed liquids to spread laterally throughout the mass resulting in the liquid quickly striking through to the back of the mass.

The present invention comprises novel composite fabrics in which the desirable capillarity

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and strength of open mesh fabrics are enhanced and in which the rate of sorption, total absorbency and available liquid contact area is greatly increased with a minimum increase in the total quantity of fibrous material used. The novel fabrics of this invention which may be soft, flexible and conformable comprise open mesh assemblies of textile yarns, woven, knitted, or netted, united with a thin layer or layers of heterogeneously intermingled binder and non-binder fibers water-inseparably bonded to or coalesced with each other, and to or with such open mesh assemblies to form a unitary fibrous structure.

The intimacy of union of the thin fibrous layer or web with the open mesh fabric and the intimacy of contact of the unspun fibers with one another obtained by developing the coalescent qualities of the binder fibers greatly contributes to the absorbency and strength of the product. In the composite fabrics of this invention the capacity and capillarity of the open mesh fabric is enhanced by providing each fabric yarn with a number of auxiliary absorbent fibers which tend to remove moisture from the yarns and distribute it over the web of unspun fibers which form a membrane over the interstices or "panes" of the open mesh fabric, thereby permitting the yarns to continue to absorb liquid. The intimacy of fiber to fiber contact and fiber to yarn contact or union also has the effect of spreading the absorbed liquid laterally over a considerable area of the composite fabric, thus permitting a dressing made therefrom rapidly to absorb surprising quantities of liquid before the liquid penetrates through the dressing.

The composite fabrics of this invention possess considerable tear strength and tensile strength, both dry and wet, attributable to the water-inseparable bonding of the fibers in the webs to one another and to the yarns of woven material, and to the presence of at least a small portion of binder fibers which resist the swelling or disrupting action of water. A further important advantage, particularly in surgical dressings, is the capacity of this composite fabric to resist raveling or fraying (i. e., the tendency of filling yarns to slip along the warp yarns to form bunches of filling yarns in one area and no filling yarns in another area), this resistance to raveling or fraying being due to the presence of the thin fibrous web and particularly to the presence of the binder fibers which tend to bond the yarns at their points of crossing thus to maintain them in relatively fixed relationship to each other and prevent the loosening of yarns, especially im-

portant at the edges. Fabrics of this nature have been found to be sufficiently resistant to fray to support stresses involved in securing them in place by means of pins.

A surprising feature of our composite fabrics is the many advantages gained by uniting in face to face contact with the open mesh fabric a relatively small amount of unspun fibrous material properly distributed in an attenuated foraminous web over the entire area of the woven fabric. Very satisfactory translucently thin composite fabrics are prepared in which the weight of the unspun web is less than 50% of the weight of woven fabric. In general, the weight of the unspun fibers will constitute not less than 15% of the weight of the composite fabric, nor more than 75%. For optimum results it is preferable, particularly when the lighter unspun webs are used, that the unspun fibers be distributed substantially uniformly over the entire area of the open mesh fabric, although for some uses, it is desirable to have heavier concentrations of unspun fibers over certain areas than over others.

The open mesh woven fabrics used in preparing the preferred sheer composite fabrics of this invention, will usually be absorbent cotton fabrics commonly employed for surgical purposes, for example, a 20 x 12 or a 14 x 10 gauze, although for some purposes heavier fabrics of cotton or other fibers are useful, for example, those having a weave construction of 36 x 32 or even 44 x 40. In general, any open mesh fabric will be suitable depending only upon the particular characteristics required in the end product.

The proportion of binder fibers present in the foraminous web of unspun fibers may be varied between wide limits depending upon the desired surface characteristics, absorbency, strength, and unification within the fibrous web and between the unspun fibers and the woven fabric. When maximum absorbency, softness and conformability are desired, a low concentration of binder fibers commensurate with the strength and degree of unification necessary should be used. Not less than an average of 5% of the unspun fibers should be binder fibers, and in most instances from 20% to 50% of the fibers will be binder fibers as is preferred, although a higher proportion of binder fibers, or even all binder fibers, is sometimes desirable when absorbency is of lesser importance and a very high degree of unification is necessary, for example, 70% binder fiber webs have been used in preparing composite fabrics for coating with continuous, thin, flexible, water resistant materials, for example, rubber, rubber substitutes, resins, or lacquers.

