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3,428,560

YARN-LUBRICATING COMPOSITION

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No Drawing. Continuation of application Ser. No. 419,207, Dec. 17, 1964, now Patent No. 3,306,850, dated Feb. 28, 1967. This application Feb. 27, 1967, Ser. No. 618,995

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1 Claim

ABSTRACT OF THE DISCLOSURE

A self-emulsifiable, stable yarn-lubricating composition of isocetyl stearate, sodium di-(2-ethyl hexyl) sulfosuccinate, and a non-ionic emulsifying agent.

A self-emulsifiable yarn-lubricating composition consisting essentially of at least 40% by weight of isocetyl stearate, about 10 to 30% by weight of a sodium di-(2-ethylhexyl)sulfosuccinate and at least 20% by weight of a nonionic emulsifying agent of glyceryl oleate, the condensation product of one mol of stearyl alcohol with 3 mols of ethylene oxide, the condensation product of 30 mols of ethylene oxide with 1 mol of sorbitol trioleate-laurate or mixtures of said nonionic agents.

This application is a continuation of my copending application Ser. No. 419,207 filed Dec. 17, 1964 now Patent No. 3,306,850 which is a continuation-in-part of my copending application Ser. No. 332,888 filed Dec. 23, 1963 which in turn is a continuation-in-part of my copending application Ser. No. 290,333 filed June 25, 1963. The latter two applications are now abandoned.

The present invention relates to textile lubricants and, more particularly, to textile lubricants of the type usually applied in the form of aqueous emulsions.

In the processing of yarns spun from polycondensation materials, such as polyesters, polyamides and the like, lubricating compositions are applied in order to improve their handling characteristics, particularly at high speeds. In many applications, it has been found desirable to apply the lubricating compositions in the form of an aqueous emulsion. Except for equilibrium amounts, the water is removed subsequently, e.g., by heat generated during drawing or other yarn-treating processes, or by evaporation in storage. To be satisfactory for commercial use, the aqueous emulsion should not only be stable and retain its properties over extended periods of time, but should also serve to lubricate the fibers with a composition having properties that do not change under varying use conditions. The use of nonionic emulsifiers to stabilize self-emulsifiable lubricating compositions results in residual lubricating compositions on the yarn which are sensitive to moisture, i.e., under changing moisture conditions, the physical properties of the lubricating composition change, becoming more viscous and tacky with increases in humidity. The presence of such compositions on yarns results in higher running tensions and can also cause deposit problems at yarn contact surfaces.

It is the primary object of this invention to provide textile-lubricating compositions that do not undergo appreciable viscosity changes with changes in relative humidity.

This and other objects of the invention are attained with self-emulsifiable textile-lubricating compositions comprised of a textile lubricant, a nonionic emulsifying agent, and an alkali metal or ammonium salt of a dialkyl sulfosuccinic acid. These compositions provide essentially unchanged lubricating and cohesion properties over

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a broad range of relative humidities such as would be encountered during dry winter and humid summer seasons. Other materials may be added, e.g., bactericides, ionic antistatic agents, antioxidants, emulsion stabilizers, without making the finish sensitive to changes in moisture content.

The textile lubricant used in the practice of this invention can be a mineral oil, an animal oil, a vegetable oil or, preferably, a synthetic ester. Preferably the synthetic esters are of the kind obtained through the reaction of a fatty acid having 8 to 20 carbon atoms in its chain with a monohydric aliphatic alcohol having 3 to 20 carbon atoms. The long-chain fatty acids can be relatively pure compounds or mixtures such as can be obtained from naturally occurring products. While the monohydric aliphatic alcohols are preferred, polyhydric aliphatic alcohols, e.g., trimethylolpropane and pentaerythritol, are also suitable. For special purposes, e.g., high-temperature processing, it may be desirable to use selected diesters such as di-(2-ethylhexyl) sebacate as the lubricant.

If desired, minor amounts of other lubrication materials, such as natural and synthetic waxes, e.g., a microcrystalline wax or a polyethylene wax, can be substituted for a portion of the lubricant. When employed, the wax should constitute no more than 25 percent of the lubricant component.

The nonionic emulsifying agent can be the condensate of ethylene oxide with an organic compound having an active hydrogen atom. Compounds suitable for use in preparing such condensates are fatty acids and fatty alcohols having 12 to 20 carbon atoms in their chain, polyhydric aliphatic alcohols and partial esters thereof, and alkyl phenols. Other suitable nonionic emulsifiers include the partial fatty acid esters of polyols or their ethylene oxide condensates and the ethylene oxide condensates of the amides of ethanol amines and a fatty acid having 15 to 20 carbon atoms in its chain. When the nonionic emulsifier contains condensed ethylene oxide, it is essential that no more than about 15 mols of ethylene oxide be condensed with each mol of the organic compound containing an active hydrogen atom. In examining a large number of textile lubricating compositions, it has been found that nonionic emulsifiers containing more than about 15 mols of condensed ethylene oxide eliminate, or seriously impair, the self-emulsifiability of the composition.

