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METHOD OF TREATING CELLULOSE ORGANIC DERIVATIVE CUT STAPLE FIBERS

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This invention relates to the manufacture of cellulose organic derivative cut staple fibers, and more particularly to a method of eliminating the tendency of such fibers to accumulate charges of static electricity in the various steps involved in the manufacture therefrom of spun yarns and fabrics.

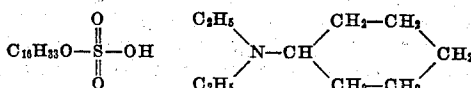
As is well-known, cellulose organic derivative materials, particularly in filament, yarn, or sheet form, are particularly subject to the accumulation on their surfaces of charges of static electricity from frictional influences. In the case of filaments and yarns in which the surface area of the material (per unit of weight) is enormously greater as compared to sheets or films, the problem of static often assumes serious proportions. In the manufacture of yarns of various types from artificial filaments, numerous steps in which the yarn is subjected to frictional influences may be necessary, as for example, twisting, winding, warping, carding, combing, drawing, spinning and the like, all of which operations tend to produce large accumulations of static on the material. This is particularly aggravated in the utilization of cut staple, as for example, in the making of spun yarn, since in carding and combing considerable friction is developed and as a result sufficient static accumulates on the fibers to make the formation of the web difficult, if not impossible; furthermore, even if a web is formed with some degree of success, the subsequent drafting operation produces a very uneven spun yarn or intermediate roving, due to the presence of the static charge. In addition, there is the ever-present fire hazard.

Cellulose derivative yarn, particularly in the form of cut staple, is extremely difficult to handle in the various operations involved in making spun yarn, not only because such material is composed of filaments having smooth, glasslike surfaces without natural kink or irregularity, but also because it has relatively negligible moisture content at normal humidities. These characteristics of this type of yarn cause it to be inherently more susceptible to accumulation of static charges than natural fibers such as cotton and wool. Indeed, the charges accumulating on cellulose derivative staple fibers are, under some circumstances, sufficient to separate the individual fibers a distance of inches, notwithstanding their relatively small size.

This invention has as its principal object to provide an improved method for the manufacture of cellulose organic derivative cut staple fibers. A further object is to provide a method for treat-

ing such fibers in which the tendency toward accumulation thereon of charges of static electricity is reduced or eliminated. A still further object is to provide a method of facilitating the handling and employment of cellulose organic derivative cut staple fibers in the various operations involved in the manufacture of spun yarns, wherein the staple is simultaneously softened and lubricated and the accumulation of static charges thereon is prevented. Another object is to provide an improved type of cellulose organic derivative cut staple having little or no tendency toward accumulation of static electrical charges. Other objects will appear hereinafter.

These objects are accomplished by the following invention which, in its broader aspects, comprises applying to cellulose organic derivative cut staple fibers an antistatic composition, preferably a composition characterized by the presence therein of an amine salt having the property of reducing or eliminating the tendency of cellulose derivative material to accumulate charges of static electricity under frictional or other influences. We have found that certain amine salts such as those of sulphated higher aliphatic alcohols of 10 or more carbon atoms such as decyl, lauryl, cetyl and myricyl alcohols are particularly efficacious as antistatic agents. A typical example of this type of amine salt is the diethylcyclohexylamine salt of setyl alcohol having the following formula:



A specific example of a composition containing this and other similar amine salts which we have found valuable for our purpose is one composed of about 22-45% by weight of the diethyl cyclohexylamine salts of sulphated decyl, lauryl, cetyl and myricyl alcohols, the balance being chiefly a lubricant or conditioning agent such as mineral oil. This composition may contain varying proportions of similar amine salts of several different higher aliphatic alcohols.

