Patented Aug. 26, 1952 2,607,980

UNITED STATES PATENT OFFICE

2,607,980

STAPLE FIBER MIXTURE AND PREPARATION OF SPUN YARN THEREFROM

George C. Ward, Cumberland, Md., assignor to Celanese Corporation of America, a corporation of Delaware

No Drawing. Application June 2, 1948, Serial No. 30,731

4 Claims. (Cl. 28—78)

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This invention relates to textile materials and relates more particularly to a novel spun yarn and to a method for its production from continuous filaments.

In the manufacture of spun yarn from artificial continuous filaments, the usual practice is to cut the artificial filaments into comparatively short lengths of from 1 to 3 inches or more, and then subject the staple fibers so produced to spinning operations similar to those employed for the production of yarns from natural fibers such as cotton or wool. It is customary in processes for producing spun yarn to blend staple fibers having bases of different materials, such as cellulose derivatives and regenerated cellulose. Such spun yards may be knitted or woven into fabrics having cross-dyeing properties, a desirable hand, satisfactory strength and a unique appearance. To obtain uniform qualities in the cloth produced from a mixed staple yarn, it is necessary that the staple fibers be thoroughly and uniformly blended before they are spun. Various methods have previously been proposed to achieve thorough blending, such as combing the fibers together and employing gill boxes for doubling the fibers, which expedients require additional apparatus and are time-consuming operations. Accordingly, it is an important object of this invention to provide a simple process for the production of mixed staple fibers and yarn which will eliminate or greatly reduce the blending operations hitherto required.

A further object of this invention is to provide a novel spun yarn having a different structure from that of spun yarns hitherto produced.

Other objects of this invention will appear from the following detailed description and claims.

I have found that a highly desirable spun yarn may be efficiently produced by forming a tow of continuous filaments, non-uniformly modifying said tow and cutting said tow to staple lengths to produce a mixture of staple fibers which require little or no further blending. This mixture of staple fibers is then spun to produce a yarn which may be converted into a fabric in any desired manner.

While this process is applicable to various types of continuous filaments, it is especially suited to the treatment of filaments of organic derivatives of cellulose, for example, cellulose esters such as cellulose acetate, cellulose propionate, cellulose butyrate, the mixed esters of cellulose, cellulose ethers such as ethyl cellulose and benzyl cellulose, and the mixed ether-esters of cellulose. Any of the properties of the filaments

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may be varied by suitable treatment and a preferred method of achieving such variation when employing an organic derivative of cellulose as the filament material, is to selectively apply a saponifying agent to the filaments.

By varying the nature, concentration and time of treatment with the saponifying agent, it is possible to vary the degree of saponification over a wide range. If the extent of saponification is small, there will be a correspondingly small change in the properties of the yarn and all portions of the yarn may be dyed with a single dye with perhaps a difference in shade between the saponified and unsaponified sections. As the degree of saponification of the filaments is increased, the properties of the yarn will undergo a large change and distinct cross-dyeing effects will be possible as the saponified areas approach the composition of regenerated cellulose.

The relative proportion of saponified and unsaponified filaments in the staple fiber may be adjusted by altering the length of the saponified sections, the number of filaments saponified or by varying both the length of the saponified sections and the number of filaments saponified. It is generally desirable that the minor constituent be present to the extent of at least 10% to produce a yarn having properties distinct from those of the unmixed staple, although in some cases a lower percentage will be effective.

Any suitable saponifying agents may be employed such as aqueous or alcoholic solutions of inorganic bases such as sodium hydroxide, potassium hydroxide, sodium carbonate, trisodium phosphate or sodium silicate, and organic bases such as methylamine, ethylamine, ethylene diamine and monoethanolamine. Thickening agents, such as British gum, may be added to the saponifying solutions to produce a saponifying paste.

Saponification of the filaments may occur at any stage during or after their production, for example, it has been found that the filaments may be efficiently treated by collecting a large number of them into a bundle or tow and selectively applying the saponifying agent to all the filaments at spaced intervals along their length, to a portion of the filaments along their entire length or in any combination of these two modes of treatment.

