May 20, 1958 ICHIRO KOSUGE 2,835,551

PROCESS FOR PRODUCING HOLLOW VISCOSE FILAMENTS

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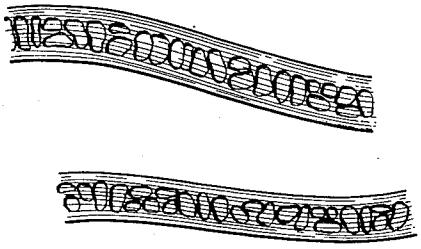


FIG. 1.

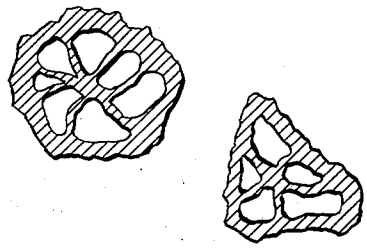


FIG. 2.

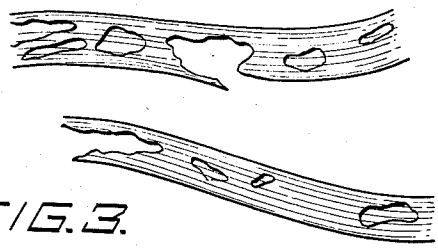


FIG. 3.

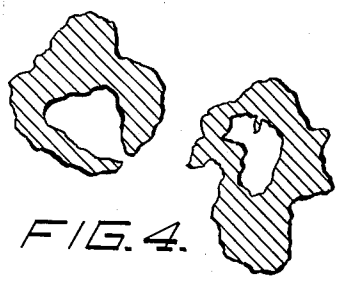


FIG. 4.

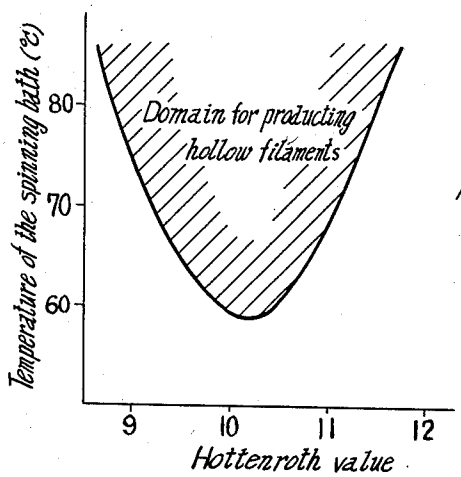


FIG. 5.

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PROCESS FOR PRODUCING HOLLOW VISCOSE FILAMENTS

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1 Claim. (Cl. 18—54)

This invention relates to a process for easily producing hollow viscose rayon filaments containing numerous independent small gas cells by viscose process. In the industrial process for producing hollow viscose rayon filaments of heretofore, sodium carbonate is added to viscose and it is necessary in general to prepare a special spinning bath such as a bath of higher acidity or of higher zinc sulfate content than usual spinning bath, and further for viscose it is necessary to add special surface active agents or carbon disulfide or to make the degree of ripeness younger than usual process. Moreover, there are disadvantages in that the filament produced contains gas cells irregularly distributed, and sometimes the cells, being tubular form, have tendency to be collapsed in subsequent procession to decrease the volume and also in that the strength and the elongation of the filament are low.

This invention is characterized in that the disadvantages as described above are eliminated and it has no necessity of using a spinning bath of special composition. According to this invention, alkali soluble carbonates of the amount of 2–4% on the basis of viscose is dissolved in viscose and said viscose is spun at 9.0–11.5 of Hottenroth value in a conventional spinning bath of the composition of 9–11.5% sulfuric acid, 18–25% sodium sulfate and 0.6–1.5% zinc sulfate at a temperature over 60° C., thereby to produce hollow filaments of large volume having not only strength and elongation not inferior to the conventional filaments but also containing uniformly distributed numerous independent small gas cells. The invention will now be explained in the following with reference to the accompanying drawings wherein,

Figure 1 are enlarged side views of hollow viscose rayon filaments produced in accordance with this invention;

Figure 2 are enlarged cross sectional views of the filaments of Figure 1;

Figure 3 are enlarged side views of filaments produced by conventional process;

Figure 4 are enlarged cross sectional views of the filaments of Figure 2; and

Figure 5 is a diagram showing the domain where hollow filaments may be produced.

The type of the filaments produced by the process of this invention is as seen in Figures 1 and 2, and has numerous independent gas cells uniformly distributed therein and has a cross section like that of a lotus rhizome. Its strength and elongation are also excellent, the wet tenacity being 0.8 g./d. while the wet elongation over 20%.

