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COMPOSITE MATERIAL

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This invention relates to composite materials, and it is directed particularly to composite textiles having marked properties of crease resistance, increased strength and retention of shape.

In the manufacture of many kinds of articles which are composed essentially of separate fibers, such as fiber mats, fabrics and the like, it is often desirable to hold the fibers in the shape or form desired by means of some binding or stiffening agent. Ordinarily this may be accomplished by impregnating the cloth, felt or fiber mat with an adhesive, preferably dissolved in a sufficient amount of a solvent to produce a solution which will penetrate between the fibers. Such a treatment, however, tends to fill the interstices of the fabric or mat, reducing its porosity and altering its appearance and properties to an objectionable degree for many uses. These disadvantages have been overcome to a certain extent by interweaving threads of cellulose acetate in the fabric and fusing the cellulose acetate to the other fibers. However, the fusion point of cellulose acetate is high enough to make resetting or reshaping operations difficult, as well as hard on the fabric, unless solvents for the cellulose acetate are used. The solvents normally employed, such as acetone, are objectionable in that they involve a fire hazard in commercial use. In other types of articles such as mops, dusters, scouring cloths and the like, binding the material with cellulose acetate is impractical where resistance to water, acids, and alkalies is necessary.

This invention provides composite fibrous articles of the classes described having certain advantages and properties which adapt them for a wide variety of uses and which are not found in the ordinary composite materials. For example, the fabrics of the invention which are suitable for the manufacture of clothing are characterized by a resistance to creasing or wilting, under ordinary conditions of use, that is considerably greater than that of standard materials, and they may be laundered many times and subjected to such reshaping operations as ironing, calendering and pressing, as encountered in the usual laundry, each time to emerge properly shaped or reshaped without the necessity of employing excessive temperatures or additional binding or stiffening agents or solvents therefor. In the case of pile fabrics such as velvet and the heavier materials used for rugs and upholstery, made in accordance with this invention, the material itself is not only unusually resistant to creasing, but the pile is not easily crushed and will resume its original form after being pressed out of shape for fairly long periods of time. For other types of articles such as mops, dusters, asbestos pads, and scouring mats containing metal fibers, this invention provides materials which do not easily leave small pieces, or lint, upon the surfaces with which they come in contact. In the case of mattresses, pillows, quilts or stuffed upholstery, this invention provides a stuffing which has increased resistance to packing or separation into uneven and relatively hard lumps, yet retains all of the natural resiliency and softness of new stuffing. Textile threads or yarns made in accordance with this invention have, in general, a high wet tensile strength by comparison with other fibers, and they have increased resistance to deterioration by acids, alkalies, and bacterial or fungal attack.

The materials of this invention consist essentially of composite fabrics, or of materials which may be woven, knitted or otherwise fashioned from composite yarns or threads. Where the composite yarn is employed, it may consist of one or more fibers of any of the well known textiles, such as wool, silk, cotton, linen and rayon, with which have been combined fibers or filaments of a vinyl resin having certain characteristics. In the case of woven fabrics or any materials made from a plurality of yarns, the desired properties of crease resistance, increased strength and the like may be obtained by incorporating the vinyl resin in the form of one or more of the individual yarns of the fabric, as distinct from a composite yarn. For example, a cloth may be woven with alternate threads of vinyl resin yarn, or in other combinations. For ribbons, a satisfactory material may be obtained by calendering parallel alternate threads of vinyl resin and another textile, the vinyl resin threads fusing to form a cross binder.

Composite yarns composed of continuous filaments may be made by twisting or doubling the vinyl resin fibers with other continuous filaments such as the cellulose esters, regenerated cellulose, other artificial fibers, spun cotton yarn, or silk. However, the fabrication of composite staple yarns is the more easily effected, since the staple vinyl resin fibers may be carded in the proper ratio with whatever other staple fibers are desired, and the composite yarn spun therefrom in the usual manner.

The vinyl resins from which fibers suitable for use in this invention may be made should have average macromolecular weights of at least 7,500 and where the fibers must have high strength, the macromolecular weight should be at least 15,000, while the upper value is limited only by the solubility of the resins in suitable liquids to yield spinnable solutions or dispersions. Molecular weights referred to herein are those calculated by means of Staudinger's formula from viscosity determinations of solutions of the resin. Vinyl resins, as ordinarily prepared, normally consist of a mixture of polymeric aggregates of different molecular sizes. The resins to be used in the fabrication of very strong fibers for the materials of the invention may be freed from polymers having excessively low molecular weights in order that the average macromolecular weight of the resin will be at least the minimum stated above. This may be accomplished by various extraction procedures, such as those described in Patent 1,990,685 to C. O. Young and S. D. Douglas, or by similar methods of partial dissolution and precipitation.

