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ART OF PRODUCING FILAMENTARY MATERIALS OF CELLULOSE ESTER

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ABSTRACT OF THE DISCLOSURE

The spinning characteristics of a solvent solution of a cellulose ester, especially a cellulose acetate, are improved by incorporating into the spinning solution from about 0.02 to about 6% by weight of the said ester, of certain epoxidized materials. These epoxidized substances are fatty acids or esters of fatty acids that contain from 6 to about 26 carbon atoms, inclusive, in the fatty chain portion thereof and having, before epoxidation, an iodine value of at least about 80 and from 1 through 4 non-conjugated ethylenic groups and, after epoxidation, containing epoxide groups across the bridges of said ethylenic groups. The epoxidized materials may be natural or synthetic in origin, and they may be derived from animal, marine, vegetable or other origin. Numerous specific examples of such epoxidized substances are given. Epoxidized soybean oil is preferred.

The dry-spinning of the above-described spinning solution, in comparison with that of a corresponding solution containing no such epoxidized material, reduces jet-deposit build-up, permits higher extrusion speeds (e.g., up to about 100% more), reduces filament spraying, lessens filament-denier variation, and provides improved color stability on aging.

This invention relates broadly to the art of producing filamentary materials comprising a cellulose ester. More particularly the invention is concerned with a new and unobvious technique for improving the spinning characteristics of a solvent solution of a cellulose ester, e.g., a cellulose ester such as cellulose acetate dissolved in a low-boiling organic solvent. The scope of the invention includes both composition, article and method features.

It is well known in the art of producing synthetic fibers that, other factors being the same, the higher the extrusion speed of the fiber-forming (fiber-formable) material, the lower is the unit cost. The present invention provides means whereby a solvent solution of a cellulose ester, more particularly a cellulose acetate and specifically a cellulose triacetate (CA_3) containing at least 59% by weight of acetyl groups calculated as acetic acid (combined acetic acid), can be spun into filamentary materials at speeds up to about 100% more than heretobefore has been obtained from a spinning solution which has not been modified in accordance with the present invention but which is otherwise the same.

The instant invention is based on my discovery that the addition of a particular type or kind of additive to a spinning solution comprising a cellulose ester provides the necessary stability and control of jet-deposit build-up so as to obtain an increase in yarn-extrusion speed of from 50 to 100% or more while providing additional unobvious benefits and advantages, e.g., minimizing jet-deposit build-up thereby increasing the life of the jet before removal for cleaning or replacement becomes necessary; greater uniformity in the denier of the individual filaments is obtained (i.e., filament-denier variation is lessened); and the finished yarn retains adequate tensile and other physical characteristics to meet the

requirements for its particular service application, and certain particular properties are actually improved.

Briefly described, the foregoing and other unobvious results are obtained by preparing and utilizing a spinning solution comprising a solvent solution of cellulose ester and, by weight of the said ester, from about 0.02 to about 6%, more particularly from about 0.05 to about 1.5%, of at least one member of the group of epoxidized materials consisting of fatty acids and fatty esters containing from 6 to about 26 carbon atoms, inclusive, in the fatty-chain portion thereof and having, before epoxidation, an iodine value of at least about 80 and from 1 through 4 non-conjugated, ethylenic groups and, after epoxidation, containing epoxide groups across the bridges of said ethylenic groups.

Illustrative examples of materials that can be epoxidized in known manner and used in practicing the instant invention include, for instance, unsaturated glycerides, acids, simple esters and complex esters having an iodine value of at least about 80, containing from 6 through about 26 carbon atoms in the fatty-chain portion thereof, and having from 1 through 4 non-conjugated, ethylenic groups. Such epoxidizable materials may be derived from, for example, animal, marine, petroleum, vegetable or other sources, and they may be of natural or synthetic origin.

