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METHOD OF CRINKLING STAPLE FIBERS

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This invention relates to the treatment of cellulose derivative filaments, fibers, yarns, fabrics and like materials to modify their physical characteristics.

In U. S. Patent No. 2,058,422 of W. A. Dickie and P. F. C. Sowter it has been disclosed that the treatment of artificial materials having a basis of an organic derivative of cellulose with media comprising organic solvents, swelling agents or latent solvents, in the absence of tension sufficient to stretch the materials, serves to increase their extensibility. This process is of considerable importance since it is known that it is imperative in weaving, knitting, twisting or other textile operations that filaments, threads, yarns and like materials should have a substantial extensibility, preferably an extensibility of 10–12 or 15% or more. Among the factors which require consideration in the selection of media to be employed is the reproducibility or control of results, this being a matter of considerable importance when dealing with textile fabrics and like materials since quite small variations in physical characteristics over the length of such materials are shown up very clearly in fabrics formed therefrom. Other factors to be considered are the over-all efficiency of the agents, their toxicity, and economic factors generally. Still further, it is of great importance for the safe operation of any process that the inflammability of the treatment media should be quite low.

In U. S. application S. No. 306,904, filed November 30, 1939, of H. Dreyfus it has been disclosed that the treatment of staple fibers having a basis of an organic derivative of cellulose with media comprising latent solvents for the cellulose derivative results in a substantial crinkling of the fibers so that their spinning qualities are greatly improved. Here again the considerations referred to above will affect the selection of the particular media to be employed.

It has now been found that media comprising certain halogenated hydrocarbons in admixture with alcohols, particularly ethyl alcohol, can be employed with very satisfactory results in the processes of U. S. Patent No. 2,058,422 and U. S. application S. No. 306,904. In particular, trichlorethylene, dichlorethylene and carbon tetrachloride may be employed, and it is found that these agents yield very satisfactory results. This is a very surprising observation, since it has previously been supposed that these agents are substantially inert to cellulose derivative materials and they have therefore been described simply as diluents.

Suitable mixtures of these agents and alcohols can be formed which have a relatively low inflammability, and carbon tetrachloride is particularly advantageous in that it forms a wide range of substantially non-inflammable alcoholic mixtures.

According to the invention, therefore, artificial filaments, threads, yarns and like continuous materials, fabrics formed therefrom, and staple fiber, having a basis of an organic derivative of cellulose, are subjected to the action of media comprising trichlorethylene, dichlorethylene or carbon tetrachloride and an alcohol, while the materials or fibers are substantially free to contract, i. e. under conditions which permit shrinkage or crimping of the materials or fibers respectively. Ethyl alcohol has been specified above, but other lower aliphatic alcohols, e. g., methyl and n- and i-propyl alcohols, may be employed. If desired water or other diluents or swelling agents specified in U. S. Patent No. 2,058,422 and U. S. application S. No. 306,904 may also be present in the treatment media.

When treating continuous materials it is preferable to carry out the treatment while they are under no tension or under only a slight tension so that they are substantially free to shrink under the influence of the treatment media. If the media are applied while the materials are under relatively high tension, the tension should be subsequently reduced or removed so that the materials are allowed to shrink while under the influence of the media.

Staple fibers are preferably treated as a loose mass and may then be agitated during treatment. However, they may be treated as bundles of fibers, e. g., a sliver or roving, provided that a sufficient degree of freedom to permit relative movement of the fibers is maintained. When treating slivers or other bundles which it is desired to maintain in form throughout the treatment, it is preferable to support them during the treatment, for example by passing them through a bath of the treatment medium or by spraying them with the medium while they are supported on a travelling band, e. g., a continuous wire gauze band or felt sheet, and allowing the bundles to remain on the band under the action of the medium for an appropriate time.

The particular treatment agent, the concentration in which it is employed, the temperature of working and the time of treatment will depend upon the particular cellulose derivative

which is present in the filaments or other materials to be treated, upon the physical characteristics of those materials, and upon the degree of modification of the physical characteristics which is desired. Preferably, shrinkage of continuous materials does not exceed about 20 or 25% and it is generally most advantageous to effect a shrinkage of 10–15%. In the case of treatment to crimp staple fiber, conditions are preferably such that shrinkage of the fibers does not exceed about 10%, and may be such that shrinkages as slight as 5% or less are brought about.