The broad scope of our invention also includes the application to cellulose organic derivative cut staple fibers of other antistatic agents as, for example, salts formed by interaction of an organic base such as an alkyl amine, a substituted alkyl amine, an alicyclic amine or an alkylolamine, with an aromatic sulfonic acid. Examples of such organic bases are amyl amine, diamyl amine, cyclohexylamine and triethanolamine. The aromatic sulfonic acid may contain a single aromatic nucleus, as in the case of benzenesulfonic acid,

or it may be of the fused or polynuclear type as represented by the naphthalene sulfonic acids. The acids may be mono- or polysulfonic acids and may contain other substituents in the nucleus, such as alkyl, amino, hydroxyl and other groups, typical examples of these acids being paratoluene sulfonic acid, orthoaminobenzene sulfonic acid, 2-naphthol-6-sulfonic acid, and isomers thereof. Specific examples of this type of salt are triethanolamine benzenesulfonate, amylamine paratoluene sulfonate, and triethanolamine toluene sulfonate. Examples of the compounded antistatic oil itself which have been found, in accordance with our invention, to give highly satisfactory results as antistatic agents when applied in the form of aqueous emulsions to cellulose organic derivative cut staple fibers are the following:

	Grams
A. Blown neat's-foot oil.....	50
Sulfonated olive oil.....	4
Triethanolamine benzenesulfonate.....	4
Water.....	352

B. Water.....	90
Amylamine p-toluene sulfonate.....	10

The broad scope of this invention also includes the application to cellulose organic derivative cut staple fibers of additional antistatic agents as for example—salts formed by interaction of an organic base, such as those above mentioned, as well as amines containing an ether linkage, with an organic acid containing a cyclic ether residue or an organic acid containing an open chain ether residue. More specifically, such salts may be formed by reacting an acid containing an ether linkage, such as tetrahydrofuroic acid with a base (amine) containing an ether linkage, giving such as tetrahydrofurfuryl amine, tetrahydrofurfurylamine tetrahydrofuroate; an acid containing no ether linkage such as butyric acid with an amine containing an ether linkage, such as tetrahydrofurfuryl amine, giving tetrahydrofurfurylamine butyrate; an amine containing no ether linkage and preferably six or more carbon atoms, such as cyclohexylamine, with an acid containing an ether linkage, giving such as tetrahydrofuroic acid cyclohexylamine tetrahydrofuroate; an acid containing an unsaturated ether linkage such as furoic acid with an amine containing a saturated ether linkage, such as tetrahydrofurfuryl amine giving tetrahydrofurfurylamine furoate. The use of this specific class of amine salts just referred to as antistatic agents in the manufacture of cellulose organic derivative cut staple, although included in the broad scope of our invention, is nevertheless the specific invention of, and covered by an application in the name of, J. R. Caldwell, Ser. No. 114,085, filed of even date.

We have found that by applying an amine salt of one of the types described above, preferably mixed or associated with a mineral or vegetable oil, in the form of a solution or an aqueous emulsion of a textile lubricant, to cellulose organic derivative cut staple fibers, the treated fibers lost substantially all tendency to accumulate charges of static electricity and the individual fibers do not repel each other in processing. We have found that such cut staple fibers can be readily handled and successfully put through all of the rather complicated operations such as carding, combing, drawing, spinning and the like which are involved in the manufacture of spun yarn by the cotton, woolen or worsted systems, a result which was wholly out of the question until the advent of the present invention. Our dis-

covery of the antistatic effect on cellulose derivative cut staple of the class of compounds above referred to is especially remarkable in view of the fact that mineral oils, butyl stearate, and other well known textile lubricants produce only a negligible antistatic effect on cellulose derivative fibers and such fibers do not lose their tendency to accumulate static charges sufficiently to make it possible to employ them in the manufacture of spun yarn.

Our invention may be conveniently described by reference to the manufacture of three different types of cut staple intended, respectively, for use in the manufacture of spun yarn on the cotton, woolen and worsted systems.

