

DESCRIPTION

TITLE OF THE INVENTION

HOLLOW POLYESTER FILAMENT AND PREPARATION METHOD THEREFOR

5

TECHNICAL FIELD

The present invention relates to a hollow polyester filament of hollow crimped shape and a preparation method thereof, and the hollow filament is suitable for making filament type fiberfill.

10

BACKGROUND ART

In the textile industry, feathers and downs of waterfowls, such as goose down, duck down, etc., are usually filled in duvets, sleeping bags and various cold-proof and warmth retention products. Bird flu that has occurred worldwide has led to a sharp decline in the production of down, which has caused prices to rise. At the same time, consumers also have doubts about the safety of down. If the natural feathers are not adequately washed, it will cause bad odor. Therefore, it is necessary to remove the odor-causing dirt in advance and maintain the cleanliness of the feathers. Moreover, there are still problems in washing feather filling products, such as feather bedding, feather jackets and the like.

20

To this end, the industry is committed to the use of synthetic fibers instead of animal downs for filling. Chinese patent CN1861871A discloses a short-fiber type of down-like fiberfill, but the short-fiber fiberfill has low fluffiness, and a heat insulating material produced therefrom has a grainy feel when touched, while the short-fiber type down-like fiberfill is prone to shifting when washed. Therefore, there is an urgent need to develop a new type of filling material instead of down. Polyester fiber is easy to produce and has the advantage of low price. The development of polyester-based filling materials has a good market prospect.

25

SUMMARY

It is an object of the present disclosure to provide a hollow polyester filament having a three-dimensionally crimped shape, which is suitable for use in the production of filament type fiberfill, and a method for preparing the hollow polyester filament.

30

1a

In an aspect, there is provided a hollow polyester filament, wherein the filament has a cross-sectional hollowness ranging from 20.0% to 45.0%, and the filament has a three-dimensionally crimped shape in a natural state, and the crimped shape has a radius of curvature ranging from 10.0 mm to 50.0 mm.

5

The hollow polyester filament of the present disclosure has a cross-sectional

hollowness ranging from 20.0% to 45.0%, and the hollow polyester filament has a three-dimensionally crimped shape in a natural state, and the crimped shape has a radius of curvature ranging from 10.0 mm to 50.0 mm.

The hollow polyester filament of the present disclosure preferably has a
5 monofilament fineness ranging from 4.0 dtex to 15.0 dtex, and more preferably from 5.0 dtex to 10.0 dtex.

The hollow polyester filament of the present disclosure still has a three-dimensionally crimped shape after dry heat treatment at 160°C for 3 minutes, and has a radius of curvature in a crimped state ranging from 3.5 mm to 10.0 mm.

10 The hollow polyester filament of the present disclosure has a polymer raw material selected from the group consisting of polyethylene terephthalate, polytrimethylene terephthalate, polybutylene terephthalate or a modified polymer thereof.

The present disclosure also discloses a method for preparing the above-mentioned hollow polyester filament, wherein a dried chip is melt-extruded by a screw and then
15 conveyed to a metering pump through a pipe, the polymer accurately measured by the metering pump is conveyed to a spinning pack, a spinneret of the spinning pack is a hollow spinneret with a cooling distance ranging from 10 to 150 mm, and a wind speed of side blowing ranges from 25 to 90 m/min.

The cooling distance preferably ranges from 60 to 110 mm; and the wind speed of
20 the side blowing ranges from 30 to 50 m/min.

The hollow polyester filament of the present disclosure is obtained by a melt spinning process, has the advantages of simple production and low cost, and has a three-dimensional crimped structure, and is suitable for processing into a fluffy processed tow which can be used as filament type fiberfill.

25

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a view showing a triangular hollow cross-sectional shape of a hollow polyester filament.

FIG. 2 is a view showing a quadrangular hollow cross-sectional shape of a hollow
30 polyester filament.

FIG. 3 is a view showing a three-dimensionally crimped shape of a hollow polyester filament in a natural state.

FIG. 4 is a schematic view showing a measurement of a radius of curvature.

DESCRIPTION OF EMBODIMENTS

In order to develop a filler that can replace down, the present invention provides a hollow polyester filament suitable for processing into a fluffy processed tow. Since the hollow fiber has a structural feature of three-dimensionally crimped shape, the obtained fluffy processed tow also has a three-dimensional structure, so that the bulk of the fluffy tow is large, and a fluffy processed tow excellent in fluffiness can be obtained. In the fiber-forming polymers, the Young's modulus of the polyester fiber is relatively high, so that the obtained fluffy processed tow has good pressure resistance and recovery.

