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# ANTISTATIC TREATMENT OF FIBROUS MATERIALS

Linton A. Fluck, Pluckemin, and Alexander L. Logan, Westfield, N. J., assignors to American Cyanamid Company, New York, N. Y., a corporation of Maine

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The present invention relates to a process for treating fibrous materials to eliminate or minimize the accumulation of electrostatic charges thereon.

It is well-known that certain fibrous materials tend to accumulate charges of static electricity when subjected to friction. This tendency to accumulate electrostatic charges is especially pronounced in the case of the hydrophobic synthetic fibers of comparatively recent origin, but it also occurs on wool and silk under conditions of low atmospheric humidity as during the winter months. This tendency is quite noticeable to the user of fabrics made from these materials by reason of the frequent and annoying although harmless shocks which he receives upon emerging from an automobile equipped with seat covers of a static-accumulating material. In addition, manufacturing difficulties have arisen in the carding or combing operations in processing staple fiber composed of hydrophobic synthetic polymers. Excessive amount of "fly" are created by the friction inherent in these operations.

An object of the invention is to minimize or eliminate the accumulation of electrostatic charges on fibrous materials.

A further object of the invention is to eliminate or minimize the accumulation of static electricity on textile fabrics.

Various other objects and advantages of the invention will be apparent to those skilled in the art upon consideration of the detailed disclosure herein.

It has been found that the accumulation of electrostatic charges on fibrous material which is normally subject to the accumulation of such charges can be substantially eliminated by applying a dispersion of a condensation product of relative proportions of 1 mol of a lower alkylolamide of dimerized unsaturated fatty acid with at least 8 mols of a lower alkylene oxide and drying the treated fibrous material with at least 0.1% thereon of the condensation product based on the dry weight of the untreated material.

The compounds employed in the novel process are of nonionic nature and it is quite surprising that they impart antistatic qualities because most of the antistatic agents of the prior art are either anionic or cationic, with the vast majority falling in the latter category.

The agents employed in practicing this invention are described in Thurston et al. Patent No. 2,470,081. They constitute the condensation products of from 8 up to 175 or more mols of a lower alkylene oxide per mol of dimerized unsaturated fatty acid alkylolamides. Suitable alkylolamides and their preparation are set forth in Thurston et al. Patent No. 2,537,493. Summarizing the teachings of these patentees, it is well known that the polyunsaturated fatty acids of 18 to 20 carbon atoms, and particularly the dienic and trienic fatty acid mixtures obtained by the saponification of semidrying and drying oils such as cotton seed oil, soya bean oil, dehydrated castor oil, linseed oil, tung oil and fish oils are converted by heating to dimers which are essentially organic dicarboxylic acids of the cycloaliphatic series. It will be understood that



the expression "dimerized polyunsaturated fatty acids containing approximately 18 carbon atoms" and similar expressions refer to the monomeric fatty acids from which the dimerized acids are prepared by heat treatment rather than to the resulting dimers which contain approximately 36 carbon atoms. These dimers are then condensed with any mono- or dialkylolamine in which the alkyl radical or radicals contain from 2 to 4 carbon atoms to form bisalkylolamides. If desired the methyl, ethyl, or propyl esters of these dimer acids may be substituted in place of the acids. Suitable amines include monoethanolamine, diethanolamine, monopropanolamine, dipropanolamine, mono- and dibutanolamine or mixed dialkyolamines. Compounds useful in the present invention are then prepared by condensing a mol of the alkylolamide with at least 8 and preferably at least 20 mols of ethylene oxide, propylene oxide or butylene oxide. Details of the preparation of these compounds are set forth in the aforesaid patents and accordingly are not repeated here.

Millson et al. Patent No. 2,470,080 describes a process for dyeing basic nitrogenous materials with metallized dyes in which the compounds of Patent No. 2,470,081 are employed as dye assistants. However, no antistatic effects are described by Millson et al. and none are produced in their treatment, because the dyed fabrics are rinsed in the customary fashion after dyeing so that substantially none of the condensation product is left on the fabric. Moreover, the concentration of nonionic agent in the dye baths is deemed inadequate to produce sufficient "add-on" for the present purposes.

Of the condensation products described by Thurston et al., those prepared with ethylene oxide and an ethanolamide are preferred. Further, it appears that the monoethanolamides are somewhat superior to the diethanolamides of the dimerized unsaturated acids. Inasmuch as these condensation products are somewhat dark in color, it is often desirable to bleach them especially when they are to be used in the treatment of either undyed or light-colored fabrics. This may be readily accomplished by merely stirring in slowly at room temperature from 5 to 10% of an aqueous hydrogen peroxide solution (30.0% $H_2O_2$) based on the weight of condensation product. Equivalent quantities of other oxygen-containing bleaches may be used if desired.