Example I.—Referring now to the manufacture of cellulose organic derivative cut staple for use on the cotton system, the filaments are spun in the usual manner. For example, a suitable cellulose acetate spinning dope is extruded in the form of three denier filaments through a spinneret mounted in a conventional type of spinning cabinet, the filaments emerging from the cabinet in a completely cured condition. The filaments are then wound in the form of a thread on bobbins by means of a cap or ring spinner which imparts to the thread a low twist, of the order of one-half turn per inch. Preferably, the yarn is lubricated to facilitate twisting and winding as it emerges from the cabinet by the application thereto of a suitable textile lubricating composition such as an aqueous emulsion of a mineral oil. Yarns from a plurality of bobbins are warped to a roving of convenient size which is fed to a stapling machine, where it is wet with water and cut to a staple length of $\frac{5}{8}$ to $1\frac{1}{2}$ inches. The cut staple is then scoured to remove the lubricant and placed in a bath of boiling water and boiled for a period of about 5 minutes. The boiling water produces a permanent crimp or kinkiness in the individual fibers. The crimped staple is then removed from the boiling bath and treated with an antistatic agent of the type mentioned above, such as by immersion, the amount deposited being equal to about .5-5%, based on the dry weight of the yarn. The antistatic agent is conveniently applied in the form of an aqueous emulsion at a temperature of about 60° C. Following application of the antistatic composition, the staple is dried in a current of warm air and picked to loosen or separate the individual fibers. The resulting product is a white resilient mass of wool-like and kinky fibers having a high degree of resiliency and closely simulating natural wool or cotton in appearance. Due to the presence of the antistatic agent in or on the fibers they have substantially no tendency to accumulate electrical charges and unlike ordinary untreated staples, are well adapted for processing in the manufacture of spun yarns on the cotton system.

Example II.—In the manufacture of cellulose organic derivative cut staple for use on the worsted system a slightly modified technique is employed. Inasmuch as natural wool fibers employed in making worsted goods have relatively great length (several inches) the cellulose derivative filaments are accordingly cut fairly long, preferably 4 to 7 inches.

The filaments as they emerge from the spinning cabinets are wound in the form of cheeses in such manner that they lie in parallel relationship to one another. Preferably, and in order to facilitate winding, the filaments are lubricated as they emerge from the spinning

cabinet with a lubricant which may, if desired, have antistatic properties. Strands or filaments from a plurality of yarn packages are warped together into the form of a relatively thick roving, the individual filaments also remaining in the roving in substantially parallel relationship. The roving is then fed to the stapling machine where the filaments are wet cut as previously described. The cut staples are then boiled for a period of about 5 minutes to crimp them and to give them the characteristic woolly form. The crimped staple is then treated with an aqueous emulsion or solution of one of the agents above described at a temperature of about 60° C., dried, and picked. The resulting product is a white woolly appearing mass of fibers well adapted for use in the manufacture of spun yarn on the worsted system.

Example III.—Cellulose organic derivative cut staple fibers for use in the manufacture of spun yarns on the wool system may also be prepared in a somewhat similar manner. Such staples are cut to a length of preferably 3 to 4 inches, as described in connection with the manufacture of the worsted type staple, dried, picked and then soaked in an aqueous bath containing a solvent, semi-solvent, or non-solvent of the cellulose organic derivative material of which the fibers are composed to bring about the desired crimp. The crimped material is then preferably treated with an emulsion or solution of one of the antistatic agents above described and again dried and picked. The resulting material is a soft, white, resilient mass of fibers closely resembling natural wool and well-adapted for the manufacture of spun yarns on the woolen system.

While we have found it convenient to illustrate our invention by reference to the application of the hereindescribed antistatic compositions to cellulose acetate filaments, threads or cut staple fibers, our invention is broadly applicable to the treatment of yarns composed of a wide variety of cellulose organic derivatives such as cellulose propionate, cellulose butyrate, cellulose acetate propionate, cellulose acetate butyrate and other single or mixed organic acid esters of cellulose, as well as the cellulose ethers.

In general, we prefer to apply relatively small amounts of the antistatic composition to the yarn. In most cases, $\frac{1}{2}$ to 5%, based on the dry weight of the yarn gives excellent results but in some cases we may use as little as 0.1% or as much as 25% or more.

The most outstanding feature of the agents herein described is their marked ability to reduce or eliminate the tendency for cellulose derivative materials to build up static charges under frictional influences. In determining the peculiar antistatic properties of these agents, we have made a number of tests particularly designed to measure the amount of static accumulating on the yarn under different frictional conditions. In these tests, the yarn was treated, respectively, with butyl stearate, mineral oil, and an antistatic agent. The treated yarn was passed first over a steel guide and then over a porcelain guide at various linear speeds and the friction and static charges measured. In the case of the yarn treated with butyl stearate it was found that in passing over each guide the yarn developed a pronounced charge of negative static electricity the charge being greater when the yarn was passed over the porcelain guide. In the case of yarn treated with mineral oil it was found that heavy charges of positive static

were developed. In striking contrast to these results, yarn treated with the antistatic agents herein described developed no detectable static charges whatever when passing over the guides under identical conditions. In fact no detectable static charges were developed regardless of speed or friction.