The binder fibers are of a synthetic character and are thermo-sensitive or solvent sensitive or both so that they may be rendered adhesive, or coalescent, when desired, and thus bonded to each other, to the unspun non-binder fibers and to the open mesh fabric, so as to produce a union between the unspun fibers themselves and between the unspun fibers and the woven fabric of sufficient strength and intimacy to provide composite fabrics of the desired absorbency and stability in the presence of water.

Satisfactory binder fibers having latent coalescent characteristics prepared from simple or mixed esters and ethers of cellulose, such as cellulose acetate, cellulose propionate, cellulose butyrate, cellulose acetate propionate, cellulose acetate butyrate, ethyl cellulose, benzyl cellulose and others may be used. Other fibers of an entirely different chemical nature, however, may be em-

ployed, such as vinyl polymers or copolymers, those of the polyamide type, a commercial example being nylon, and those of the vinylidene type known commercially as Saran. The invention is not limited to use with any particular kind of binder fibers, provided they have those characteristics suited to the purposes of this invention and are of sufficient length to be handled on standard textile equipment, for example, even bleached cotton fibers can be used as the binder fibers if suitable fusing or activating agents are used in the activating treatment. Plasticizers may be used if they are so chosen as to assist in the unification or contribute desirable properties to the final product. Or, plasticizers may be used to assist unification, and the unified composite body may be given an after treatment to remove the plasticizers as the presence of such compounds are often objectionable in products for surgical use.

The non-binder fibers may consist of any of the common textile fibers which are not susceptible to the activating treatment to which the fibrous body is to be subjected and which will contribute the desired properties to the final product. The non-binder fiber most commonly used is cotton, which may be bleached or unbleached, although rayon of the regenerated type, and others may be used.

In unifying the elements of the composite fabric it is necessary to so activate the binder fibers that they will become soft or adhesive. This activation may be accomplished in any suitable manner as by treatment with gelatinizing or solvent agents under properly controlled conditions or with heat. The use of those binder fibers which are susceptible to activation by heat is preferred since thermal activation is more easily accomplished in standard textile equipment than is solvent activation. However, where it is desired to use a solvent activation the particular solvent employed necessarily will be determined by the character of the binder fibers and other practical considerations. A wide variety of solvents for use with various binders above mentioned are known, including acetone, methyl alcohol, methyl Cellosolve, propylene oxide, methyl acetate, ethyl acetate, acetic acid, diacetone, chlorobenzene, chloroform, toluol, carbon tetrachloride, and diethyl ether. For binders of the vinylidene type such solvents as trichlorobenzene or dichloro-diethyl ether may be used. With polyamides, the phenols can be used as solvents. In some cases, also, it will be found desirable to use compound solvents, as for example, a mixture of acetone and methanol. Such mixtures are useful in controlling the degree or severity of attack on the fibers by the solubilizing agent. In other words, assuming for purposes of preparing the fabrics of this invention, the binder fibers to be of cellulose acetate, which is readily dissolved by acetone, the extent to which the fibers will be swollen or softened can be controlled by mixing a suitable proportion of ethyl alcohol with the acetone and thus providing a reagent having a greatly reduced activating power, compared to that of acetone alone, and such power can be made consistent with the nature and size of the fibers.

In making the composite fabrics of the invention, the unspun binder and non-binder fibers are mixed together. The mixture of fibers is then formed into a web or webs of the desired weight, for example, by carding. The web, or a plurality of superposed webs, and a strip of open

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mesh fabric are fed together through an activating treatment (heat or solvent) to render the binder fibers soft or adhesive to unify the assembly. If a high degree of unification is desired, the number of bonds may be increased by subjecting the composite fabrics to pressure while the binder fibers are soft or adhesive, the pressure creating a more intimate contact between the unspun fibers themselves and with the open mesh fabric.

