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[54] ANTISTATIC CARDING LUBRICANT

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[58] **Field of Search** ..... 252/8.8, 8.75; 117/139.5 F

[56] **References Cited**

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[57] **ABSTRACT**

A water-emulsifiable antistatic carding lubricant for textile processing comprising a mixture of a mineral oil, a phosphoric acid ester of an ethyoxylated linear aliphatic alcohol, an alkanolamine, a long chain fatty acid, sulfonated sperm oil, an ethoxylated linear aliphatic alcohol and oleic diethanolamide.

16 Claims, No Drawings

ANTISTATIC CARDING LUBRICANT

This invention relates to novel compositions for use in the textile art and more particularly to an emulsifiable antistatic textile fiber lubricant particularly suitable for use in carding operations.

A familiar problem in textile processing is the tendency of fibers to accumulate and retain static electrical charges, which result from both fiber-to-fiber and fiber-to-metal friction. A great number of both natural and synthetic fibers are poor electrical conductors and the elimination of the tendency of said fibers to accumulate and retain static electrical charges is a critical factor for efficient textile processing.

Carding is one segment of overall textile processing whose particular purpose is to produce a continuous strand or sliver of fabric. Originally, the carding technique was developed as part of the cotton system of processing, but it is used today in the manufacture of both natural and manmade fibers. In the carding technique, a revolving flat card is used to convert the fiber sheets or laps from the picking operation into a continuous sliver. After carding, subsequent operations include such procedures as combing and drawing to clean and parallelize the fibers, and roving, spinning, winding and twisting to further finish the fibers.

In carding, as opposed to other textile processing operations, special properties are required for an acceptable lubricant. There must be a proper balance of cohesion and lubricity. Too much cohesion causes the fibers to cling to each other, while, if there is insufficient cohesion, the carding will not be uniform. During carding the webbed fibers slide next to each other, and effective lubrication results in a uniformity of distribution of fibers to the web. The proper degree of static inhibition must be obtained so that the fibers do not repel each other as static charges are accumulated. Good lubricity also enables the doff to be removed continuously. Furthermore, the end product of carding, the strand or sliver, will not be compact, well-rounded and readily pliable unless the correct degree of lubricity has been applied to the fabric.

In accordance with the present invention there is provided a novel antistatic carding lubricant comprising in combination one or more of each of the following materials in the stated parts by weight:

a. A mineral oil having a viscosity of from about 50 to 125 Saybolt Universal Seconds (S.U.S) at 100° F., from about 60 to 70 parts;

b. A phosphoric acid ester of an ethylene oxide adduct (1) of a C_8 to C_{18} linear alkyl alcohol, or (2) of a C_{10} to C_{20} branched chain alkyl alcohol, or (3) of a mono- and/or dialkyl phenol in which the alkyl radical contains from five to 12 carbon atoms, said adducts containing from 2 to 20 mols of ethylene oxide per mol of the alcohol or alkyl phenol, as the case may be, from about 4 to 6 parts;

c. An alkanolamine having two to nine carbon atoms, from about 5 to 8 parts;

d. A long chain fatty acid containing predominately from 14 to 18 carbon atoms, from about 4 to 6 parts;

e. A sulfonated sperm oil, from about 10 to 12 parts;

f. An ethylene oxide adduct (1) of a C_{10} to C_{18} linear alkyl alcohol, or (2) of a C_{12} to C_{20} branched chain alkyl alcohol, or (3) of a mono- and/or dialkyl phenol in which the alkyl radical contains from five to 12 carbon atoms, said adducts containing from 2 to 8 mols of ethylene oxide per mol of the alcohol or the alkyl phenol, as the case may be, from about 4 to 6 parts; and

g. An alkanolamide of a C_{16} to C_{18} normally liquid fatty acid, from about 3 to 4 parts.

The phosphoric acid esters, which, as prepared, are generally mixtures of mono- and diesters, are preferably made by reacting 1 mol of P_2O_5 with from 2 to 4.5 mols of the linear aliphatic alcohol or the branched chain aliphatic alcohol or the alkyl phenol, as the case may be, at a temperature in the range up about 100° C., in the presence or in the absence of an inert organic liquid diluent, most advantageously in the range of about 50° to 65° C. Such phosphating procedures are disclosed, for instance, in U.S. Pat. Nos. 2,441,295; 2,676,975; 2,701,258 and 3,004,056; Chemical Industries, Oct. 1942, pp. 516–521 and 557; and Organo Phosphorous Compounds, John Wiley & Sons, New York, 1950, pp. 220–223.

