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METHOD AND APPARATUS FOR SPINNING ARTIFICIAL FILAMENTS

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This invention relates to improvements in the manufacture of artificial fibers from viscose.

Artificial fibers comprising regenerated cellulose from viscose are obtained by the wet spinning method, that is the viscose is spun through a spinneret into an acid spinning bath in which individual streams of viscose emerging from the spinneret are coagulated and regenerated. Under such conditions, the acid bath contains a large amount of suspended gas bubbles. Ordinarily the spinneret has a comparatively low orifice area density and the gas bubbles do not interfere with the orderly and continuous progress of the individual streams of viscose away from the face of the spinneret and the streams are separately acted upon by the bath and coagulated. However, in the manufacture of filaments which are destined for cutting into staple fibers, it is desirable to spin a great many filaments from a single spinneret and collect the bundle of filaments in the form of a long tow which is then fed to a staple fiber cutting mechanism. The spinnerets are made from precious metals such as platinums or the like, and for obvious reasons of economy, must be kept as small as possible which, in the case of spinning a very large number of filaments from a single spinneret, requires a high orifice area density. When viscose is spun through such spinnerets having an orifice area density so high that the orifice area density factor K is greater than 800 when determined in accordance with the following formula

$$D=\frac{KS}{A} \text{ or its equivalent, } K=\frac{AD}{S}$$

where

D=orifice density, orifices/sq. in.
S=periphery of the face of the jet in inches
A=and area of the face of the jet in sq. inches

it is a common observation that the gas bubbles which permeate the bath are attracted to and tend to adhere to or cling to the face. Under those conditions, the progress of the acid to the individual streams of viscose issuing from the spinneret away from the face into the bath is seriously hampered. The bubbles clinging to the exceedingly small unperforated portions of the face which exist between the densely packed orifices interfere with acid distribution and permit a multiplicity of the streams of raw viscose to come together without having been coagulated. As they are drawn through the spinning bath by the action of the godet wheel, the merged streams are coagulated and cemented together to form excessively large filaments or "splinters" which occur haphazardly throughout the final bundle. The phenomenon of gas bubble adherence to the face of the spinneret is extremely troublesome, necessitating frequent discontinuance of the spinning operation and manual dislodgement of the gas bubbles, and requiring the spinning of a large number of ends in order to obtain a tow having sufficient average total denier over a long period of time. The problem is encountered only in those instances when the spinneret employed has a face of small diameter and an orifice area density such that, according to the foregoing formula, the value of K is greater than 800. No satisfactory solution of the problem has been propounded heretofore.

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This invention has as an object improvements in the spinning of artificial fibers through spinnerets having high orifice area density. A further object is to alter the inter-facial tensions existing at the face of such spinnerets in acid spinning baths to prevent the adherence of gas bubbles to the face. Another object is to coat the face of such a spinneret with a substance which will repel gas bubbles and neutralize their tendency to adhere to the surface thereof. Other objects will appear hereinafter.

These objects are accomplished by coating the spinneret face with a film of a synthetic thermosetting resin. Preferably, the outside face of the spinneret is coated with a solution of the partially reacted constituents of the resin, and completion of formation of the resin or setting thereof is effected in situ. For example, the outer face of the spinneret may be coated with a solution of a partially polymerized resin which is transformed subsequently by heat into the hardened infusible form. The resin may be, for instance, a melamine-aldehye, urea-aldehyde, or phenol-aldehyde resin; a glycerol-polybasic acid resin; a polyolefine resin, alkyd resin, or the like. Some of the resinous solutions are cationic and can be deposited electrolytically on the spinneret face. For example, a solution of a partially condensed melamine-formaldehyde resin in dilute hydrochloric acid, such as the product available under the tradename "Aerotex 607" is cationic and may be deposited electrolytically. Upon subsequent heating the resin is set and, in the final polymerized form is non-ionogenic. Other of the resinous solutions, such as solutions of partially polymerized urea- and phenol-aldehydes are non-iogenic and cannot be deposited electrolytically. However, such solutions may be applied by other methods, as by spraying, etc., care being taken to prevent plugging of the spinneret orifices.