The solution or paste including a saponifying agent may be applied to the filaments in any manner and a suitable apparatus for treating all the filaments at selected and adjustable intervals along their length is shown in U. S. Patent No. 2,145,945. Alternatively, a saponifying paste

may be applied to the filaments by means of an engraved printing roller. When saponification is to be restricted to less than all the filaments in the tow this may be accomplished by flattening the tow and passing the tow, in its flattened condition, over a roller to which a second roller applies a band of saponifying agent narrower than the flattened tow. The tow may also be divided into one or more smaller bundles and one or more of these bundles passed into contact with or through a saponifying bath while other bundles remain untreated. By dividing the tow into more than two bundles, it is possible to selectively vary the extent and degree of saponification of several of the bundles to produce a tow including three or more distinct fibers.

After the tow has been non-uniformly saponified, it is cut to produce a staple fiber having a uniform or non-uniform length and spun into yarn. The length of the staple and the length of the saponified portions of the filaments, when saponification has been at spaced intervals along the length of the filaments, may be adjusted to have any desired relationship. For example, when the length of the staple cut from the filaments is longer than the length of both the saponified and unsaponified portions all of the staple fibers will include both saponified and unsaponified sections. If, however, the length of the staple is materially shorter than the length of the saponified portions of the filaments from which it is cut most of the staple fibers will be exclusively of saponified or unsaponified material. Interesting and varied effects may be achieved by controlling and adjusting the relationship between the length of the staple fibers and length of the saponified portions of the filaments from which the fiber is cut. Since the tow includes both saponified and unsaponified portions, cutting produces a mixed staple fiber which requires very little or no blending to uniformly distribute each type of fiber in the mass of staple.

Conversion of the staple fiber to yarn may follow the so-called cotton, wool or worsted system depending both on the length of the individual fibers and the appearance desired in the finished fabric. When the cotton system of spinning is followed, the staple fibers will be passed through carding, drawing, roving and spinning operations, whereas for the worsted system the staple fibers are carded, combed, drawn and spun. The yarn is then knitted or woven to produce a fabric which may be finished in conventional manner.

Either the tow, the yarn or the fabric may be dyed although it is customary to dye the fabric. Various single dyes or combinations of dyes may be employed to selectively dye the unsaponified or the saponified fibers. For example, the dyes may selectively dye only the unsaponified fibers to produce a pepper and salt effect or the dye may selectively dye only the saponified fibers to achieve a like result. A combination of dyes or successive dyeings may selectively dye the saponified and unsaponified fibers the same color or different colors to produce fabrics having a single color or a mixture of colors. Other dyes will dye both the saponified and unsaponified fibers the same color in the same or different shades

In order further to illustrate my invention, but without being limited thereto, the following examples are given.

Example I

A tow of continuous filaments of cellulose acetate was formed and two inch length spaced six inches apart were printed with a paste prepared by adding 20% British gum to an 8% solution of sodium hydroxide. The filaments were then cut to form a staple fiber which was converted to a yarn and the yarn woven into fabric. By dyeing the fabric with Erie Black NCW, C. I. 539 a pepper and salt effect was produced since only the saponified portions of the fibers will be dyed black.

Example II

Alternate six inch lengths of a tow of cellulose acetate filaments were printed with the saponifying paste of Example I and the continuous filaments converted to a staple fiber and spun to produce a yarn. The yarn was dyed with Amanil Sky Blue FF, C. I. 518, and the saponified portions of the fibers acquired a deep blue color whereas the unsaponified portions of the fibers remained undyed. After dyeing the yarn was converted to a fabric.

Example III

Approximately 50% of the filaments of a tow of cellulose acetate filaments were saponified for their entire length with the paste of Example I and the filaments converted to a fabric in the manner set forth in this example. Dyeing with Erie Pink 2B, C. I. 128, produced a fabric in which the saponified portions of the fibers had a deep pink color and the unsaponified portions of the fibers were a very pale shade of pink.

Example IV

Alternate two-inch lengths of a tow of cellulose acetate filaments were printed with the saponifying paste of Example I and the filaments converted to a fabric as set forth in the same example. The fabric was then dyed with Amanil Sky Blue FF, C. I. 518, and p-nitroaniline-dioxyethyl-m-toluidine which produced a blue color on the saponified portions of the fibers and a red color on the unsaponified portions of the fibers.

Example V

Alternate two-inch lengths of a tow of cellulose acetate filaments were printed with the saponification paste of Example I, the filaments cut into staple lengths, spun to produce a yarn, converted to a fabric and dyed with Amanil Chrysophenine G. Ex, Conc., C. I. 365. The saponified portions of the fibers were dyed a bright yellow, whereas the unsaponified portions of the fibers remained white.