Although fibers of any vinyl resins having the macromolecular weights described above may be used in making the materials of this invention, the strongest and most durable fibers are made from the vinyl ester resins, especially such as are described in Patent 1,935,577 to E. W. Reid, and these resins may be made by the processes described in that patent or by other means, such as the process described in Patent 2,064,565 to E. W. Reid. Of these resins, which are known as conjoint polymers of vinyl halides with vinyl esters of aliphatic acids, the preferred resins are those which contain from about 50% to about 95% by weight of the halide in the polymer. The particular composition which is most desirable depends upon the nature of the material with which the vinyl resin is to be combined, and its intended use, for increasing the vinyl halide in the polymer increases its fusion temperature. In the same manner, increasing the macromolecular weight of the resin raises its fusion temperature, so that if a resin is selected which is composed almost entirely of a vinyl halide, it is desirable that its macromolecular weight be relatively low, so that its fusion temperature will not be high enough to injure other textile fibers or render shaping operations difficult. The most desirable resins of this type are made by the conjoint polymerization of vinyl chloride with vinyl acetate, and where high strength is desired, the vinyl chloride in the polymer should be between about 80% and about 95%, with a macromolecular weight not very much lower than about 15,000.

These conjoint polymers of a vinyl halide and a vinyl ester of an aliphatic acid are resistant to water, acids, alkalies, hydrocarbons and alcohols, although they are soluble in ketones, such as acetone, and most chlorinated hydrocarbons. In addition, they are immune to attack by bacteriar or fungi.

Where the fabric may be exposed to concentrated ultraviolet light or to elevated temperatures for long periods of time, as is the case with some industrial fabrics, the polyvinyl partial acetal resins may be more suitable than the vinyl ester polymers. These resins may be considered as the reaction product of polymerized vinyl alcohol with an insufficient quantity of aldehyde to acetalize all of the hydroxyl groups of the polyvinyl alcohol. Since two molecular equivalents of the monomeric vinyl alcohol, in the polymerized material, will combine with one molecule of aldehyde, the degree to which the aldehyde has been combined with the polyvinyl alcohol may be indicated directly as percent acetalization. The polyvinyl partial acetal resins which are particularly suitable for use in this invention are, in general, those in which the polyvinyl alcohol has been acetalized, or combined with aldehyde, from about 33% to about 94%, with an aliphatic aldehyde having from two to six carbon atoms, although the degre of acetalization varies to some extent with the aldehyde employed. The preferred resins are those in which the polyvinyl alcohol has been acetalized from 88% to 94% with acetaldehyde, from 52% to 92% with propionaldehyde, from 42% to 82% with butyraldehyde, from 35% to 62% with valeraldehyde, or from about 33% to 45% with hexaldehyde. Of these, the polyvinyl partial acetal resins acetalized from 42% to 82% with butyraldehyde are especially desirable. The actual degree of acetalization will also depend upon the desired thermoplasticity of the resin. Increased acetalization, or increase in the molecular weight of the aldehyde employed, decreases the softening point of the resin. The polyvinyl alcohol may be acetalized with a mixture of aldehydes, if desired, providing the total acetalization is within the broad range given. The polyvinyl partial acetal resins described are insoluble in water, hydrocarbons and ketones, and they are soluble in alcohols and water-miscible liquids like the glycol monoalkyl ethers. These resins do not have the excellent resistance to water, alkalies and acids that is characteristic of the conjoint polymers of vinyl halides with vinyl esters of aliphatic acids, and therefore fibers made from them are less desirable for incorporation in fabrics which are to be submerged in water for very long periods of time, or subjected to many repeated launderings.

The polyvinyl partial acetal resins may be made directly from polyvinyl alcohol, or they may be made by the simultaneous hydrolysis and acetalization of a polyvinyl ester, and the method by which they originate is not essential to this invention.

