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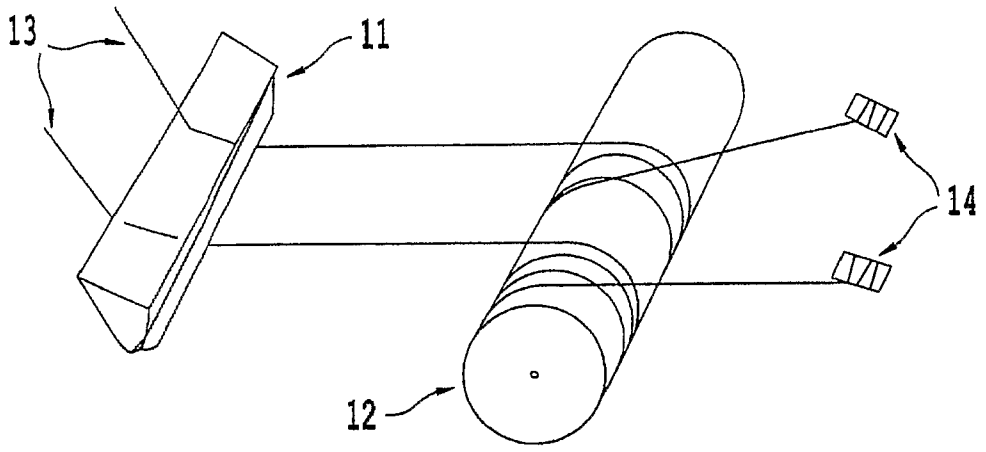
(54) **Title:** METHOD FOR COATING FIBERS AND YARNS AND THE COATED PRODUCTS FORMED THEREFROM



(57) **Abstract:** A method for coating one or more yarn components, either individually or in an assembled configuration, with a (co)polymer coating is provided involving (i) immersing the one or more yarn components, either individually or as an assembled unit of two or more of said yarn components, in a treatment bath containing a carrier medium and a (co)polymer that can be dissolved or dispersed in the carrier medium; (ii) removing the one or more yarn components from the treatment bath; and (iii) evaporating excess carrier medium from the one or more yarn components to thereby form a coating of the (co)polymer on a surface of the one or more yarn components; and the coated yarn products formed thereby.

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TITLE OF THE INVENTION

METHOD FOR COATING FIBERS AND YARNS AND THE COATED PRODUCTS FORMED THEREFROM

BACKGROUND OF THE INVENTION

Field of Invention

The present invention relates generally to a method for providing one or more types of coatings on a fiber or yarn to enhance the properties of the fiber or yarn, and/or protect the fiber or yarn from infiltration by contaminants, and the coated fibers or yarns produced therefrom.

Discussion of the Background

There are many types of fibers and yarns that are conventionally produced, from monofilaments to multicomponent composite yarns. However, often the yarns produced do not have a good feel, or "hand" as it is called in the trade, or do not possess good wear and durability characteristics. Further, in the area of composite yarns, it can often be difficult to provide a yarn of a single consistent color, due to the different types of fibers making up the various constituents of the composite yarn.

Many attempts have been made through the years to improve the hand of fiber and yarn products, most often by application of some sort of finish chemical. These are conventionally liquid materials that coat the surface of the fibers, and provide better processability and hand. Oftentimes, however, even application of a finish does not avoid fuzziness of a final yarn product.

One method for dyeing multicomponent composite yarns has been proposed in US Serial No. 10/972,332, filed October 26, 2004, the contents of which are incorporated herein by reference. However, this method of dyeing, while providing consistent coloring of any type of fiber and mixtures of fibers, does not provide improved processability, durability and hand.

SUMMARY OF THE INVENTION

Accordingly, one object of the present invention is to provide a method for coating a yarn component, or plurality of yarn components individually or assembled into a single unit, with a (co)polymer that is environmentally friendly, and efficient.

A further object of the present invention is to provide a method for coating a yarn component, or plurality of yarn components individually or assembled into a single unit, that can also color the yarn component simultaneously and uniformly.

A further object of the present invention is to provide a method for coating a composite yarn with a (co)polymer to improve processing and durability of the resulting coated product, as well as prevent infiltration of contaminants into the body of the resulting coated yarn product.

A further object of the present invention is to provide a coated yarn product prepared by the method of the present invention.

These and other objects of the invention have been satisfied by the discovery of a method for coating one or more yarn components with a (co)polymer comprising:

a. immersing said one or more yarn components, either individually or as an assembled unit of two or more of said yarn components, in a treatment bath comprising a carrier medium and a (co)polymer that can be dissolved or dispersed in said carrier medium;

b. removing said one or more yarn components from said treatment bath; and

c. evaporating excess carrier medium from said one or more yarn components to thereby form a coating of said (co)polymer on a surface of said one or more yarn components;

and the coated products made thereby.

