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TEXTILE FINISH

William F. Bernholz, Wayne, Roop C. Nahta, Parsippany, and John P. Redston, Montclair, N.J., assignors to PVO International Inc., San Francisco, Calif.

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U.S. Cl. 252—8.8 8 Claims

ABSTRACT OF THE DISCLOSURE

Textile lubricating compositions for polyester, nylon and other fibers which contain a fatty-triglyceride, an alkylene oxide adduct of a diglyceride and an alkanolamide which may be alkoxylated.

This invention relates to a new composition of matter and articles produced therewith. More particularly, this invention concerns textile-lubricating compositions suitable for use in producing a synthetic, continuous-filament, false-twist, textured yarn as well as other yarns.

In the commercial production of synthetic, continuous filament yarns, it is common practice to apply to the filaments lubricating compositions to reduce the tendency towards breakage of the individual filaments when they are subjected to various mechanical strains. These textile-treating compositions are referred to as finishes and since the finish is commonly applied during the spinning step, they are frequently referred to as spin finishes. Such finishes serve to lubricate the yarn during the manufacturing process and in subsequent handling operations.

A common method of producing bulky yarns is the so-called false-twist process. The essential elements in producing bulky yarns via false twist consists of a yarn supply, a heating element to set twist in the yarn, a false-twist spindle, and a windup. Lubricants employed on yarns manufactured by the false-twist process, which are to remain for use during subsequent texturing, must be relatively stable and serve their lubrication functions at both room temperature and high temperature.

Texturizing of yarns and the application of a false-twist to thermoplastic yarn is well known in the art. Reference is made to the publications Textile World, July 1968 at page 101, and America's Textile Reporter, Apr. 9, 1970 at page 16 et seq.

Finishes are applied to facilitate drawing or attenuation of the polymer—a process similar to the attenuation or drawing that takes place in the spinning of natural fibers such as cotton or wool.

The primary function of a finish is to provide surface lubricity to the yarn such that smooth high speed transfer over various metallic guides during weaving and knitting operations can take place with a minimum of fibre breakage.

Finishes also bring about fibre to fibre cohesiveness which is necessary to maintain uniform diameter and uniform twist configuration in the continuous multifilament yarn system and winding.

A lack of cohesion can cause either irregularity in drawing and twisting due to static or breakage through abrasion of individual filaments.

Most synthetic fibres, due to their hydrophobic nature, are static prone that is, they demonstrate a marked tendency to retain electrostatic charges. During the processing of the yarn, high speed operations accelerate generation and retention of electrostatic charge. Without static protection of yarn, several problems may occur thereto such as "ballooning" or yarn due to "like charge" replusion between individual filaments, dimensional distortion, clinging of fibre to metal and tactile shock upon contact with processing equipment. To ameliorate such problems, incorporation of a static suppressant in the finish composition is considered desirable.

Conventional spin finishes tend to have low viscosity in order to obtain the lowest possible yarn tensions. If the viscosity is too low the lubricant will thin out to such a degree that it is not present on the fibre in sufficient quantity to act as a lubricating buffer between the raw fibre and the metal. Also, these low viscosity lubricants may volatilize during high temperature processing. Thermal deterioration of the lubricating system is often followed by broken filaments and losses of yarn strength.

Furthermore, the formation of highly objectionable fumes and condensates can give rise to serious health and environmental pollution problems.

It is a primary object of the present invention to provide a textile lubricating composition suitable for application to yarn processed at both room temperature and high temperature.

It is an object of this invention to provide a textile finish suitable for satisfactory high-temperature processing of synthetic continuous-filament yarns.

It is a further object of the invention to provide a yarn lubricated with the novel lubricant, which can be used in the production of highly uniform, false-twist textured yarn.

It is a further object to provide a composition for the lubrication of yarns at elevated temperatures without adversely affecting yarn performance or the properties of the yarn.

It is still a further object of this invention to provide a textile finish that is suitable for satisfactory high temperatures processing of synthetic continuous filament yarns.

Yet another object is to provide a yarn lubricated with a novel lubricant which yarn can be used in the production of uniformly false twisted textured yarn.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the product possessing the features, properties and the relation of components which are exemplified in the following detailed disclosure, and the scope of which will be indicated in the appended claims.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description.