More specific examples of epoxidizable vegetable oils are the drying and semi-drying oils among which may be mentioned linseed, perilla, tung, candlenut, safflower, walnut, sunflower, soybean, oiticica, corn, cottonseed and rapeseed oils. More specific examples of epoxidizable marine oils having the required characteristics are pilcher, menhaden, cod, sardine, whale and shark oils. Animal, vegetable and marine oils that are sometimes classified as nondrying oils may be epoxidized and used in practicing the instant invention provided that they possess the minimum iodine value and other characteristics set forth in the preceding paragraph. Examples of such oils are tallow, peanut and sperm oils. Other examples of oils and of fatty acids derived therefrom that have the required properties for epoxidation and subsequent use in this invention are given in Lewkowitsch's "Chemical Technology and Analysis of Oils, Fats and Waxes," Volumes II and III, 6th Ed., published in 1922 by Macmillan and Company, Limited (London), and wherein is also given detailed information with regard to the composition and properties of the aforementioned and other fatty oils and fatty acids derived therefrom that meet the above-described requirements.

Tall oil is illustrative of another oil that constitutes a source of epoxidizable material. This oil is a complex composition containing mixtures of esters of saturated and unsaturated fatty acids having from 6 to about 26 carbon atoms in the fatty-chain portion thereof and with from 1 through 4 non-conjugated, ethylenic groups in the unsaturated fatty acid components.

The preferred epoxidizable material employed is soybean oil. This oil is typical of a class of unsaturated, non-conjugated compounds containing one or more ethylenic groups that can be epoxidized and used in carrying this invention into effect. Soybean oil is representative of the following general types of epoxidizable glycerol esters: glycerol trioleate; glycerol trilinoleate; glycerol monooleate monolinoleate monolinolenate; glycerol monostearate dilinoleate; glycerol monooleate dilinoleate; glycerol monolinoleate dioleate; glycerol monoleate distearate; and glycerol monostearate dioleate.

Glycerol esters constitute a basic source of fatty acids and other esters or products for epoxidation. As the source of the epoxidizable material there may be isolated from such esters and utilized either the unsaturated components

after separation of the saturated components; or, alternatively, the mixture of saturated and unsaturated components can be epoxidized without separation of saturated components. The latter is preferred. The epoxidized material is then used in practicing the instant invention.

Illustrative examples of unsaturated, non-conjugated fatty acids containing one or more ethylenic groups that may be isolated from fatty oils, and the isolated acids then epoxidized and used in carrying this invention into effect, are lauroleic, myristoleic, ricinoleic, linoleic, linolenic, arachidonic, palmitoleic and clupanodonic. The aforementioned oils are typical of the natural, mixed glycerides that contain such fatty acids and which can be epoxidized either separately or admixed with each other, and/or with the unsaturated acids from tall oil, and the epoxidized material used in practicing the present invention.

If desired, the mixed fatty acids isolated from the natural glycerides may be re-esterified with other polyhydric alcohols, e.g., ethylene glycol, diethylene glycol, propylene glycol, dipropylene glycol, pentaerythritol, trimethylolethane, trimethylolpropane, dipentaerythritol, sorbitol, etc., and the resulting esterifiication product then epoxidized and utilized in carrying the instant invention into effect.

The natural oils or fatty acids derived therefrom may be converted to various types of esters, e.g., by alcoholysis or by esterifiication with aliphatic or aromatic, saturated or unsaturated, substituted or unsubstituted, mono- or polyhydric alcohols. The alcohol groupings also may contain one or more epoxidizable ethylenic groupings.

Other examples of epoxidizable materials which, in epoxidized form, can be used in this invention are those involving the reaction of fatty oil- or fatty acid-derived compounds with themselves or with products from other sources, e.g., petroleum. Thus, fatty acids or fatty esters (in the presence or absence of other components, e.g., a fatty alcohol) of the kind hereinbefore described may be dimerized or polymerized with themselves or copolymerized with other unsaturated reactive compounds, e.g., olefins such as olefinic hydrocarbons, acids, esters, amides, nitriles, etc., to yield epoxidizable materials.

Cellulose ester filamentary materials are produced in accordance with this invention by forming the same from a spinning solution of the kind set forth in the fourth paragraph of this specification and, more specifically, elsewhere herein.

