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METHOD OF PRODUCING CRIMPED FIBROUS MATERIAL

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ABSTRACT OF THE DISCLOSURE

A method for producing an improved crimped fibrous material comprising passing a fiber-formable polymer film over at least one edge crimping body under tension during or after subjecting the fiber-formable polymer to a uniaxial stretching step, splitting the film into crimpable fibrous material, then generating crimps in said fibrous material by heating or swelling.

The present invention relates to a method of producing improved fibrous material from a film or tape of a fiber-formable polymer, and more particularly the invention concerns a method of producing crimped fibrous material. The method comprises subjecting a fiber-formable polymer film or tape, during or after uniaxially stretching same, to a crimping step employing a particular edge crimping blade(s) and/or wire, and thereafter splitting the thus treated film or tape into crimpable fibrous material and generating crimps in this fibrous material by heating or swelling treatment, if necessary.

It has been proposed to produce textile fibers from a thin film or tape of such polymeric materials as polyethylene, polypropylene, polyamide, polyester, polyvinyl chloride and the like. In a conventional method, the polymer film is first uniaxially stretched and then split into fibrous material by using various methods such as, for example, brushing with a file-like surface, combing with needle-like projections, cutting with regularly oriented edge projections, twisting, rubbing or the like. Thusly prepared fibrous materials, however, are in general not suitable for use in textile purposes because of their poor crimping and bulkiness properties.

Accordingly, a principal object of the present invention is to provide a novel and effective method of producing improved fibrous material from a film or tape of fiber-formable polymer material.

Another object of the invention is to provide a method of producing high bulky and crimped fibrous material from fiber formable polymer film or tape.

Other objects and advantages will be apparent from the following description and the claims which follow.

The present invention is characterized by passing a fiber formable polymer film, during or after subjecting same to a uniaxial stretching step, over an edge crimping blade having a tip of a small radius of curvature and/or a wire of a small diameter at an acute angle to alter the shrinkage of the oriented film at both sides, and the film is, if desired after being subjected to a rapid cooling, split into fibrous material. In order to generate crimps,

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the split fibrous material obtained is heated or swollen in a conventional way.

In the case of a conventional multifilament bundle being passed over the edge crimping blade in usual way, each filament in the bundle cannot always be in contact with the blade to thereby give irregular crimping upon the filaments. However, in the present invention, when the film is first passed over the edge crimping blade to produce latent crimping and then split into fibrous material, excellent crimping of every split fiber can be evenly obtained, because the entire surface of one side of the film is evenly rubbed by the blade during the crimping stage. Furthermore, the present invention is characterized by producing excellent crimped split fibrous material at a lower cost and with a simpler procedure, as compared with a case employing the method comprising uniaxially stretching and splitting a laminated film of two different kinds of polymers.

Any of the known fiber-formable thermoplastic polymers may be satisfactorily employed in the present invention, including, for example, high density polyethylene, polypropylene, polyvinyl chloride, polyvinylidene chloride, polyacrylonitrile, polyvinyl alcohol, polyesters, polyamides, viscose rayon, acetate, and the like. These polymers may be formed into films by employing any of the known methods, e.g. melt, dry or wet process. The term "edge crimping method" employed herein refers to the method in which a polymer film is passed under tension over an edge having a tip of a small radius of curvature or a wire of a small diameter at an acute angle, at which angle the film approaches and leaves the edge or wire. In the present invention, said edge or wire may be of a fixed type or of a movable type including rotation type, but the edge tip or wire itself must be straight. The blades having a small radius of curvature as mentioned in U.S. Patent 3,346,931, Japanese patent publication 8867/55, 1700/58, 7149/60 and 8146/60 can be used. When using a wire instead of a blade edge, it is preferable to use such wire as results in approximately the equivalent effects and advantages as the blade body described above.

By acute angle is meant the angle between the in-coming and out-going film at the edge crimping blade or wire.