The three-dimensionally crimped shape means that the fiber exhibits an irregular spiral structure in the long direction (FIG. 3), and at the same time, due to the difference in alignment between a part of the monofilaments, the rotation mode and direction of the monofilaments are different so as to form a multi-dimensional stereoscopic form.

The hollow polyester filament of the present invention is a hollow fiber produced by melt spinning technique. The molten polyester chips are discharged through a profiled hollow spinneret and then coiled after side blow cooling to obtain the hollow polyester filament. In the process of melt spinning, the hollow fiber is controlled to have a hollowness ranging from 20.0% to 45.0% and a radius of curvature of the three-dimensionally crimped shape ranging from 10.0 mm to 50.0 mm by adjusting the position of the side blowing to change the cooling distance, adjusting the wind speed of the side blowing, and the spinning speed. Compared with a solid fiber with the same fiber diameter, the fluffy processed filament obtained by using the hollow fiber has a higher fluffiness, and the higher the hollowness is, the more obvious the light weight is. If the radius of curvature of the hollow fiber is too small, the cohesion between the filaments of the fiber is high, the fiber is not easy to be split during the processing of the fluffy tow, and the diameter of the ring formed by the fiber is small, which affects the fluffiness of the processed tow. On the other hand, if the crimp radius of the fiber is too large, the diameter of the ring formed by the fiber after being processed into a fluffy processed tow is too large, which may weaken or fail to reflect the original three-dimensional effect of the sheath fiber, and also affect the fluffiness of the processed tow.

According to the differences in the shape and arrangement of the hollow spinneret discharge holes, and the change of the production process, the obtained hollow fiber has a slightly different cross-section, and the hollow portion has a circular shape, an approximately triangular shape, an approximately square shape, an approximately pentagon shape, and the

like. At the same time, the number of holes in the hollow section is not limited to one hole.

The monofilament fineness of the hollow polyester filaments of the present invention is preferably in a range from 4.0 dtex to 15.0 dtex. As the raw material fiber for the fluffy processed tow, the higher the monofilament fineness of the fiber is, the better the rigidity of the fiber is, and meanwhile the better the fluffiness of the resulting fluffy tow is, and the better the pressure resistance and the recovery property are. However, if the diameter of the monofilament fiber is too large, it is not easy to be cooled during spinning, and the uniformity of the fiber is lowered, and the obtained fluffy tow has a hard hand feeling. Therefore, it is more preferable that the monofilament fineness of the hollow polyester filament is in a range from 5.0 dtex to 10.0 dtex.

The raw materials of the hollow polyester filaments of the present invention are mainly common polyesters such as polyethylene terephthalate, polytrimethylene terephthalate or polybutylene terephthalate. In order to impart a special function to the fluffy processed yarn, a modified copolymer of the above polymer, such as an antibacterial and anti-mite modified polymer, can also be used, and the same effect as the common polyester can be achieved in terms of fluffiness properties.

The hollow polyester filament is one of the raw materials for making fluffy processed tows for filling. The hollow polyester filament can be directly used as filament type fiberfill by directly combining N fibers into a fluffy processed tow, and can also be used in combination with other raw materials, such as a fiber which is slightly lower in melting point to be made into a blended fiber, and then used as filament type fiberfill. Alternatively, the blended fiber and the hollow polyester filament are subjected to core-sheathing and then partially melted to obtain a more excellent fluffy processed tow, which is then used as filament type fiberfill.

The hollow polyester filament of the present invention still has a three-dimensional shape after dry heat treatment at 160°C for 3 minutes. The crimped shape changes due to the thermal shrinkage of the fiber, and the radius of curvature is preferably in a range from 3.5 mm to 10.0 mm. In this case, even after the subsequent processing, the hollow polyester filament can maintain a fluffy three-dimensionally crimped shape, and is excellent in hand feeling, fluffiness, heat retention and the like.