Both the vinyl ester resins and the polyvinyl partial acetal resins may be spun into filaments by the "dry-spinning" process, preferably employing acetone as the solvent for the vinyl ester resins and methanol as the solvent for the polyvinyl partial acetal resins, but since the conjoint polymers of a vinyl halide with a vinyl ester of an aliphatic acid are the preferred resins for use in this invention and require special treatment to impart high tensile strength to the fibers made therefrom, the following description of the preparation of the fibers is with reference to them.

In general, the vinyl ester resin may be dispersed satisfactorily in warm dry acetone. By "dry" acetone is meant this substance which contains less than about 0.60% by weight of water. The concentration of the vinyl resin in the spinning solution is dependent upon and varies inversely with the macromolecular weight of the resin, but the resin content ordinarily employed using acetone as the solvent is about 25% or less by weight.

The spinning, or filament extrusion, operation may be carried out in equipment customarily employed for so-called "dry-spinning" of other types of textile filaments. A bobbin-type thread take-up may be employed, or the filaments may be given a twist at the point of spinning by employing a "cap-type" mechanism. If staple fibers are to be made, the filaments may be gathered into a thread and passed directly to the stapling machine, unless the filaments are to be stretched before being combined with other fibers. The filaments or thread delivered from the take-up bobbin may be twisted, or doubled and twisted, to form a yarn. Unless a special treatment is applied, it is necessary in most cases to permit the freshly-extruded filaments to age for at least twelve hours before the twisting and doubling operations are performed, but aging of the filaments can be advantageously accelerated or replaced by a more brief treatment with heated water. For example, if the filaments on the bobbins are immersed in water at 65° C. for a period of 2 to 5 hours, no further aging is required.

The next step in the yarn processing is that of stretching. The importance of this step is more or less in direct proportion to the strength desired in the fibers when being carded or combined with other textiles. An unstretched vinyl resin staple may tend to stretch during spinning of the staple yarn, whereas the previously stretched fiber does not appreciably elongate upon being made into a composite yarn. Fusion of a stretched vinyl resin filament to other textile fibers does not increase the strength of the material more than will the fusion of an unstretched fiber, since the increase in strength of the composite material is largely due to the binding effect of the vinyl resin filaments. In cases where it is desirable to impart a creping or crimping effect to the fabric (which has an effect upon the porosity of the fabric) the stretching of the yarn is of paramount importance, for it is by heating the finished fabric to about the softening temperature of the resin, with a consequent release of the strains developed in the stretching operation, that the shrinkage is obtained. The stretching operation may be applied equally advantageously to the polyvinyl partial acetal resins as to the vinyl ester resins.

If it is desirable to stretch the yarn, the amount of stretch imparted to the yarn may vary considerably up to about 400%, and in normal procedure a stretch of about 75% to 180% may be applied. The extent of the stretch used is determined by the polymer size (average macromolecular weight) of the resin, and by the characteristics desired in the finished fabric. It is important to conduct this operation while the yarn is adequately surface-wetted, and this may be done by immersing the spools from which the yarn is to be stretched in water which may contain a wetting agent or surface tension depressant, such as a sodium salt of a higher alkyl sulfate, or another of the materials commonly used for this purpose in textile operations. It may be desirable to apply the stretch in two or more stages. Thus, the yarn may be initially stretched, say, 90%, and in two subsequent operations given additional stretching to the extent of 10% or 20% in each stage.

For a period after the yarn has been stretched, it shows a marked tendency to contract. This characteristic may be readily controlled and modified by a "setting" treatment, for example, by prolonged aging of the yarn under tension, or by subjecting the yarn under tension to moderately elevated temperatures, which greatly accelerate the rate of setting. After this setting treatment the continuous filament yarn may be incorporated directly with other textiles or it may first be stapled and then carded with other fibers.

The process of producing yarn from the conjoint polymers of a vinyl halide and a vinyl ester of an aliphatic acid, which is suitable for use in this invention is disclosed in Patent No. 2,161,766, issued June 6, 1939, to E. W. Rugeley, T. A. Feild and J. F. Conlon, with which this application contains material in common.