The bond, union, or other relationship of the unspun fibers to each other and to the open mesh fabric produced by the various methods described herein and which is relied upon mainly to give the composite fabric its stability and strength, is frequently herein designated as "coalescence," and the methods of treatment as "coalescing," whether or not these terms are used in their strict or technical sense. Consequently, where such terms appear herein they will be used to convey the meaning just described.

The following is a typical example of the production of a composite fabric in accordance with this invention by the application of heat and pressure: A mixed fiber lap suitable for carding is prepared by mixing together in standard textile equipment, 35 parts plasticized cellulose acetate propionate fibers and 65 parts bleached cotton fibers. The lap is fed to a card which works the mixed fibers into the form of a web of heterogeneously intermingled fibers. One mixed fiber web or two superposed mixed fiber webs weighing about 12 grams per square yard are passed through a hot calender simultaneously with an 18 x 14 absorbent surgical gauze at a speed of 20 yards per minute, the calender rolls being maintained at 400° Fahrenheit, thus developing the coalescent characteristics of the binder fibers and bonding the heterogeneously intermingled fibers and the 18 x 14 gauze to provide the firmly united composite fabric of this invention.

If a product having a web or a plurality of thin webs of unspun fibers on each side is desired, the gauze or other open mesh fabric may be passed through the calender between webs of unspun mixed binder and non-binder fibers.

For the purposes of this invention, only fibers of textile length are suitable, it being necessary to employ fibers of such length in forming the dry assembled web on ordinary textile machinery. Furthermore, a considerable portion of the fibers must be of sufficient length to bridge the interstices of even the coarsest open mesh fabrics used in order to provide foraminous membranes of the desired strength.

Although the composite fabrics described herein are primarily used for absorbing liquids, blood, and the like, and removing the absorbed material from the site of a wound, the presence of the attenuated fibrous membrane extending over the interstices of the open mesh fabric make these composite fabrics particularly useful for the application of liquid or plastic medicaments to wounds. In using gauze for such applications, the medicament is applied to the wound in the pattern of the gauze, not as a continuous coating. When our composite fabrics are used, the medicament is carried as a thin continuous film by the fibrous membranes and is then brought into contact uniformly with the entire healing surface of a wound, while at the same time, the permeable nature of the membrane permits the access of air to the healing surface as the medicament is adsorbed, these fabrics thus provide a flexible, conformable, pervious, yet continuous water-

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stable medium for the application of healing compounds. These same properties make this fabric useful as a carrier for semi-permanent or permanent films as in the formation of waterproof backings, for example, for dressings. The high wet strength obtainable by the use of a high proportion of binder fibers which resist the swelling or disrupting action of water in the unspun fiber mixture is particularly useful in this connection.

Another advantage of this composite fabric is its softness and flexibility. Highly twisted yarns of open mesh fabrics are harsh and tend to irritate or chafe delicate tissues. The presence of the thin fibrous web greatly decreases the abrasive characteristics of the twisted yarns and contributes materially to the comfort of any patient who must wear a dressing, the smooth soft surface of the composite fabric minimizing body friction.

Composite fabrics prepared as described heretofore resemble smooth sheeted materials. We have discovered that the remarkable sorptive properties of the fabrics are still further improved by subjecting the fabric to a rimpling process which wrinkles and corrugates the fabric as well as tending to fluff up but not to detach the unspun fibers. The marked increase in the rate of sorption is apparently due to the increased concentration of material over a given area and to the increased fiber freedom accomplished by the rimpling process without disruption of the bonds which serve to unify the structure.

Having thus described our invention, what we desire to claim as new is:

1. As a new article of manufacture, a composite textile fabric comprising an open-mesh textile sheet material composed of regularly spaced yarns having in intimate face-to-face contact with at least one side thereof a thin uniform layer made up of a plurality of superposed carded webs of heterogeneously intermingled unspun fibers characterized by an average of at least five percent of said fibers having inherent latent coalescent characteristics with said unspun fibers water-inseparably bonded to each other and to the yarns of said open-mesh sheet material by the said coalescent characteristics of the fibers themselves.

