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COATED TEXTILE YARN

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ABSTRACT OF THE DISCLOSURE

A rubber-like textile yarn having a coating of a primary branched chain saturated liquid alcohol such as 2-butyl-1-hexanol, or esters of such alcohols with fatty acids such as hexadecyl stearate. These coatings act as lubricants for the rubber-like yarns without adversely affecting the yarn.

Cross-reference to related application

This application is a continuation-in-part of copending application Ser. No. 277,457, filed May 2, 1963, now abandoned.

Background of the invention

This invention relates to a new and novel class of rubber-like textile yarns and fibers. In particular, it relates to new and improved rubber stretch yarns and fibers or yarns containing such rubber components having a protective coating thereon.

Coning oils are used in the textile industry in processes for lubrication of yarns and fibers to assure, inter alia, free delivery of the yarn or fiber without plucks and jerks to the knitting device. There are many necessary attributes possessed by a good coning oil, namely, it should be stable, essentially odorless, non-staining, and it should possess good properties of scourability and the like.

To enhance knitting, warping, braiding operations and the like a good coning oil must above all, however, be a good lubricant. This means that the viscosity of the oil should remain substantially constant throughout the range of temperature changes occurring under operating conditions. Where the oil is lacking in such property the pickup of oil by the yarn or fiber as it is passed in contact with the oil varies. Thus, as the viscosity increases, the yarn or fiber tends to pick up a greater amount of oil; and conversely, as the viscosity lessens, less oil is generally picked up by a yarn or fiber in contact with the oil. This change in viscosity then causes the amount of friction to vary, thus producing variation in the delivery of the yarn or fiber to the process, and it also creates nonuniformity in the physical characteristics of the lubricated yarn or fiber itself. Perhaps the most disadvantageous quality caused by a poor lubricant, however, is the variation in friction, whether thread-to-thread friction or thread-to-metal friction. The problems caused by high friction, whether static or dynamic, are well known and a great amount of elaboration is unnecessary. It will suffice to say, however, that high friction adversely affects the quality and uniformity of the fabric produced and produces considerable wearing of machine parts.

Few oils, if any, possess all of the advantages required of an ideal coning oil and for this reason coning oils are often blends and mixtures of oils. Mineral oil, in particular, is often added as a component in such oils to lessen changes in viscosity.

Recent technology would demand yet another and vitally important requirement of coning oils. For example, fairly recent types of yarns contain rubber or rubber-

like yarns and fibers. These materials comprise the so-called stretch fabrics or spandex yarns, e.g., Hiflex 95 (Goodrich) and Lycra (Du Pont). Coning oils, generally in even larger amounts than formerly, must also be used in the processing of these yarns and fibers but, unfortunately, present coning oils adversely affect the rubber by causing it to swell, and in some cases even visibly causing it to shrink or shrivel. Such action by these oils not only immediately seriously impairs the normal elastic stretch properties of the rubber but also greatly reduces its durability. In fact, over even a relatively short period of time the rubber is degraded to such extent that its normal properties of elasticity are essentially destroyed. Mineral oil, an important blending component of many coning oils, for example, adversely affects rubber in this regard. Butyl stearate and butyl oleate, both commercially acceptable coning oils, soften rubber. In fact, presently used coning oils in general leave much to be desired insofar as the lubricating properties of the oil are concerned, and they are acutely lacking as lubricants for continuous filament elastic yarns.

Summary of the invention

Accordingly, it is an object to obviate the deficiency regarding the need of textile coning oils or oils for use in the processing of yarns and fibers containing rubber and rubber-like components. More particularly, it is an object to provide new and improved coated textile yarns and fibers to more uniformly reduce friction during processing.

These and other objects are achieved in accordance with the present invention by providing a rubber-like textile yarn having a coating thereon comprising a primary branched chain saturated liquid alcohol containing from about 10 to 18 carbon atoms in the total molecule, or a liquid ester produced by the reaction of said alcohol and a fatty acid.

Description of the preferred embodiments

The alcohols useful in this invention are further characterized by having a freezing point less than about -25° C. Preferably the alcohol is one having alkyl radicals in the molecule which contain at least about 4 carbon atoms. Such compounds, quite unexpectedly, are found to show especially good lubricating properties within the range of temperatures at which coning oils are normally used—viz. at from about 5° C. to about 32° C., and higher. Moreover, these compounds as sharply contrasted with the normally used coning oils of commerce do not significantly adversely affect rubber or rubber-like materials as by causing them to swell or shrink. Exemplary of such alcohols are 2-butyl-1-hexanol, 2-butyl-1-octanol, 2-hexyl-1-octanol, 2-butyl-1-decanol, 2-hexyl-1-decanol and 2-octyl-1-decanol.

