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METHOD FOR IMPROVING ANTI-PILLING CHARACTERISTICS OF SYNTHETIC FIBERS

James M. Faria, Decatur, and James R. Biles, Athens, Ala., assignors to Monsanto Company, St. Louis, Mo., a corporation of Delaware

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ABSTRACT OF THE DISCLOSURE

Anti-pilling characteristics of the synthetic fibers are improved by immersing the fibers in an aqueous bath of a metal salt of a strong acid, adding a strong base to the aqueous solution, dispersing a latex throughout the aqueous solution, and polymerizing the latex on the fibers by allowing the disperson to dry thereon.

BACKGROUND OF THE INVENTION

This invention relates to a method for increasing the pill resistance of fabrics containing synthetic fibers, and more specifically to a method for reducing the pilling tendencies of fabrics being comprised of synthetic fibers, natural fibers or blends thereof by coating the fibers with a latex composition.

The pilling of natural fibers, such as wool, when woven into fabrics has been a problem for years, especially, in carpeting and in sweaters. Generally, the balls or pills which are formed can be easily removed or brushed off when the fabric is made from wool. Unfortunately, fabrics made from synthetic fibers have a tendency to pill more easily and the pills cling more tenaciously thereto than do pills which form on fabrics made from natural fibers or fabrics being comprised of at least 50 percent natural fibers. While pilling is very unsightly when it occurs on sweaters, the problem is more acute as applied to carpets, for pilling not only removes an amount of fiber from the body of the carpet but it also weakens the tufting arrangement by which the tufts are secured to the carpet backing. It is evident that a method to control pilling would be a welcomed advance in the art.

An object of this invention is to provide a method for reducing pilling in fabrics being comprised of at least 50 percent of synthetic fibers.

Another object of this invention is to provide a method which prevents pilling by applying to the surface of the fibers a light layer of butadiene-styrene latex.

A further object of this invention is to provide a method for reducing pilling by applying to a fiber a finish which locks the fibers in place when incorporated in a carpet or sweater.

A still further object of this invention is to provide a method for applying butadiene-acrylonitrile latex to the fibers of a fabric being comprised of at least 50 percent of synthetic fibers for the prevention of pilling.

Yet, still another object of this invention is to provide a method for reducing pilling of fibers of fabrics being comprised of at least 50 percent synthetic fibers by applying thereto a latex which does not require a curing step.

Other objects and advantages of this invention will be apparent to those skilled in the art from the following more detailed description which illustrates and discloses but is not intended to limit the scope of this invention.

It is thought that pilling is caused by the severage of a fiber from the main bodies of a fabric, the fiber becoming entangled in the ends of adjacent secured fibers and tying them together. Once a pill has started to form, it rapidly builds up when agitated externally. These pills are most difficult to remove from the fabric for the fibers

which are still connected to the main body of the fabric tenaciously cling thereto due to the strength thereof and the manner of construction. It was thought that by putting a coating on each individual fiber or filament the tensile strength thereof would be increased. Also, this coating would hold the fiber in place and prevent its becoming entangled in the ends of other secured filaments. By applying a butadiene-styrene or butadiene-acrylonitrile coating thereto, the broken fibers do not have the tendency to slip past the secured fibers for the fibers having this rubber-like coating thereon frictionally engage each other which results in the secured fibers holding the broken fibers in place in the body of the fabric. It can also be seen that this finish would aid in the processing on the cotton, linen, worsted, jute or the woolen systems. If continuous tow were used as the substrate, this finish would aid the processing thereof in commercial available tow-to-top converters and webbers.

The objects of this invention are accomplished by the application of a rubber-like latex to a fiber. This invention discloses the use of a butadiene-styrene latex and a butadiene-acrylonitrile latex for coating fibers; however, any latex having the characteristics of becoming polymerized by the mere evaporation of the emulsion liquid may be used. It is, of course, necessary that the latex be compatible with the fibrous substrate and not interfere with their commercial qualities in any way.

This invention is carried out in a conventional dyestock machine. A dyestock machine is a container which has perforated sides for the admission of fluids and perforated column in the center thereof through which the fluid after having been in contact with the fibers is drained away therefrom. It is desirable to dye the fibers to be treated before being subjected to this process. The fibers may be in either staple or tow form; however, it is desirable to process the fibers in loose form for the latex is not adapted to penetrate a heavily knitted or woven fabric. After the dyed fibers have been placed in the dyestock machine, water at room temperature is introduced therein through the apertures in the outside wall. Water conditions the fiber so that the latex may be distributed thereover and will not accumulate or group in any one part. Any standard wetting agent may be used for this process, however, they must be compatible with the fibers. Water is used in this application mainly because it is economically desirable to do so.

