METHOD OF STABILIZING BULKED CONTINUOUS FILAMENT THERMOPLASTIC YARN

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5 Claims

ABSTRACT OF THE DISCLOSURE

The method involves stabilizing a core supported wound package of bulked, continuous filament yarn, at a predetermined bulk level by replacing the core with a core of a predetermined smaller diameter to allow the bulk level of the yarn in the inner portion of the package to increase up to the level of the remaining yarn in the package, compressing the package to obtain more uniform density, and thereafter stabilizing the yarn in a heated liquid.

This invention relates to the production of textured or bulked yarns formed from highly stretchable, continuous filament, heat-settable thermoplastic yarns and more particularly to a method of stabilizing such yarns with heat to obtain a uniform bulk level therein.

Textured continuous filament yarns are now extensively used in the textile industry due, at least in part, to their outstanding covering ability, texture and hand, easy care and serviceability, long wear life, etc.

Many different processes have been developed for texturizing the raw continuous filament thermoplastic yarns, but all of such processes generally involve a combination of heat-setting and distorting the yarn. Thus, for example, such yarns can be texturized by being passed between heated intermeshing gears, or by being overfed and stuffed into a heating chamber or box, or by a combination of heat-setting and twisting, such as a false-twist operation wherein the yarn is twisted, heat-set and untwisted in one continuous operation.

In those processes involving twisting and heat-setting to bulk the yarn, the yarn is quite lively or unbalanced, and highly stretchable after twisting. Thus, it is common to modify or stabilize the yarn at the desired bulk level by subjecting it to an additional heat-setting treatment.

The ease with which continuous filament thermoplastic yarns can be texturized or bulked by twisting is more than offset by the problems encountered in stabilizing the yarn at a desired, uniform bulk level within the length of one yarn and from yarn package to yarn package, since the unstabilized yarn is lively and highly stretchable and it is most difficult to maintain a quantity of such yarn at a given bulk level for a length of time sufficient to stabilize it. Moreover, the yarn shrinks to varying degrees during stabilization.

Several methods have evolved in the art for stabilizing these highly stretchable lively bulk yarns. For example, where uniformity of bulk level is not too important, it is common merely to heat-set a take-up package of such yarn with steam, the yarn having been overfed onto the package to an extent sufficient to create a predetermined theoretical bulk level. Although this method is highly desirable from the standpoint of expediency and cost, since it involves a minimum of steps, it has not hitherto resulted in obtaining a uniform bulk level throughout the package. This is due to the fact that the yarn, which has a strong tendency to contract due to its highly stretchable nature, begins to contract (and therefore gain bulk) after it is wound into package form, and while the yarn in the outer portion of the package can so contract a calculable amount inwardly of the package, the yarn in the inner portion of the package does not have the same amount of freedom due to the presence of the winding core. As a result of this, after stabilization (and thus, even more shrinkage) of such package, the yarn in the inner portion of the package will have a lower bulk level than the yarn in the outer portion, often as much as 8 to 10% lower, depending upon the particular yarn.

Another method involves winding the unstabilized yarn onto a take-up bobbin without overfeeding (and thus without bulk) and then removing the bobbin whereupon the yarn is then wholly free to contract inwardly toward the center of the package and bulk to a given bulk level. The thus bulked yarn is then stabilized at such given bulk level. A considerable drawback to this method is that all of the bulk must be developed after the yarn is wound into package form, and thus, uniformity and control of bulk level within packages and from package to package is most difficult to obtain.

Still other methods involve rewinding of the package into another more suitable form for stabilizing, such as a skein, but of course, such rewinding naturally adds considerably to the cost of the processing.

In accordance with the present invention, I have discovered a new method of stabilizing bulked continuous filament, thermoplastic yarns by which an exceptionally high degree of bulk uniformity can be maintained with a minimum of winding or handling operations. Basically, this new method involves the modification of a package of bulked, highly stretchable yarn wherein the bulk of the yarn in the outer portion of the package is at substantially the desired bulk level by replacing the winding core thereof with a perforate core of a predetermined smaller diameter to permit the bulk level of the yarn in the inner portion of the package to increase to the desired bulk level of the other yarn and give such yarn more room to shrink during stabilization. The thusly modified package is then compressed to "break-up" the yarn and obtain a more uniform density, whereupon it is then stabilized by forcing a heated liquid through the package, as for example, by treating it in a yarn package dyeing machine.