Illustrative alcohols and alkyl phenols from which the aforesaid ethylene oxide-adducts are made and which are reacted, for example, with P_2O_5 to produce said phosphoric acid esters are n-octyl alcohol, n-nonyl alcohol, n-decyl alcohol, n-dodecyl alcohol, n-tridecyl alcohol, n-tetradecyl alcohol, n-pentadecyl alcohol, n-hexadecyl alcohol, oleyl alcohol, n-stearyl alcohol; Oxo alcohols containing from 10 to 20 carbon exemplified by Oxo tridecyl alcohol, Oxo hexadecyl alcohol, and Oxo pentadecyl alcohol (and others as shown in U.S. Pat. No. 2,965,678); 2-ethyl octanol, and branched chain dodecanols, tetradecanols, hexadecanols and octadecanols; amyl phenol, diamyl phenol, nonyl phenol, dinonyl phenol, dodecyl phenol and didodecyl phenol. Of especial usefulness are the phosphoric acid esters of the 2 to 8 mol ethylene oxide adducts of C_{10} to C_{14} linear aliphatic alcohols (decyl, undecyl, dodecyl, tridecyl and tetradecyl alcohols) and mixtures of two or more of said alcohols.

The alkanolamines which are especially useful in the compositions of the present invention are monoethanolamine, diethanolamine and triethanolamine, and mixtures of two or more thereof, and, particularly, diethanolamine. Other alkanolamines, particularly those which contain from two to nine carbon atoms, can however, be used as, for instance, propanolamines, isopropanolamines, butanolamines, hexanolamines, ethyl ethanolamine, aminoethyl ethanolamine and glycerolamines. The alkanolamines react with the aforementioned phosphoric acid esters and with the long chain fatty acids to neutralize the same. While small proportions of inorganic alkalies, such as sodium hydroxide or potassium hydroxide, may be used in conjunction with the alkanolamines, it is preferred not to do so.

The long chain fatty acids containing predominately from 14 and, particularly, from 16 to 18 carbon atoms include the saturated and unsaturated fatty acids, for instance, myristic acid, palmitic acid, stearic acid, oleic acid, palmitoleic acid and, especially, tall oil fatty acids. The rosin content of the tall oil fatty acids does not adversely affect the utility of the tall oil fatty acids for the purposes of the present invention.

The sulfonated sperm oil is conventionally made by reacting sperm oil with sodium bisulfite, a true sulfonate, i.e., a carbon to sulfur linkage resulting. Sperm oil is composed mainly of fatty alcohol esters of fatty acids in the C_{12} to C_{22} range, the fatty acid portion of the molecule generally comprising 80–90 percent unsaturated fatty acids and 10–20 percent saturated fatty acids. The sulfonated sperm oil sold under the trade designation "Eureka 400" (Atlas Refinery, Inc.) is illustrative of sulfonated sperm oils which are very satisfactory for use in the compositions of the present invention.

Those of the 2 to 8 mol ethylene oxide adducts of the C_{10}–C_{18} linear aliphatic alcohols or of the C_{12}–C_{20} branched chain aliphatic alcohols or of the alkyl phenols which are particularly useful in the compositions of the present invention are normally liquids at ambient temperatures. Most desirable are the approximately 3 mol ethylene oxide adducts of the C_{12} to C_{15} linear aliphatic alcohols, namely, dodecyl alcohol, tridecyl alcohol, tetradecyl alcohol and pentadecyl alcohol.

The alkanolamides of the C_{16} to C_{18} normally liquid fatty acids which constitute one of the ingredients of the compositions of the present invention include, by way of illustration, oleic diethanolamide, tall oil fatty acid diethanolamide, linoleic acid diethanolamide and the corresponding fatty acid amides of glycerol mono- and diamines, dipropanolamine, diisopropanolamine, aminoethyl ethanolamine, dibutanolamine and diisobutanolamine. Oleic diethanolamide is especially satisfactory and it may be made, for instance, by condensing equal mols of diethanolamine and oleic acid, or by condensing about 1.5 to 2 mols of diethanolamine with 1 mol of oleic acid, at temperatures of 150° to 165° C. for several hours, or by condensing the oleic acid, in the form of an ester thereof, such as the methyl ester or the triglyceride ester, with diethanolamine.