In order to impart the characteristics of crease resistance and crease permanence to the finished composite fabric, it is generally necessary that the filaments of the vinyl resin incorporated into the fabric be fused or at least partly fused, thereby bonding the vinyl resin with the other fibers present. Since the vinyl resins described are thermoplastic, the desired shape or crease may be imparted to the fabric at elevated temperatures. When used in conjunction with such fibers as cellulose acetate, it is desirable to select a vinyl resin whose molecular weight approaches the lower limit specified, and which may at the same time contain a lower percentage of the vinyl halide in the polymer, if the conjointly polymerized vinyl ester resin is employed, or a high degree of acetalization if the polyvinyl partial acetal resin is employed. The reason for this is that where the vinyl resin filaments are to be fused with other thermoplastic fibers, such as cellulose acetate, it is necessary to employ a vinyl resin of lower softening point than the cellulose acetate, so that the latter will not be adversely affected.

There are many applications of the vinyl resin filaments described. For example, vinyl resin staple may be carded with cotton in a ratio empiracally determined for the desired ultimate binding effect. The card sliver is spun by the standard cotton system and the threads then woven into a fabric which may be used as an interliner for non-wilting collars, cuffs, shirt fronts, and the like. The thermoplastic vinyl resin will on each laundering and pressing function as a stiffening and non-creasing agent for the multiple layer fabric construction. An alternate method consists in preparing a thin felt of vinyl resin staple and cotton, placing this between the outer fabrics and heating under pressure. The vinyl resin produces a tight bond between the layers. In cases where an especially dull appearance of the material is desired, a pigment, such as titanium oxide, in finely-divided form, may be incorporated in the vinyl resin filament by dispersing the pigment in the vinyl resin solution or "dope" from which the filaments are spun.

It is generally recognized that a spun staple fabric consisting either of viscose or cellulose acetate staple, although of pleasing appearance is unsatisfactory with respect to strength, both in the wet and dry state, and is characterized by a tendency toward distortion, and susceptibility toward creasing. The carding of the vinyl resin staple with viscose or cellulose acetate staple in a ratio ranging from 10% to 20%, the spinning of the thread in the normal fashion, the weaving of the fabric and the calendering of the finished fabric yields a product of markedly improved tensile strength, both in the wet and dry states, of good crease resistance, of excellent resistance to distortion, and of a pleasing full "hand" without harshness. Such fabrics serve well as dress goods.

Carding the vinyl resin staple with wool, spinning and weaving the threads thus formed, followed by a calendering treatment at the end of the usual finishing treatment yields a composite fabric that withstands acid carbonizing. The fabric is of higher strength, which is particularly desirable in light-weight worsted construction, that is crease resistant and tends to retain pressed lines after each pressing, and that is capable of being made up in special novel mottled effects by cross dyeing if desired.

Due to the chemical resistance of the vinyl ester resins described, yarns prepared by carding together vinyl ester resin staple and cotton may, if desired, be given the usual mercerization treatment for cotton alone, while at the same time the calendered fabrics have increased strength, a novel appearance and improved "hand." These fabrics, whether mercerized or not, are particularly suitable for the fashioning of summer suits.

Since the vinyl ester resins described have much of the chemical resistance, certain physical properties and non-support of combustion of glass, they may be combined with glass fiber, either in the form of continuous filaments, or staple fibers of the two materials may be carded together. In the latter case the thread may be spun under the conditions developed for glass fiber staple spinning, whereupon it is given a heat treatment so that the resin may partly fuse and act as a binder for the glass filaments. Such binding is highly preferable to that normally employed, since a higher strength thread results, there is no appreciable loss of strength on wetting, and the effect is permanent, along with chemical resistance and the special physical properties of the two fibers. The polyvinyl partial acetal resin filaments may similarly be combined with glass fibers, but these resins do not have the unusual chemical resistance of the vinyl ester resins. In addition to the composite goods mentioned, the vinyl resin fibers may be used as supporting threads for asbestos yarn, the thread if desired being especially made up with loops to aid in picking up the asbestos fibers, preferably following by partial fusion. Composite threads or strings of silk and vinyl resin fibers may be used for the manufacture of tennis racket strings and like materials, since such threads after bonding the fibers by fusion are very strong and impervious to moisture. Unwoven ribbons may be made by calendering parallel threads of natural or artificial silk and vinyl resin filaments, since the partial or complete fusion of the vinyl resin serves as a cross binder for the other materials. Composite threads of artificial silk and vinyl resin fibers may be used in sewing suit linings, for upon pressing the vinyl resin fibers will lock the stitch to the material. Cotton staple, carded with the vinyl resin staple described, may be heated to the fusing temperature of the resin without pressing to form a fluffy stuffing which maintains its shape well.