BRIEF DESCRIPTION OF THE FIGURE

A more complete appreciation of the invention and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

Fig. 1 represents a preferred embodiment of the process of the present invention, wherein one or more yarn components (13) are passed through a treatment bath (11) in which is contained a treatment composition.

DETAILED DESCRIPTION OF THE INVENTION

The term "fiber" as used herein refers to a fundamental component used in the assembly of yarns and fabrics. Generally, a fiber is a component which has a length dimension which is much greater than its diameter or width. This term includes ribbon, strip, staple, and other forms of chopped, cut or discontinuous fiber and the like having a regular or irregular cross section. "Fiber" also includes a plurality of any one of the above or a combination of the above.

As used herein, the term "high performance fiber" means that class of synthetic or natural non-glass fibers having high values of tenacity greater than 10 g/denier, such that they lend themselves for applications where high abrasion and/or cut resistance is important. Typically, high performance fibers have a very high degree of molecular orientation and crystallinity in the final fiber structure.

The term "filament" as used herein refers to a fiber of indefinite or extreme length such as found naturally in silk. This term also refers to manufactured fibers produced by, among other things, extrusion processes. Individual filaments making up a fiber may have any one of a variety of cross sections to include round, serrated or crenular, bean-shaped or others.

The term "yarn" as used herein refers to a continuous strand of textile fibers, filaments or material in a form suitable for knitting, weaving, or otherwise intertwining to form a textile fabric. Yarn can occur in a variety of forms to include a spun yarn consisting of staple fibers

usually bound together by twist; a multi filament yarn consisting of many continuous filaments or strands; or a mono filament yarn which consist of a single strand.

For convenience, the term "yarn component" as used herein, encompasses fiber, monofilament, multifilament and yarn.

The term "composite yarn" refers to a yarn prepared from two or more yarns, which can be the same or different. Composite yarn can occur in a variety of forms wherein the two or more yarns are in differing orientations relative to one another. The two or more yarns can, for example, be blended, parallel, wrapped one around the other(s), twisted together, or combinations of any or all of these, as well as other orientations, depending on the properties of the composite yarn desired. Examples of such composite yarns are provided in U.S. Patents 4,777,789; 5,177,948; 5,628,172; 5,845,476; 6,351,932; 6,363,703 and 6,367,290, the contents of which are hereby incorporated by reference.

The term "air interlacing" as used herein refers to subjecting multiple strands of yarn to an air jet to combine the strands and thus form a single, intermittently commingled strand. This treatment is sometimes referred to as "air tacking." This term is not used to refer to the process of "intermingling" or "entangling" which is understood in the art to refer to a method of air compacting a multifilament yarn to facilitate its further processing, particularly in weaving processes. A yarn strand that has been intermingled typically is not combined with another yarn. Rather, the individual multifilament strands are entangled with each other within the confines of the single strand. This air compacting is used as a substitute for yarn sizing and as a means to provide improved pick resistance. This term also does not refer to well known air texturizing performed to increase the bulk of single yarn or multiple yarn strands. Methods of air interlacing in composite yarns and suitable apparatus therefore are described in U.S. Patents 6,349,531; 6,341,483; and 6,212,914, the relevant portions of which are hereby incorporated by reference.

The present invention is directed to a method for treating or coating a yarn component that is quick, efficient, low-cost and multi-dimensional. Within the context of the present invention, the term "multi-dimensional" is used to denote the ability to provide multiple fiber or yarn treatments in a single pass through a treatment bath. In its broadest

embodiment, the present method is as depicted in Fig. 1. Fig. 1 shows one or more yarn components (13) being passed through a treatment bath (11) in which is contained a treatment composition. The treated yarn components are then wound around a heated roller (12) one or more revolutions, followed by takeup on tubes or bobbins (4).

The treatment composition can take any form, including but not limited to solutions, dispersions and emulsions. The treatment composition contains at least one (co)polymer suitable for coating the yarn component. This at least one (co)polymer can be in solution or present as a (co)polymer emulsion or dispersion. The (co)polymer can be present in any desired amount in the treatment composition, preferably from about 1-15% by weight of the composition, more preferably from about 2-10% by weight, most preferably from about 3-9% by weight. Preferred (co)polymers for use as this component are polyvinylchloride (PVC), polyurethane polymers and copolymers, and ethylene-vinyl acetate copolymers.