The lubricant compositions of the present invention are most advantageously applied to the fiber as an oil-in-water emulsion. The emulsions are readily made at room temperature using conventional emulsification techniques. Generally speaking, the oil-in-water emulsions will comprise, by weight, from about 5 to 20 parts lubricant composition to about 95 to 80 parts water.

The carding lubricant emulsions of the present invention may be applied to the fiber by any conventional method. Preferably, they are sprayed onto the fabric during the picking operation just prior to carding.

The carding lubricant compositions are not limited in their ultimate application to any particular fibers or class of fibers. They can be utilized with any fiber requiring lubrication during carding. They have been found especially suitable in treating acrylic, polyamide, polyolefin and polyester fibers and blends of these fibers with each other and with natural fibers such as polyester-wool and polyester-cotton blends.

The following examples are illustrative of the invention and are not to be construed as in any way limitative of its scope. All parts listed are by weight.

EXAMPLE I

i. A liquid, emulsifiable antistatic carding lubricant was prepared by combining the following components:

	Parts
a. Mineral oil (55 S.U.S. at 100° F.)	65
b. Phosphoric acid ester of linear aliphatic alcohol (C_{10}-C_{14} alkyl radicals) of average molecular weight 180 and containing 6 mols of ethylene oxide per mol of alcohol	5.4
c. Diethanolamine	5.0
d. Tall oil fatty acids	4.5
e. Sulfonated sperm oil	12.0
f. Mixture of C_{12}-C_{15} linear aliphatic alcohols containing 3 mols of ethylene oxide per mol of alcohol	4.5
g. Oleic diethanolamide	3.6

The product was a clear liquid with a cloud point and a pour point of less than −5° C.

ii. A 5 percent oil-in-water emulsion was prepared from the composition of part (i) hereof and applied by spraying onto nylon fiber prior to carding. The lubricated fiber processed satisfactorily with excellent static control. No card loading was observed.

EXAMPLE II

A composition was prepared as described in part (i) of Example I except that 62.0 parts of the mineral oil and 8.0 parts of diethanolamine were used.

EXAMPLE III

A composition was prepared as described in part (i) of Example I except that 61.9 parts of the mineral oil, 6.3 parts of diethanolamine and 1.7 parts of potassium hydroxide were used.

EXAMPLE IV

The compositions of Examples II and III were clear liquid products. When 5 percent emulsions in water of each of the compositions of Examples II and III were prepared, they were translucent and exhibited excellent long term stability with no creaming or other instability evident.

EXAMPLE V

The following test data on polyester fiber indicates the superior antistatic qualities of the compositions of the present invention. A 5 percent emulsion of the lubricant described in Example I was employed. The static inhibition was tested by the resistivity method using Rothschild testing equipment. Excellent antistatic half-life reproducibility is demonstrated.

Skein Section	A	B	C
Half-life of static charge on skein section*	35 secs.	79 secs.	59 secs.

*Each value is an average of two trials on the same section.

It may be noted that it is known in the art to produce antistatic textile assistants utilizing various phosphate esters such as are disclosed, for example, in U.S. Pat. Nos. 2,730,498; 2,842,462; 3,170,877 and 3,056,744. Neither in these patents nor elsewhere, so far as we are aware, however, is there any disclosure or suggestion of the compositions which we have evolved which we have found to possess highly advantageous properties and which are quite low in cost.