A suitable means of preparing such cellulose ester filametnary materials comprises first making a concentrated solution of the epoxidized material in a suitable organic solvent. This solution is then added to a solution of the cellulose ester in the same solvent in proportions such that the admixture contains the desired amount of epoxidized material. After deaeration and filtration, the resulting spinning solution is then formed into a filamentary material comprising a cellulose ester by conventional spinning technique and subsequent processing. Of course, if desired, a spinning solution containing the cellulose ester and the epoxidized material in the concentration desired therein for spinning may be prepared without first making the aforementioned concentrated solution of the epoxidized material.

The organic solvent employed is preferably a volatile (volatilizable) organic solvent, e.g., acetone, methyl acetate, methylene chloride, tetrachloroethane, dioxane, nitromethane, methyl "Cellosolve" acetate (the acetic ester of 2-methoxyethanol), diacetone alcohol (4-hydroxy-4-methyl-2-pentanone), methyl ethyl ketone alcohol, or mixtures of such solvents, alone or with diluents or other solvents, in various proportions, e.g., a mixture of a major proportion of methylene chloride and a minor proportion of methanol.

The present invention is adapted for improving the spinning characteristics of a solvent solution of a cellulose ester, more particularly an organic acid ester of cellulose, whereby the aforementioned unobvious advantages and results are obtained. As cellulose esters there may be employed, for example, any of the various lower alkanoic esters of cellulose including, for example, cellulose propionate, cellulose butyrate, cellulose acetobutyrate, etc., and especially cellulose acetate. The cellulose acetate may be conventional cellulose acetate having an acetyl value of about 55% by weight calculated as acetic acid (combined acetic acid); or it may be cellulose acetate having an acetyl value in excess of about 59% (e.g., up to about 62.5%), calculated on the same basis as the aforementioned cellulose acetate of lower acetyl value, the one of higher acetyl value being more commonly designated at cellulose triacetate. The other organic esters of cellulose may have corresponding variations in their acyl and free hydroxyl contents.

By practicing the present invention the extrusion speeds in spinning (dry-spinning) a spinning solution comprising a solvent solution of an unpigmented (i.e., "bright") cellulose triacetate of the kind hereinbefore described, using an additive in the said solution comprising about 0.4%, by weight of said cellulose triacetate, of an epoxidized soybean oil and chromium-plated double conical countersunk jets (i.e., DDC jets), have been increased from, for example, 337 to 563 meters per minute. The epoxidized soybean oil additive employed is commercially available as Epoxol 7–4 from Swift & Company, Chicago 4, Ill.

In a 42-day, 40-position trial of this spinning technique, filament-denier variation and jet-deposit build-up were materially reduced, and the jet life (before shut-down for claning and/or replacement) was increased from 30 days (for normal unpigmented or bight cellulose triacetate production of filamentary material) to 59 days. Tenacity and elongation obtained at the increased speed were 1.21 g.p.d. and 26.8 or 25.5% (at jet-level temperatures of 76° and 73° C., respectively) vs. 1.14 g.p.d. and 26.4% (at the same jet-level temperatures just mentioned) for normal, unpigmented or bright cellulose triacetate.

Furthermore, accelerated aging tests (in air or in sealed tubes at 100° C.) demonstrated that cellulose ester yarn spun from a dope containing epoxidized material did not develop color as compared with similarly spun yarn that contained no epoxidized material.

It was quite surprising and unobvious that such results should have been obtained by adding to the spinning dope an epoxidized material of the kind with which this invention is concerned, specifically an epoxidized soybean oil. This is because there is nothing in the chemical constitution of such epoxidized materials or in their physical properties that would lead one to believe that addition of such an additive to a cellulose ester, more particularly a cellulose triester, spinning dope would reduce jet-deposit build-up, permit higher extrusion speeds, reduce filament spraying[1], improve color stability and provide other advantages described above and elsewhere in this specification.

In order that those skilled in the art may better understand how the present invention can be carried into effect, the following examples are given by way of illustration and not by way of limitation. All parts and percentages are by weight unless otherwise indicated or specified.