The sulfosuccinates useful in this invention are the alkali metal and ammonium salts of a dialkyl sulfosuccinic acid. Preferably, each alkyl group in the sulfosuccinate will contain between 4 and 16 carbon atoms in its chain. In addition to serving as an acid in the emulsification of the lubricant, the dialkyl sulfosuccinate functions to minimize viscosity changes when the lubricated fiber is exposed to a high humidity environment.

When an antistatic agent is used, the neutral salts of partial esters of phosphoric acid and a long-chain fatty alcohol are preferred. Suitable fatty alcohols are those containing about 12 to 18 carbon atoms in their alkyl chains, for example, lauryl, oleyl, and stearyl alcohols. In preparing the partial esters, the amount of long-chain fatty alcohol should be sufficient to introduce about one or two ester groups in the phosphoric acid. The neutral salts are obtained by neutralization of the partial ester with a suitable base such as, for example, potassium hydroxide, sodium hydroxide, ammonia and aliphatic amines. Preferably, the salt is a potassium salt. The corresponding morpholine, diethanol amine and triethanol amine salts also are satisfactory.

The lubricant compositions of this invention contain, by weight, at least 40 percent of a lubricating material, at least 10 percent of a nonionic emulsifier and between 10 and 30 percent of a dialkyl sulfosuccinate. The con-

centration of the sulfosuccinate must not exceed about 30 percent in order to maintain a relatively constant viscosity under changing conditions of relative humidity. Amounts of the sulfosuccinate below about 10 percent provide insufficient protection to viscosity change. The composition can also contain from 10 to 15 percent of an antistatic agent. When the neutral salt of the partial phosphate ester is used as an antistatic agent, the combined concentration of the sulfosuccinate and phosphate must not exceed a concentration of about 30 percent.

The lubricating compositions are prepared by mixing the ingredients until a smooth, uniform blend is obtained. The blend is then dispersed with the appropriate amount of water to give stable emulsions containing from about 1 to 20 percent by weight of the composition. The emulsion may be applied to filamentary material in any convenient manner, such as, for example, by a roll rotating in a trough containing the aqueous emulsion, or by bath-dipping, spraying, and the like. The new emulsions are applied to continuous filaments or staple fibers, the surfaces of which may be smooth or roughened, of conventional denier in the usual amounts, i.e. from less than one to several percent or more, based on the material being treated. Similarly, these lubricants can be employed with any synthetic polymer filamentary material desired, but usually will be used on the various nylons (polyamides) that are presently commercial. Typical nylons known in the art are disclosed in U.S. Patents Nos. 2,130,948, 2,071,251, and 2,071,253 and like disclosures.

Although the dialkyl sulfosuccinates possess emulsifier characteristics, they are not sufficiently effective to give stable emulsions of the lubricant when used, as the only emulsifying agent, in amounts less than 30 percent of the total weight of the ingredients. When 30 percent or more of the sulfosuccinate is employed, the aqueous emulsions still have poor stability. The use of an ionic antistatic agent aggravates this situation since it necessitates a reduction in the amount of sulfosuccinate with a concomitant decrease in emulsion stability. By comparison, aqueous emulsions of a lubricant composition containing 10 percent of sodium dioctyl sulfosuccinate and 10 percent of the product obtained by condensing 1 mol of lauric acid with 13 mols of ethylene oxide are highly stable.

The viscosity of the lubricating compositions is measured at 35° C. using Ostwald-Fenske type capillary viscometers. All of the lubricating compositions have an initial water content of 0.4 percent or less which corresponds to an estimated equilibrium relative humidity of about 20 percent or less. Incremental amounts of water are added and the equilibrium relative humidity measured. The equilibrium relative humidity is determined by placing 50 milliliters of the lubricating composition into a one-quart Mason jar. A lid containing a moisture-sensing element is used to seal the jar. The contents of the jar are allowed to stand for 48 hours and the electrical resistance of the moisture-sensing element is measured and the percent relative-humidity determined from a standard curve. The relative humidity measurements are made over the range of about 20 to about 100 percent. At 100 percent relative humidity the measurement becomes uncertain because of condensation on the sensing element.