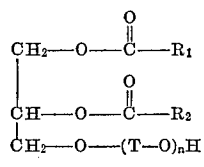
The invention in its broadest sense comprises a three (3) part composition comprising by weight (A) 40 to 80 parts of an unsaturated triglyceride having an iodine value in the range of 1 to 90 (B) 20 to 50 parts of alkylene oxide mono-adducts of di-glycerides, and (C) 5 to 30 parts of the optionally alkoxylated, reaction product of at least one hydroxyalkylamine and one triglyceride, namely an alkylolamide.

This composition is dispersed in water to form an aqueous emulsion, which is then applied to textile yarns whereby there is obtained a treated yarn having outstanding high-temperature processing properties.

More particularly, component (A) comprises the triglycerides formed from the reaction of glycerine with unsaturated fatty acids. These fatty acids may be utilized in the form of the free acid, or mixtures thereof, as for instance in vegetable oils, or as the transesterified vegetable oils. For brevity, the term "fatty acid" will be utilized to signify all of the above. The unsaturated acids utilized in the formation of component (A) should be of low iodine value, within the range of 1 to 90. While satisfactory results are obtained from unsaturated fatty acids containing from as low as 6 carbon atoms to as high as 24 carbon atoms, superior results are obtained from fatty acids containing from 12 to 18 carbon atoms. Vegetable oils that are rich in fatty acids of the preferred range include coconut, cohune, ouricuri, and palm-kernel among others. Transesterification products of these and other vegetable oils are well known in the art, as are the methods of preparing same. Such transesterified oils may be utilized to react with the glycerine provided that the oil is of high thermal stability, that is, an oil that will not break down at temperatures below 400° F.

Component (B) comprises one or more lower alkylene oxide mono-adducts of a diglyceride. Utilizable diglycerides which can be alkoxylated include those prepared from the glycerolysis of any one or more saturated or unsaturated fatty acids containing from about 6 to about 22 carbon atoms such as tall oil fatty acids. Typically these diglycerides are obtainable from coconut oil, tallow, and soybean oil. Other diglycerides utilizable are those derived from triglycerides which have been rearranged with a glycol such as ethylene or propylene glycol.

These mono-adducts, (B), are of the formula:



wherein T is an alkylene group of from 2 to 4 carbon atoms, R_1 and R_2 are the same or different alkyl groups of from 8 to 22 carbon atoms, and n is an integer of from about 10 to about 60.

Component (C) comprises either the monoaddition reaction product of the alkoxylated monoaddition reaction product of one or more mono-, di-, or tri-primary, secondary or tertiary hydroxyalkyl amines with 1 or more C_6 to C_{22} fatty acid triglycerides. It is seen that these amines contain reactable hydroxyl and reactable amine functions. Since the amine addition is the preferential reaction of the two, and is the desired one here, the amine to hydroxyl group ratio should be 1:1 or greater in favor of the hydroxyl. Furthermore, it is seen that the amine addition can take place at one or more sites on the triglyceride. While the mono-adduct is preferred, due to lower costs, it is not necessary to isolate the mono-adduct from the di and tri addition products. The hydroxyalkyl portion of the amine contains from 2 to 6 carbon atoms, though no reason is seen why higher carbon atom content alkyl portions are not similarly suitable. Among the triglycerides utilizable in the preparation of component (C), mention may be made of coconut, palm-kernel, soybean, and hydrogenated soybean oils. Among the suitable hydroxyalkylamines utilizable herein, mention may be made of monoethanolamine, diethanolamine, and hydroxyethyl ethylene diamine among others.

Components (B) and (C) are obtainable in either a solid or liquid form, as determined by the molecular weight of the material. The lubricating characteristics of component (B) materially increase with the lengthening of the carbon chain of the fatty acid component of the triglyceride. The volatility decreases, i.e., smoke flash and fire points increase, in the same manner. Compounds designated component (C) similarly, are less subject to thermal degradation as the molecular weight of the fatty acid portion of the triglyceride increases, but not to as great an extent as the compounds utilized as (B) components. It is also known that the lower ratio of nitrogen content to the total molecular weight of the (C) component, the greater the lubricating characteristic of the (C) component. It is within the skill of the art to optimize for yarn processing, the choice of both (B) and (C) components for these novel fibre finish compositions.

The key component (A), has been chosen specifically for high temperature processing of the yarn. In addition to providing good lubricating properties over a great range of temperature conditions, these compounds have high smoke points over 350° F. and are stable at elevated temperatures.

Components (B) and (C) are utilized both to emulsify the lubricant and to contribute antistatic properties to the composition. As can be seen, both of these components are nonionic in nature. They were particularly chosen to overcome the shortcomings of those of prior art which suffer from poor thermal stability, and conference of excessive crimp shrinkage upon the yarn.

