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PROCESS OF STABILIZING RAYON-CONTAINING TEXTILE FABRICS

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1

The present invention relates to a process of stabilizing rayon and rayon-containing textile fabrics so as to render such fabrics resistant to shrinking, stretching or distortion when they are subjected to laundering or dry cleaning. The process of the invention can be employed to improve dyeing qualities, and in a preferred embodiment to render the fabric resistant to creasing. The process of the invention can also be used to produce artificial crinkle or seersucker effects as well as two-tone dyeing effects on rayon or rayon-containing textile fabrics.

It is well known in the art that cotton fabrics can be treated with a concentrated caustic soda solution and that seersucker effects can be produced on cotton fabrics by the method of printing a concentrated solution of caustic soda directly on such fabrics, or by printing on the said fabrics a substance that resists the action of the caustic, and then padding the fabric so printed in a concentrated caustic solution. Such treatments do not dissolve to any noticeable extent the cotton fibre, do not weaken the fabric or impair in any way its usefulness. Up to the present time, however, it has not been possible to obtain stabilization of, or crinkle effects on fabrics woven completely or in substantial part from yarns of rayon. The inability to apply to rayon fabrics a process similar to that applied to cotton fabrics is due to the well known fact that rayon fibers are much more soluble in strong alkali solutions than are cotton fibers and would be dissolved more or less completely if subjected to treatment with caustic of sufficient strength to mercerize cotton.

It is generally known that the degree of polymerization of the undegraded cellulose molecule is of the order of 2,500 to 3,000 whereas that of viscose rayon staple fiber, for example, is of the order of 250 to 430. The macrodimentsions of the cellulose molecule in cotton are so long, that although treatment with strong alkali will cause it to swell and shrink in length, very little if any of the molecule will go into solution. Due, at least in part, to its comparatively low degree of polymerization, viscose rayon, for example, dissolves extensively in a 10% alkali solution at low temperature. When higher concentrations of alkali are used on rayon fabrics in an attempt to achieve mechanical stabilization or to obtain a satisfactory crinkle, the rayon is partially dissolved and rendered brittle and useless. If the concentration of alkali is reduced sufficiently to eliminate this solvent action, no stabilization is obtained because the swelling and shrinkage in length of the fibers is very limited.

2

The primary object of this invention is to provide a method of pre-treating rayon fibers and fabrics in such a manner that they can be stabilized by the action of caustic alkali without being deleteriously affected, i. e., rendered resistant to shrinking, stretching and distortion when they are subjected to laundering or dry cleaning.

Another object is to improve the dyeing qualities of rayon and rayon-containing fabrics.

Still another object of a preferred embodiment of the invention is to provide a method of making rayon and rayon-containing fabrics resistant to creasing simultaneously with the stabilization.

A further object of the invention is to provide a method for producing artificial seersucker or crinkling effects in rayon and rayon-containing fabrics.

It is also an object of the present invention to provide a method of imparting two-tone dyeing effects on rayon and rayon-containing fabrics in one simple dyeing operation.

I have found that rayon and rayon-containing textile fabrics can be stabilized by the action of alkali, and if desired, rendered creaseproof and given any desired crinkling and two-tone effect by treating said fabrics with a protective material prior to their treatment with alkali. It is surprising, in view of the state of the art, that the application to the fibers of a protective material prior to treatment with alkali in concentration and under conditions similar to those used in treating cotton fibers, permits the alkali to act on the rayon fiber in a modified manner and without interfering with the stabilizing action of the alkali, and yet at the same time checking and inhibiting the dissolving and deleterious action of the alkali on the rayon.

This process can be applied to any rayon material. The term "rayon" is used, in the present application, in the sense ordinarily used in the textile art and includes synthetic fibers such as viscose, cellulose acetate, cuprammonium, and nitrocellulose, and particularly the so-called spun rayons in which the continuous filament rayon has been cut into short pieces and manufactured into yarns by cotton or wool spinning processes. The process is likewise applicable to other cellulosic fabrics—for example: cotton, linen, hemp, ramie, etc. containing a substantial proportion of such rayon material.

