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MANUFACTURE OF CELLULOSE ACETATE TEXTILE MATERIALS

Frank Brentnall Hill and John Downing, Spondon, near Derby, England, assignors to British Celanese Limited, a British company

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This invention relates to the manufacture of textile materials consisting of or containing wet spun cellulose acetate filaments or staple fibres made from such filaments, hereinafter referred to generally as wet spun cellulose acetate textile materials.

In the manufacture of wet spun cellulose acetate textile materials it is sometimes desirable to increase the lustre of the materials. If this is done it is naturally very important that the increase in lustre should be uniform, and also that the lustre should be substantially uniformly retained, or at least uniformly modified, when the material is subsequently scoured, dyed, laundered or given any other treatment which may tend either to delustre or to increase the lustre of cellulose acetate textile materials in general. It is also important that the lustre-increasing treatment should be cheap and easy to apply, and should make use only of easily available agents.

According to the present invention, the lustre of wet spun cellulose acetate textile materials is increased by giving them a treatment with a lower aliphatic alcohol, especially a mono-hydric alcohol that is completely miscible with water. (The term "lower aliphatic" is used to describe compounds containing at most 4 carbon atoms in the molecule.) The preferred agent is ethyl alcohol, but methyl and isopropyl alcohols for example may also be used. The alcohol, need not be anhydrous or pure; for example ethyl alcohol can be used in a denatured form such as industrial spirit (i. e. industrial alcohol) or methylated spirit, and isopropyl alcohol can be used as its constant boiling mixture with water; it is however desirable that the alcohol itself should make up at least 80%, and preferably at least 85%, of the weight of the treating liquid, and that the greater part or all of the remaining components of the liquid should be compounds which are neither solvents nor strong swelling agents for cellulose acetate.

The wet spun cellulose acetate textile material may be treated at any stage in its manufacture after the actual spinning operation. For example a freshly spun yarn may be washed with the alcohol to remove coagulating liquid from it, or a yarn which has already been washed may be treated before or after it is dried. A fabric may be treated either before or after it is dyed or subjected to any other finishing operation, except of course that if a particular finish is adversely affected by the alcohol treatment, the treatment should precede the finishing operation.

It is usually preferred to treat the textile material with the alcohol at a temperature which is above about 30° C. but not so high as to cause a substantial degree of tendering, i. e. not above about 60° C. for example ethyl alcohol is best used at temperatures between about 45° and 55° C. Lower temperatures can however be used; in particular when the alcohol is employed to wash residual coagulating liquid out of a freshly spun yarn, satisfactory results can be obtained by employing it at about, or not much above, room temperature, i. e. at about 20°–30° C.

The duration of the treatment can be quite short, varying for example from a few seconds to 15 minutes or more; when previously dyed yarns or fabrics are treated it is often advisable to limit the period for which they are subjected to the action of the alcohol to a maximum of about 2–3 minutes, especially at temperatures above 30° C., so as to avoid causing a significant reduction in the intensity of the colour. After the treatment the alcohol may be removed from the material, as by evaporation or by washing.

The means employed for applying the alcohol to the wet spun cellulose acetate textile material will of course depend partly on the stage in its manufacture at which the material is to be treated. If a yarn is to be treated it is usually preferable to employ a continuous method; for example a running yarn may be passed through a bath of the alcohol or in contact with one or more rollers or wicks kept wet with the alcohol, or the alcohol may be applied to a yarn moving along a thread-storage thread-advancing reel or rollers (hereinafter referred to simply as an advancing reel or rollers). If desired however yarn may be treated in package form, for instance while wound on a perforated bobbin. Fabrics may be treated continuously or batchwise by immersion or dipping or continuously by padding methods.

When the textile material has been in contact with the alcohol for the desired period of time, the alcohol is removed, preferably by washing or evaporation or both. A suitable washing agent is water. Advantageously the application of the alcohol to the material and its subsequent removal are effected as consecutive steps in a continuous operation. For example a running yarn which has passed through a bath of the alcohol, or over a roller or wick wet with the alcohol, may first pass through a bath of water or be sprayed with water, and then pass through a drying device, e. g. round heated rollers or through a tube or chamber in which it is subjected to the evaporative action of a stream of hot air. Yarn which has been treated with the alcohol on an advancing reel or rollers may usefully be washed and dried on one or more further advancing reels or rollers, or while it is moving along further parts of the reel or rollers on which it has been treated with the alcohol. In all these methods the washing step can be omitted, the alcohol being substantially completely removed by evaporative drying.

The invention is of particular importance in the manufacture of wet spun cellulose acetate textile materials by a process in which the spinning operation is carried out by extruding an acetone solution of the cellulose acetate into a coagulating bath consisting of a solvent for the cellulose acetate diluted with sufficient water to render it a non-solvent, such as aqueous acetone or especially aqueous diethylene glycol diacetate. Processes of this kind are described in U. S. applications Ser. Nos. 323,788, filed December 3, 1952; 451,190, filed August 20, 1954; 451,191, filed August 20, 1954; 451,193, filed August 20, 1954; 457,721, filed September 22, 1954; 457,684, filed September 22, 1954; 451,192, filed August 20, 1954; 488,868, filed February 17, 1955; 499,166, filed April 4, 1955; 510,754, filed May 24, 1955, and United States application Serial No. 514,617, filed June 10, 1955, corresponding to U. K. application No. 17,942/54, filed June 18, 1954, and yarns obtained by any of these processes, and fabrics made of or containing such yarns, may be given the treatment of the present invention. The treatment may also be applied to materials obtained by extruding acetic acid solutions of cellulose acetate, including acetone-insoluble cellulose triacetates of acetyl value above 59% and especially above 60 or 61% (reckoned as acetic acid), using as the coagulating liquid aqueous acetic acid which may contain a salt, e. g. an alkali metal acetate, in high concentration, or by extrud-

ing solutions of such cellulose triacetates in mixtures of methylene chloride with a small proportion, e. g. 5–10%, of methyl or ethyl alcohol into aqueous methyl or ethyl alcohol or other coagulating bath as described for example in U. S. Patent No. 2,657,973.