An outstanding alcohol for use in a process utilizing a coning oil is hexadecyl alcohol, and it is readily available and particularly effective from a cost standpoint. This compound is sold by Enjay Chemical Co. under the trade name Hexadecyl Alcohol and is believed to consist essentially of 2-octyl-1-octanol. Furthermore, however, this alcohol is found to have excellent textile lubricating properties in many ways far superior to the normally used coning oils.

An even superior coning oil for use in such process is one, or a mixture of esters resulting from the reaction of the above described alcohols with fatty acids containing generally from about 8 to about 18 carbon atoms in the molecule. Examples of such acids include saturated acids as caprylic acid, capric acid, lauric acid, myristic acid, palmitic acid, stearic acid and the like, and such unsaturated acids as caproic acid, lauroic acid, myristoleic

acid, palmitoleic acid, oleic acid and the like. The reaction products obtained by reaction between the alcohol and saturated fatty acids, particularly those containing from about 12 to about 18 carbon atoms, provide particularly effective coning oils.

Outstanding esters for use in accordance with this invention are those produced by reaction between Hexadecyl Alcohol and stearic acid or lauric acid. These esters, namely, hexadecyl stearate and hexadecyl laurate, are excellent textile lubricants and do not significantly adversely affect rubber-like yarns brought into contact therewith under the normal conditions of operations.

The rubber-like yarns utilized in this invention include those yarns and fibers prepared from natural rubber as well as the various types of synthetic rubber including synthetic segmented elastomeric polymers and copolymers having rubber-like properties. Rubber-like yarns and fibers are those yarns and fibers which exhibit the properties of rubber such as stretching, elastic recovery and low stress decay. Generally, these yarns and fibers will display elongations at the break in excess of 150%, elastic recovery above about 90% and stress decay below about 20%. The terms "elastic recovery" and "stress decay" are well known in the art.

The preferred types of rubber-like yarns and fibers utilized in this invention are the synthetic segmented elastomeric copolymers consisting of segments of high-melting crystalline polymers alternating with segments of low-melting, amorphous polymers. The crystalline high-melting segment may be derived from, for example, polyurethanes, polyamides and polyesters. Examples of low-melting amorphous segments include polyesters and polyethers. Polymers of the spandex type are illustrative of such segmented copolymers.

Under the Textile Fizer Products Identification Act, the generic name of "spandex" fibers designates elastomeric fibers in which the fiber-forming substance is a long-chain polymer consisting of at least 85% segmented polyurethane. A discussion of "spandex" fibers including details as to their preparation, structure, properties and applications is found in *High Polymers*, pages 694-713, Volume XVI, Part II, J. H. Saunders and K. C. Frisch, Interscience Publishers, New York, 1964. As noted therein, the chemical composition of spandex fibers will vary depending upon the nature of the segments in the polymer. However, all spandex fibers contain urethane groups but also may have other functional groups such as urea, dihydrazide amide and sulfonamide. Examples of commercially available rubber-like yarns of the spandex type include Lycra (Du Pont), Vyrene (U.S. Rubber Co.) and polythane (Polythane Corp.).

The coating is generally applied to a continuous yarn, filament or strand of fiber by continuously and substantially uniformly drawing the yarn, filament, or strand through a liquid body or over an applicator means such as a brush or roller in contact with such liquid body, so that it is wetted by the alcohol or ester. In general, such fiber or filament will pick up from about 0.5 up to about 6% preferably from about 2 to about 4%, based on the weight of the yarn, of the alcohol or ester which is absorbed upon the textile material. The amount of the alcohol absorbed, however, is directly related to the ambient temperature and, inter alia, the precise nature and denier of the synthetic fiber drawn therethrough. An outstanding feature of the invention is that the amount of liquid absorbed upon the material per any given unit lengths is relatively constant.

The following examples will serve to illustrate the mode of practicing the invention, but should not be construed as in any manner limiting or restrictive of the invention.

Example I

A rubberized nylon elastic yarn is continuously wetted, at a temperature of 70° F., by passage against a roller in contact with a body of Enjay Chemical Co.'s Hexadecyl

Alcohol contained within a vessel. The yarn is passed continuously through the liquid at a rate of 200 yards per minute and is thereafter fed upon the knitting device. It is found that the yarn moves smoothly and easily, under a tension of 10 grams.

It is found that the yarn is wetted smoothly and uniformly. In other words, the pickup of the alcohol by the yarn is uniform, about 4.0% of the alcohol being absorbed by the nylon yarn.

