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METHOD OF THERMALLY PROCESSING THERMOPLASTIC YARNS

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ABSTRACT OF THE DISCLOSURE

There is provided a method for processing a yarn to obtain a molecularly reoriented structure. The yarn is spun from suitable staple fibers of which fibers at least some are thermoplastic. The spun yarn is conglutinated by impregnating with an adhesive which is a solution of polyethylene oxide dissolved in perchloroethylene and subsequently drying the yarn. The conglutinated spun yarn temporarily holds the stapled fibers in a relative position in a geometric structure of the spun yarn so that stresses may be introduced into the yarn by twisting while the staple fibers are held in their relative position in their geometric structure. After the stresses have been applied, the adhesive is dissolved from the twisted yarn to create strains therein.

The present invention relates to an improvement in a method of processing yarns spun from staple fibers, and more particularly, to a method of processing spun yarns having at least some thermoplastic staple fibers, the resulting yarn having a molecularly reoriented structure which has characteristics of being fluffy, lively, lofty, and stretchy.

Heretofore in the thermal processing of spun yarn composed of thermoplastic staples or blends of thermoplastic staples with non-thermoplastic staples, such as cotton, silk, wool, or the like, the spun yarns have been treated by coating or penetrating the staples with thermoplastic resins. The subsequent processing of the yarn after spinning by winding or twisting the same for introducing stresses and then heat treating the yarn in a regulated heat zone, or for that matter, winding and twisting the spun yarn while heat treating, has resulted in the heat settable thermoplastic resins becoming an integral part of the yarn. The principal objection to such prior processing of yarn is that with the heat settable thermoplastic resin becoming an integral part of the yarn, it becomes soft during the heat setting, allowing the staple fibers of the yarn, which have been placed under a stress by twisting, to become displaced from their position in the geometric structure of the yarn after spinning so that the stresses introduced into the yarn become strains. In other words, since the staple fibers become displaced from their original position in the geometric structure of the yarn, when the yarn is heated, they cannot return to their former geometric position even though the thermoplastic fibers of the same may have been molecularly reoriented. Additionally, such yarns require further processing assistants, such as coning oils or lubricants, sizing, and the like, to enable the building of a proper package (cone, cheese, pirn, etc.), or to give the yarn aesthetic hand, or to give the yarn proper characteristics to enable easy fabrication with the yarn such as during knitting, weaving, and the like.

A principal object of the present invention is to obtain a yarn prepared from thermoplastic staples or blends of thermoplastic staples with non-thermoplastic staples, which is capable of molecular reorientation by thermally altering the same with shrinking, stretching, deforming, or stabilizing.

Still another object of the present invention is to provide a method for thermally processing spun yarns in which the geometric structure of the fibers after spinning and with subsequent treating remains substantially the same or returns to the same.

A further object of the present invention is to provide a method of thermally processing spun yarns, the yarn after heat setting being normally smooth, whereby it may be easily wound for dye packages, warped, or knitted, or quilled for weaving.

Ancillary to the immediately preceding object, it is still another object of the present invention to provide a method of processing yarns having staple thermoplastic fibers or a blend of staple thermoplastic fibers and non-thermoplastic fibers which permits weaving without additional sizing and without kinking, spiralling, or the like. Fabrication is thus accomplished withuot uneven tension streaks in the resulting product.

A still further object of the present invention is to provide a method for processing a spun yarn which involves coating or impregnating the fibers of the yarn with a non-thermoplastic adhesive which will hold the spun fibers in a relative position to each other during the introduction of stresses by twisting, or during shrinking, stretching, deforming, or stabilizing of the thermoplastic fibers by heat setting, the non-thermoplastic adhesive being easily removed after packaging of the yarn or after fabrication with the yarn.

These and other objects and advantages of the present invention will appear more fully from the following detailed description of the method and the following claims.