While the advantages of the invention are most marked when it is applied to continuous filament yarns or fabrics made of or containing them, the lustre of yarns spun from staple fibre and of fabrics made of or containing such yarns can also be increased by its means. If desired a tow which is to be converted into staple fibre, or the staple fibre itself before it is spun into yarn, may be treated with the alcohol.

The lustre imparted to the materials is reduced either not at all or substantially uniformly by later treatments with water, such as scouring and laundering, at temperatures of for example 70°–80° C.; moreover after such treatments the treated materials may be ironed without causing substantial differential lustre effects, providing of course that the ironing is carried out at a "safe" temperature for the cellulose acetate, i. e. a temperature at which glazing and like effects do not occur.

The differential lustre effects sometimes observed on cellulose acetate fabrics, particularly fabrics containing wet spun continuous filament yarns, which have at some stage become splashed with water, and which are usually enhanced by subsequent ironing, are also largely or completely eliminated by the alcohol treatment. The invention thus makes it easy to avoid the wastage which results when yarns which, owing to some slight deviation from the optimum spinning conditions, are prone to develop differential lustre of this type, are woven into fabrics before their defect is discovered.

The treatment of the invention has also a further advantage over treatments involving the use of known lustre-producing agents such as acetic acid, in that it leaves the textile properties of the material (in particular the tenacity and extensibility of the filaments or fibres) substantially unimpaired.

The invention is illustrated by the following examples.

Example I

A 60 denier cellulose acetate yarn was formed by extruding an acetone solution of cellulose acetate into 34% aqueous diethylene glycol diacetate at 34° C. in a downward spinning device, drawing the yarn from the spinning device at 40 metres per minute over a friction device to wipe off adhering coagulant, and forwarding it to a washing device comprising a pair of inclined advancing rollers, all as described in the example in U. S. application Ser. No. 510,754. The yarn made a total of about 60 wraps round the advancing rollers. Industrial spirit at about 50° C. was applied at a rate of 5 litres per minute to the upper end of the lower roller and flowed down the roller to its lower end. The yarn after leaving the washing device was at once dried by passing it round a pair of heated advancing rollers. The dried yarn contained less than 1.5% by weight of diethylene glycol diacetate, and had a considerably higher lustre than when water was used as the washing agent. Fabrics woven from the yarn could be laundered and ironed without developing differential lustre effects.

When this treatment was modified by employing as the washing agent industrial spirit at 25–30° C., a yarn of slightly lower but equally uniform lustre was obtained.

Example II

A fabric woven from a cellulose acetate yarn made by extruding an acetone solution of cellulose acetate into aqueous diethylene glycol diacetate as described in U. S. application Ser. No. 451,191 was immersed in industrial spirit for 1½ minutes and then rapidly dried by passing it through a current of warm air in a drying chamber. The lustre of the fabric was substantially increased, and the fabric could be laundered and ironed without developing differential lustre effects. A similar but somewhat less marked effect was obtained if, instead of the industrial spirit, the constant boiling mixture of isopropyl alcohol and water was used.

The same effect is not obtained if known relustring agents for cellulose acetate are used instead of the alcohols. For example, one well recognised relustring agent is aqueous acetic acid of concentration about 20%, but if this is used in place of the alcohol in the processes of the above examples, and the fabrics are subsequently washed and ironed, differential lustre effects are usually observed.

Example III

Fabric woven from a particular slightly sub-standard yarn made by wet spinning an acetone solution of cellulose acetate using aqueous diethylene glycol diacetate as the coagulating liquid developed differential lustre effects when splashed with water and subsequently ironed. If before being woven the yarn was treated with industrial spirit at 50° C. for 2 minutes and then dried, the resulting fabric was no longer sensitive to splashing. Similarly fabric woven from the untreated yarn and given the treatment of Example II above was no longer sensitive to splashing. Treatment of either the yarn or the fabric with 20% aqueous acetic acid resulted in a product which, although its overall lustre was increased, was still sensitive to water splashing, and developed areas of increased lustre which were intensified by ironing.

Having described our invention, what we desire to secure by Letters Patent is:

1. A process for the manufacture of wet spun cellulose acetate textile materials resistant to the development of differential lustre, which comprises extruding an acetone solution of cellulose acetate into a coagulating bath consisting essentially of an aqueous solution of diethylene glycol diacetate, drawing the filaments so produced from the coagulating bath as a yarn under a tension sufficient to give them the denier required in the final product, subjecting the yarn at the same filament denier to the action of a monohydric lower aliphatic alcohol selected from the group which consists of ethyl and isopropyl alcohols of centration at least 85% at a temperature between 20° and 60° C., and subsequently removing the alcohol from the yarn.

2. Process according to claim 1, wherein the yarn is treated with the alcohol at a temperature of 30°–60° C., after it has been formed into a fabric.

3. Process according to claim 1, wherein the yarn is subjected to the action of ethyl alcohol of concentration at least 85% at a temperature of 45°–55° C.

4. Process according to claim 3, wherein the yarn is subjected to the action of ethyl alcohol of concentration at least 85% at a temperature of 45°–55° C.

5. Process according to claim 1, wherein the alcohol is removed by washing with water.

6. Process according to claim 1, wherein the alcohol is removed by evaporation.

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