It is of course possible to produce hollow filaments also by a process other than this invention at temperature lower than 50° C. of the spinning bath, but in such a case, it is necessary to make the concentration of sulfuric acid higher than 13% or to make the zinc sulfate content higher than 3%. Moreover the filament produced has gas cells distributed irregularly as shown in

Figures 3 and 4 and it is difficult to produce a hollow filament of uniform quality, causing great uneveness in lustre and dyeing.

The conditions for producing hollow filaments are very delicate. On the extrusion of a viscose filament into a spinning bath, regenerated cellulose film is firstly formed around the outside of the filament and acid diffuses through this film into the inside to mix with the material therein and, reacting with sodium carbonate in the viscose, produces carbon dioxide, which forms gas cells since the evasion of the carbon dioxide is prevented by the outside film. Accordingly the conditions of the distribution and the nature of the gas cells may be varied greatly depending upon the condition and the rate of the formation of the outside film as well as the condition and the rate of the diffusion of the liquor of the bath. If the formation of the film is too slow or too quick and a thick film is formed, the formation of gas cells may not be achieved or become very irregular even if they are formed.

As an example showing the above, employing the conventional viscose having 8% cellulose concentration and 6.3% total alkalinity and added with 2.8% sodium carbonate on the basis of the amount of the viscose, spinning is carried out in the conventional spinning bath containing 10.5–10.7% sulfuric acid, 20–23% sodium sulfate and 1% zinc sulfate, and changing the temperature of the spinning bath and the coagulation value (Hottenroth value), the conditions of production of gas cells in a filament spun are illustrated in Figure 5. It is noted that gas cells are produced at the bath temperature over 60° C. with Hottenroth value in the range 10–10.5, but when the degree of ripeness of the viscose is increased or decreased, it is necessary to raise the bath temperature in order to obtain hollow filaments. The range of ripeness required for obtaining hollow filaments at the relatively low bath temperature depends upon the concentration of sulfuric acid of the spinning bath, and the higher the concentration is, the range of ripening moves to younger side while the lower the concentration is, it moves to older side. However, with Hottenroth value of higher than 11.5, it is necessary to make the sulfuric acid concentration higher than 11.5% and the size of gas cells produced becomes larger and the distribution thereof uneven to give undesirable result. On the other hand, with Hottenroth value of less than 9.0, production of gas cells will be lessened and therefore it is not desirable either.

When the amount of sodium carbonate added to viscose is increased or decreased, the domain for producing gas cells may be increased or decreased as a whole, while with sodium carbonate of less than 2.0% the production of gas cells is little even at the optimum domain for the production, while with the addition of sodium carbonate of more than 4%, the strength and the elongation of the filament is lowered although the production of gas cells is great and therefore neither of them is desirable.

In the followings, some examples of this invention will be described.

Example 1

To conventional viscose having 8% cellulose and 6.3% total alkalinity is added 2.5% sodium carbonate and is thoroughly dissolved. The viscose is ripened to Hottenroth value 10.5, and is spun into yarn of 150 denier composed of 30 filaments in a spinning bath containing 10.8% sulfuric acid, 22% sodium sulfate and 0.9% zinc sulfate at 63° C. with immersion length of 60 cm. at spinning speed of 65 m./min. Hollow filaments as shown in Figures 1 and 2 are produced that has numerous independent gas cells distributed therein and have cross sections like that of a lotus rhizome.

Its physical properties are as follows:

Dry tenacity	g./d.	1.8
Wet tenacity	g./d.	1.0
Dry elongation	percent	24.8
Wet elongation	do	34.2

Example 2

3% sodium carbonate is added to the same viscose as in Example 1 and the viscose is spun at Hottenroth value 11.0 in spinning bath containing 11.0% sulfuric acid, 21.5% sodium sulfate, and 1.2% zinc sulfate at 65° C., and hollow filaments similar to those in Example 1 are obtained.

Example 3

To viscose is added 2.5% ammonium carbonate, and the viscose is spun at Hottenroth value 9.5 in spinning bath containing 10.2% sulfuric acid, 22% sodium sulfate, and 0.7% zinc sulfate at 66° C. and similarly hollow filaments are obtained. In this instance, however, the size of the unit gas cell is somewhat larger than the cell of the preceding two examples and the number of the cells is less.

What is claimed is:

Process for producing hollow viscose rayon filaments comprising adding 2–4% carbonates to viscose, and spinning said viscose in the range of Hottenroth value 9–11.5 in a spinning bath of the composition containing 9–11.5% sulphuric acid, 18–25% sodium sulfate, and 0.6–1.5% zinc sulfate at temperature of over 60° C.

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