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TREATMENT OF STAPLE FIBER

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This invention relates to the treatment of textile materials and relates more particularly to an improved process for rendering staple fiber materials having a basis of cellulose acetate or other organic derivative of cellulose more amenable to textile processing operations.

An object of this invention is to provide a novel process for the treatment of cellulose acetate or other organic derivative of cellulose staple fiber materials to render the same more amenable to textile operations such as combing, carding and the like.

Another object of this invention is the provision of a novel conditioning treatment for cellulose acetate or other organic derivative of cellulose staple fiber materials whereby these staple fiber materials may be subjected to textile processing operations without the development of any detrimental amount of static electricity.

A further object of this invention is the provision of a conditioning treatment for staple fiber materials having a basis of cellulose acetate or other organic derivative of cellulose in which harsh treatment of the staple fiber materials during the conditioning operation is avoided.

Still another object of this invention is the provision of a condiitoning process for staple fiber materials having a basis of cellulose acetate or organic derivative of cellulose in which the amount of moisture placed on the treated fibers during the conditioning is substantially reduced.

Yet another object of this invention is the production of staple fiber materials having a basis of cellulose acetate or other organic derivative of cellulose of improved hand.

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

In the treatment of staple fiber materials, having a basis of cellulose acetate or other organic derivative of cellulose, which are to be spun into yarns, threads and the like, various liquid conditioning agents are usually applied to the fibers to impart the desired textile processing properties thereto. To be satisfactorily processed, the staple fiber materials must not only possess particular frictional qualities but the electrical qualities must be such that the fibers generate the minimum amount of static electricity during combing, carding, spinning and like operations where the fibers are in constant frictional contact. The presence of static electricity on the fibers creates a substantial problem since it not only causes the fibers to stick to the machinery, but it also causes them to resist adherence to each other during spinning operations. This difficulty is particularly aggravated when the textile operations are conducted under conditions of low temperature and low humidity.

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The finishing or conditioning agents heretofore employed have usually been applied to the textile materials in the form of an aqueous emulsion after the textile materials were reduced to the form of staple fibers. Excess emulsion was removed by passing the staple fibers through squeeze rolls and the like, and after drying, the conditioned fibers were ready for textile processing. Such methods of applying the conditioning agent require that the aqueous emulsions be formulated with great care and that the squeeze roll pressure be maintained with great uniformity to insure that the total amount of conditioning agent applied to the staple fiber is constant and uniform at all times. Variations in squeeze roll pressure and possible evaporation of water from the emulsion had to be considered and compensated for when processing the staple fibers. Since these factors always rendered a carefully controlled application of the conditioning agent to the fibers highly uncertain, this method of applying conditioning agents to staple fiber materials has not proved to be entirely satisfactory for the production of staple fiber materials of uniform textile processing characteristics. Furthermore, the aqueous emulsion method of applying the conditioning agents tends to give the staple fibers a harsh and wiry hand.

We have now discovered a novel process wherein these and other disadvantages arising out of prior methods of conditioning staple fiber textile materials are avoided. In accordance with the process of our invention, we apply a self-scouring or self-emulsifying lubricating agent comprising mineral oil to a continuous filament yarn, associate the lubricated filaments into a tow and then apply, directly thereto, a concentrated, substantially non-aqueous sulfonated conditioning agent before severing the filaments into staple fiber lengths. Optimum results are achieved employing a conditioning agent comprising the reaction product of a mixture of a long chain higher fatty acid, vegetable oil and a mineral oil with oleum, having added thereto a penetrating agent, and neutralized with alkali and a hydroxyalkyl amine. The conditioning agent is preferably applied at an elevated temperature. The treated tow may then be crimped, if desired, severed to the desired staple fiber length by suitable cutting means, and then blown directly into a continuous drier where it is dried

to the desired moisture content, which is usually from about 5 to 6.5% by weight.

The yarns to be treated in accordance with this invention may be made of or contain any suitable organic derivatives of cellulose such as organic esters of cellulose and cellulose ethers. Examples of organic esters of cellulose are cellulose acetate, cellulose propionate and cellulose butyrate, or mixed esters such as cellulose acetate-butyrate or cellulose acetate-propionate, while examples of cellulose ethers are ethyl cellulose and benzyl cellulose.

