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PROCESS FOR CONTINUOUSLY HEATING, DRYING AND HEAT-SETTING TOWS OF FILAMENTS OF SYNTHETIC POLYMERS

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6 Claims

ABSTRACT OF THE DISCLOSURE

Heating, drying and heat-setting wet tows of filaments or fibers of synthetic polymers of high molecular weight in an electric high frequency field.

The present invention relates to a process for continuously heating, drying and heat-setting tows of filaments or fibers of synthetic polymers of high molecular weight.

In many cases fibrous materials consisting of or containing synthetic polymers of high molecular weight, such as polyesters, polyamides, polyolefins or polyacrylonitrile must be heated during that part of the manufacturing process which follows the spinning process, for example before, during or after the drawing process. The fibers can be heated with the aid of contact heating, for example on hot rotating rolls or drums, with hot gases or vapors, with air or with hot liquids or melts. All these processes enable, however, only relatively thin layers of fibers to be heated rapidly enough and, above all, uniformly so that the fibers must be used in a stretched or slightly expanded form. It is not possible to use these methods for uniformly heating, drying and heat-setting a bundle of fibers in which the individual fibers are crimped and pushed together and which has a thickness of one or even several centimeters. It is, therefore, not possible to crimp a tow of filaments in the wet state and to dry and heat-set it in the same state as it leaves the crimping chamber, that is to say without expanding or at least relaying it.

When a tow of filaments that has been crimped in the wet state must be dried and set after crimping a relatively long drying zone is required in which the tow is laid down in a slightly expanded state and dried with the aid of contact heating or hot gases, vapors or air.

The present invention provides a process for continuously heating, drying and heat-setting wet tows of filaments or fibers consisting of or containing synthetic polymers of high polymers of high molecular weight, such as polyesters, polyamides, polyolefins, or polyacrylonitrile, by passing said tows of filaments or fibers through an electric high frequency field. It is advantageous to use an electric high frequency field having an intensity in the range of from 0.2 to 5 kilovolts/centimeter and a frequency of 2 to 60 megacycles. It has proved particularly advantageous, however, to use an electric high frequency field having an intensity of 1 to 1.5 kilovolts/centimeter and a frequency of 5 to 25 megacycles. The process according to the invention is especially suitable for heating, drying and heat-setting tows of crimped filaments or fibers, respectively, which are wet as they have left the crimping chamber and are not expanded or laid down.

To carry out the process of the present invention the tows of filaments are continuously passed between the plates of a plate condenser at the speed of the processing line of the sliver. Between the plates of the plate condenser a strong electric alternating field is generated, preferably having a field strength of 0.2 to 5 kilovolts/centimeter, and more preferably of 1 to 1.5 kilovolts/centimeter. The frequency of the electric alternating field ranges of from 2 to 60 megacycles and advantageously 5 to 25 megacycles. The dielectric losses of wet tows of filaments involve a generation of heat within the tow of filaments. Thus the heat is not applied to the tow from the outside with formation of disturbing temperature gradients, but generated inside the tow itself.

The drying and heat-setting of wet tows of filaments according to the invention is especially advantageous when the tows contain 4 to 20% of water, calculated on the weight of the wet tows, prior to the high frequency treatment. Together with the proper absorption of the polymer, the amounts of humidity and treating agents always present in tows of filaments commonly considered to be dry provoke a dielectric absorption in the electric alternating field, so that also "dry" tows of filaments can be heated and, if desired, further dried and set. In this case, however, a longer time of treatment in the electric alternating field is required than for drying and heat-setting wet tows of filaments with a higher water content in the same electric alternating field.

As compared with the known process for drying wet tows of filaments before it enters the crimping chamber with subsequent crimping in the dry state and heat-setting of the slightly expanded tow, the process of the present invention offers the following advantages:

The processing line of the sliver can be essentially shortened because drying and heat-setting take place simultaneously and the tow of filaments is densely pushed together. In the dyeing process the simultaneity of drying and heat-setting involves a higher dyestuff absorption with otherwise identical textile properties. Owing to the wet crimping the closeness of the tow is improved. As the tow of filaments is not expanded after crimping a higher packing density in the container is obtained and simultaneously the discharge of the container, which is important for the further treatment, is improved.

In comparison with a wet crimping with subsequent drying by means of a contact heating or hot gases, vapors or air, the process according to the invention permits a considerable economy in space and in the case of wet and crimped tows of filaments a higher packing density in the container, because relaying and expanding are no longer necessary, and a better cohesion of the tow.