Some of the objects of the invention having been stated, other objects will appear as the description proceeds, when taken in connection with the accompanying drawings, in which:

FIGURE 1 is a schematic illustration of a yarn false-twisting operation;

FIGURE 2 is an isometric view of an apparatus suitable for replacing and inserting cores of and into yarn packages and for compressing such packages;

FIGURE 3 is an enlarged fragmentary side elevatiion of the core replacing elements and comprising the apparatus shown in FIGURE 2;

FIGURE 4 is similar to FIGURE 3 and additionally shows a yarn package positioned for replacement of its core;

FIGURE 5 is a still further enlarged fragmentary vertical sectional view of a yarn package as in FIGURE 4 during replacement of the winding core thereof; and

FIGURE 6 is similar to FIGURE 4 and shows the yarn package after replacement of the core and during compression.

Referring now more specifically to the drawing, and particularly FIGURE 1, there is represented a schematic illustration of a conventional false-twisting operation for bulking a continuous filament thermoplastic yarn such as polyester, nylon or cellulose tricarboxilate. In the operation, a yarn is typically bulked by being led from the supply package (10), through suitable holding means (11), heating means (12), a false-twist spindle (13), another holding means (14), and finally, onto a take-up package (15) wound on a core (16), such as a cardboard tube. As is well known in the art, the foregoing arrangement produces a
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3, lively, highly stretchable yarn by continuously twisting, heat-setting and then untwisting. In producing bulk yarns by this process, it is common to overfeed the yarn from the holding means 14 onto the take-up package 15. This overfeeding together with the tendency of the yarn to contract (due to its highly stretchable nature) causes the yarn to bulk and this can be controlled by producing a desired tension on the yarn. As stated previously, however, the bulk level of the yarn within such a take-up package tends to vary as much as 8 to 10% from the inside to the outside of the package due to the fact that the yarn in the inner portion of the package is prevented from contracting by the winding core 16. In view of the foregoing, in accordance with the present invention, a package 15 of such yarn is formed so that the bulk level of the yarn in the outer portion is at that level which is ultimately desired, and the bulk level of the yarn in the inner portion of the package is below such level.

Due to the delicate nature of some continuous filament yarns, it is often desirable to cover the yarn package 15 with a sock 17 or the like, as shown in the figures. Such a cover usually takes the form of a knitted tube which covers and is stored with the winding core 16 before winding and which has sufficient length and stretchability to fit around the package after winding.

In modifying the thus formed package 15, the core replacing operation should be accomplished by simultaneously inserting the perforate core while removing the winding core, as by pushing one with the other. Otherwise, the package 15 will close inwardly too much and the bulk level of the yarn toward the center of the package will increase to a level greater than that of the yarn toward the outside. By the same token, therefore, it is necessary that the perforate replacement core be of a diameter just enough smaller than the diameter of the winding core 16 to permit just enough inward expansion of the package to achieve the desired uniform bulk level. This difference in diameter will vary with different types and deniers of thermoplastic yarns. For example, in the case of polyester yarns in the range of 70 to 200 denier, the difference in diameters should be within the range of about .240 to .500 inch. The replacement core is perforate, such as a foraminous stainless steel tube or perforated stainless steel tube or tubing, to permit free flow of liquid therethrough and through the package during the stabilizing treatment.

For removing the winding core 16 from the package 15, I provide an apparatus such as that shown in FIGURE 2-6, which comprises a vertically movable mandrel 20, and upon actuation of the air cylinder 21, 21 mounted thereabove. A flange 22 is provided on the upper end of the mandrel for reasons which will become apparent hereinafter. A platform 23 is provided below the mandrel 20 for supporting a yarn package to be cored, such platform having an opening 24 therein to permit passage of the expelled winding core 16 through the platform and to a collection point (not shown).

As shown, the package 15 is centered on the platform 23 so that the core 16 is positioned directly over the opening 24. A perforate tube 25 is then placed on the mandrel 20, and upon actuation of the air cylinder 21, the perforate tube 25 is engaged by the flange 22 and pushed downwardly into engagement with tube 16, whereupon continued downward movement causes the tube 25 to push the tube 16 completely out of the package.