To the cold water bath which is contained by the dye machine, from 1 to 10 percent of aluminum sulfate based on the weight of the fiber is added and run from 2 to 5 minutes. The aluminum sulfate reduces pH of the fiber and the bath from about 7 to about 3.5. It also acts as a fiber conditioner which causes the latex to be evenly dispersed over the area of the fibers. Any homologue of aluminum sulfate may be used provided it has the characteristics of a metal base of a strong acid and provided it does not degrade the fiber. Next, 1 to 10 percent ammonium hydroxide based on the weight of the fiber is added to the bath and run from 2 to 5 minutes. This raises the pH to 10 and gives the fiber an affinity for the rubber-like latex. If the ammonium hydroxide were not added, the latex would not coagulate on the fibers and would tend to lump together thereby resulting in globules of latex which tact onto portions of the fiber. Again, it is to be noted that any homologue could be used provided it has the characteristics of a strong base. The last additive which is applied to the bath before the latex is introduced therein is zinc oxide. Zinc oxide is added to the bath in the amount of from 1 to 10 percent based on the weight of the fiber and acts as a dispersing agent for the butadiene-styrene, or butadiene-acrylonitrile latex. The zinc oxide also functions to break down the latex emul-

sion into finer particles thereby securing a more even covering or coating on the fiber. The aqueous mixture which contains the above-mentioned compounds is then circulated among the fibers from 2 to 5 minutes.

After the above fiber conditioning steps have been completed, butadiene-styrene latex in the amount of from 1 to 20 percent based on the weight of the fiber is added to the bath and is run from 5 to 20 minutes. The run is completed and the butadiene-styrene latex is exhausted when the bath obtains a slightly milky appearance. The latex is added to the bath in the form of an aqueous emulsion rather than in a solution for the emulsion tends only to coat the fibers while the solution has the tendency to polymerize the touching fibers and change basic fiber characteristics, such as, color stability, heat and light stability, and tenacity. After the run has been completed, the aqueous bath is drained from the dyestock machine and the fibers are rinsed with clear water and then allowed to dry. Drying may be done in a tumbler of by evaporation at room temperature. The polymerization of the latex whether it be styrene-butadiene or the butadiene-acrylonitrile takes place during drying by the action of the ammonium hydroxide thereon.

The polymeric substrates which may be employed in the practice of the present invention, are acrylonitrile, copolymers, including binary, ternary and tetrapolymers containing at least 80 percent by weight of acrylonitrile and the polymer molecule, or a blend comprising polyacrylonitrile or copolymers comprising acrylonitrile with from 2 to 50 percent of another polymeric material, the blend having an overall polymerized acrylonitrile content of at least 80 percent while the preferred monomers employed in the instant invention are those containing at least 80 percent of acrylonitrile, generally recognized as the fiber-forming acrylonitrile polymers it will be understood that the invention is likewise applicable to polymers containing less than 80 percent acrylonitrile and the same stability is realized with the inhibiting agents defined herein. The method as disclosed herein may also be applied to polyester fibers and articles produced therefrom. The polyester fiber may be formed by extruding a typical polyester melt such as polyethylene terephthalate, through a conventional spinnerette downwardly through a chimney where the melt may be air quenched and hardened into filaments. These fibers are converged and collected on a bobbin as undrawn yarn. This finish is especially useful also on fibers composed of polyamides. Simple linear polyamides which are normally insoluble in alcohol but are soluble in thenols are of two types, those derived from polymerizable monoaminomonocarboxylic acids or their amide forming derivatives and those derived from the reaction of a suitable diamine with suitable dye carboxylic acids on hydrolysis with mineral acids, the polyamide yield monomericamide forming reactants. The activating compounds of this invention are applicable to the polycarbonamides of the type derived from the reaction of a suitable diamine with a suitable dicarboxylic acid. On hydrolysis with hydrochloric acid, these carbonamides yield the dibasic acid and the diamine hydrochloride. Other synthetic fibers are to be included herein, such as, polypropylene, polyethylene, glass fibers, cellulose fibers and derivatives thereof, and any other fiber having a naturally slick surface.

The invention will now be illustrated by the following specific examples which are cited to illustrate the invention; they are not intended to limit it in any way.