As will be apparent from the above examples and description, the antistatic agents applied to the yarn in accordance with our invention remains thereon during the processing of the yarn in the manufacture of spun yarn and similar products. It will thus be seen that we have in reality produced a new and useful product namely, a cellulose organic derivative cut staple yarn which, unlike untreated yarn, is well adapted for processing on the cotton, woolen or worsted systems. The agents herein described are, however, susceptible of ready removal by means of the ordinary scour baths customarily employed in the textile industry.

Our invention has made possible a result not heretofore attainable, namely, the use of cellulose acetate and other cellulose organic derivative yarns in the form of cut staple for the manufacture of spun yarns. This is an important step forward in the art and opens up an entirely new and extensive field of usefulness for cellulose derivative yarns. Many different types of products may be produced from the spun yarn which it is now possible to make from this tube of material, such as suitings, "woolen" blankets and many similar products. Not only does the material produced in accordance with our invention possess numerous inherent advantages over natural products such as cotton and wool, but the textile products produced therefrom are characterized by properties not attainable in materials obtained from natural sources. One of the most outstanding of these properties is that natural brilliance or luster peculiar to cellulose derivative materials, ordinarily lacking in natural products.

While we have chosen to illustrate our invention by reference to certain specific antistatic agents, our process is in no sense limited thereto. On the contrary, the broad scope of our invention includes the application to cellulose organic derivative cut staple yarns and other types of yarns, filaments and fibers of any antistatic agent which is capable of reducing or eliminating the tendency of such material to accumulate static charges.

What we claim and desire to secure by Letters Patent of the United States is:

1. Method of eliminating the tendency of cellulose organic derivative cut staple yarns to accumulate charges of static electricity, which comprises applying thereto an antistatic composition, the essential antistatic component of which is a cyclohexyldialkylamine salt of a sulphated aliphatic alcohol containing at least 10 carbon atoms.

2. Method of eliminating the tendency of cellulose organic derivative cut staple yarns to accumulate charges of static electricity, which comprises applying thereto an antistatic composition, the essential antistatic component of which is a cyclohexyldiethylamine salt of a sulphated aliphatic alcohol containing at least 10 carbon atoms.

3. Method of eliminating the tendency of cellulose organic derivative cut staple yarns to accumulate charges of static electricity, which comprises applying thereto an antistatic com-

position, an antistatic component of which is a diethylcyclohexylamine salt of sulphated lauryl alcohol.

4. Method of eliminating the tendency of cellulose organic derivative cut staple yarns to accumulate charges of static electricity, which comprises applying thereto an antistatic composition, an antistatic component of which is a diethylcyclohexylamine salt of sulphated cetyl alcohol.

5. Method of eliminating the tendency of cellulose organic derivative cut staple yarns to accumulate charges of static electricity, which comprises applying thereto an antistatic composition, the essential antistatic component of which is a mixture of the diethylcyclohexylamine salts of sulphated decyl, lauryl, cetyl and myricyl alcohols.

6. Method of eliminating the tendency of cellulose organic derivative cut staple yarns to accumulate charges of static electricity, which comprises applying thereto an antistatic composition composed of about 22% to 45% by weight of a mixture of the diethylcyclohexylamine salts

of sulphated decyl, lauryl and cetyl alcohols, and 78% to 55% by weight of mineral oil.

7. A cellulose organic derivative cut staple yarn containing an antistatic composition, the essential antistatic component of which comprises a mixture of the diethylcyclohexylamine salts of decyl, lauryl, cetyl and myricyl alcohols.

8. The method of eliminating the tendency of cellulose organic derivative cut staple yarns to accumulate charges of static electricity, which comprises applying thereto an antistatic composition, the essential antistatic component of which is a diethylcyclohexylamine salt of a sulphated aliphatic alcohol selected from the group consisting of decyl, lauryl, cetyl, and myricyl alcohols.

9. A cellulose organic derivative cut staple yarn coated with an antistatic agent, the essential antistatic component of which is a diethylcyclohexylamine salt of a sulphated aliphatic alcohol selected from the group consisting of decyl, lauryl, cetyl, and myricyl alcohols.

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