The treatment composition can optionally contain one or more additional treatment components, including but not limited to antimicrobial agents, antistatic agents, colorants, and lubricants. Preferably, the treatment bath contains the one or more (co)polymers and at least one of the additional components, more preferably at least two of the additional components. In a most preferred embodiment, the treatment composition comprises an aqueous solution or dispersion of ethylene-vinyl acetate copolymer, a colorant and an antimicrobial agent. Most preferably, the components contained in the treatment composition are chemically compatible (i.e. do not detrimentally react with one another; note this does permit reaction or interaction between components, so long as the reaction or interaction is not detrimental to the formation of the (co)polymer coating, or other desired properties, such as color, antimicrobial properties or anti-static properties, etc.).

The treatment composition is preferably aqueous, although non-aqueous compositions are also included within the present invention. When non-aqueous compositions are used, proper precautions must be taken for removal of organic vapors during the drying step at the heated drying roller. The treatment composition can be used at ambient or room temperature or can be heated or cooled as desired.

The yarn component to be treated can be made of or contain any natural or synthetic fiber, alone or in combinations or blends, including, but not limited to, cotton, wool, nylons, polyesters, polyethylenes, polypropylenes, aramids, glass, and metal fibers. The component to be treated may be in the form of a monofilament fiber, multifilament fiber, yarns made from these fibers, composite yarns, or the components of composite yarns, such as the core or individual sheath or wrap layers of the composite yarn.

In a preferred embodiment, the process is used to treat the core of a composite yarn such as those disclosed in US 5,177,948 (already incorporated by reference above). Most preferably, the composite yarn being treated has a core that contains no high performance fibers (in the present context, "high performance fibers" is defined as fibers having a tenacity of at least 10 g/den, such as glass, aramids, and extended-chain polyethylene). In this embodiment, when the treatment composition is applied and dried, the resulting core has surprisingly improved resistance to cutting, compared to the same composition having no treatment composition applied. This process permits the preparation of composite yarns that are therefore cut-resistant or cut-proof, without the costly inclusion of high-performance fibers. The process further permits the introduction of color into the product, as well as anti-microbial and or antistatic properties as desired, all in a single treatment bath, thus lowering production costs significantly.

In another preferred embodiment of the present process, the composite yarn contains a low-melting encasing yarn in the core, which has a softening point below the temperature of the heated drying roll (4), such that during the drying process, the encasing yarn softens and forms an encasing covering on the underlying fiber or yarn. In doing so, the composite yarn that results has a coating of (co)polymer on the exterior of the outer sheath or wrap layer, with an additional coating of the encasing yarn forming a layer between the core and innermost sheath or wrap layer. Suitable encasing yarns include, but are not limited to, those disclosed in US 6,230,524 and US 6,367,290, the contents of which are hereby incorporated by reference.

The present process can be used to improve the cut-resistance of a composite yarn, and can also improve the appearance and/or hand of a composite yarn. In particular, in some instances when preparing conventional composite yarns, the resulting product has high levels

of fuzz present on the exterior surface of the yarn. Additionally, in some instances conventional composite yarns have a problem with evenness of the exterior surface properties, particularly in dyeing or coloring of the composite yarn. Using the present process to coat the exterior of the yarn with a coating containing a (co)polymer as described herein, then passing the coated product over the heated drying roll, results in significant reductions of fuzz level. Additionally, when the treatment bath contains a colorant in addition to the (co)polymer, the colorant is evenly distributed by the treatment composition, and evenly colors the (co)polymer coating. This is particularly effective in providing better uniformity of color in the final product, as the surface layer is all the same (co)polymer, and thus has more uniform dye or colorant uptake compared to uptake of the dye with the surface of the composite yarn itself, which may have multiple types of fibers exposed at the surface.

Although the present invention has been described with preferred embodiments and examples of those embodiments, it is to be understood that modifications and variations may be utilized without departing from the spirit and scope of this invention, as those skilled in the art would readily understand. Such modifications and variations are considered to be within the purview and scope of the appended claims

CLAIMS:

1. A composite yarn comprising:

a. two or more yarn components; and

b. a (co)polymer coating on at least one of said two or more yarn components.

2. The composite yarn of claim 1, wherein said two or more yarn components form (i) a core comprising at least one of said two or more yarn components, and (ii) one or more wrapping layers wrapped around said core, wherein said (co)polymer coating coats at least one of (i) said core, (ii) one or more of said wrapping layers, or both.

3. The composite yarn of claim 2, wherein said core comprises two or more yarn components, at least one of which is a high-performance fiber.

4. The composite yarn of claim 1, wherein said two or more yarn components are blended together and said (co)polymer coating forms a coating around the resultant blended yarn.