The present invention concerns yarns which are spun from staple fibers rather than continuous filaments, the staple fibers often being referred to as "discontinuous" staple fibers. The staple fibers of the yarn may be one hundred percent thermoplastic or a blend of any proportion of thermoplastic staple fibers with non-thermoplastic staple fibers. Thermoplastic fibers are, for example, polyamide, polyester, polypropylene, cellulose acetate, cellulose triacetate, acrylic, or any other fibers which are capable of being thermally altered to shrink, stretch, deform, or stabilize. On the other hand, when the yarn is composed of blends of staple fibers, the non-thermoplastic fibers may be such natural fibers as cotton, silk and wool, or the like, or those manmade fibers which are not thermoplastic. Also, the thermoplastic fibers of the spun yarn may be of discontinuous staples of bi-component or multi-component content of several thermoplastic generic types or combinations of multi-component fibers partly of thermoplastic types and partly of non-thermoplastic types regardless of whether the fibers are contiguous, heterogenous or agglomerate.

The method of the present invention broadly involves coating or impregnating the fibers of a spun yarn with a non-thermoplastic adhesive which, when it conglutinates, will hold the staple fibers of the yarn in relative position while stresses are introduced by twisting and/or while the thermoplastic fibers of the yarn are thermally altered, for example, to shrink, stretch, deform, or sta-

bilize, by heat treatment of the same. The nonthermoplastic adhesive holding the staple fibers of the spun yarn in relative position to each other is easily dissolved out of the yarn before or after whatever further processing step is desired, dependent upon the ultimate use of the yarn. For example, the yarn after inducing stresses and after thermally altering the fibers, will have a generally smooth exterior which makes it easily wound for dye packages, warped or knitted, or quilled for weaving and woven with or without additional sizing. At the proper stage in the use of the spun yarn, the non-thermoplastic adhesive is dissolved out from the spun yarn fibers and the resulting yarn which has been molecularly reoriented, will have characteristics of being fluffy, lively, lofty and stretchy.

In more detail, it has been found that an ideal adhesive for use in coating or impregnating the fibers of the spun yarn to hold the fibers relative to one another so that they do not lose their position in the geometric structure of the yarn during subsequent treatment, is a solution of polyethylene oxide dissolved in perchloroethylene. The fibers of the yarn may be either coated or impregnated during spinning or after spinning, the perchloroethylene solvent being reclaimed from the solution when the non-thermoplastic adhesive is vacuum dried to set.

The process of the present invention may have several sequences of procedure but with whatever sequence is used, the primary purpose of the process is to conglutinate the staple fibers of the yarn into a fixed relationship with each other so that they retain their position while heat setting and/or while twisting or untwisting, whether or not through zero to opposite twist. Non-thermoplastic adhesive remains upon the spun yarn and aids in retaining the yarn's previous general appearance and general handling characteristics. The final resulting characteristics of the yarn of being fluffy, lively, lofty and stretchy, does not become evident until the adhesive is removed from the yarn, thus releasing the fibers from each other.

Example A

The yarn was spun from a blend of 65 percentage of thermoplastic fibers made from polyester and a 35 percentage of cotton non-thermoplastic staple fibers made from cotton. As the yarn was spun, it was also subjected to a regulated heat zone at 450° Fahrenheit in which the thermoplastic staple fibers were molecularly reoriented. Immediately after spinning of the yarn, the yarn was coated or impregnated with a solution of polyethylene oxide dissolved in perchloroethylene, the yarn then being subjected to a vacuum to dry the same with reclamation of the volatile perchloroethylene. After the conglutinating of the adhesive, the yarn was then twisted to create stresses in the same. The yarn was then made into a package and subsequently strains were created in the yarn by dissolving out the adhesive by use of water as a solvent.

Before the adhesive was dissolved from the yarn by washing in water, the yarn had a smooth exterior surface which enhanced its ability to be packaged, warped, quilled and used in weaving, with or without additional sizing. Once the adhesive had been dissolved from the yarn, the yarn assumed its final characteristics of being fluffy, lively, lofty and stretchy.