The process of the invention is not limited to tows of filaments of a definite size as the drying period at a given frequency substantially depends on the energy density of the electric field characterized by the electric field strength. Hence, it follows that with a sufficient power intensity of the generator the drying period does not increase with a higher amount of fibrous material to be dried per unit of time. The high frequency power of the generator required is hardly higher than that calculated from the specific heat of the fibrous material and of water and the vaporization heat of the water.

The following examples serve to illustrate the invention but they are not intended to limit it thereto.

EXAMPLE 1

(a) A tow of polyethylene terephthalate fibers having an individual titer of 3 deniers which, after spinning, had been shrunk by 41–42% at 97° C. was drawn in a ratio of 1:4.5 in superheated steam of about 190° C. The tow was then dried on drums of 90° C., the circumferential speed of which was equal to that of the tow, and crimped in the dry state. The bundle of fibers was then slightly expanded to form a wavy band and heat-setting was performed for 60 seconds in superheated steam having a temperature of 155–185° C. at the outlet of the steam (sample 1a).

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(b) A tow of polyethylene terephthalate fibers of the same nature as described above was likewise drawn in a ratio of 1:4.5 and then crimped in the wet state. After having left the crimping chamber the bundle of fibers contained 12% of humidity, calculated on the weight of the wet tow. The bundle of fibers having a cross section of about 40 x 120 mm. was exposed, in the state in which it left the crimping chamber, for 72 seconds to an electric alternating field of 16 megacycles and a field strength of 1.25 kilovolt/centimeter, whereby it was dried and simultaneously set (sample 1b).

20 grams of each sample were then treated for 30 minutes at 80° C. in 1 liter of water containing 0.6 g. (=3% of the sample weight) of disperse blue 56 (Color Index, 2nd edition (1956)) and 4 cc. of a carrier on the basis of o-phenyl-phenol.

The amount of dyestuff remaining in the bath was determined colorimetrically. The following dyestuff absorptions were found:

Sample—	Amount of dyestuff originally contained in the bath	Percent by weight
1a	-----	60
1b	-----	70

EXAMPLE 2

(a) A tow of polyethylene terephthalate fibers having an individual titer of 4 deniers, which had been shrunk by 38% at 97° C. after spinning, was drawn in a ratio of 1:4.5 in super-heated steam of about 190° C. The tow was subsequently dried on drums of 90° C., the circumferential speed of which was equal to the speed of the tow, and then crimped in the dry state. Heat setting of the tow in the form of a slightly wavy band was then performed for 60 seconds in superheated steam having a temperature of 155 to 185° C., measured at the steam outlet. The shrinking values are indicated in the following table under 2a.

(b) A tow of polyethylene terephthalate fibers of the type specified above was likewise drawn in a ratio of 1:4.5, crimped in the wet state and then passed through the high frequency condenser in the state in which it left the crimping chamber as a bundle having a cross section of about 40 x 120 mm. After crimping the tow had a degree of humidity of 7%, calculated on the weight of the

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moist tow. The applied field strength was 1.2 kilovolt/centimeter with a frequency of 16 megacycles. The tow remained in the condenser for 60 seconds. The shrinking values indicated under 2b reveal that besides drying a heat-setting analogous to 2a had taken place.

	Shrinkage at the boil, percent	Shrinkage at 200° C., percent
2a	0.2	7
2b	0.1	5

What is claimed is:

1. A process for continuously heating, drying, and heat-setting wet tows of filaments consisting of or containing synthetic polymers of high molecular weight, which comprises passing the tows of filaments continuously through an electric high frequency field said tows being in the wet and crimped state in which they leave a crimping chamber without being expanded or laid down.

2. The process of claim 1 wherein the tow is passed through the high frequency field at the speed of the processing line of the sliver.

3. The process of claim 1, wherein the synthetic polymers of high molecular weight are polyesters, polyamides, polyolefins or polyacrylonitrile.

4. The process of claim 1, wherein the electric high frequency field has a strength in the range of from 0.2 to 5 kilovolt/centimeter and a frequency ranging from 2 to 60 megacycles.

5. The process of claim 1, wherein the electric high frequency field has a strength of from 1 to 1.5 kilovolt/centimeter and a frequency ranging from 5 to 25 megacycles.

6. The process of claim 1, wherein the tows of filaments contain 4 to 20% of water, calculated on the weight of weight of the tows, before they are subjected to the high frequency treatment.

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