In applying the lubricating agent to the filaments, we preferably place the finish on the filaments directly as they pass from the bottom of the spinning cabinet, as by leading the filaments over a rotating wick which is partly submerged in a vessel containing the mineral oil lubricant. From 0.25 to 3% of the lubricating agent may be applied to the yarns but we have found that optimum results are obtained when about 0.75% based on the weight of the filaments, of the mineral oil lubricant is applied to the continuous running filaments.

A number of the lubricated filaments are then gathered to form a tow of from 100 to 500 ends and of a denier of 25,000 to 100,000, and the sulfonated conditioning agent is then placed directly on the tow. The finishing agent may be applied by spraying directly on to the tow or by feeding a controlled thin stream of the finish on to the tow. The most desirable results are obtained when this finish is applied to the tow in amounts of 0.35 to 2% by weight and at a temperature above 40° C. and preferably, at 50° C., or even higher. After the finish has been applied to the tow, the latter may then be crimped, if desired, by being passed through a series of serrated crimping rolls or unserrated rollers may be used to force the yarn into a chamber in such a way that back pressure causes crimping, or by any other suitable crimping means. A permanent crimp is thus placed in the filaments. The crimped tow is then cut to accurately controlled uniform lengths by means of a suitable cutting device and the staple lengths of fiber are dried in a continuous drier. In lieu of employing a continuous drier after the filaments are severed, the conditioned tow may be passed over a series of heated cans and thus dried, before being severed into staple fiber lengths. The drying is most satisfactorily effected at temperatures of 65 to 95° C.

Although by our novel process, the conditioning agent is not applied directly to each of the fibers, following the direct application of the lubricating agent, our method of applying the finish is extremely effective in producing staple fiber materials which are eminently satisfactory with regard to their hand and to their textile processing qualities. When subjected to combing, carding, spinning and other textile operations, the staple fibers may be processed in a smooth and even manner with the development of little or no static electricity.

In order further to illustrate our invention but without being limited thereto, the following example is given:

Example

A 25% solution of cellulose acetate of an acetyl value of about 54%, calculated as acetic acid, in 95/5 acetone/water, is extruded through a spinneret into an evaporative atmosphere in a spinning cabinet to form a 120 denier, 40 filament yarn. The yarn is drawn from the base of the spinning cabinet and passed over a rotating wick partly submerged in a vessel containing a lubricating agent comprising mineral oil and containing emulsifying agents which render the lubricant self-scouring when the yarn is immersed in water. The contact between the yarn and the rotated wick is so adjusted that 0.75%, based on the weight of the yarn, of the lubricating agent is applied to the yarn. A number of yarns, with the mineral oil finish contained thereon, are gathered together to form a tow containing 30 ends of 36,000 total denier and passed through a pair of rolls which forces the yarns into a crimping chamber. Just prior to entering the crimping rolls which force the yarn into the crimping chamber, a controlled stream of the sulfonated conditioning agent, heated to 50° C., is fed on to the moving tow. The rate of feed is such as to place about 0.45% by weight of the finish on the tow. Back pressure in the chamber places a permanent crimp in the yarns. The crimped tow is drawn from the chamber and is then cut to staple fiber of approximately two inch lengths or any other desired length by means of a centrifugal cutter. The staple lengths of fiber are dried in a continuous drier at 95° C. so that the final moisture content of the dried yarns leaving the drier is about 6%. When combed, carded, and spun into staple fiber yarns, the lubricated, conditioned crimped staple fibers have a soft hand, and, due to their excellent anti-static quality, may be processed with the production of a minimum amount of fly.

The mineral oil lubricating composition employed for the initial treatment comprises mineral oil of about 50 to 100 Saybolt viscosity, together with small quantities of a sulfonated vegetable oil such as sulfonated olive oil, peanut oil, rice oil or even sunflower oil, unsulfonated vegetable oil, oleic acid, soap and water in amounts to give the desired viscosity, stability and emulsification. The mineral oil may comprise about 75% by weight of the composition, which may contain from 8 to 10% of sulfonated vegetable oil, about 3 to 4% of oleic acid, about 7 to 8% of unsulfonated vegetable oil, about 2% of a soap such as sodium oleate, and 1% of water. The soap and sulfonated vegetable oil present render the lubricating composition self-emulsifying so that it may be scoured easily and completely from the staple fiber materials after they have been spun into yarns.