The protective material used in this process may be any resin that becomes insolubilized during the treatment with, and by the action of, the alkali and remains in the fabric after said treatment and after the usual finishing operations to

which the fabric is subjected. Examples of these resins are the lactic acid-urea-formaldehyde and lactic acid-urea-melamine resins of the type disclosed in co-pending applications Serial Nos. 619,254 and 619,255 respectively, filed September 28, 1945. These resins are prepared by reacting, preferably in the presence of water, an aldehyde, an alpha-hydroxy monocarboxylic acid, an alpha-substituted ethanol and either a urea compound, such as urea, thiourea, guanidine, carbamyl urea or biuret, or an amino-triazine having at least one primary amino group, such as melamine or ammeline, to form a clear, light colored and slightly viscous resin that is soluble in water in substantially all proportions and is insolubilizable by the application thereto of an alkali.

An aqueous solution of a resin typical of such resins may, for example, be prepared in the following manner: 46.7 grams of 40% aqueous formaldehyde and 50.3 grams of 50% lactic acid are mixed and heated to 160° F. with agitation and refluxed for one hour. The reaction mass is then cooled to 140° F. and 14.0 grams of urea are added. Heating with agitation is continued until the reaction mass attains a temperature of 205° F., and it is maintained at this temperature, with agitation, for one hour and fifty minutes. The reaction mass is then cooled to 110° F., 20 grams of ethylene glycol are added with agitation and then the reaction mass is cooled to 70° F. The reaction product has a pH of 4. It is clear, straw colored, slightly viscous and soluble in water in all proportions.

Any of these or other resins, or combinations thereof with one another or with other materials may be applied in the form of solutions or dispersions of resin or resin-forming materials.

It is within the contemplation of this invention to use any suitable combination of resin and protective colloid. Furthermore, the resin or protective colloid, or any combination thereof, may be modified with any plasticizer or softener that is removable subsequently or remains fixed with the resin.

It is to be understood, of course, that the resins named specifically are listed only for the purpose of illustration. Any other resin that becomes insolubilized by the action of alkali and that will modify the action of alkali are suitable.

In the practice of the invention, the protective material is applied to the fabric uniformly, preferably by padding. To obtain uniform stabilization and resistance to creasing simultaneously in accordance with the preferred embodiment of the invention, the caustic is likewise applied to the fabric uniformly, preferably also by padding. If on the other hand, the object of the treatment is to obtain a seersucker effect or a two-tone dyeing effect, then the protective material is applied to the fabric uniformly, preferably by padding, but the caustic treatment is applied non-uniformly, for example in stripes, designed patterns, by machine printing, stencil, block or screen printing.

When the resin is applied uniformly to the fabric, it will not only modify uniformly the action of the alkali on the fabric but its precipitation or condensation in the fibers will also effect creaseproofness in the finished product. If, on the other hand, the resin is applied uniformly to the fabric, but the action of the caustic is localized, the shrinking will take place only in the places where the caustic has been applied, and a crinkle effect will result and the fabric will acquire non-uniform dyeing properties. Those por-

tions of the fabric which have been shrunk by the action of the alkali are found to have a greater affinity for dye, with the result that excellent two-tone effects can be obtained in one simple dyeing operation.

In practice I have found that it is economically preferable to treat the goods, in accordance with the invention, as they come from the loom. After the treatment with the protective material and then with alkali, the goods are neutralized, boiled, scoured, bleached and dyed in the usual manner. It is quite possible, however, to treat the goods in accordance with this invention at any stage of their manufacture.

If the process is carried in the preferred manner previously indicated, the gray goods from the loom are padded with a solution or dispersion containing the protective material in an amount to prevent dissolution of the rayon by the alkali. The amount will vary depending on the particular protective material and to some extent on the protection desired. Generally a concentration of from 3 to 25% by weight is suitable. The goods are then framed and dried while being held to a constant width in a frame. The preferred embodiment is to use resins that are condensed and insolubilized by the action of the alkali itself. The advantages of this preferred embodiment of the invention are that it eliminates the use of catalysts, which ordinarily have a tendency to tenderize the fabric, and eliminates the high temperatures of 290° F. to 350° F. necessary for curing. Such resins, for example, are the lactic acid-urea formaldehyde and lactic acid-melamine formaldehyde resins mentioned hereinbefore.