In preparing the aqueous emulsion, the lubricant (A) and the emulsifiers, (B) and (C) are melt-blended and the blend slowly poured into preferably heated water. These components can of course be blended in any order of addition. The resulting emulsion is highly stable and thus maintains a high degree of uniformity over extended periods of use. The concentration, by weight, of the non-aqueous constituents, i.e., solids, may vary from about 1 percent to about 30 percent but is preferably about 4 to about 10 percent since such concentrations will permit application of the desired amount of solids on the yarn in the most effective manner. The emulsion is applied to yarn preferably by using a roller, and about 0.1 percent to 8 percent by weight of the solids based on the weight of the resulting yarn is applied.

The lubricating compositions of this invention are adapted for use on yarns of polyamides such as polyhexamethyleneadipamide (66 nylon), polycaproamide (6 nylon) or other well known nylons. They can also be utilized on polyesters, such as polyethylene glycol terephthalate, and polyethylene glycol isophthalate, as well as on polypropylene yarns.

For purposes of the present invention, the yarns are made in accordance with present commercial practice and in the usual range of deniers for textile applications.

Lubricating properties partly depend on viscosity, which is highly temperature dependent generally. As is known, textile lubricating compositions cannot have a high viscosity at room temperature because of the increased friction which would result from their use. However, conventional low viscosity finishes have their drawbacks as indicated previously. On the other hand, for false twist texturizing the lubricant must have high enough friction at elevated temperatures to provide frictional contact between the yarn and twist trap to minimize twist slippage. It has been discovered, surprisingly, that the compositions of this invention which have high viscosity or solid character at room temperature result in an unexpectedly low friction at room temperature and additionally they remain relatively unchanged, and at a satisfactory level at high temperature. Further, the relatively constant tension provided by these compositions also provides a highly uniform, false twist textured yarn.

Because of the high density of the yarn in the bulking chamber and the high temperature to which the chamber is heated, the role of the yarn lubricating composition is especially critical. The composition must lubricate the yarn so that it moves smoothly and uniformly as it is being compacted and forced through the heating chamber. Heat must be transmitted from the walls of the chamber to the center of the compacted yarn core in a uniform manner so that bulk potential and dyeing uni-

formity will not be impaired. Also, the compositions must be stable to the high temperatures of the heated crimping chamber and not cause obnoxious fumes or yarn-damaging thermal decomposition products. Further, the compositions should not be susceptible to temperature induced interactions in the heated chamber that result in unacceptable losses of yarn strength. The compositions of this invention are seen to possess all of these desired characteristics of a good textile lubricant, which is not the case for compositions of the prior art. For example certain textile lubricants of the prior art may have good lubricating properties, but give rise to objectionable condensates which can be a health hazard.

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 weight of the material being treated.

The compositions of this invention may be applied as a primary finish to yarn in the manner described above, and they may also be applied to a yarn which has previously been coated with a finish, i.e., used as a secondary, or overlay, finish. With respect to the previously applied finish, the amount of overlay finish should constitute about 20 to about 50 percent, by weight of the total amount applied. Application at these levels will be sufficient to provide the lubricating properties required for high temperature processing and will minimize or eliminate the propensity of the primary finish to create undesirable fumes or condensates. In general, the higher amounts will be applied to low-denier-per-filament yarns, i.e., yarns having a d.p.f. of about 1 to 3. Low-denier-per-filament yarns are highly sensitive to tension levels and irreparable consequences can result when such yarns are stripped of their protective lubricating coating by the degradative action of heat. For most textile uses wherein the yarn is exposed to high temperatures, i.e., temperatures of 150° to 300° C. and more, the total amount of finish should not normally exceed about 1 to 1.5 percent based on the weight of the resulting yarn.

In keeping with conventional practice, minor amounts of additives such as, for example, bactericides, tinting agents, anti-oxidants, buffering agents and the like may be included as desired.

Antistatic agents may also be incorporated in these novel compositions. When added, they allow the processing of the yarn to be carried out in environments that possess both high and low humidity. In view of the high temperatures utilized in the fibre processing, these additives must be thermally stable. For this reason, the nonionic agents are preferred as they tend to remain more stable at high temperatures than do most ionic anti-static agents.

The following specific examples illustrate the preparation of typical compositions of this invention, wherein all parts are by weight unless indicated to the contrary.