Example I

A quantity of fibers being comprised of 93 percent acrylonitrile and 7 percent vinyl acetate was placed in a conventional dyestock machine. The fibers were rinsed with water being at room temperature and an amount of water was left in the dyestock machine sufficient to completely submerge the fibers. Powdered aluminum sulfate in the amount of 6 percent based on the weight of the fiber was dissolved in the bath. This solution was circulated through the fibers for approximately 5 minutes. Then 8 percent ammonium hydroxide based on the weight of the fiber was added in the form of a 28 percent aqueous solution. The whole solution was then circulated through the fibers for approximately 5 minutes. The next ingredient that was charged to this aqueous mixture and which was added in the amount of 2 percent based on the weight of the fibers was zinc oxide which was in the form of a 50 percent aqueous suspension. Again, the total mixture was circulated through the fibers for 5 minutes. After the above steps of the process were completed, the fibers were in condition to receive the latex. To the mixture in the dye machine, 3 percent based on the weight of the fiber of a butadiene-styrene latex which consisted of 50 percent butadiene, and 50 percent styrene was added. The latex as added was a 45 percent aqueous solids emulsion. The whole mixture was then circulated for a period of approximately 10 minutes. Complete exhaustion of the latex was seen when the bath was slightly milky in appearance.

The results of this application were determined visually. The fibers were spun into yarn and tufted into a carpet backing thereby forming a carpet. Identical yarn, which had not been treated with the finish described above, was also tufted into a carpet backing. Pills were formed by rubbing the carpet samples with an abrasive cloth in a circular motion. The duration and intensity of the rubbing were the same for both samples. Identical areas from both carpet samples were examined for pills and it was observed that the untreated sample had approximately eight times as many pills as the treated sample had. In fact, the treated sample showed very little pilling.

Example II

The steps of Example I were repeated.

Nylon fibers were treated as described in Example I except that a latex composition consisting of 45 percent acrylonitrile and 55 percent butadiene was used in place of the butadiene-styrene latex.

The results indicated that pilling was seven times more prevalent in the untreated carpet sample than in the treated sample.

Example III

Polyester fibers were treated as described in Example I except that a 5 percent, based on the weight of the fiber, butadiene-styrene latex was used which consisted of 30 percent styrene and 70 percent butadiene.

The results showed that the pilling was eight times as great for the untreated sample as for the treated sample.

It is to be noted that the latex may consist of most any proportion of butadiene and styrene, the same being true for the butadiene-acrylonitrile latex. There is a synergistic action between the components of the two latex samples; however, the particular amount of either is not critical.

It will be understood to those skilled in the art that many apparently different embodiments of this invention can be made without departing from the spirit and scope thereof. Accordingly, it is to be understood that this invention is not to be limited to the specific embodiments thereof except as defined in the appended claims.

We claim:

1. A method for improving the anti-pilling characteristics of synthetic fibers by

(a) immersing synthetic fibers in an aqueous bath,

(b) dissolving in said aqueous bath from about 1 to about 10% by weight of the fiber of a metal salt of a strong acid, the resulting solution being circulated among said fibers,

(c) adding from about 1 to about 10% by weight of the fiber of a strong base to said aqueous solution, the resulting solution being circulated among said fibers,

(d) charging said aqueous solution with from about 1 to about 10% by weight of the fiber of zinc oxide, the resulting aqueous mixture being circulated among said fibers, and

(e) adding from about 1 to about 20% by weight of the fiber of a latex to said aqueous mixture, said latex being circulated with said aqueous mixture among said fibers until said fibers are coated therewith.

2. The method according to claim **1** wherein the synthetic fibers are comprised of acrylonitrile and vinyl acetate.

3. The method according to claim **1** wherein the synthetic fibers are nylon.

4. The method according to claim **1** wherein the synthetic fibers are polyester.

5. A method for improving the anti-pilling characteristics of synthetic fibers by

(a) immersing synthetic fibers in an aqueous bath,

(b) charging said aqueous bath with from about 1 to about 10% by weight of the fiber of aluminum sulfate, the resulting solution being circulated among said fibers,

(c) adding from about 1 to about 10% by weight of the fiber of ammonium hydroxide to said aqueous solution, the resulting solution being circulated among said fibers,

(d) charging said aqueous solution with from about 1 to about 10% by weight of the fiber of zinc oxide, the resulting aqueous mixture being circulated among said fibers, and

(e) adding to said aqueous mixture from about 1 to about 20% by weight of the fiber of a latex comprising butadiene and a member selected from the group consisting of acrylonitrile and styrene, said mixture being circulated among said fibers until said fibers are coated therewith.