2. As a new article of manufacture, an absorbent composite textile fabric having high capillarity and large capacity for retaining liquids comprising an open-mesh textile sheet material composed of cellulosic yarns having in intimate face-to-face contact with at least one side thereof a thin uniform layer of a heterogeneously intermingled unspun mixture of fibers having inherent binder and non-binder characteristics, the binder fibers constituting at least five percent of said mixture and water-inseparably uniting said mixture of fibers and water-inseparably bonding said layer to said sheet material to provide a unitary coherent structure.

3. As a new article of manufacture, a composite waterproofed textile fabric comprising an open-mesh textile sheet material composed of spaced yarns having in intimate face-to-face contact with at least one side thereof a thin layer of heterogeneously intermingled unspun fibers including binder fibers which have a normally latent capacity for coalescence and which water-inseparably unite said unspun fibers and water-inseparably bond said layer to said sheet material to provide a unitary coherent structure, and a

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thin flexible coextensive layer of waterproof material adherent thereto.

4. As a new article of manufacture, a composite textile fabric comprising an open-mesh textile sheet material composed of regularly spaced yarns having in intimate face-to-face contact with at least one side thereof a thin layer of heterogeneously intermingled unspun fibers characterized by an average of at least five percent of said fibers having inherent latent coalescent characteristics with said unspun fibers water-inseparably bonded to each other and to the yarns of said open-mesh sheet material by the said coalescent characteristics of the fibers themselves, the weight of the thin layer of heterogeneously intermingled unspun fibers being not more than 75% of the weight of the open-mesh material.

5. As a new article of manufacture, a composite textile fabric comprising an open-mesh woven textile sheet material having not more than 44 yarns per inch in the warp nor more than 40 yarns per inch in the filling, said yarns being regularly spaced, and having in intimate face-to-face contact with at least one side thereof a thin layer of heterogeneously intermingled unspun fibers characterized by an average of at least 5% of said fibers having inherent latent coalescent characteristics with said unspun fibers water-inseparably bonded to each other and to the yarns of said open-mesh woven textile sheet material by the said coalescent characteristics of the fibers themselves, the weight of the thin layer of heterogeneously intermingled unspun fibers being not more than 75% of the weight of the open-mesh woven material.

6. As a new article of manufacture, a soft absorbent composite textile fabric having high capillarity and large capacity for retaining liquids suitable for surgical purposes comprising an open-mesh, woven textile sheet material having not more than 44 yarns per inch in one direction nor more than 40 yarns per inch in the other direction, said yarns being regularly spaced, and having in intimate face-to-face contact with at least one side thereof a thin layer of heterogeneously intermingled unspun fibers forming thereby a permeable membrane over the interstices of the open-mesh material, said layer of unspun fibers

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being characterized by an average of at least five percent of said fibers having inherent latent coalescent characteristics with said unspun fibers water-inseparably bonded to each other and to the yarns of said open-mesh sheet material by the said coalescent characteristics of the fibers themselves, whereby at least one side of the composite fabric is smooth and will not chafe or irritate delicate tissues when said fabric is placed against the body.

7. As a new article of manufacture, a textile fabric comprising an easily frayable open-mesh sheet material composed of regularly spaced yarns having in intimate face-to-face contact with at least one side thereof a thin layer of heterogeneously intermingled unspun textile fibers forming thereby a permeable membrane over the interstices of the open-mesh material, said layer of unspun fibers being characterized by an average of at least five percent of said fibers having inherent latent coalescent characteristics with said unspun fibers water-inseparably bonded to each other and to the yarns of said open-mesh sheet material by the said coalescent characteristics of the fibers themselves, whereby the yarns of the easily frayable material are secured in place and said material is rendered fray-resistant in the body of the fabric and at the cut edges.

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