Example 1

Epoxidized soybean oil (6.63 pounds) was dissolved in 30.52 pounds of a mixture of, by weight, methylene chloride and methanol in a ratio of 91 parts of the former to 9 parts of the latter. The resulting solution (37.15 pounds) was added to 37.85 pounds of C-stage, bright, cellulose triacetate dope, and the components were tumbled together in an oxygen tank. This yielded 75 pounds of a modified cellulose triacetate dope concentrate that contained 11.0% flake cellulose triacetate and 8.84% epoxi-

[1] "Filament spraying" is defined as the increase in diameter (measured in millimeters) of a 20-filament bundle determined at a point one-inch below the jet face during extrusion.

dized soybean oil. This modified dope concentrate (density: 1.20 g./cc. at 20° C.) was continuously injected into unmodified C-stage, bright, cellulose triacetate dope in a weight ratio such that the epoxidized soybean oil content of the extruded yarn was 0.4% on a net dry basis. Additional 75-pound bombs of the concentrate were prepared as required.

Three different, pilot-plant, dry-spinning, continuous runs were made wherein 20 ends of the above-described, modified cellulose triacetate dope and 20 ends of the dope in unmodified form as a control were spun and processed. Regular hot-cabinet, up-draft conditions were employed. The modified dope was used in conjunction with the surface application to all the trial yarns (including the control yarns) of 3.25% ±0.3%, based on the weight of the yarn, of a finishing composition comprising, by weight, about 18–22% of oxidized soyabean oil, about 13–15% of oleyl acid phosphate, about 6–7% of an alkylaminoalkanol such as dibutylethanol, about 0.05 to 0.15% of an antioxidant such as di-t-butyl-p-cresol, and the remainder mineral oil (50 SUV at 37.7° C.).

The operating conditions for producing a cellulose triacetate yarn, 75/0.25Z/20, are summarized below:

Denier, target	73.5.
Extrusion rate, m./min.	563.
Temperatures, ° C.:	
Dope, after booster	34.
Jet level	76.
Mid-cabinet	72.
Aspiration:	
Solvent air ratio, percent	1.5.
Disc orifice diameter, inches	7/8.
Suction, inches of water	3.75.
Dope supply	Bright cellulose triacetate.
Residual solvent, target percent	24.
Finish, target, percent	3.25±0.3.
Jet type	DCC.
Diameter, inches	1.0.
Number holes	20.
Hole diameter, microns	36.
Speeds:	
Feed rolls, r.p.m.	1129.
Spindles, r.p.m.	6000.
Traverse, cycles, cycles/min.	1.3.
Finish applicator	Lightweight wicking.
Number of fils./end	20.
Jet porosity: Porositaire range, inches of water	96–106.
Dope additive	Epoxidized soybean oil (0.4% on yarn weight).
Doffing cycle	45/week at 224 minutes.
Looping bar guides	Porcelain, unglazed blue satin, regular groove.
Back guides	(1) Heanium (essentially Al_2O_3). (2) Sapphire.

Run 1: In alternate spinning positions there were utilized chromium-plated DDC jets (i.e., DCCP jets) and non-plated DDC jets.

Run 2: Because of the early failure of the non-plated DDC jets when spinning the control dope in Run 1, the control dope was spun in this run using DCCP jets and stainless steel filter cloth discs, 1¾" diameter, "23M5" micro-mesh, approximately 5 micron retention twilled Dutch weave, Type 304.

Run 3: In this run both the modified and the control CA_3 dopes were spun using DCCP jets and the same type of stainless steel filter cloth discs described in the preceding paragraph.

A summary of the results obtained from the foregoing runs follows:

Bright CA_3 yarn can be extruded at 563 meters per minute using chromium-plated DCC jets and 0.4% epoxidized soybean oil as an extrusion dope additive. Under these conditions the plated DCC jets had an average rate of jet replacement of 1.7 jets per 100-position days, or an average jet life of 59 days. In marked contrast, there was used, in the regular commercial production of 75/20 bright CA_3 yarn at only 337 meters per minute with regular plated conical jets, an average of 3.37 jets per 100-position days, which represents a jet life of approximately 30 days. On a pound basis, the average jet life at extrusion speeds of 563 meters per minute was far superior to the average jet life obtained in normal manufacturing operations heretofore in use at the lower speed, i.e., at 337 meters per minute.