Where the vinyl resin fibers have been stretched during their preparation, they will shrink to some extent upon being bonded to the other textile fibers, unless the material is supported under tension while the fusion of the vinyl resin fibers takes place. This shrinkage causes the vinyl resin fibers to become quite crinkled, and so helps to bind all of the fibers together.

Other vinyl resins than the ones described are suitable for use in this invention, provided they are insoluble in water, have average macromolecular weights of at least 7,500, and have softening points sufficiently low so that they may be fused with textiles without injury thereto.

Many special uses and adaptations of the materials of this invention will be apparent to those skilled in the art. The procedures by which the new materials are made can be varied in many of their details, and such modifications are included within the invention as defined by the appended claims.

We claim:

1. Composite materials comprising fibers reinforced by a binding agent, said binding agent consisting of at least partially fused fibers of a water-insoluble vinyl resin, said resin having an average macromolecular weight of at least 7500.

2. Composite materials comprising fibers reinforced by a binding agent, said binding agent consisting of filaments of a water-insoluble vinyl resin having an average macromolecular weight of at least 7,500, and said filaments being at least partially fused to said fibers.

3. Composite materials comprising textile fibers mixed with fibers of a vinyl resin substantially identical with the resin resulting from the conjoint polymerization of a vinyl halide with a vinyl ester of an aliphatic acid and containing between about 50% and about 95% by weight of the halide in the polymer, said vinyl resin having an average macromolecular weight of at least 7500, said vinyl resin fibers being at least partially heat-fused with said textile fibers.

4. Composite materials comprising textile fibers combined with fibers of a vinyl resin substantially identical with the resin resulting from the conjoint polymerization of vinyl chloride with vinyl acetate, which contains from about 80% to about 95% by weight of the chloride in the polymer and which has an average macromolecular weight of at least 15,000, said vinyl resin fibers being at least partially fused with said textile fibers.

5. Composite materials comprising staple fibers of a vinyl resin substantially identical with the product resulting from the conjoint polymerization of a vinyl halide with a vinyl ester of an aliphatic acid and containing between about 50% and about 95% by weight of the halide in the polymer, and said vinyl resin having an average macromolecular weight of at least 7,500, said staple fibers being combined with metal fibers.

6. Composite materials comprising staple fibers of a vinyl resin substantially identical with the product resulting from the conjoint polymerization of a vinyl halide with a vinyl ester of an aliphatic acid and containing between about 50% and about 95% by weight of the halide in the polymer, said vinyl resin having an average macromolecular weight of at least 15,000, said fibers being at least partially heat-fused with metal fibers.

7. Heat- and light-resistant composite materials comprising fibers reinforced by a binding agent, said binding agent consisting of filaments of a vinyl resin substantially identical with a polyvinyl partial acetal resin wherein the polyvinyl alcohol has been acetalized with an aldehyde from the group consisting of acetaldehyde from about 88% to about 94%, propionaldehyde from about 52% to about 92%, butyraldehyde from about 42% to about 82%, valeraldehyde from about 35% to about 62%, and hexaldehyde from about 33% to about 45%; and said vinyl resin having an average macromolecular weight of at least 7,500, and being resistant to ultraviolet light and to elevated temperatures for long periods of time.

8. Heat- and light-resistant composite materials comprising staple fibers of a vinyl resin substantially identical with a polyvinyl partial acetal resin wherein the polyvinyl alcohol has been acetalized with an aldehyde from the group

consisting of acetaldehyde from about 88% to about 94%, propionaldehyde from about 52% to about 92%, butyraldehyde from about 42% to about 82%, valeraldehyde from about 35% to about 62%, and hexaldehyde from about 33% to about 45%; said vinyl resin having an average macromolecular weight of at least 7,500, and being resistant to ultra-violet light and to elevated temperatures for long periods of time, and said staple fibers being combined with staple fibers of a material of different composition.

9. Composite materials comprising asbestos fibers supported by fibers of a water-insoluble vinyl resin having an average macromolecular weight of at least about 15,000, said vinyl resin fibers being at least partially fused to said asbestos fibers.

10. Composite materials comprising asbestos fibers supported by fibers of a water-insoluble vinyl resin having an average macromolecular weight of at least about 15,000, said vinyl resin fibers having been stretched up to about 400%, said vinyl resin fibers being at least partially fused to said asbestos fibers.