Socks woven and then treated by scouring, dyeing, etc. in conventional manner are normal in all respects. It is found, however, that the rubber of the fabric is essentially unaffected in the processing.

To more sharply demonstrate the unique quality of the Hexadecyl Alcohol in not attacking the rubber of the yarn comparative data is given in the following example.

Example II

Ten inch length segments of the yarn of the foregoing example are carefully weighed and then completely immersed in Hexadecyl Alcohol on the one hand and, on the other, in butyl stearate, a well known and highly successful commercially used coning oil.

These lengths of yarn are left therein, at room temperature, for 48 hours. At the end of this time the segments of yarn are measured and compared. It is found that the amount of swell is 1300 percent higher for those segments of yarn immersed in the butyl stearate, as contrasted with those immersed in Hexadecyl Alcohol. The amount of swell for the yarn immersed in the Hexadecyl Alcohol is, in fact, far less than would be expected for any known commercial coning oil.

In fact, rubber-containing fabrics from the knitting device wherein Hexadecyl Alcohol is used as a coning oil have been left for four or five weeks without scouring but yet the rubber properties of the material were not significantly adversely affected.

Example III

To a glass lined reaction vessel fitted with thermometer means, stirring means and condenser fitted at its lower portion with a water trap, is charged 266.2 parts of Hexadecyl Alcohol and 237.8 parts of Industrene 330 (commercial stearic acid; containing a mixture of fatty acids ranging from C₈ to about C₂₀). Next are added 2.5 parts of paratoluene sulfonic acid and 90 parts of toluene as solvent. Reaction is initiated and over a period of two hours, the duration of the reaction, the temperature is raised gradually to 160° C.

From the reaction mass is recovered a crude sample of hexadecyl stearate. The hexadecyl stearate is washed with water, separated in a separatory vessel, and a portion of the hexadecyl stearate is then vacuum stripped to remove essentially all traces of water and other volatile impurities.

Essentially pure hexadecyl stearate is then used as in Example I. The filament is found to pass through the liquid to the knitting device freely and easily without plucks or jerks, requiring only 4 grams of tension to effect delivery of the yarn to the knitting device.

The textile lubricating properties of hexadecyl stearate are found as good as and even superior to, the butyl stearate.

In runs wherein yarns are compared by immersion in hexadecyl stearate and thence in butyl stearate, as in Example II, it is found that rubber yarn is far more susceptible to attack by the butyl stearate than by hexadecyl stearate. There is only a slight swelling of the rubberized yarn by hexadecyl stearate.

Example IV

A segmented polyurethane yarn (Lycra) is coated with Hexadecyl Alcohol as in Example I resulting in a pickup of about 4.5% of alcohol on the yarn. This coated yarn exhibits no significant adverse effects such as swelling or discoloration when allowed to stand for several weeks.

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Substantially similar results are obtained when other types of spandex yarns are coated with the alcohols and esters of this invention.

The coated rubber-like textile yarns of this invention are useful in a wide variety of products. The coated yarns find particular utility in preparing foundation garments, girdles, corsets, or surgical hosiery, swim wear and socks. The coated yarns of this invention may be employed in the above mentioned applications in the form of either continuous filaments or as blends of staple fibers depending on the particular utility.

The alcohols and stearates utilized in this invention are not only good textile lubricants but also serve as a treating agent for blooming out the fiber.

Having described the invention, what is claimed is:

1. A rubber-like textile yarn having a coating thereon consisting essentially of from about 0.5 to about 6% based on the weight of the yarn of a primary branched chain saturated liquid alcohol containing from about 10 to 18 carbon atoms in the total molecule or a liquid ester produced by the reaction of said alcohols and a fatty acid.

2. The rubber-like textile yarn of claim 1 wherein the branched chain is an alkyl radical having at least about 4 carbon atoms and wherein the alcohol has a freezing point less than about -25°C .

3. The textile yarn of claim 1 wherein the coating is 2-octyl-1-octanol.

4. The textile yarn of claim 1 wherein the coating is a liquid ester produced by the reaction of

(a) a primary branched chain saturated liquid alcohol characterized by containing from about 10 to about 18 carbon atoms in total molecule; and

(b) a fatty acid containing from about 8 to about 18 carbon atoms in the molecule.

5. The textile yarn of claim 4 wherein the fatty acid used in the preparation of the ester contains from about 12 to about 18 carbon atoms.

6. The textile yarn of claim 4 wherein the ester is formed by the reaction of 2-octyl-1-octanol and a fatty acid selected from the group consisting of stearic acid and lauric acid.

7. The textile yarn of claim 1 wherein the rubber-like yarn is a spandex yarn.

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