Non-plated DCC jets had an average rate of replacement of 6.8 jets per 100-position days or an average jet life of 14.7 days. In addition, filament spraying was marked when non-plated jets were used, and occurred within 2 days' extrusion at 563 meters per minute.

The difference in tenacity and elongation were mentioned in a portion of this specification prior to the examples. The tensile properties were highest using non-plated DCC jets. The tenacity using non-plated DCC jets was 1.22 g./d.; elongation, 30.0%.

The jet deposits cause an increase in filament-denier variation. The rate of increase was 10 times greater using non-plated DCC jets when compared with runs made using plated DCC jets and epoxidized soyboan oil-modified CA_3.

The addition of epoxidized soybean oil to the CA_3 dope decreases the rate of jet-deposit build-up. The rate of build-up of jet deposit, using DCCP jets in both cases, was over twice as great in the absence of the additive as compared with the corresponding spinning of CA_3 dope containing the epoxide additive.

The third or final run or phase of this example confirmed, by extruding 75/20 bright, epoxidized soybean oil-modified CA_3 for six weeks from 40 positions, that which was indicated by the results of the first two runs or phases. In this third run there were used DCCP jets which yielded Porositaire readings in the 92–106 inches of water range. The mid-cabinet temperature was 760° C., and the jet-level temperature was 73° C. The properties (average of 429 samples tested) were as follows:

Denier	72.7
Tenacity, g./denier	1.20
Elongation, percent	25.2

The corresponding properties (average of a large number of samples taken during regular production over 6-months period) of unmodified (i.e., no epoxide added), bright CA_3 yarn produced at about 337 meters per minute were as follows:

Denier	73.6
Tenacity, g./denier	1.14
Elongation, percent	26.4

In other words, even though the extrusion speed was about 78% higher when using the epoxidized soybean oil-modified CA_3 the aforementioned properties of the CA_3 yarn were not adversely affected; and, in fact, there was a little more than 5% increase in tenacity in grams per denier.

Other conclusions that properly may be drawn from the results of the foregoing runs are:

(1) Filament-denier variations when use is made of DDCP jets (i.e., chromium-plated DCC jets) and an epoxidized material of the kind used in practicing this invention, specifically epoxidized soybean oil, can be maintained at an average of 0.30 denier per filament for 42 days at an extrusion speed of 563 meters per minute. At this same extrusion speed, in the absence of the

epoxidized additive, filament-denier variation increases within 10 days to four times this value, that is, to 1.20.

(2) Extrusion stability is improved by reducing the jet level temperature from 76° C. to 73° C. and porosity from 93–108 inches of water (Porositaire) to 96–103 inches of water.

(3) The jet life (that is, its life before cleaning or replacement is required), when an epoxide additive is incorporated in the dope, is about twice that experienced with regular conical-plated jets and about four times that experienced with unplated DCC jets.

(4) The rate of jet-deposit build-up, when use is made of DCCP jets and an epoxide additive, is about ⅓ the rate of jet-deposit build-up when the same type of jets are used but no epoxide additive is incorporated in the CA_3 dope; and about 1/10 the jet-deposit build-up rate when unplated DCC jets are employed and no addition of epoxide material to the dope is made.

(5) Compared with the use of unplated DCC jets, chromium plating increases the jet life by a factor of about 3; and the introduction of an epoxidized material, specifically epoxidized soybean oil, increases the jet life by an additional factor of about 2.

(6) The use of DCCP jets reduces filament spraying by a factor of about 4. The use of a CA_3 dope containing an epoxide additive and DCCP jets further reduces filament spraying by a factor of about 3.

Example 2

This example illustrates the effect of the use of an epoxidized material, specifically epoxidized soybean oil, in a dope comprising a cellulose ester, specifically cellulose triacetate containing about 61.7% (same as in Example 1) of acetyl groups calculated as combined acetic acid.