It is not unusual for finish oils equilibrated at about 100 percent relative humidity to gain sufficient moisture to comprise up to 45 percent of their total weight. In this regard, high moisture content, e.g., 30 to 45 percent, may result in the beginning of gel formation. The beginning of gel formation is readily detected since at this point the normally clear lubricating composition becomes turbid. Gel formation seriously interferes with viscosity measurements due to the formation of a second phase. When the dropwise addition of water produces a change from clear to turbid, the addition of water is stopped and the equilibrium relative humidity and viscosity are measured. It is for this reason that some of the relative humidity values are given less than 99 percent. However, the change in

viscosity of the composition between this point and that of complete moisture saturation is small.

The invention will be described further in conjunction with the following specific examples.

Example I

A lubricant composition is prepared by blending together 65 parts by weight of isobutyl palmitate, 10 parts by weight of sodium di(2-ethylhexyl) sulfosuccinate, 10 parts by weight of the product obtained by condensing 1 mol of lauric acid with 13 mols of ethylene oxide, and 15 parts by weight of the potassium salt of a mixture consisting essentially of mono- and dioleoyl orthophosphates. As measured at 35° C., the lubricating composition has a viscosity of about 30 centipoises over the range of 10 to 100 percent relative humidity. The above mixture is warmed to 60° C. and the resulting clear solution is poured, with agitation, into 566 parts of water at 60° C. The 15 percent aqueous emulsion is translucent and highly stable. It is also highly suitable for lubricating nylon continuous-filament yarns in that no appreciable variations in running tension are experienced.

Example II

A self-emulsifiable textile lubricant is prepared by blending together 44.5 parts by weight of isocetyl stearate, 22 parts by weight of sodium di(2-ethylhexyl) sulfosuccinate, 22 parts by weight of the product obtained by condensing 1 mol of stearyl alcohol with 3 mols of ethylene oxide, and 11.1 parts by weight of microcrystalline wax. The composition has a viscosity of 150 to 175 centipoises over the range of 20 to 100 percent relative humidity at 35° C. The composition emulsifies readily when poured into water with stirring. The aqueous emulsions are highly stable.

Example III

A self-emulsifiable textile lubricant is prepared by blending together 72.5 parts by weight of isocetyl stearate, 12.5 parts by weight of sodium di(2-ethylhexyl) sulfosuccinate, 12.5 parts by weight of glyceryl oleate (a material containing about 60 percent by weight of glyceryl monoleate) and 2.5 parts by weight of the product obtained by condensing 30 mols of ethylene oxide with one mol of sorbitol trioleatelaureate (oleic to lauric ratio of 4:1). The composition has a viscosity of 60 to 70 centipoises over the range of 20 to 98 percent relative humidity at 35° C. The composition forms a stable emulsion when added to water with stirring. The emulsion is highly suitable for lubricating continuous-filament nylon yarn in that it provides a product whose running tension is unaffected by humidity changes.

Replacement of the sulfosuccinate with an equivalent weight of potassium oleate emulsifier results in a composition whose viscosity, as measured at 35° C., varies from about 75 to over 1,000 centipoises over the 20 to 98 percent relative humidity range. Such viscosity variations can only lead to undesirable variations in running tensions.

Example IV

This example illustrates the use of various types of lubricants in the practice of this invention.

The self-emulsifiable textile lubricating compositions are prepared by adding one part by weight of sodium di(2-ethylhexyl) sulfosuccinate and one part by weight of the product obtained by condensing 3 mols of ethylene oxide with one mol of stearyl alcohol to two parts by weight of the lubricant. The lubricants are listed in Table I. All of the compositions have an initial water content of 0.4 percent or less which corresponds to an estimated equilibrium relative humidity of 15 to 25 percent. The viscosity of each composition over the relative humidity range of about 20 to about 90 percent and higher is determined as previously described. The viscosity range, and the relative humidity range for which it is determined, are given in Table I. All of the compositions give stable

emulsions upon stirring one part of the composition into 9 parts of water.