The present invention will be now described in detail with reference to the accompanying drawings, wherein FIG. 1 is a schematic view of one preferable apparatus employed in carrying out the present invention, illustrating the film being passed over the edge crimping blade in the course of stretching step, and FIG. 2 is a schematic view of another preferable apparatus, illustrating the film being passed over the edge crimping blade after stretching thereof.

In FIG. 1, unstretched tape 1 is fed to a pair of driving rolls 2 and stretched in a stretching bath 17 placed between rolls 2 and another pair of intermediate rolls 3. In this case, edge crimping blades 15 and 16 as well as guide rolls 7, 8, 9 and 10 are placed in the bath 17, and the film is rubbed under tension while being uniaxially stretched in this device. Thereafter, the film is sent to a round bar file 14 placed between rolls 3 and another pair

of rolls 4, whereby the film is rubbed and split into fibrous material. The angle at which the film approaches and leaves bar file 14 may be controlled by adjusting the positions of guide roll 12 placed between the rolls 3 and bar file 14, and of guide roll 13 placed between the file 14 and bar rolls 4, respectively. If desired, the fibrous material coming out of rolls 4 may be heated by a heating means 18 to generate crimps, and taken up onto bobbin 19 by means of take-up roll 5.

In another embodiment shown in FIG. 2, uniaxially stretched tape 21 is fed onto a pair of driving rolls 22, and then passed over the edge crimping blades 26 and 27 placed in a warm water bath 25 while maintaining appropriate tension of the film by controlling the speed of each of the driving rolls 22, the second driving rolls 24 and the intermediate rolls 23. Thereafter, the film is sent to a round bar file 29 placed between rolls 24 and another pair of rolls 31, whereby the film is rubbed and split into fibrous material. The angle at which the film approaches and leaves round bar file 29 may be controlled by adjusting the positions of guide roll 28 placed between rolls 24 and round bar file 29, and of guide roll 30 placed between round bar file 29 and rolls 31, respectively. If desired, the fibrous material coming out of the rolls 31 may be heated by a heating means 32 to generate crimps and taken up onto bobbin 34 by means of take-up roll 33. In the present invention, the stretching, when employed, may be of the wet type or dry type. In splitting the thus stretched, crimpable film into fibrous material, any of the known suitable methods may be employed, including, for example, brushing by a file-like surface, combing by needle-like projections, cutting by regularly-oriented edge projections, twisting or rubbing. Various of these methods are described in, for example, Japanese patent publications 9,092/57, 10,517/61, 5,819/62 and U.S. Patent No. 2,185,789.

Thus, in the present invention, film or tape of fiber formable polymer is, during or after being uniaxially stretched, passed over the edge crimping blade or wire of small diameter to give latent crimping to the film, and thereafter split into fibrous material. The fibrous material thus prepared is successively or afterwardly heated or swollen to generate crimps thereon. As already described, in the edge crimping method of the present invention, it is possible to employ either fixed type or movable type (including rotation type) of edge crimping blade or wire. However, in the practical sense, the following must be taken into account in carrying out said step. That is, since the crimping is most favorably effected at an elevated temperature, the edge or wire is preferably placed in a warm water bath or heated by an appropriate means.

Furthermore, in the crimping stage, the best results are obtained when the edge crimping blade or wire of small diameter is placed at right angle to the running direction of the film in a hot bath including water as a heating medium.

Many other modifications not mentioned in this specification may easily be made by those skilled in the art without departing from the spirit of the invention, which modifications are, however, all included within the scope of the present invention. The following examples are intended to illustrate the invention, but the present invention is not limited thereby in any way.

Example 1

A polypropylene film of $\frac{5}{100}$ mm. thickness and prepared by the so-called inflation method was slit into film tapes, of 40 mm. width, and the thusly prepared film tape was fed into the apparatus shown in FIG. 1. The temperature of stretching bath was maintained at 90° C., and the film tape was passed over the edge crimping blade having a $\frac{3}{100}$ mm. radius of curvature, at an angle of 30°, at which the tape approached and left the edge, to stretch the film to 7 times its original length.