The procedure was essentially the same as described in Example 1, Run 3, with the exception that the runs were made at an extrusion rate of 387 meters/minute. The dye index results were as follows:

	Dye index
Control—No additive to dope	44.4
Epoxidized soybean oil, based on weight of CA_3, added to dope:	
0.4%	47.8
0.6%	48.6

Parenthetically it may be mentioned that the degree to which acetate yarns, more particularly CA_3 yarns, take up dyestuffs is an important characteristic that is reflected in the appearance of the finished fabric. Since variations in dye pick-up may be caused by various operating factors, a measure of this quality termed the "dye index" provides a valuable quality-control test.

The dye-index value of a yarn (and by which is meant specifically a CH_3 yarn), dyed under specified conditions, is defined as 100 times the absorbance of a solution, in 10 ml. of a solvent, of the dye taken up by 30 meters of filament. In some cases, the yarn and the dye are dissolved by the solvent; in other cases, the dye is extracted from the yarn by a solvent in which the yarn is insoluble. The yarn samples are prepared and dyed with Celliton Fast Blue FFRN under specified conditions. If the sample is bright yarn, it is dissolved in 10 ml. of a solvent consisting of, by weight, 91 parts methylene chloride and 9 parts methanol. If the sample is dull yarn, the dye is extracted from the yarn with 10 ml. of monochlorobenzene. In each case the transmittance is measured in a 1.0 cm. cell at 645 mμ. From the percent transmittance, the dye index is calculated.

Example 3

The same procedure is followed as described in Example 1, particularly Run 3 of that example, with the exception that instead of epoxidized soybean oil there is added to the CA_3 dope about 0.3%, by weight of the CA_3, of fatty acids derived from soybean oil that had been epoxidized. Similar results are obtained.

If desired, one may use mixtures, in any proportions, of epoxidized soybean oil and fatty acids derived from soybean oil that have been epoxidized.

Example 4

Example 3 is repeated using cellulose acetate containing about 55% of acetyl groups calculated as combined acetic acid instead of cellulose triacetate containing about 61.7% of acetyl groups calculated on this same basis.

If desired, the amount of epoxidized material added to the dope of the foregoing examples can be decreased below 0.3–0.4%, e.g., as low as 0.02% but preferably not lower than 0.05%; or it may be increased above 0.4%, e.g., to 2 or 3% or more, but preferably not higher than about 1.5%. All percentages are based on the weight of the cellulose acetate in the dope.

Also, if desired, instead of the epoxidized soybean oil or fatty acids derived from soybean oil that have been epoxidized (that is, those employed in the foregoing examples), there may be used any other epoxidized material of the kind defined in the fourth paragraph of this specification. Numerous examples of such epoxidized materials have been given in the portion of this specification prior to the examples.

The products or articles of the invention are cellulose ester filamentary materials containing the epoxidized material or materials that were added to the dope. Analyses of the finished cellulose ester yarns indicate that the epoxidized material is present in the finished yarn in approximately the same weight percentage proportion in which it was introduced into the dope. In general, the epoxidized material is distributed (substantially homogeneously distributed) throughout the individual filaments of which the yarn is comprised.

It is to be understood that the foregoing description is given merely by way of illustration and that many variations may be made therein without departing from the spirit of my invention.

Having described my invention, what I desire to secure by Letters Patent is:

1. A spinning solution comprising a fiber-forming lower alkanoic ester of cellulose dissolved in an organic solvent for said ester and, by weight of the said ester, from about 0.02 to about 6% of at least one member of the group of epoxidized materials consisting of fatty acids and fatty esters containing from 6 to about 26 carbon atoms, inclusive, in the fatty-chain portion thereof and having, before epoxidation, an iodine value of at least about 80 and from 1 through 4 non-conjugated ethylenic groups and, after epoxidation, containing epoxide groups across the bridges of said ethylenic groups.

2. A spinning solution as in claim 1 wherein the fiber-forming, lower alkanoic ester of cellulose is cellulose acetate.

3. A spinning solution as in claim 2 wherein the cellulose acetate is cellulose triacetate containing at least 59% by weight of acetyl groups calculated as combined acetic acid.