When treating materials having a basis of acetone-soluble cellulose acetate it is found that a satisfactory modification in physical characteristics can be secured by treating continuous materials in the absence of tension or staple fibers in a loose mass which is agitated during treatment with a medium consisting of, for example, a 20–90% solution of trichlorethylene in ethyl alcohol, especially a 30–40% solution, or a 75–85% solution, e. g., 80%. Such solutions do not require the employment of elevated temperatures, and temperatures of the order of 20–25° C. are usually quite satisfactory. Similar results with the same materials may also be obtained by treatment with a 50–80%, preferably about 70%, solution of carbon tetrachloride in ethyl alcohol, but with such solutions it is preferable to carry out the treatment with the solutions at a temperature of about 30 or 40–55° C., especially about 50° C.

For the treatment of continuous materials the treatment media according to the invention may be employed in any of the methods described, for example, in U. S. Patents Nos. 2,070,583 and 2,058,422. The invention is of the greatest importance when applied to filaments, threads, yarns, ribbons and the like, fabrics or fibers containing or derived from high tenacity wet-spun materials or materials which have been stretched to 200% or more of their original length in hot water or wet steam or in a medium containing an organic solvent or swelling agent. It will be understood, however, that the invention is not limited to the treatment of these materials, but is applicable generally to organic derivative of cellulose materials, the physical characteristics of which it is desired to modify.

Reference has been made above to materials having a basis of acetone-soluble cellulose acetate and the invention is of the greatest importance in connection with the treatment of such materials. However, materials made from other cellulose acetates or other esters of cellulose such as, for example, cellulose formate, propionate and butyrate, and mixed esters, e. g., cellulose aceto-propionate and acetobutyrate, and also from cellulose ethers, e. g., metyl, ethyl and benzyl cellulose, or from cellulose ether-esters, may be treated.

The following examples illustrate the invention:

Example 1

Dry-spun acetone-soluble cellulose acetate yarn, which has been stretched in wet steam to 1000% of its original length, is immersed for 10 minutes at 20° C. in hank form in a bath of 80 parts by volume of trichlorethylene and 20 parts by volume of ethyl alcohol and allowed to shrink freely. The treatment medium is lightly squeezed from the hanks, which are then dried in warm air. The yarn is found to possess a substantially improved extensibility.

Example 2

Staple fibers cut from continuous acetone-soluble cellulose acetate filaments are immersed as a loose mass in a bath of 70 parts by volume of carbon tetrachloride and 30 parts by volume of ethyl alcohol at 50° C. and are thoroughly agitated therein by means of a punch or stick for 10 minutes, the liquor ratio being 20 parts by volume of liquor to 1 part by weight of fiber. The liquor is then drained off and the fibers centrifuged for 1 minute and dried in warm air. The resulting fibers are well crimped, showing a good resistance to separation on being pulled apart.

Example 3

The operations of Example 2 are carried out using a bath of 40 parts by volume of trichlorethylene and 60 parts by volume of ethyl alcohol at 22° C., and similar results are obtained.

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

1. Process for crinkling staple fiber having a basis of an organic derivative of cellulose, which comprises subjecting said staple fiber to the action of a medium comprising a lower aliphatic alcohol and a chlorinated hydrocarbon selected from the group consisting of trichlorethylene, dichlorethylene and carbon tetrachloride, while the fibers are substantially free to contract.

2. Process for crinkling staple fiber having a basis of an organic derivative of cellulose, which comprises subjecting said staple fiber to the action of a medium comprising a lower aliphatic alcohol and a chlorinated hydrocarbon selected from the group consisting of trichlorethylene, dichlorethylene and carbon tetrachloride, while the fibers are substantially free to contract and under conditions such that shrinkage does not exceed about 10% of their original length.

3. Process for crinkling staple fiber having a basis of an organic derivative of cellulose, which comprises subjecting said staple fiber to the action of a medium comprising 30% to 40% by volume of trichlorethylene and 70% to 60% by volume of ethyl alcohol at a temperature of the order of 20–25° C., while the fibers are substantially free to contract.

4. Process for crinkling staple fiber having a basis of an organic derivative of cellulose, which comprises subjecting said staple fiber to the action of a medium comprising 75 to 85% by volume of trichlorethylene and 25 to 15% by volume of ethyl alcohol at a temperature of the order of 20–25° C., while the fibers are substantially free to contract.

5. Process for crinkling staple fiber having a basis of an organic derivative of cellulose, which comprises subjecting said staple fiber to the action of a medium comprising 50 to 80% by volume of carbon tetrachloride and 50 to 20% by volume of ethyl alcohol at a temperature of the order of 30–55° C., while the fibers are substantially free to contract.

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