The treatment of the present invention produces its greatest benefits on the hydrophobic, thermoplastic, synthetic textile fibers as these are the most troublesome from the standpoint of static; however, it also produces good results with wool and silk. The aforesaid synthetic fibers include linear polyamides such as nylon, polymeric acrylonitrile such as the homopolymers and copolymers of acryonitrile with one or more compatible ethylenic monomers such as methylacrylate, 2-methyl 5-vinyl pyridine and other vinyl pyridines, vinyl acetate, vinyl chloride, etc., copolymers of vinylidine chloride and vinyl chloride, copolymers of vinyl chloride and vinyl acetate, and polyesters such as cellulose acetate and polyethylene-glycol terephthalate.

The present invention may be practiced with fibrous materials in the raw state prior to carding or combing to prevent static accumulation during processing or with finished knitted, nonwoven, felted or woven fabrics of either flat or pile construction subsequent to all dyeing, finishing and laundering or other liquid treatments in order that the antistatic agent will remain on the finished textile article. The treatment of the present invention is especially suitable for automobile seat covers, upholstery fabrics, slip covers, rugs, etc.

It does not alter the hand of any textile fabric, and moreover has little or no effect on the color of the fabric, particularly when a decolorized or bleached condensation product is employed.

The process of this invention is extremely simple as it merely involves dispersing one of the aforesaid condensation products in water or another suitable solvent in sufficient concentration so that a fabric to which the solution is applied by padding, spray, or other suitable means will take up a sufficient quantity of the solution to retain after drying at least 0.1% of the condensation product based on the dry weight of the untreated fibrous material. Although there appears to be no rigid limit of the maximum amount of the condensation products which may be deposited upon the fibrous materials, there is nothing to be gained by coating or impregnating the fibrous material with more than 5% of the condensation product based on the weight of dry fibers, and the recommended application is between 0.25 and 2.0%. To accomplish this, a solution should contain at least about 0.1% by weight of the nonionic compound. Thereafter the treated fibrous material is dried without any rinsing or washing treatment. While air drying may be used, it is preferred in commercial practice to dry at elevated temperatures to accelerate production. Any drying temperatures may be employed which the untreated fibrous material will stand without deterioration. Temperatures ranging from 180 to 250° F. will be found suitable for most purposes. Although aqueous applications are greatly preferred in textile establishments in order to achieve maximum economy and avoid problems concerned with the toxicity and recovery of organic solvents, the condensation products described above may be applied to the fibrous materials as solutions in methanol, ethanol, n-butanol, tert-butanol, amyl alcohol, cyclohexanol, acetone, pyridine, carbon tetrachloride or diethyleneglycol ethylether.

For a better understanding of the nature and objects of this invention, reference should be had to the following illustrative examples. Unless otherwise stated, all proportions are given in terms of weight.

*Example 1*

Two parts of the condensation product of 49 mols of ethylene oxide per mol of bismonoethanolamide of dimerized cotton seed fatty acids, prepared substantially according to Example 2 of Thurston et al. Patent No. 2,470,081 is dissolved in 98 parts of water. A woven nylon fabric is padded through this solution at room temperature with the squeeze rolls adjusted for a wet pick-up of 60%, based on the dry fabric weight; then the fabric is dried at 225° F. without any washing or rinsing. The dried fabric with an "add-on" of 1.2% of the condensation product is rubbed briskly against a glass rod in an atmosphere of relatively low humidity the fabric displays no evidence of an electrostatic charge when tested with a gold leaf electroscope.

*Example 2*

Example 1 is repeated on a piece of woolen goods with similar results.

*Example 3*

The procedure of Example 1 is repeated again, with a fabric woven from polyethyleneglycol terephthalate fibers of the type known as "Dacron" (registered trade-mark of E. I. du Pont de Nemours & Co.) without evidence of any static accumulation in the glass rod test.

*Example 4*

Example 1 is repeated using a cellulose acetate fabric with the same results.

*Example 5*

The procedure of Example 1 is again repeated with an automobile seat cover fabric woven from "Saran" (registered trade-mark of the Dow Chemical Company) fibers produced from the product of the copolymerization of vinylidene chloride and vinyl chloride. Again, the application of the glass rod test to the treated fabric shows that no substantial amount of static electricity accumulates on the fabric.



*Example 6*

The procedure of Example 1 is duplicated, using pad baths of varying concentrations in order to provide "add-ons" of 0.1, 0.3, 0.5, 0.8 and 2.5% of the condensation product on nylon fabric. In each instance, no static charge is found on the fabric upon application of the glass rod test.

*Example 7*

Example 1 is repeated with a fabric woven from acrylonitrile homopolymers with pad bath concentrations and squeeze rolls adjusted to provide dry pick-ups or add-ons of 0.5% and 1% on two samples of the cloth. Both of these treated materials display no accumulation of electrostatic charges by the glass rod tests.

