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PROCESS OF MANUFACTURING FILAMENTS, FILMS AND THE LIKE FROM KERATINOUS MATERIALS

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It has been proposed to dissolve materials containing keratin, such as horns, hooves, feathers, hair and wool and waste products thereof in alkali hydrates, or metal amines and to spin the solutions thus obtained into filaments. No favorable results, however, have been obtained therewith so that the method has not been adopted in practice.

Keratin-containing materials, particularly wool, have also been dissolved in alkali sulphides, but up to the present such solutions have not been spun into filaments.

According to the invention suitable filaments, films or the like can be obtained by adding to the spinning solution and/or to the spinning bath substances which during the manufacturing process will form condensation products either individually or in combination with each other, or in combination with the keratinous substance.

When trying to coagulate solutions of keratin—e. g. in alkalihydrate or sulphide—in one of the baths which are generally used for spinning cellulose solutions, it will be found that either one obtains no filaments at all, or that there are formed filaments which are practically useless. If, however, one or more of the substances mentioned above are added, this will act favorably upon the formation of the filament, while the mechanical properties of the filament thus formed and the finished product made thereof are considerably improved.

The keratin solutions used according to the invention are preferably prepared by dissolving the keratinous starting material, such as e. g. waste wool or hooves in a solution of alkali sulphide. It is supposed that the keratin molecule when dissolved in alkali sulphides is disintegrated to a smaller degree than when dissolved in alkali hydrates. According to modern conceptions the chains which are supposed to be present in the albumen molecule are connected with each other by means of the sulphur atoms. It is plausible that this so-called "sulphur-bridge" will be ruptured to a lesser degree by a treatment with alkali sulphides than by a treatment with alkali hydrates and that it is of advantage to keep the molecules of the albuminous residues from which the condensation products are produced in the process according to the invention, as large as possible.

The solution may be prepared by heating the material with a sodium or a potassium sulphide solution, and subsequently separating the solution from the undissolved residue by filtering. It is also possible to use other keratin solutions, e. g. solutions in alkali hydrates or ammonical copper oxide, but these solutions generally will produce less favorable results. The keratin, for instance, will be disintegrated too far if dissolved in a highly alkaline liquid such as an alkali hydrate solution.

The substances to be added may be of different character and they may be added either to the spinning solution, to the spinning bath or to both.

In the first place substances may be used which will form condensation products with keratin, such as e. g. aldehydes or rhodanides. They may be added to the spinning solution, preferably at such a time that an initial condensation will have taken place already prior to the spinning treatment. This maturing process, however, may not proceed so far as to render the keratin insoluble. It is, however, also possible to add the said substances to the spinning bath, in which case condensation occurs in the spun filament.

According to the invention preferably two or more substances are used which together will produce a condensation product. Most suitable for this purpose are those substances which under manufacturing conditions, i. e. in an aqueous medium or during the drying of the filament at a moderate temperature, will yield synthetic resinous products, e. g. urea and formaldehyde or other aldehydes, phenols and aldehydes or the like.

The process preferably is carried out in such a way that both the aldehyde and the other synthetic resin component are added to the spinning solution and that the spinning solution is subjected to a maturing process, for the purpose of obtaining the degree of condensation of the synthetic resin components, desirable for spinning. Other embodiments of the invention are also possible; one may, for example, add one of the components (preferably the aldehyde) to the spinning bath and the other component to the spinning solution or else dissolve both components in the spinning bath, in which case this latter may of course, only be used within a given time after the preparation thereof.

When using the abovementioned combinations of substances one of the components of which is an aldehyde, it will of course be possible to obtain both synthetic resin-like products and condensation products of the aldehydes with keratin.

The best results have been obtained by adding urea and formaldehyde to the spinning solution. The maturing time depends on various factors, such as the composition of the spinning solution and the temperature, and may vary between a

few hours and several days. Good results have been obtained e.g. with a spinning solution containing 0.15–0.25% of urea and at room temperature the maturing time may be 16 to 18 hours. If maturing is continued for a longer time the filament may become too brittle; if the maturing period is too short, the filament will be plastic, but too weak. At higher temperatures the maturing process will proceed more quickly, and this will also be the case, if acetaldehyde is used instead of formaldehyde.

It has been found that the known spinning baths used in the viscose industry which together with sulphuric acid contain one or more salts, particularly sodium sulphate, magnesium sulphate, ammonium sulphate, zinc sulphate and the like, are also extremely suitable for the coagulation of the keratin solutions according to the invention. The filaments are washed immediately or some time after spinning, contingently after having been passed through a second bath in order to remove the water soluble constituents and subsequently dried.

In the processes described above there is added a substance which will form a condensation product either with a substance added or with the keratin itself. However, substances having the property of producing polymerization products, e.g. compounds belonging to the class of the vinyl resins, may also be used. These substances also will generally be added to the spinning solution and not to the spinning bath and like in the preceding case a maturing period will be desirable.

The filaments obtained may be hardened, if desired, by treatment in a suitable bath, e.g. of a formaldehyde or an alum solution.

The invention will be illustrated by the following example.

250 grams of finely ground hooves are mixed with a solution of 250 grams of sodium sulphide in 1150 grams of water, and the mixture is heated while stirring to a temperature near the boiling point. The ground hooves will dissolve for the greater part, the solution is separated from the undissolved residue by filtration.

In the keratin solution thus obtained 15 grams of urea are now dissolved and 150 grams of formaline (40%) are added. This solution is allowed to mature during 18 hours at room temperature, and is extruded at room temperature in a bath containing 30% of H_2SO_4, 10% of Na_2SO_4 and 3% of $(NH_4)_2SO_4$. The filament obtained is washed with water and dried at a moderate temperature.

Instead of ground hooves one may also use other keratin containing substances. A very suitable first material is e.g. waste wool obtained by shearing which consists of very short fibres, and is therefore unsuitable for textile materials.

The invention renders it possible to produce synthetic wool or wool silk in the form of filaments so fine as to be particularly suitable in the hosiery industry, especially for the making of fine hose for which natural wool has proved to be rather unsatisfactory. Apart from the fine yarns to be worked into fabrics or into knitted goods other products such as e.g. artificial horse hair and films can also be produced from the keratin solution according to the invention. The material is also suitable for electrical insulations.

If desired the keratin solution may be mixed with other artificial silk spinning solutions, e. g. with alkaline casein solutions or with viscose or ammoniacal copper oxide-cellulose solutions. In that case filaments or films are produced which consist of mixtures of keratin with another albuminous substance or with cellulose.

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