After the protective material has dried, the goods are taken out of the frame and treated with a caustic solution in a padder or similar device. The range of concentration of the caustic may be from about 10 to 35%, depending upon the particular rayon, the temperature, and other conditions, although I prefer to use concentrations of from about 18 to 28%. The concentration of caustic should be at least sufficient to obtain the desired stabilizing effect. Higher concentrations of caustic are unnecessary unless special effects, such as increased stiffness in the finished fabric, are desired, in which event concentrations of from 30 to 35% usually suffice. The temperature of the caustic solution may vary depending upon the concentration of the solution and the time of treatment. In general it will fall within the range of 50° to 100° F., but for a commercial process in present day operation, I prefer to use a temperature of from 60° to 70° F.

The time of the caustic treatment should be sufficient to secure the desired effect, and may vary according to the type and weight of the goods, between thirty seconds and about ten minutes. It is to be understood, of course, that concentration of caustic, temperature and time of treatment are interrelated and may be varied to suit the purpose in view.

When the treatment with caustic is finished, the goods are rinsed and neutralized with any neutralizing agent, such as bicarbonate of soda or the like, rinsed and processed in any other manner conventionally used to treat goods subjected to treatment with caustic. After this, the fabrics may be boiled off, bleached, dyed or otherwise processed in any conventional manner. Finally they are slack dried, cold framed to finished width, decatized, and calendered if necessary. Goods so processed will not shrink or

5

stretch more than 1% in subsequent laundering operations.

Example 1

A fabric woven with pigmented filament rayon both for filling or weft and warp, count 92/68, greige width 40½ inches, to be finished and stabilized at 38½ inches, was treated in the greige with a lactic acid-urea formaldehyde type resin solution having a concentration of 7-8%. The pick-up was between 80 and 90%. The fabric was then frame dried at 190° to 200° F. to greige width and then padded in a caustic solution of 28% concentration, kept under the action of the caustic for 5 minutes, then neutralized with bicarbonate of soda, rinsed, boiled off, bleached in a solution of hydrogen peroxide, slack dried, cold framed, vat dyed, slack dried again, cold framed to finished width and decatized. The finished and stabilized fabric was given five washing tests using the cotton method of testing of 40 minutes boil, 20 minutes rinse. The following changes in dimensions were noted upon measurement after each successive washing test:

	Warp	Filling
	Per cent	Per cent
First wash.....	-1.0	-0.2
Second wash.....	-0.8	-0.3
Third wash.....	-0.9	-0.5
Fourth wash.....	-0.7	-0.6
Fifth wash.....	-0.9	-0.5
Average change.....	-0.86	-0.42

The tensile strength of this fabric, the seam slippage resistance, and the abrasion resistance were better than those of a piece of the same type of fabric finished in the ordinary way without stabilization, and the creaseproofing was excellent.

Example 2

Another fabric woven from spun rayon thread and cotton threads, count 70/42, greige width 42 inches, to be finished and stabilized at 38½ inches, was treated in the same manner as the fabric in Example 1. The finished and stabilized fabric was given five washing tests using the cotton method of testing of 40 minutes boil, 20 minutes rinse. The following changes in dimensions were noted upon measurement after each successive washing test:

	Warp	Filling
	Per cent	Per cent
First wash.....	+0.2	+0.8
Second wash.....	-0.7	+0.4
Third wash.....	-1.0	+0.35
Fourth wash.....	-0.9	+0.4
Fifth wash.....	-0.5	+0.4
Average change.....	-0.58	+0.47

The tensile strength, the seam slippage resistance, the abrasion resistance and creaseproofing were excellent and superior to those of a piece of the same cloth finished in the ordinary way without stabilization.

Example 3

Another fabric woven from 80% viscose staple fibers and 20% cellulose acetate staple fibers was treated in the same manner as the fabric of Example 1. The count of this fabric was 104/68, the greige width 40½ inches, to be finished and stabilized at 38 inches. The finished and stabilized fabric was given 5 washing tests using the same method as with fabric in Example 1. The follow-

6

ing changes in dimensions were noted upon measurement after each successive washing test:

	Warp	Filling
	Per cent	Per cent
First wash.....	-0.7	+0.32
Second wash.....	-1.2	+0.32
Third wash.....	-0.8	+0.36
Fourth wash.....	-0.9	+0.37
Fifth wash.....	-0.9	+0.36
Average change.....	-0.9	+0.346

The tensile strength, the seam slippage resistance, and the abrasion resistance compared very favorably with a piece of the same fabric finished in the ordinary way without stabilization, and the creaseproofing was very good.