The long-fiber hollow polyester filament of the present invention can be prepared by the following method, but is not limited to the method:

First, the raw material polyester chips are dried to reduce the water content of the polyester chips, improve the spinnability, and control the water content of the chips to be 50

ppm or less. The dried chips are spun by a general melt spinning method. The chips are melted by a screw or a hot plate and then conveyed to a metering pump through a pipe, and the melt polymer is accurately metered by the metering pump and then enters the spinning pack, wherein the spinneret used in the spinning pack is a spinneret dedicated to hollow fiber spinning. The polymer discharged from the spinneret is cooled, oiled and then coiled. In order to obtain a slightly crimped hollow fiber, the requirement for the cooling distance (the distance from the lower edge of the spinneret to the upper edge of the side-blowing for cooling) in the spinning process is relatively strict, and it is generally controlled within a range from 10 to 150 mm, preferably within a range from 60 to 100 mm. At the same time, in order to produce the difference between the structures on both sides of the hollow fiber, there is also limitation for the wind speed of the side blowing. According to the fiber type (total fineness and number of filaments), it is generally controlled within a range from 25 to 90 m/min, preferably from 30 to 50 m/min.

When the cooling distance is less than 10 mm, the polymer discharged from the spinneret is rapidly cooled, the asymmetric effect is obvious, the radius of curvature of the obtained fiber is too small, the cohesion between the fiber monofilaments is high, and the fluffing effect is affected, and at the same time the temperature of the spinneret is easily lowered to cause fiber breakage and thus the spinnability is not good. When the cooling distance is greater than 150 mm, the polymer discharged from the spinneret has been uniformly cooled to a certain extent. Even if forced cooling is then performed by the side blowing, the asymmetric effect is weakened, and the radius of curvature of the fiber is too large, which also affects the fluffing effect.

When the wind speed of the side blowing is less than 25 m/min, the asymmetric cooling effect is not obvious, and the radius of curvature of the fiber is too large. When the wind speed of the side blowing is greater than 90 m/min, the asymmetric effect is obvious, resulting in the curvature radius of the obtained fiber being too small, and excessive side blowing results in a large swing of the fiber, unstable spinning, and easy to appear floating monofilament and broken filament.

In order to prevent physical properties from differing between the filaments due to the difference in cooling, the arrangement of the spinneret discharge holes is preferably a "houndstooth" arrangement, which is often referred to as a diamond arrangement. Preferably, the spinning process mainly adopts a one-step spinning process, that is, spinning/stretching is completed simultaneously, that is, commonly known as FDY. However, it can also be

obtained by a two-step process, that is, a pre-oriented fiber is first obtained, which is commonly known as POY, and then subjected to a drawing process by an extension machine, which is commonly known as DT.

The hollow polyester filament of the present invention has a three-dimensional crimped structure, and at the same time, the fiber monofilament is relatively thick, and the fluffy processed tow obtained from the hollow filament has a high excluded volume, and has high fluffiness while having excellent compression resistance.

The test method involved in the present invention is as follows:

(1) Test method for total fineness and monofilament fineness

The total fineness test was performed according to the JIS L 1013:2010 standard, and the monofilament fineness was calculated by the total fineness and the number of filaments.

(2) Hollow rate

The hollow filament was cut into thin slices (i.e., fiber cross-section) in the cross sectional direction, which were then photographed under a normal optical microscope to a suitable magnification, and the area S_1 of the hollow portion and the area S_2 of the entire fiber (including the hollow portion) were calculated according to the photograph, then it was calculated as:

$$\text{Hollow ratio} = (S_1/S_2) \times 100\%.$$

(3) Test method for radius of curvature

Radius of curvature in a natural state: the yarn was passed through a scaler (for fineness measurement) to crimp the sample for 10 turns (1 m/turn), and then the sample to be tested was placed (suspended) for 8 hours or more in a constant temperature and humidity environment ($20^\circ\text{C} \times 65\% \text{ RH}$) to stabilize its state (FIG. 3), then the crimped part within 20 cm below the sample was selected to measure the radius, and 20 different places were selected for measurement and averaged, and the obtained data was the radius of curvature. The measuring instrument was a digital microscopy system (VHX-2000C) manufactured by KEYENCE. The magnification was 20 times, and the radius of curvature was measured by the calculation function of the radius of curvature in the software (FIG. 4). That is, the radius of curvature of the fibers was measured by three locations on the crimped fiber.

Curvature radius after dry heat treatment: the yarn was passed through a scaler (for fineness measurement) to crimp the sample for 10 turns, and then placed in a dryer for heat treatment. The treatment condition was $160^\circ\text{C} \times 3 \text{ min}$, and then the sample was placed in a

constant temperature and humidity environment for 4 hours or more, and finally the crimped part within 20 cm of the lower portion was selected to measure the radius, and 20 different places were selected for measurement and averaged, and the obtained data was the radius of curvature.