6. The method of claim **5** wherein the said latex is butadiene-acrylonitrile latex.

7. The method of claim **5** wherein the said latex is butadiene-styrene latex.

8. A method for improving the anti-pilling characteristics of synthetic fibers by

(a) immersing synthetic fibers in an aqueous bath,

(b) charging said aqueous bath with from about 1 to about 10% by weight of the fiber of aluminum sulfate, the resulting solution being circulated among said fibers,

(c) adding from about 1 to about 10% by weight of the fiber of ammonium hydroxide to said aqueous solution, said resulting solution being circulated among said fibers,

(d) charging said aqueous mixture with from about 1 to about 10% by weight of the fiber of zinc oxide, said resulting aqueous mixture being circulated among said fibers,

(e) adding from about 1 to about 20% by weight of the fiber of a butadiene-styrene latex to said aqueous mixture, said latex mixture being circulated by said aqueous mixture among said fibers until said fibers are coated therewith, and

(f) polymerizing said butadiene-styrene latex on said fibers by allowing the same to dry.

9. A method for improving the anti-pilling characteristics of synthetic fibers by

(a) charging an aqueous bath with a quantity of synthetic fibers,

(b) conditioning said fibers by lowering the pH of said aqueous bath containing said synthetic fibers to below 5,

(c) treating said fibers with from about 1 to about 10% by weight of the fiber of ammonium hydroxide while in said aqueous bath to give the same an affinity for a rubber-like latex,

(d) adding to said aqueous bath from about 1 to about 10% by weight of the fiber of zinc oxide for distributing said rubber-like latex throughout the aqueous medium,

(e) charging said aqueous medium with from about 1 to about 20% by weight of the fiber of a latex comprised of butadiene and a member selected from the group consisting of styrene and acrylonitrile, and

(f) polymerizing said latex on said fibers by allowing the same to dry thereon.

10. A method for improving the anti-pilling characteristics of synthetic fibers comprising:

(a) charging an aqueous bath with a quantity of synthetic fibers,

(b) conditioning said fibers by lowering the pH of said aqueous bath containing said synthetic fibers to below 5 by charging a metal salt of a strong acid to said aqueous bath,

(c) treating said fibers while in said aqueous bath to give the same an affinity for a rubber-like latex by adding a strong base to increase the pH of said aqueous bath to above 10,

(d) adding to said aqueous bath from about 1 to about 10% by weight of the fiber of zinc oxide for distributing said rubber-like latex throughout the aqueous medium,

(e) charging said aqueous medium with from about 1 to about 20% by weight of the fiber of a latex being comprised of butadiene and a member selected from the group consisting of styrene and acrylonitrile, and

(f) polymerizing said latex on said fibers by allowing the same to dry thereon.

11. A method for improving the anti-pilling characteristics of synthetic fibers comprising

(a) immersing said synthetic fibers in a cold water bath,

(b) adding to said cold water bath from 1 to 10 percent of aluminum sulfate by weight of the fiber, the resulting solution being circulated among said fibers from 2 to 5 minutes,

(c) charging said aqueous mixture with from 1 to 10 percent of ammonium hydroxide based on the weight of the fiber, the resulting solution being circulated among said fibers from 2 to 5 minutes,

(d) charging said aqueous mixture with from 1 to 10 percent based on the weight of the fiber of zinc oxide, the resulting aqueous mixture being circulated among said fibers from 2 to 5 minutes,

(e) adding a butadiene-styrene latex to said aqueous mixture, said latex being circulated by said aqueous mixture among said fibers until said fibers are completely coated therewith, and

(f) polymerizing said latex on said fibers by allowing the same to dry.

12. A method for improving the anti-pilling characteristics of synthetic fibers comprising

(a) immersing said synthetic fibers in a cold water bath being contained in a conventional dyestock machine,

(b) adding powdered aluminum sulfate in the amount of 6 percent based on the weight of the fiber to said bath,

(c) circulating the resulting solution through the fibers for approximately 5 minutes,

(d) charging said aqueous solution with 8 percent ammonium hydroxide based on the weight of the fiber,

(e) circulating the resulting solution through said fibers for approximately 5 minutes,

(f) charging said aqueous solution with 2 percent zinc oxide based on the weight of the fiber,

(g) circulating the resulting mixture through said fibers for 5 minutes,

(h) adding to said aqueous mixture 3 percent based on the weight of the fiber of a butadiene-styrene latex, said latex consisting of 50 percent butadiene and 50 percent styrene,

(i) circulating the whole mixture through said fibers for a period of approximately 10 minutes, and

(j) polymerizing said latex on said fibers by allowing said fibers to dry.

13. The method of claim **12** wherein the fibers are comprised of 93 percent acrylonitrile and 7 percent vinyl acetate.

14. The method of claim **12** wherein the synthetic fibers are nylon.

15. The method of claim **12** wherein the synthetic fibers are polyester.

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WILLIAM D. MARTIN, *Primary Examiner.*

J. E. MILLER, *Assistant Examiner.*