In winding yarn into packages, it is almost impossible to obtain uniformity of yarn density throughout the package due primarily to the tendency of the yarn to build up and form hard spots at the end of the traverse at the top and bottom of the package. Thus, the compression or breaking up of the modified package is also important in the present method in that it tends to break up any hard spots in the package and achieve a more uniform density throughout. To this end, a compressing of the package may be carried out during the core replacement operation as shown, for example, in FIGURE 6 wherein continued downward movement of the mandrel 20 after insertion of the tube 25 brings the flange 22 into axial compressing engagement with the package 15.

After replacing the core 16 with the bulk level, compressing the package as heretofore described, the thusly modified package has a uniform bulk level throughout and is in condition for stabilization. In stabilizing, I have found that a considerably more uniform bulk level can be maintained by "wet-setting," that is, setting with a liquid such as water, rather than steam-setting the yarn. This is, of course, highly desirable since it permits use of conventional yarn package dyeing machinery rather than an autoclave for stabilizing the yarn and further permits one to stabilize during a conventional dyeing cycle.

Some examples of the complete process are as follows:

(I)

A 200 denier continuous filament polyester yarn is bulked on a false-twist machine by inserting 56 turns per inch through the heating zone with the heater block being maintained at 195° C., with the yarn being overfed 1% in the heating zone to allow for shrinkage, and with the take-up package being run at a speed 10% slower than the yarn supply speed to allow the yarn to bulk to a predetermined level.

A package of bulked yarn is thus formed weighing approximately 1.3 lbs. and being supported on a paper take-up tube having an outside diameter of 1.903 inches (1% inches I.D. and .140 inch wall thickness). The package is then placed in any suitable apparatus where the tube or core is pushed out with and replaced by a stainless steel perforate dye tube having an outside diameter of 1.645 inches (1% inches I.D. and .010 inch wall thickness) and the package is then compressed by applying an axial compressive force thereto.

The thus compressed and modified package, which now has a uniform bulk level throughout, is then placed along with other similar packages in a package dyeing machine where the yarn is then stabilized by pumping water at 250–260° F. through the packages for 30–40 minutes. The yarn packages are then pressure extracted and dried in a conventional manner.

(II)

A 150 denier continuous filament polyester yarn is bulked in a manner similar to that described in Example I except that 60 turns per inch of twist and 16% overfed onto the take-up package are used.

In this instance, the yarn is taken up onto a paper tube having an outside diameter of 1.875 inches (1% inches I.D. and .125 inch wall thickness).

The package is then modified in the same way as in Example I by replacing the core with a stainless steel perforate dye tube having an outside diameter of 1.645 inches (1% inches I.D. and .010 inch wall thickness) and compressed by applying an axial compressive force thereto.

The package is then placed along with other similar packages in a yarn package dyeing machine and dried with the temperature of the dye bath being held at 250–260° F. for at least 30 minutes. The dried and stabilized yarn packages are then pressure extracted and dried in a conventional manner.

In the drawings and specification there has been set forth a preferred embodiment of the invention and, although specific terms are employed, these terms are used in a generic and descriptive sense only, and not for purposes of limitation, the scope of the invention being defined in the claims.

I claim:

A method of stabilizing a core supported wound package of highly stretchable, bulked, continuous fila-
ment, heat-settable, thermoplastic yarn in which the bulk of the wound yarn in the outer portion of the package is at substantially a desired bulk level and the bulk of the wound yarn in the inner portion of the package is below such desired bulk level, said method comprising the steps of:

increasing the bulk level of the yarn in the inner portion of the package while maintaining substantially constant the bulk level of the yarn in the outer portion of the package by removing the package core while inserting in lieu thereof a perforate core of a predetermined smaller diameter to obtain a more uniform bulk level throughout the package, axially compressing the package to obtain a more uniform density throughout, and then treating the package with a heated liquid to stabilize the entire package of yarn at substantially said desired bulk level.

2. A method according to claim 1 wherein the package is treated with a heated, dyestuff containing, aqueous bath to dye the yarn while stabilizing the same.

3. A method according to claim 1 wherein the yarn is a polyester yarn in which the bulk and high stretch-ability has been imparted thereto by twisting, heat-setting and untwisting in a continuous operation.

4. A method according to claim 3 wherein the package is treated with an aqueous bath at 250–260°F. for at least 30 minutes.

5. A method according to claim 4 in which a dyestuff is present in the aqueous bath for dyeing the yarn during stabilization thereof.

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