The resins form a water-insoluble film on the surface of the spinneret which film is substantially acid and alkali resistant and which does not dissolve in the spinning bath or exert an untoward effect on the filaments. The resinous solutions may be applied to spinnerets constructed of various metals such as gold, tantalum, platinum, and various alloys, the choice of method of application being determined by whether the solutions are of the cationic or non-iogenic type. The resins are effective over a sufficiently prolonged period to permit the obtention of satisfactory tows which are substantially free of splinters, without requiring the spinning of a large number of ends. The orifices may be distributed in the conventional circular area, but it will be understood that the invention is not limited to spinnerets in which the orifices are distributed in an area of any particular shape.

The following examples will illustrate the invention.

Example I

A solution of partially reacted melamine-formaldehyde resin-forming components in hydrochloric acid was deposited electrolytically on the outer surface of a circular metal spinneret having a diameter of two inches and an orifice area density factor K of 950 when determined by the formula

$$D=\frac{KS}{A}$$

where

D=orifice density, orifices/sq. in.
S=6.2813 inches
A=3.14 sq. in.

care being exercised to prevent clogging of the orifices. The spinneret was then heated to complete formation of the resin. Viscose was extruded through the treated spinneret into an acid spinning bath to form a bundle of individual filaments.

Example II

A solution of partially reacted urea-formaldehyde resin-forming components was sprayed on the outer face of a spinneret having a factor K of 850. The treated spinneret was then heated to complete formation of the resin in situ. Viscose was extruded through the treated spinneret to form a bundle of separate and distinct filaments.

While preferred embodiments of the invention have been shown, it is to be understood that changes and variations may be made without departing from the spirit and scope of the invention as defined by the appended claims.

We claim:

1. The method of producing filamentary bundles substantially free of splinters which comprises substantially continuously extruding viscose over a prolonged period of time into an acid spinning bath through a metallic spinneret having an orifice area density factor K greater than 800 determined by the general formula $K=AD/S$ where D is the orifice density of the spinneret expressed as orifices per square inch, S is the periphery of the spinneret face in inches, and A is the area of the spinneret face in square inches, the outer surface of the orificed spinneret face being coated with a synthetic thermosetting resin set to the infusible state.

2. The method of claim 1 in which K has a value up to 950.

3. The method of claim 2 in which the resin is a melamine-aldehyde resin.

4. A metallic spinneret having an orifice area density factor K greater than 800 determined by the formula $K=AD/S$ where D is the orifice density of the spinneret expressed as orifices per square inch, S is the periphery of the spinneret face in inches, and A is the area of the spinneret face in square inches, the outer surface of the orificed spinneret face being coated with a synthetic thermosetting resin set to the infusible state.

5. The spinneret of claim 4 in which K has a value up to 950.

6. The spinneret of claim 5 in which the resin is a melamine-formaldehyde resin.

7. The method of producing filamentary bundles substantially free of splinters which comprises substantially continuously extruding viscose over a prolonged period of time into an acid spinning bath through a metallic spinneret having an orifice area density factor K greater than 800 and up to 950 determined by the general formula $K=AD/S$ where D is the orifice density of the spinneret expressed as orifices per square inch, S is the periphery of the spinneret face in inches, and A is the area of the spinneret face in square inches, the outer surface of the orificed spinneret face being coated with a urea-aldehyde resin set to the infusible state.

8. The method of producing filamentary bundles substantially free of splinters which comprises substantially continuously extruding viscose over a prolonged period of time into an acid spinning bath through a metallic spinneret having an orifice area density factor K greater than 800 and up to 950 determined by the general formula $K=AD/S$ where D is the orifice density of the spinneret expressed as orifices per square inch, S is the periphery of the spinneret face in inches, and A is the area of the spinneret face in square inches, the outer surface of the orificed spinneret face being coated with a phenol-aldehyde resin set to the infusible state.

9. A metallic spinneret having an orifice density factor K greater than 800 determined by the formula $K=AD/S$ where D is the orifice density of the spinneret expressed as orifices per square inch, S is the periphery of the spinneret face in inches, and A is the area of the spinneret face in square inches, the outer surface of the orificed spinneret face being coated with a urea-formaldehyde resin set to the infusible state.

10. A metallic spinneret having an orifice area density factor K greater than 800 determined by the formula $K=AD/S$ where D is the orifice density of the spinneret expressed as orifices per square inch, S is the periphery of the spinneret face in inches, and A is the area of the spinneret face in square inches, the outer surface of the orificed spinneret face being coated with a phenol-formaldehyde resin set to the infusible state.

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