EXAMPLE I

Forty-five (45) parts of coconut oil (component A) were mixed under medium shear with fifty (50) parts of (B) tallow, which had been ethoxylated, following rearrangement, with forthy-three (43%) percent by weight of ethylene oxide. To this mixture was added five (5) parts of the sixty-two (62%) percent ethoxylated monoethanolamide of coconut oil fatty acid. These ingredients were thoroughly blended under mild heat and added to nine hundred (900) parts of water, at one hundred twenty (120°) degrees F. An emulsion was formed which was ready for application to fibre.

The compositions of Examples II, III, and IV, were prepared utilizing substantially similar techniques.

	Formulations		
	II	III	IV
Coconut oil triglyceride (lubricant)	60	50	55
Tallow diglyceride, 43% by weight ethoxylated		20	25
Tallow diglyceride, 70% by weight ethoxylated	20		10
Coconut diglyceride, 64% by weight ethoxylated		20	
Tallow monoethanolamide reacted with 12 moles ETO	15		
Diethanolamide of coconut oil		10	10
Decaglycerol tetraoleate [1]	5		
Total, percent	100	100	100
Chemical properties:			
Free fatty acid	1.5	1.3	1.3
Saponification value	210	185	187
Iodine value	13	18	20
Hydroxyl value	77	85	70

[1] The decaglycerol tetraoleate is an emulsification adjunct or secondary mulsifier.

The decaglycerol tetraoleate is an emulsification adjunct or secondary emulsifier.

The following examples which are illustrative only and are not intended to be limiting, illustrate the utilization of typical compositions of this invention.

EXAMPLE V

A three component fiber finish was prepared as follows:

A rearranged triglyceride made from 60% by weight triolein, 33% by weight coconut oil, and 7% by weight hydrogenated soybean oil, as component (A).

Tallow diglyceride, 43% by weight ethoxylated and coconut diglyceride, 64% by weight ethoxylated, each comprise half the weight of component (B).

Coconut oil diethanolamide (1 mole of oil reacted with 1 mole of diethanolamine) as component (C).

50 parts component (A) 40 parts of component (B), and 100 parts of component (C) were mixed together under medium shear.

These materials, after blending, were added to 900 parts of water to form an oil/water emulsion, as in Example I, at 120° F.

The fibre lubricating composition so obtained was applied to polyethylene terephthalate yarn by means of a transfer roll having tangential contact with the lubricating composition along the length of the roll. Yarn passage over the roll thus deposited finish on the fibre to a weight of 0.5% finish, exclusive of water, upon the fibre.

The treated yarn was now ready for false-twist texturizing by commercially available equipment such as the (Leesona Corp. "Superloft" Model 553).

EXAMPLE VI

A four component fibre finish was prepared as follows:

60 parts of decaglycerol decaoleate was component (A).

20 parts of tallow diglyceride, 70% by weight ethoxylated was component (B).

15 parts of tallow monoethanolamide, ethoxylated with 15 moles of ethylene oxide, comprised component (C).

5 parts of decaglycerol tetraoleate was included in the composition to serve as an emulsification adjunct.

These materials were blended as in Example I, and then added to 900 parts of water.

The fibre lubricating composition was applied to polyethylene terephthalate yarn by means of a hypodermic syringe. Lubricant expulsion from syringe to yarn at a uniform rate was controlled by the speed of a gear-actuated device which exerted pressure upon the plunger of the syringe. Such apparatus is exemplified by the so-called "Braun Applicator" (B. Braun apparatebau, Melsungen, German Federal Republic).

The finish so applied was 0.3% by weight on fibre exclusive of the water used in dispersing the finish. The fibre so treated was now ready for false-twist texturizing by commercially available equipment.

EXAMPLE VII

A three component fibre finish was prepared as follows:

55 parts hydrogenated tallow as component (A).

25 parts of tallow diglyceride, 43% ethoxylated and 10 parts tallow diglyceride, 70% ethoxylated comprised the 35 parts of component (B).

10 parts of the 1:1 diethanolamide of coconut oil as component (C).

These materials were blended as in Example I, then were added to 900 parts of water to give a 10 percent emulsion.

The fibre lubricating composition was applied by spraying upon polyethylene terephthalate yarn as it passed through a longitudinal chamber having spray nozzles arranged radially along the path of the fibre traverse. The discharge rate of lubricating composition effected a finish deposit, exclusive of the water, of about 0.3% on weight of fibre.

The fibre was now ready for false-twist texturizing by any one of the known methods after this successful application of fibre lubricant.

