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METHOD OF MAKING SILK PRODUCTS

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This invention relates to the preparation of filaments, yarns, threads and other articles made of or containing natural silk from solutions of natural silk in acids.

In the throwing of natural silk to form yarns or threads, a comparatively large amount of waste silk fibre is produced, which silk cannot be employed in the ordinary manner. We have found that such waste natural silk may be converted into continuous filaments or yarns and other useful substances by dissolving the same in acids, working the resultant solutions into desired form and then precipitating the silk in a suitable manner.

In accordance with our invention we dissolve natural silk in a strong acid at suitable low temperatures and the solution thus formed is extruded through orifices of a spinneret into a suitable precipitating bath.

Natural silk in any form may be treated in accordance with our invention. This silk may be in the gum but is preferably degummed. While for economic reasons we prefer to employ the waste silk fibres resulting from the spinning of silk yarns and threads, other silk material may be used. Thus even silk fabrics may be dissolved in accordance with our invention, and economic sources of such fabrics are old silk rags and the scrap pieces of fabric resulting from cutting fabric into garments.

The natural silk is dissolved in a strong acid, but care should be taken that the acid is not sufficiently strong at the temperature employed to impair the usefulness of the silk material. We prefer to use mineral acids like sulfuric acid of say 25 to 75%, phosphoric acids such as the syrupy ortho phosphoric acid (H_3PO_4), strong hydrochloric acid, etc.

The temperature at which the silk is dissolved in acid should be sufficiently low to prevent serious deterioration of the silk. We prefer to employ temperatures at or near the freezing temperature of water, say from −10° C. or less to approximately 10° C. These low temperatures should preferably be maintained throughout the whole process of solution, storage of the solution, if any, and precipitation, since if high temperatures prevail, the silk is liable to be destroyed.

The solution thus formed may be extruded through orifices of such size as to form filaments of any required size, say from 1 to 50 denier or more. If desired, much heavier filaments may be formed, say from 50 to 2000 or more denier, which filaments may be used as artificial bristles, horse-hair, etc., for use in brushes and the like. Artificial straws, films and the like may be formed by extruding or casting the silk solution.

The solution of the silk is extruded into a suitable precipitating bath. This bath preferably is of large volume and it comprises either a diluent for the acid or a substance adapted to neutralize the acid or both. Thus a precipitating bath may consist of water or aqueous solutions of salts. The bath may be alcohols such as ethyl alcohol, methyl alcohol or denatured alcohol, either pure or in admixture with water or other liquids. The bath may contain alkaline substances such as sodium hydroxide, potassium hydroxide or ammonium or it may contain salts of strong bases and weak acids such as the acetates of sodium, potassium or ammonium.

The filaments formed in accordance with our process may be wound onto suitable packages and then associated by twisting. If desired, a plurality of filaments may be drawn from precipitating bath and simultaneously twisted and wound by a suitable device such as a cap spinning device or a centrifugal spinning pot. The filaments formed by our invention may be cut into short lengths or staples, and these staples associated together to form "spun" yarn. The yarns formed in accordance with our invention may be employed for making woven, knitted or other fabrics and they may be associated with other yarns such as ordinary natural silk yarn, yarns of cellulose acetate or other organic derivatives of cellulose, cotton or wool yarns. Fabrics formed from or containing this yarn may be employed in making any suitable or desired garments.

In order further to illustrate our invention but without limiting the scope thereof, the following specific example is given:

Example

25 litres of an aqueous solution of sulfuric acid of 50% concentration are cooled to a temperature of about 0° C. To the cold sulfuric acid there are added 8 kilograms of degummed silk fibres, and the whole is mixed, while cooling, until a homogeneous colorless heavy solution is formed. This solution while cold is extruded through orifices of a spinneret into a large bath containing either water or ethyl alcohol, which bath is kept at a temperature of about 0° C. The filaments thus formed may then be drawn and then twisted together and wound by means of a cap spinning device, a centrifugal spinning pot or other suitable device to form yarn that is strong and tough. The filaments should be thoroughly washed to

remove traces of acid either prior or subsequent to being wound.

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

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

1. The method of forming filaments, threads or yarns which comprises dissolving natural silk in a strong acid, and extruding the solution into a liquid coagulating medium maintained at a temperature below 10° C.

2. The method of forming filaments, threads or yarns which comprises dissolving natural silk in sulphuric acid, and extruding the solution into a liquid coagulating medium maintained at a temperature below 10° C.

3. The method of forming filaments, threads or yarns which comprises dissolving natural silk in phosphoric acid, and extruding the solution into a liquid coagulating medium maintained at a temperature below 10° C.

4. The method of forming filaments, threads or yarns which comprises dissolving natural silk in sulphuric acid, and extruding the solution into ethyl alcohol maintained at a temperature below 10° C.

5. The method of forming filaments, threads or yarns which comprises dissolving natural silk in phosphoric acid, and extruding the solution into ethyl alcohol maintained at a temperature below 10° C.

6. The method of forming filaments, threads or yarns which comprises dissolving natural silk in sulphuric acid of 50% concentration at 0° C., maintaining the solution at 0° C., and extruding the solution into ethyl alcohol maintained at 0° C.

7. In the method of forming filaments, threads or yarns which comprises dissolving natural silk in a strong acid and extruding the solution into a liquid coagulating medium, the step of maintaining the coagulating medium at a temperature below 0° C.

8. In the method of forming filaments, threads or yarns which comprises dissolving natural silk in sulphuric acid and extruding the solution into a liquid coagulating medium, the step of maintaining the coagulating medium at a temperature below 0° C.

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