Thereafter, the film tape was split by using a round bar file of 15 mm. diameter rotating at a surface velocity 5 times as fast as the running speed of the film, the angle, at which the film approached and left the file, being 90°, whereby split fibrous material was obtained, each fiber of the fibrous material having weak crimping and a net-work structure and being of mean size of 10–15 denier. Upon heating with 100° C. steam under no tension, excellent crimps were evenly generated in the fibers thus treated.

Example 2

Uniaxially stretched, high density polyethylene film tape (7 mm. in width and $\frac{2}{100}$ mm. in thickness) was fed into the apparatus shown in FIG. 2. This film tape was passed under tension over the edge crimping blades ($\frac{2}{100}$ mm. radius of curvature) placed in a hot water bath (90° C.), at an angle of 30°, at which the tape approached and left the edge. Thereafter, the film tape was split into fibrous material by sending it over a round bar file of 25 mm. diameter rotating at a surface velocity 5 times as fast as the running speed of the film, the angle at which the film approached and left the file being 90°, whereby split fibrous material was obtained, each fiber having a net-work structure and a mean size of 7–10 denier. After heating at 100° C. under no tension, the fibrous material was processed to give relatively mild twists (e.g. 30 twists per meter), whereby excellent, beautiful split fibrous material was obtained, each fiber having 15–25 crimps per 25 mm.

Example 3

A polymer tape prepared by the so-called wet-process from a copolymer consisting of 91% by weight of acrylonitrile and 9% by weight of methyl acrylate was stretched in one direction up to 12 times its original length in a hot water bath (97° C.) to give a uniaxially oriented film tape of 4 mm. in width and $\frac{2}{100}$ mm. in thickness. This tape was fed into the apparatus shown in FIG. 2, and treated in the manner described in Example 2. Excellent crimped split fibrous material was obtained the average denier of each fiber being 10–15 denier and the number of crimps per 25 mm. being 25–35. This product was characterized by having outstanding bulkiness.

When a file or similar device is used to brush the film or tape to obtain split fibrous material in the present invention, the crimping effect can be improved by brushing and splitting the same surface thereof.

What we claim is:

1. A method of producing a crimped fibrous material, said method comprising uniaxially stretching a film of a fiber-formable polymer in its longitudinal direction under heating while passing said film over at least one edge of a crimping body which is in linear contact with said film at an acute angle to form a stretched and crimpable film, splitting the thusly stretched and crimpable film into crimpable fibrous material and generating crimps in said fibrous material.

2. A method according to claim 1, wherein said heating is effected in a bath employing a heating medium.

3. A method according to claim 1, wherein said heating is effected by heating the crimping means over which said film is passed.

4. A method according to claim 1, wherein said edge is a blade edge.

5. A method according to claim 1, wherein the generation of crimps is effected by heating said fibrous material under a substantially tensionless state.

6. A method according to claim 1, wherein the generation of crimps is effected by swelling said fibrous material under a substantially tensionless state.

7. A method of producing a crimped fibrous material, said method comprising uniaxially stretching a film of a fiber-formable polymer in its longitudinal direction under heating, passing the thusly stretched film over a crimping means comprising at least one edge of a body in linear

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contact therewith at an acute angle to form a crimpable film splitting the thusly stretched and crimpable film into crimpable fibrous material and generating crimps in said fibrous material.

8. A method according to claim 7, wherein the stretched film is passed over the crimping means in a hot bath.

9. A method according to claim 7, wherein the crimping means over which the stretched film passes is heated.

10. A method according to claim 7, wherein said edge is a blade edge.

11. A method according to claim 7, wherein the generation of crimps is effected by heating said fibrous material under a substantially tensionless state.

12. A method according to claim 7, wherein the gen-

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eration of crimps is effected by swelling said fibrous material under a substantially tensionless state.

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