Example VI

Two-inch lengths, spaced six inches apart, of a tow of cellulose acetate filaments were saponified with the paste of Example I and converted to a fabric in the manner set forth in this example. By dyeing the fabric with Erie Catechine G, PR 69—A. A. T. C. C.—1946 Year Book, page 494, the saponified portions of the fibers acquired a dark brown shade and the unsaponified portions of the fibers acquired a very light tan shade.

Example VII

Alternate two-inch lengths of a tow of cellulose acetate were saponified with the paste of Example I and converted to a fabric in the manner set forth in this example. By dyeing the fabric with 1-oxy-4-amino-anthraquinone the

unsaponified portions of the fibers acquired a red shade, whereas the saponified portions of the fibers remained white.

Example VIII

Alternate two-inch lengths of a tow of cellulose acetate were saponified with the paste of Example I and converted to a fabric in the manner set forth in this example. A dyebath was prepared by adding 3 parts by weight of Ponsol Jade Green (C. I. 1101) to 50 parts by weight of water containing 2 parts by weight of sodium hydrosulfite and 10 parts by weight of 10% by weight aqueous solution of sodium hydroxide, and heating to 50° C. for 15 minutes. Thereafter a solution of 20 parts by weight of sodium thiocyanate in 300 parts by weight of water and 140 parts by weight of diacetone alcohol was added to the dyebath producing a bath having a pH between 10.5 and 11.5. The dyebath was brought to a temperature of 47° C. and the fabric immersed in the dyebath for one minute, after which the fabric was rinsed and the wet, rinsed fabric immersed for 10 minutes in an aqueous solution maintained at 30° C., and containing 0.1% by weight of sodium bichromate and 0.3% by weight of acetic acid to oxidize the dye. Both the saponified and the unsaponified portions of the fibers acquired a uniform blue green shade.

Many other dyes may be employed alone or in combination and the relative proportions of saponified and unsaponified fiber may be varied to produce a wide variation in the properties and appearance of the finished fabric.

It is to be understood that the foregoing detailed description is given merely by way of illustration and that many variations may be made therein without departing from the spirit of my invention.

Having described my invention, what I desire to secure by Letters Patent is:

1. A staple fiber mixture comprising staple lengths of unmodified organic ester of cellulose staple lengths, at least partially saponified organic ester of cellulose staple lengths, the saponification being along the full length thereof and organic ester of cellulose staple lengths having a lengthwise portion thereof unmodified and a lengthwise portion thereof at least partially saponified.

2. A staple fiber mixture comprising staple lengths of unmodified cellulose acetate staple lengths, at least partially saponified cellulose acetate staple lengths, the saponification being along the full length thereof and cellulose acetate staple lengths having a lengthwise portion thereof unmodified and a lengthwise portion thereof at least partially saponified.

3. Process for forming a spun yarn consisting of a blend of staple lengths of fiber from a tow of continuous filaments having a basis of an organic ester of cellulose, which comprises flattening the tow, passing the flattened tow over a rotating surface to spread said tow, saponifying at least some of the continuous filaments comprising said flattened tow by applying a saponifying agent to a portion of the width of said flattened tow, continuously varying the portion of the width of said flattened organic ester of cellulose tow to which the saponifying agent is applied, cutting said saponified tow into staple fiber lengths of such size that the resulting staple fiber yarn consists of a blend of substantially unmodified organic ester of cellulose staple lengths, at least partially saponified organic ester of cellulose staple lengths and organic ester of cellulose staple lengths having a portion which is unmodified and a portion modified by saponification, and converting the mixture of staple lengths into a spun yarn.

4. Process for forming a spun yarn consisting of a blend of staple lengths of fiber and a tow of continuous filaments having a basis of cellulose acetate which comprises flattening the tow, passing the flattened tow over a rotating surface to spread said tow, saponifying at least some of the continuous filaments comprising said flattened tow by applying a saponifying agent to a portion of the width of said flattened tow, continuously varying the portion of the width of said flattened cellulose acetate tow to which the saponifying agent is applied, cutting said saponified tow into staple fiber lengths of such size that the resulting fiber yarn consists of a blend of substantially unmodified cellulose acetate staple lengths, at least partially saponified cellulose acetate staple lengths and cellulose acetate staple lengths having a portion which is unmodified and a portion modified by saponification, and converting the mixture of staple lengths into spun yarn.

GEORGE C. WARD.

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