4. A spinning solution as in claim 1 wherein the epoxidized material is epoxidized soybean oil.

5. A spinning solution as in claim 1 wherein the epoxidized material is epoxidized soybean oil and the fiber-forming lower alkanoic ester of cellulose is cellulose acetate.

6. A spinning solution as in claim 1 wherein the epoxidized material is epoxidized soybean oil and the fiber-forming, lower alkanoic ester of cellulose is cellulose triacetate containing at least 59% by weight of acetyl groups calculated as combined acetic acid.

7. A spinning solution as in claim 1 wherein the organic solvent is selected from the group consisting of acetone, methyl acetate, methylene chloride, tetrachloroethane, dioxane, nitromethane, the acetic ester of 2-meth-

oxyethanol, diacetone alcohol, methyl ethyl ketone alcohol, mixtures of the aforesaid solvents with each other, and a mixture of a major proportion of methylene chloride and a minor proportion of methanol.

8. A spinning solution consisting essentially of cellulose triacetate containing at least 59% by weight of acetyl groups calculated as combined acetic acid dissolved in an organic solvent mixture of methylene chloride and methanol in a weight ratio of 91 parts of the former to 9 parts of the latter, and said solution additionally containing from 0.05% to about 1.5% of epoxidized soybean oil based on the weight of the said cellulose triacetate.

9. A spinning solution as in claim **8** wherein the amount of the epoxidized soybean oil is about 0.4% based on the weight of the cellulose triacetate.

10. The method of improving the spinning characteristics of a solution of a fiber-forming, lower alkanoic ester of cellulose dissolved in a low-boiling organic solvent for said ester which comprises incorporating into the said solution from about 0.02 to about 6%, by weight of the said ester, of at least one member of the group of epoxidized materials consisting of fatty acids and fatty esters containing from 6 to about 26 carbon atoms, inclusive, in the fatty-chain portion thereof and having, before epoxidation, an iodine value of at least about 80 and from 1 through 4 non-conjugated ethylenic groups and, after epoxidation, containing epoxide groups across the bridges of said ethylenic groups.

11. The method as in claim **10** wherein the opoxidized material is epoxidized soybean oil.

12. The method as in claim **10** wherein the epoxidized material is epoxidized soybean oil and the fiber-forming lower alkanoic ester of cellulose is cellulose acetate.

13. The method of increasing the extrusion speed of a spinning solution comprising a solution of an unpigmented cellulose triacetate dissolved in an organic solvent therefor, said triacetate containing at least 59% by weight of acetyl groups calculated as combined acetic acid, said method comprising incorporating into the said solution, prior to spinning thereof, from about 0.05 to about 1.5%, by weight of the said cellulose triacetate, of an epoxidized soybean oil.

14. A yarn of filaments of a fiber-forming, lower alkanoic ester of cellulose having distributed throughout the individual filaments of the said yarn from, by weight of the said filaments, about 0.02 to about 6% of at least one member of the group of epoxidized materials consisting of fatty acids and fatty esters containing from 6 to about 26 carbon atoms, inclusive, in the fatty-chain portion thereof and having, before epoxidation, an iodine value of at least about 80 and from 1 through 4 non-conjugated ethylenic groups and, after epoxidation, containing epoxide groups across the bridges of said ethylenic groups.

15. Yarn as in claim **14** wherein the cellulose ester is cellulose aectate.

16. Yarn as in claim **15** wherein the cellulose acetate is cellulose triacetate containing at least 59% by weight of acetyl groups calculated as combined acetic acid.

17. Yarn as in claim **14** wherein the epoxidized material is epoxidized soybean oil.

18. Yarn as in claim **14** wherein the cellulose ester is cellulose acetate and the epoxidized material is epoxidized soybean oil.

19. Yarn as in claim **18** wherein the cellulose acetate is cellulose triacetate containing at least 59% by weight of acetyl groups calculated as combined acetic acid, and the epoxidized material is epoxidized soybean oil.

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