The sulfonated conditioning agent employed in accordance with the process of our invention is prepared by first reacting a mixture of oleic acid, a vegetable oil such as peanut oil, and mineral oil with 20% oleum whereby the oleic acid and vegetable oil are partially sulfated and/or sulfonated, and then adding to the sulfonated mixture a spreading and penetrating agent such as diamyl phenol. Triethanolamine and aqueous sodium hydroxide are then added so as to substantially neutralize any free acid present forming the sodium and triethanolamine salts thereof. A fungicide such as sodium orthophenyl phenate may also be added to inhibit the growth of any undesirable organisms in the resulting mixture. The preparation of such conditioning agents is more particularly described in co-pending United States application S. No. 470,662 filed on December 30, 1942.

Our novel method of applying the lubricant at the metier or spinning cabinet in the manner described and the application of the sulfonated con-

ditioning agent directly to the tow just prior to the crimping feed rolls permits extremely accurate control of the application of the lubricating and conditioning agents. The usual method of applying the conditioning agent in the form of an aqueous emulsion may thus be eliminated entirely and substantially improved staple fibers obtained.

Our novel method not only permits the finish to be applied accurately in carefully controlled amount, but it also eliminates the necessity for putting the staple fiber through harsh treatments during the conditioning treatment since squeeze rolls for removing excess emulsion and pin-strippers for breaking the mat of fibers are no longer necessary. Also, the harsh opening treatment for opening the matted staple fiber previously necessary when the finishing agent was applied in emulsion form is avoided. Furthermore, as previously pointed out, the use of substantially non-aqueous conditioning agent makes possible a substantial heat saving in the drying of the conditioned staple fibers since far less moisture must be removed to reduce the moisture content to the desired degree. The elimination of the treatment of the staple fiber with conditioning agents after the cutting operation also results in a considerable saving in space since additional equipment for the treatment of the bulky staple fiber is no longer necessary.

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 our invention.

Having described our invention, what we desire to secure by Letters Patent is:

1. In a process for the production of staple fiber textile materials, having a basis of filaments of an organic derivative of cellulose, of improved textile processing characteristics, the step which comprises applying to a mineral oil lubricated, continuous filament textile material a substantially non-aqueous conditioning agent comprising the product formed by reacting a mixture of a mineral oil, a vegetable oil, a higher fatty acid and oleum at a temperature no greater than about 20° C. whereby sulphonation of at least part of the higher fatty acid and vegetable oil occurs, to which product is added a spreading and penetrating agent and an amount of alkali-metal hydroxide and an alkylolamine to neutralize all of the oleum and the major portion of the higher fatty acid.

2. In a process for the production of staple fiber textile materials, having a basis of filaments of an organic derivative of cellulose, of improved textile processing characteristics, the step which comprises applying to a mineral oil lubricated, continuous filament textile material a substantially non-aqueous conditioning agent comprising the product formed by reacting a mixture of a mineral oil, a vegetable oil, a higher fatty acid and oleum at a temperature no greater than about 20° C. whereby sulphonation of at least part of the higher fatty acid and vegetable oil occurs, to which product is added an alkylated phenol and an amount of alkali-metal hydroxide and an alkylolamine to neutralize all of the oleum and the major portion of the higher fatty acid.

3. In a process for the production of staple fiber textile materials, having a basis of filaments of an organic derivative of cellulose, of improved textile processing characteristics, the step which comprises applying to a mineral oil lubricated,

continuous filament textile material a substantially non-aqueous conditioning agent comprising the product formed by reacting a mixture of a mineral oil, a vegetable oil, a higher fatty acid and oleum at a temperature no greater than about 20° C. whereby sulphonation of at least part of the higher fatty acid and vegetable oil occurs, to which product is added diamyl phenol and an amount of alkali-metal hydroxide and an alkylolamine to neutralize all of the oleum and the major portion of the higher fatty acid.