*Example 8*

The procedure of Example 1 is duplicated on a fabric woven from a copolymer of 40% acrylonitrile and 60% vinyl chloride by weight with the concentration of the pad baths and squeeze rolls adjusted to provide "add-ons" of 0.5 and 1% by weight of the condensation product. Again, no static charge is produced on the treated fabrics by the brisk rubbing against a glass rod.

*Example 9*

The procedure of Example 1 is followed in impregnating two samples of a fabric woven from fibers of the copolymer of 90% acrylonitrile, 5% vinyl acetate and 5% vinyl pyridine by weight with 0.5 and 1.0% respectively of the aforesaid condensation product. Both of the treated samples also fail to display any tendency to accumulate static electricity in the glass rod test.

*Example 10*

A blanket material having a brushed nap and woven from synthetic fibers consisting of the copolymers of 95% acrylonitrile and 5% methyl acrylate is treated according to the procedure of Example 1 except that the impregnation is adjusted to provide a dry pick-up of 2.0% of the condensation product on the blanket material. Again, no evidence of electrostatic charges on the fabric is found in the glass rod test.

*Example 11*

Two samples of woven nylon fabric are padded separately through aqueous baths containing 0.8 and 2.0% respectively of the condensation product of 50 mols of ethylene oxide with 1 mol of the bisdiethanolamide of dimerized polyunsaturated fatty acids prepared substantially according to Example 6 of Thurston et al., Patent No. 2,470,081. The wet pick-up amounts to 60% in both cases to provide "add-ons" of 0.5 and 1.2% respectively of the condensation product. The fabric samples are dried at 225° F. and show no accumulation of static electricity in the glass rod test in a relatively dry atmosphere.

*Example 12*

Example 11 is repeated substituting the reaction product of the condensation of 75 mols of ethylene oxide with the same amount of diethanolamide. Both treated fabrics are found to have no tendency to accumulate static electricity in the glass rod test.

*Example 13*

Example 11 is repeated substituting the reaction product obtained by the condensation of 100 mols of ethylene oxide with the same amount of diethanolamide. The treated nylon material shows no accumulation of static charges in the glass rod test.

The electroscope indicates a substantial electrostatic charge on untreated samples of each of the fabrics used in Examples 1 to 13, inclusive, when these untreated samples are subjected to the glass rod test set forth in Example 1.

Various modifications of the process described above

may be made without departing from the scope of the invention, and it is to be understood that the above samples are intended to illustrate rather than limit the scope of this invention.

We claim:

1. A process which comprises applying a solution of a water-soluble product of the condensation of relative proportions of 1 mol of a lower alkylolamide of a dimerized unsaturated higher fatty acid with at least 8 mols of a lower alkylene oxide to a static-accumulating fibrous material in sufficient amount to deposit at least 0.1 per cent of the condensation product based on the dry weight of the fibrous material and drying the treated material with said quantity of the condensation product thereon whereby the accumulation of electrostatic charges on the material is minimized.

2. A process which comprises applying a solution of a water-soluble product of the condensation of relative proportions of 1 mol of a bisalkylolamide containing from 2 to 4 carbon atoms of a thermally dimerized polyunsaturated fatty acid containing approximately 18 carbon atoms with at least 8 mols of an alkylene oxide containing 2 to 4 carbon atoms to a static-accumulating fibrous material in sufficient amounts to deposit at least 0.1 per cent of the condensation product based on the dry weight of the fibrous material and drying the treated material with said quantity of the condensation product thereon, whereby the accumulation of electrostatic charges on the material is minimized.

3. A process according to claim 2 in which said alkylene oxide comprises ethylene oxide and in which said solution is an aqueous solution.

4. A process which comprises applying an aqueous solution of a water-soluble bleached product of the condensation of a mol of a bisethanolamide of a thermally dimerized polyunsaturated fatty acid containing about 18 carbon atoms with at least 8 mols of ethylene oxide to a static-accumulating fibrous material in sufficient amount to deposit at least 0.1 per cent of the condensation product based on the dry weight of the material and drying the material with said quantity of the condensation product thereon, whereby the accumulation of electrostatic charges on the material is minimized.



5. A process according to claim 4 in which said fibrous material is dried with at least 0.25 per cent of the condensation product thereon.

6. A process according to claim 4 in which said fibrous material comprises nylon.

7. A process according to claim 4 in which said fibrous material comprises a copolymer of vinylidene chloride and vinyl chloride.

8. A process according to claim 4 in which said fibrous material comprises polymeric acrylonitrile.

9. A process according to claim 4 in which said fibrous material comprises synthetic polyester fibers.

10. A process according to claim 4 in which said fibrous material comprises wool.

11. A process according to claim 4 in which said fibrous material is a knitted textile fabric.

12. A process according to claim 4 in which said fibrous material is a woven textile fabric.

13. A process according to claim 4 in which said fibrous material is a nonwoven fabric.

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