I claim:

1. An emulsifiable carding lubricant composition consisting essentially of, by weight,

a. from about 60 to 70 parts of mineral oil having a viscosity of from about 50 to 125 S.U.S. at 100° F.;

b. from about 4 to 6 parts of a phosphoric acid ester of an ethylene oxide adduct of at least one member selected from the group consisting of (i) a C_8 to C_{18} linear alkyl alcohol, (ii) a C_{10} to C_{20} branched chain alkyl alcohol, and (iii) mono- and/or dialkyl phenols in which the alkyl radical contains from five to 12 carbon atoms, said adducts containing from 2 to 20 mols of ethylene oxide per mol of the alcohol or alkyl phenol, as the case may be;

c. from about 5 to 8 parts of an alkanolamine having two to nine carbon atoms;

d. from about 4 to 6 parts of a fatty acid containing predominately from 14 to 18 carbon atoms;

e. from about 10 to 12 parts of sulfonated sperm oil having a carbon to sulfur linkage;

f. from about 4 to 6 parts of an ethylene oxide adduct of at least one member selected from the group consisting of (i) a C_{10} to C_{18} linear alkyl alcohol, (ii) a C_{12} to C_{20} branched chain alkyl alcohol, and (iii) mono- and/or dialkyl phenols in which the alkyl radical contains from five to 12 carbon atoms, said adducts containing from 2 to 8 mols of ethylene oxide per mol of the alcohol or alkyl phenol as the case may be; and

g. from about 3 to 4 parts of an alkanolamide of a C_{16} to C_{18} normally liquid fatty acid, said alkanolamide being derived from an alkanolamine selected from the group consisting of diethanolamine, glycerol mono- and diamines, dipropanolamine, diisopropanolamine, aminoethyl ethanolamine, dibutanolamine and diisobutanolamine.

2. A composition according to claim **1**, wherein the (b) ingredient is a phosphoric acid ester of a 2 to 8 mol ethylene oxide adduct of a C_{10} to C_{14} linear alkyl alcohol.

3. A composition according to claim **1**, wherein the (c) ingredient is at least one member selected from the group consisting of monoethanolamine, diethanolamine and triethanolamine.

4. A composition according to claim **1**, wherein the (d) ingredient is at least one member selected from the group consisting of oleic acid and tall oil fatty acids.

5. A composition according to claim **1**, wherein the (f) ingredient is an approximately 3 mol ethylene oxide adduct of a C_{12} to C_{15} linear alkyl alcohol.

6. A composition according to claim **1**, wherein the (g) ingredient is a diethanolamide of a fatty acid selected from the group consisting of oleic acid and tall oil fatty acids.

7. A composition according to claim **2**, wherein the (c) ingredient is at least one member selected from the group consisting of monoethanolamine, diethanolamine and triethanolamine.

8. A composition according to claim **7**, wherein the (d) ingredient is at least one member selected from the group consisting of oleic acid and tall oil fatty acids.

9. A composition according to claim 8, wherein the (f) ingredient is an approximately 3 mol ethylene oxide adduct of a C_{12} to C_{15} linear alkyl alcohol.

10. A composition according to claim 9, wherein the (g) ingredient is a diethanolamide of a fatty acid selected from the group consisting of oleic acid and tall oil fatty acids.

11. A composition according to claim 1, wherein the (a) ingredient consists essentially of about 65 parts of mineral oil having a viscosity of about 55 S.U.S. at 100° F., the (b) ingredient consists essentially of about 5.4 parts of a phosphoric acid ester of an approximately 4 mol ethylene oxide adduct of a C_{10} to C_{14} linear alkyl alcohol, the (c) ingredient consists essentially of about 5 parts of diethanolamine, the (d) ingredient consists essentially of about 4.5 parts of tall oil fatty acids, the (f) ingredient consists essentially of about 4.5 parts of an approximately 3 mol ethylene oxide adduct of C_{12} to C_{15} linear alkyl alcohol, and the (g) ingredient consists essentially of about 3.6 parts of an oleic diethanolamide.

12. An aqueous emulsion consisting essentially of, by weight, from about 80 to 95 parts of water and from about 20 to 5 parts of the composition of claim 1.

13. An aqueous emulsion consisting essentially of, by weight, from about 80 to 95 parts of water and from about 20 to 5 parts of the composition of claim 2.

14. An aqueous emulsion consisting essentially of, by weight, from about 80 to 95 parts of water and from about 20 to 5 parts of the composition of claim 3.

15. An aqueous emulsion consisting essentially of, by weight, from about 80 to 95 parts of water and from about 20 to 5 parts of the composition of claim 10.

16. An aqueous emulsion consisting essentially of, by weight, from about 80 to 95 parts of water and from about 20 to 5 parts of the composition of claim 11.

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