TABLE I

Lubricant	Viscosity Range of Composition (centipoises)	Relative Humidity Range (percent)
No. 50 Mineral Oil	28-70	20-92
Corn Oil	50-57	20-91
Coconut Oil	48-52	20-99
Neatsfoot Oil	61-70	20-91
Sperm Oil	41-50	20-99
Methyl Stearate	22-38	20-90
Butyl Stearate	22-57	20-99
Isopropyl Palmitate	21-70	20-94
Isopropyl Myristate	16-67	20-95
Isocetyl Stearate	44-54	20-97
Dioctyl Sebacate	30-43	20-99
Tripelargonate of Trimethylolpropane	42-50	20-93
Tetrapelargonate of Pentaerythritol	53-60	20-99

Example V

This example illustrates the use of various types of nonionic emulsifiers used in the practice of this invention. This example is the same as Example IV except that the same lubricant, isocetyl stearate, is used in all the compositions and the nonionic emulsifier differs with each composition. The same procedure is used and the results obtained are analogous. As in Example IV, two parts by weight of lubricant and 1 part each by weight of nonionic emulsifier and sodium di(2-ethylhexyl) sulfosuccinate are used in preparing the compositions. The emulsifiers used and the results obtained are given in Table II. Notations such as "Stearyl Alcohol/10 EO" refer to the condensation product obtained by condensing stearyl alcohol with 10 mols of ethylene oxide.

TABLE II

Emulsifier	Viscosity Range of Composition (centipoises)	Relative Humidity Range (percent)
Stearyl Alcohol/10 EO	63-100	20-95
Lauryl Alcohol/4 EO	37-45	20-99
Sorbitan Monolaurate	73-105	20-99
Sorbitan Monoleate/5 EO	49-102	20-99
Nonyl Phenol/6 EO	74-110	20-86
Monolaurate of Polyethylene Glycol of Mol. Wt. 400	46-91	20-86
Oleyl Amide/5 EO	50-226	20-89

Example VI

This example illustrates the use of sulfosuccinates other than sodium di(2-ethylhexyl) sulfosuccinate.

A self-emulsifiable textile lubricating composition is prepared by adding 1 part by weight of sodium diamyl sulfosuccinate and 1 part by weight of the product obtained by condensing 1 mol of stearyl alcohol with 3 mols of ethylene oxide to 2 parts by weight of isocetyl stearate. The composition has a viscosity of 55 to 100 centipoises over the relative humidity range of 20 to 99 percent, measured at 35° C.

Replacing the sodium diamyl sulfosuccinate with an equal weight of sodium di(tridecyl) sulfosuccinate gives a composition having a viscosity of 50 to 105 centipoises over the relative humidity range of 20 to 99 percent, measured at 35° C.

The compositions described above give stable emulsions when stirred into water, e.g., by adding 1 part by weight to 9 parts by weight of water.

Example VII

A self-emulsifiable textile lubricant is prepared by blending together 35 parts by weight of isocetyl stearate, 23 parts by weight of butyl stearate, 30 parts by weight of sodium di(2-ethylhexyl) sulfosuccinate, 10 parts by weight of the product obtained by condensing 3 mols of ethylene oxide with 1 mol of stearyl alcohol, 1 part by weight of 2,2'-thio-bis-(4,6-dichlorophenol) and 1 part by weight of didecylpentaerythritol diphosphite. The composition has a constant relative viscosity of 60 centipoises at 35° C. over the range of 20 to 100 percent relative humidity. The composition emulsifies when stirred into water and forms a stable emulsion. When applied to polyester staple, the finish reduces deposits, results in lower drafting forces, and causes less roll wrapping when used under high humidity conditions.

Example VIII

This example illustrates, for comparative purposes, the viscosity behavior of a commercial self-emulsifiable textile lubricating composition with respect to changes in relative humidity.

The composition contains, as essential ingredients, in parts by weight, 36 parts of No. 50 white oil, 19 parts of a mixture of mono- and dioleoyl acid orthophosphates, 15 parts of butyl stearate, 15 parts of the product obtained by condensing 1 mol of lauryl alcohol with 4 mols of ethylene oxide, 8.3 parts of diethanol amine, and 4.7 parts of palmitic acid. The composition has a viscosity ranging from about 100 centipoises at 20 percent relative humidity to over 5,000 centipoises at 90 percent relative humidity as measured at 35° C. Such a viscosity variation can only lead to undesirable variations in running tensions.

While the foregoing invention has been described and illustrated with respect to specific materials and detail, it will be appreciated that changes can be made without departing from its scope.

What is claimed is:

1. A self-emulsifiable yarn-lubricating composition consisting essentially of at least 40% by weight of isocetyl stearate, about 10 to 30% by weight of a sodium di-(2-ethylhexyl) sulfosuccinate and at least 20% by weight of a nonionic emulsifying agent selected from the group consisting of glyceryl oleate, the condensation product of one mol of stearyl alcohol with 3 mols of ethylene oxide, the condensation product of 30 mols of ethylene oxide with 1 mol of sorbitol trioleate-laurate and mixtures of said nonionic agents.

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252-8.6, 8.75, 8.9; 117-139.5