The compositions of Examples V, VI, and VII were applied to nylon 66, in substantially the same amounts by the methods recited therein. All applications were judged successful, and the fibre was judged ready for false-twist texturizing.

The beneficial attributes of the compositions of this invention are many in number and some of these have been recited. In addition, minimal shrinkage of the fibres treated with these high smoke point compositions is achieved, as well as excellent lubricity at both high and low temperatures, not only at the heat setting stage but also during the spinning stage.

These compositions are non-deleterious to polyurethane or other plastics utilized in the rollers, belts and other parts of the conveying apparatuses utilized in conjunction with the manufacture of the finished fibres. Less than ten percent (10%) swelling of the urethane surfaces takes place after continuous contact with the finishes of this invention.

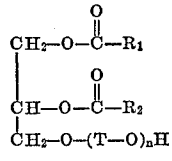
Since certain changes may be made in the above compositions without departing from the scope of the invention herein involved, it is intended that all matter contained in the above description shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A non-ionic fibre finish for application to textile yarns which are to be subjected to false-twisting, consisting essentially of by weight:

(A) from about 50 to about 80 parts of the triglycerides of one or more unsaturated fatty acids having from 6 to 24 carbon atoms and said triglycerides having an iodine number of from 1 to about 90,

(B) from about 20 to 50 parts of a lower alkylene oxide mono-adduct of a compound of the formula:



wherein T is an alkylene group of from 2 to 4 carbon atoms and R_1 and R_2 are the same or different alkyl groups of from 8 to 22 carbon atoms, and n is an integer of from about 10 to about 60; and

(C) from about 5 to about 30 parts of a compound selected from the group consisting of an amide-reaction product of (1) a mono- or di-hydroxy alkyl amine having from 2 to 6 carbon atoms in the hydroxy alkyl portion thereof and (2) one or more triglycerides of unsaturated fatty acids having from 6 to 22 carbon atoms in the fatty acid portion thereof, said amide being oxyethylated with from 12 to 15 moles of ethylene oxide.

2. A non-ionic fibre finish as set forth in claim 1 wherein said component (A) is taken from the class consisting of the triglycerides of triolein, coconut oil, hydrogenated soybean oil and hydrogenated tallow.

3. A non-ionic fibre finish as set forth in claim 1 wherein said component B is taken from the class consisting of ethoxylated hydrogenated tallow diglyceride, ethoxylated coconut diglyceride and ethoxylated tallow diglyceride.

4. A non-ionic fibre finish as set forth in claim 2 wherein said component B is taken from the class consisting of ethoxylated hydrogenated tallow diglyceride, ethoxylated coconut diglyceride and ethoxylated tallow diglyceride.

5. A non-ionic fibre finish as set forth in claim 1 wherein component (C)(2) is taken from the class consisting of coconut oil, palm kernel oil, soybean oil, hydrogenated soybean oil and combinations thereof.

6. A non-ionic fibre finish as set forth in claim 2 wherein component (C)(2) is taken from the class consisting of coconut oil, palm kernel oil, soybean oil, hydrogenated soybean oil and combinations thereof.

7. A non-ionic fibre finish as set forth in claim 2 wherein component (C)(2) is taken from the class consisting of coconut oil, palm kernel oil, soybean oil, hydrogenated soybean oil and combinations thereof.

8. A non-ionic fibre finish as set forth in claim 4 wherein component (C)(2) is taken from the class consisting of coconut oil, palm kernel oil, soybean oil, hydrogenated soybean oil and combinations thereof.

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HERBERT B. GUYNN, Primary Examiner

U.S. Cl. X.R.

117—139.5 F; 252—8.9

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,785,973 Dated January 15, 1974

Inventor(s) William F. Bernholz, Roop C. Nahta, John P. Redston

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 3, "'ballooning' or yarn" should read --"ballooning" of yarn--.

Column 3, line 47, "product of" should read --product or--.

Column 4, lines 22-23, "conference" should read --conferences--.

Column 4, line 41, "66 nylon" should read --6-6 nylon--.

Column 6, line 16, "mulsifier" should read --emulsifier--.

Column 6, lines 18-19, delete this two-line paragraph as it is a repetition of the footnote of lines 15-16.

Column 8, line 34, "claim 2" should read --claim 3--.

Signed and sealed this 30th day of July 1974.

(SEAL)
Attest:

McCOY M. GIBSON, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

FORM PO-1050 (10-69)

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