11. Method of making a stabilized textile fabric which includes yarns of at least two different types of fibers of textile making length, one of which is a water-insoluble vinyl resin fiber having inherent tackiness on heating and having an average macromolecular weight of at least 7500; which comprises forming a fabric containing said different types of fibers and stabilizing said fabric by subjecting it to heat at a temperature at which said synthetic resin fibers become tacky, but below the temperature at which the other fibers are damaged, to cause strong and substantially permanent adhesion of said fibers in said textile fabric without rendering the textile non-porous, whereby said fabric is highly resistant to creasing and wilting and is capable of being reshaped at temperatures sufficiently low to prevent injury to the fabric while retaining its natural resiliency and softness.

12. Method of making stabilized textile fabric from at least two different types of textile yarns, one of which consists of thermoplastic synthetic vinyl resin fibers, said vinyl resin having an average macromolecular weight of at least 7500, which comprises forming a fabric of said different types of yarns and stabilizing said fabric by subjecting it to heat at a temperature at which said vinyl resin fibers become tacky but below the temperature at which the other fibers are damaged, to cause a strong and substantially permanent adhesion of said fibers in said textile fabric without rendering the textile non-porous, whereby said fabric is highly resistant to creasing and wilting and is capable of being reshaped at temperatures sufficiently low to prevent injury to the fabric while retaining its natural resiliency and softness.

13. Composite textile material characterized by crease resistance, increased strength, and ability to retain its shape, comprising a fabric composed of interassociated yarns respectively formed from different types of fibers of textile-making length, one of said yarns being composed of fibers of a water-insoluble vinyl resin having an average macromolecular weight of at least 7500, said vinyl resin fibers being at least partially heat-fused to said different type of fibers.

14. Composite textile material characterized by crease resistance, increased strength, and ability to retain its shape, comprising a fabric composed of one type of yarn intimately associated with another type of yarn, one of said yarns being composed of a vinyl resin substantially identical with the product of the conjoint polymerization of a vinyl halide with a vinyl ester of an aliphatic acid, the proportion of vinyl halide to vinyl ester in the polymer and the average macromolecular weight of the polymer being so correlated that vinyl resin fibers formed therefrom fuse at a temperature sufficiently low to avoid injury to said other yarn during a heat-fusing operation, said polymer having an average macromolecular weight of at least 7500, the two types of yarn being at least partially fused to each other.

15. Composite textile material characterized by crease resistance, increased strength, and ability to retain its shape, comprising a fabric composed of one type of yarn intimately associated with another type of yarn, said yarns being at least partially fused to each other, one of said yarns being composed of fibers of a vinyl resin substantially identical with the product resulting from the conjoint polymerization of a vinyl halide with a vinyl ester of an aliphatic acid and containing between about 50% and about 95% by weight of the halide in the polymer, said resin having an average macromolecular weight of at least 7500, whereby said fabric is highly resistant to creasing and wilting and is capable of being reshaped at temperatures sufficiently low to prevent injury to the fabric while retaining its natural resiliency and softness.

16. Composite textile material characterized by crease resistance, light resistance, increased strength, and ability to retain its shape, comprising a fabric composed of one type of yarn interwoven with another type of yarn, said yarns being at least partially fused together and one of said yarns being composed of fibers of a polyvinyl partial acetal resin wherein the polyvinyl alcohol has been acetalized with an aldehyde selected from the group consisting of acetaldehyde from about 88% to about 94%, propionaldehyde from about 52% to about 92%, butyraldehyde from about 42% to about 82%, valeraldehyde from about 35% to about 62%, and hexaldehyde from about 33% to about 45%; said vinyl resin having an average macromolecular weight of at least 7500, and being resistant to ultra-violet light and to elevated temperatures for long periods of time.

17. Composite textile material composed of at least two different types of fibers of textile-making length, one of said fibers being composed of a vinyl resin having an average macromolecular weight of at least 7500, and substantially identical with the product resulting from the conjoint polymerization of a vinyl halide with a vinyl ester of an aliphatic acid and containing between about 50% and about 95% by weight of the halide in the polymer, said vinyl resin fibers being capable of becoming permanently bonded with the other type of fibers by at least partial heat fusion of said vinyl resin fibers at temperatures below that at which the other fibers are adversely affected, and of imparting to said composite textile material the characteristics of crease resistance, crease retention and increased strength.

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