In view of the foregoing disclosure, variations and modifications will be apparent to one skilled in the art. The invention contemplates all such variations and modifications as come within the scope of the appended claims.

I claim:

1. A process which comprises treating fabric containing synthetic fibers selected from the group consisting of viscose, cellulose, acetate, cuprammonium and nitrocellulose fibers with an aqueous solution containing from 3 to 25% by weight of a water-soluble reaction product of an aldehyde, an alpha-hydroxy monocarboxylic acid, an alpha-substituted ethanol and a member selected from the group consisting of urea, thio-urea, guanidine, carbamyl urea, biuret and an amino-triazine having at least one primary amino group, drying the treated fabric at a temperature up to about 200° F., and stabilizing the treated fabric by treating it, for a period of from about thirty seconds to about ten minutes and at a temperature between about 50° and 100° F., with an alkali solution having a concentration of from about 10 to about 35%.

2. A process which comprises treating fabric containing synthetic fibers selected from the group consisting of viscose, cellulose acetate, cuprammonium and nitrocellulose fibers with an aqueous solution containing from 3 to 25% by weight of a water-soluble reaction product of formaldehyde, lactic acid, an alpha-substituted ethanol and urea, drying the treated fabric at a temperature up to about 200° F., and stabilizing the treated fabric by treating it, for a period of from about thirty seconds to about ten minutes and at a temperature between about 50° and 100° F., with an alkali solution having a concentration of from about 10 to about 35%.

3. A process which comprises treating fabric containing synthetic fibers selected from the group consisting of viscose, cellulose acetate, cuprammonium and nitrocellulose fibers with an aqueous solution containing from 3 to 25% by weight of a water-soluble reaction product of formaldehyde, lactic acid, an alpha-substituted ethanol and melamine, drying the treated fabric at a temperature up to about 200° F., and stabilizing the treated fabric by treating it, for a period of from about thirty seconds to about ten minutes and at a temperature between about 50° and 100° F., with an alkali solution having a concentration of from about 10 to about 35%.

4. A process which comprises treating fabric containing synthetic fibers selected from the group consisting of viscose, cellulose acetate, cuprammonium and nitrocellulose fibers with an aqueous solution containing from 3 to 25% by weight of a water-soluble reaction product of an aldehyde, an alpha-hydroxy monocarboxylic acid,

7

an alpha-substituted ethanol and a member selected from the group consisting of urea, thio-urea, guanidine, carbamyl urea, biuret and an amino-triazine having at least one primary amino group, drying the treated fabric at a temperature up to about 200° F., and stabilizing the treated fabric by treating it, for a period of from about thirty seconds to about ten minutes and at a temperature between about 60° and 70° F., with a caustic alkali solution having a concentration of from about 18 to about 28%.

5. A process which comprises treating fabric containing synthetic fibers selected from the group consisting of viscose, cellulose acetate, cuprammonium and nitrocellulose fibers with an aqueous solution containing from 3 to 25% by weight of a water-soluble reaction product of formaldehyde, lactic acid, an alpha-substituted ethanol and urea, drying the treated fabric at a temperature up to about 200° F., and stabilizing the treated fabric by treating it, for a period of from about thirty seconds to about ten minutes and at a temperature between about 60° and 70° F., with a caustic alkali solution having a concentration of from about 18 to about 28%.

6. A process which comprises treating fabric containing synthetic fibers selected from the group consisting of viscose, cellulose acetate, cuprammonium and nitrocellulose fibers with an aqueous solution containing from 3 to 25% by weight of a water-soluble reaction product of formaldehyde, lactic acid, an alpha-substituted ethanol and melamine, drying the treated fabric at a temperature up to about 200° F., and stabiliz-

8

ing the treated fabric by treating it, for a period of from about thirty seconds to about ten minutes and at a temperature between about 60° and 70° F., with a caustic alkali solution having a concentration of from about 18 to about 28%.

7. A fabric treated by the process of claim 1.

8. A fabric treated by the process of claim 2.

9. A fabric treated by the process of claim 3.

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