The steps of the above example were repeated in their entirety but instead of using a blend of thermoplastic and non-thermoplastic staple fibers, the yarn was spun from one hundred percent thermoplastic fibers of polyester material. The resulting spun yarn treated in the same manner as above, produced the same advantages for further handling of the same while the adhesive was still on the yarn and also had the same general characteristics once the adhesive was removed from the yarn by washing of the yarn with water.

Example B

The yarn was produced by spinning the same from a blend of 55 percent of thermoplastic staple fibers made from polyester and with 45 percent of non-thermoplastic staple fibers made from rayon. In this experiment, the blend of staple fibers was coated or impregnated with a solution of polyethylene oxide dissolved in perchloroethylene as they were spun and then the spun yarn was subjected to a vacuum for reclaiming the volatile solvent. Stresses were then introduced into the yarn by twisting the yarn. After the stresses had been introduced, the yarn was subjected to 450 degrees Fahrenheit in a regulated heat zone so as to heat set the thermoplastic staple fibers. Prior to removing the adhesive, the yarn had excellent packaging characteristics in that its exterior surface was smooth and easily wound into packages. Additionally, the yarn could be fabricated into cloth, with or without the use of sizing. The adhesive was removed after packaging and after fabrication by washing in water and the resulting characteristics of the yarn caused by the strains introduced and the molecular reorientation of the thermoplastic fibers were fluffiness, liveliness, loft and stretch.

A second yarn was made by the same steps as referred to above in Example B, only the yarn was made from one hundred percent of thermoplastic fibers made from polyester material. The yarn prior to removel of the adhesive, had excellent characteristics for further processing such as winding, knitting or weaving and after removal, obtained its end characteristics of being fluffy, lively, lofty and stretchy.

Having set forth the nature, objects and advantages of the present invention, it will be obvious from the description of the invention that the method is susceptible to some changes and modifications without departing from the principle and spirit thereof. For this reason, the terminology used in this specification is merely for the purpose of description and not limitation, the scope of the invention being defined by the claims.

What is claimed is:

1. A method of processing a yarn to obtain a molecularly reoriented structure comprising the steps of: spinning the yarn from suitable staple fibers in which at least some of the staple fibers are thermoplastic; conglutinating the spun yarn by first impregnating the yarn with a solution of polyethylene oxide dissolved in perchloroethylene and then drying the yarn to temporarily hold the staple fibers in a relative position in a geometric structure of the spun yarn; then introducing stresses into the yarn by twisting the yarn while the staple fibers are still held in their relative position in the geometric structure of the spun yarn; and subsequently dissolving the polyethylene oxide from the twisted yarn to create strains therein.

2. A method as claimed in claim 1 including heat setting the thermoplastic staple fibers of the yarn.

3. A method as claimed in claim 2 in which the step of heat setting of the thermoplastic staple fibers is accomplished during the spinning of the yarn.

4. A method as claimed in claim 2 in which the heat setting of the thermoplastic staple fibers is accomplished after twisting of the spun yarn.

5. The method of claim 1 wherein the yarn which has been impregnated with the solution of polyethylene oxide in perchloroethylene is dried in a vacuum and the perchloroethylene is reclaimed.

6. A method as claimed in claim 1 in which impregnation of the yarn with the solution of polyethylene oxide in a solvent of perchloroethylene is accomplished during the spinning of the yarn.

7. A method as claimed in claim 6 including heat setting the thermoplastic staple fibers of the spun yarn after introducing stresses by twisting.

8. A method as claimed in claim 1 in which impregnation of the yarn with the solution of polyethylene oxide in a solvent of perchloroethylene is accomplished after spinning of the yarn and before introducing of stresses in the yarn by twisting.

9. A method as claimed in claim 8 including heat set-

ting the thermoplastic staple fibers in the yarn during spinning of the yarn.

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