4. In a process for the production of staple fiber textile materials, having a basis of filaments of an organic derivative of cellulose, of improved textile processing characteristics, the step which comprises applying to a mineral oil lubricated, continuous filament textile material a substantially non-aqueous conditioning agent comprising the product formed by reacting a mixture of a mineral oil, a vegetable oil, a higher fatty acid and oleum at a temperature no greater than about 20° C. whereby sulphonation of at least part of the higher fatty acid and vegetable oil occurs, to which product is added an acetylated castor oil and an amount of alkali-metal hydroxide and an alkylolamine to neutralize all of the oleum and the major portion of the higher fatty acid.

5. In a process for the production of staple fiber textile materials, having a basis of filaments of an organic derivative of cellulose, of improved textile processing characteristics, the step which comprises applying to a mineral oil lubricated, continuous filament textile material a substantially non-aqueous conditioning agent comprising the product formed by reacting a mixture of a mineral oil, a vegetable oil, oleic acid and oleum at a temperature no greater than about 20% C. whereby sulphonation of at least part of the higher fatty acid and vegetable oil occurs, to which product is added a spreading and penetrating agent and an amount of alkali-metal hydroxide and an alkylolamine to neutralize all of the oleum and the major portion of the higher fatty acid.

6. In a process for the production of staple fiber textile materials, having a basis of filaments of an organic derivative of cellulose, of improved textile processing characteristics, the step which comprises applying to a mineral oil lubricated, continuous filament textile material a substantially non-aqueous conditioning agent comprising the product formed by reacting a mixture of a mineral oil, a vegetable oil, oleic acid and oleum at a temperature no greater than about 20° C. whereby sulphonation of at least part of the higher fatty acid and vegetable oil occurs, to which product is added diamyl phenol and an amount of alkali-metal hydroxide and an alkylolamine to neutralize all of the oleum and the major portion of the higher fatty acid.

7. In a process for the production of staple fiber textile materials, having a basis of filaments of an organic derivative of cellulose, of improved textile processing characteristics, the step which comprises applying to a mineral oil lubricated, continuous filament textile material a substantially non-aqueous conditioning agent comprising the product formed by reacting a mixture of mineral oil, raw peanut oil, oleic acid and oleum at a temperature no greater than about 20° C. whereby sulphonation of at least part of the higher fatty acid and vegetable oil occurs, to which product is added diamyl phenol and an amount of alkali-metal hydroxide and an al-

kylolamine to neutralize all of the oleum and the major portion of the higher fatty acid.

8. In a process for the production of staple fiber textile materials, having a basis of filaments of an organic derivative of cellulose, of improved textile processing characteristics, the step which comprises applying to a mineral oil lubricated, continuous filament textile material in tow form a substantially non-aqueous conditioning agent comprising the product formed by reacting a mixture of a mineral oil, a vegetable oil, a higher fatty acid and oleum at a temperature no greater than about 20° C, whereby sulphonation of at least part of the higher fatty acid and vegetable oil occurs, to which product is added a spreading and penetrating agent and an amount of alkali-metal hydroxide and an alkylolamine to neutralize all of the oleum and the major portion of the higher fatty acid.

9. In a process for the production of staple fiber textile materials, having a basis of filaments of cellulose acetate, of improved textile processing characteristics, the step which comprises applying to a mineral oil lubricated, continuous filament textile material in tow form a substantially non-aqueous conditioning agent comprising the product formed by reacting a mixture of a mineral oil, a vegetable oil, a higher fatty acid and oleum at a temperature no greater than about 20° C, whereby sulphonation of at least part of the higher fatty acid and vegetable oil occurs, to which product is added a spreading and penetrating agent and an amount of alkali-metal hydroxide and an alkylolamine to neutralize all of the oleum and the major portion of the higher fatty acid.

10. In a process for the production of staple fiber textile materials, having a basis of filaments of cellulose acetate, of improved textile processing characteristics, the step which comprises applying at a temperature of at least 40° C. to a mineral oil lubricated, continuous filament textile material in tow form a substantially non-aqueous conditioning agent comprising the product formed by reacting a mixture of a mineral oil, raw peanut oil, oleic acid and oleum at a temperature no greater than about 20° C. whereby sulphonation of at least part of the higher fatty acid and vegetable oil occurs, to which product is added diamyl phenol and an amount of alkali-metal hydroxide and an alkylolamine to neutralize all of the oleum and the major portion of the higher fatty acid.

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