5. The composite yarn of claim 1, wherein said (co)polymer is at least one member selected from the group consisting of polyvinylchloride, polyurethane polymers and copolymers, and ethylene-vinyl acetate copolymers.

6. The composite yarn of claim 2, wherein said (co)polymer is at least one member selected from the group consisting of polyvinylchloride, polyurethane polymers and copolymers, and ethylene-vinyl acetate copolymers.

7. The composite yarn of claim 2, wherein said (co)polymer forms a coating on an exterior surface of the assembled composite yarn.

8. The composite yarn of claim 2, wherein said (co)polymer forms a coating directly on said core.

9. The composite yarn of claim 2, wherein said core comprises two or more yarns in an arrangement with respect to each other selected from parallel, twisted around one another or one wrapped around the other(s).

10. The composite yarn of claim 9, wherein said (co)polymer forms a coating around at least one of said two or more yarns in said core.

11. The composite yarn of claim 2, wherein said (co)polymer coating coats said core and at least one of said wrapping layers.

12. The composite yarn of claim 11, wherein said (co)polymer coating coats said core and each of said wrapping layers.

13. A method for coating one or more yarn components with a (co)polymer, comprising:

a. immersing said one or more yarn components, either individually or as an assembled unit of two or more of said yarn components, in a treatment bath comprising a carrier medium and a (co)polymer that can be dissolved or dispersed in said carrier medium;

b. removing said one or more yarn components from said treatment bath; and

c. evaporating excess carrier medium from said one or more yarn components to thereby form a coating of said (co)polymer on a surface of said one or more yarn components.

14. The method of claim 13, wherein said carrier medium is water.

15. The method of claim 13, wherein said (co)polymer is at least one member selected from the group consisting of polyvinylchloride, polyurethane polymers and copolymers, and ethylene-vinyl acetate copolymers.

16. The method of claim 13, wherein said one or more yarn components are assembled to form a composite yarn prior to said immersing step.

17. The method of claim 13, wherein said treatment bath further comprises at least one member selected from the group consisting of antimicrobial agents, antistatic agents, colorants, and lubricants.

18. The method of claim 13, wherein said immersing step is performed by passing said one or more yarn components continuously through said treatment bath.

19. The method of claim 18, wherein said evaporating step is performed by wrapping said one or more yarn components around a heated roller a number of revolutions sufficient to permit evaporation of substantially all of said carrier medium while in contact with said heated roller at a given continuous throughput of said one or more yarn components.

20. The method of claim 19, further comprising a step of collecting said coated one or more yarn components on a bobbin or tube.

21. The method of claim 19, further comprising drying said coated one or more yarn components by heating said coated one or more yarn components at a temperature sufficient to remove the remainder of said carrier medium.

22. The method of claim 21, wherein said drying step is performed by passing said coated one or more yarn components through a heated oven at a temperature and for a duration of time sufficient to effect said drying.

23. The method of claim 19, further comprising drying the collected coated one or more yarn components by placing the collected yarn and the tube or bobbin on which the one or more yarn components are collected into a heater at a temperature and for a duration of time sufficient to effect said drying.

24. The method of claim 13, wherein said (co)polymer is present in said treatment bath in an amount of from 1-15% by weight.

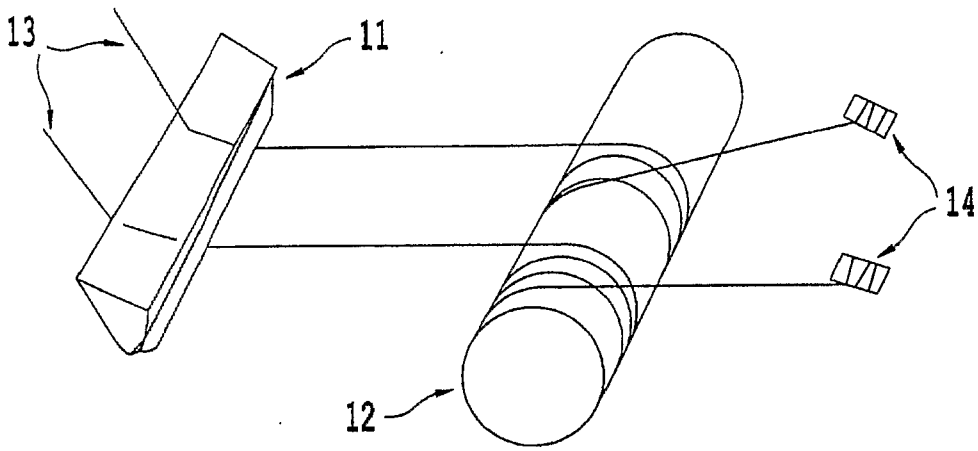

Fig. 1