5 (4) Fluffiness

Test according to the IDFB method:

(i) Firstly, the sample to be tested was placed in an environment of $20^{\circ}\text{C} \times 65\% \text{ RH}$ for 8 hours or more, so that the sample to be tested was stabilized;

(ii) 30g of sample were weighted, manually shaken to a fluffy state, placed in a
10 measuring barrel and covered with a lid;

(iii) the weight plate was moved down to the highest point of contact with the sample, then the weight plate was released to make it fall freely, and it was started to measure time at the time of releasing the weight plate, and after 1 minute for stabilization, the height was read and recorded;

(iv) the lid was open to take out the sample, which was shaken again to the fluffy
15 state, placed in the measuring barrel and covered with the lid, and measured again according to step (iii), and the same method was repeatedly tested for 5 times;

(v) the fluffiness was calculated by calculating the average height of the 5 times of tests.

20 The contents of the present invention are explained below by way of examples, but the present invention is not limited to the contents listed in the examples.

Example 1:

As a raw material, semi-dull polyester chips (T200N manufactured by Toray Fibers
25 (Nantong) Co., Ltd.) were used, and the polyester chips were dried by a pre-crystallization dehumidifying dryer to have a water content of 39 ppm after drying. The dried chips were melted and extruded by a screw and conveyed to a metering pump through a pipe. The polymer accurately metered by the metering pump was conveyed to the spinning pack. The spinneret of the spinning pack was a hollow special spinneret with a cooling distance of 65
30 mm. The wind speed of the side blowing was 25 m/min, and the hollow polyester fiber was obtained through the DSD high-speed spinning process. The characteristics of the hollow fiber were as follows: a fiber type of 300T-20f, a triangular hollow cross-section, a hollowness of 20.0%, a monofilament fineness of 15.0 dtex, and a radius of curvature of 50.0 mm before

heat treatment, and a radius of curvature of 10.0 mm after dry heat treatment at 160°C for 3 minutes. The fiber was selected as the raw material for the sheath fiber and the core fiber and was fed by overfeeding at a ratio of sheath filament feeding speed/core filament feeding speed of 20 times, processed into core-sheath type fluffy filaments, and every 6 filaments were combined into one to obtain a fluffy processed tow, and the fluffiness of the fluffy processed tow was tested to be 390 inch³/30 g. See Table 1 for details.

Example 2:

As a raw material, semi-dull polyester chips (T200N manufactured by Toray Fibers (Nantong) Co., Ltd.) were used, and the polyester chips were dried by a pre-crystallization dehumidifying dryer to have a water content of 39 ppm after drying. The dried chips were melted and extruded by a screw and conveyed to a metering pump through a pipe. The polymer accurately metered by the metering pump was conveyed to the spinning pack. The spinneret of the spinning pack was a hollow special spinneret with a cooling distance of 65 mm. The wind speed of the side blowing was 40 m/min, and the hollow polyester fiber was obtained through the DSD high-speed spinning process. The characteristics of the hollow fiber were as follows: a fiber type of 150T-10f, a triangular hollow cross-section, a hollowness of 30.0%, a monofilament fineness of 15.0 dtex, and a radius of curvature of 42.0 mm before heat treatment, and a radius of curvature of 8.5 mm after dry heat treatment at 160°C for 3 minutes. The fiber was selected as the raw material for the sheath fiber and the core fiber and was fed by overfeeding at a ratio of sheath filament feeding speed/core filament feeding speed of 20 times, processed into core-sheath type fluffy filaments, and every 6 filaments were combined into one to obtain a fluffy processed tow, and the fluffiness of the fluffy processed tow was tested to be 600 inch³/30 g. See Table 1 for details.

Example 3:

As a raw material, semi-dull polyester chips (T200N manufactured by Toray Fibers (Nantong) Co., Ltd.) were used, and the polyester chips were dried by a pre-crystallization dehumidifying dryer to have a water content of 39 ppm after drying. The dried chips were melted and extruded by a screw and conveyed to a metering pump through a pipe. The polymer accurately metered by the metering pump was conveyed to the spinning pack. The spinneret of the spinning pack was a hollow special spinneret with a cooling distance of 65 mm. The wind speed of the side blowing was 40 m/min, and the hollow polyester fiber was

obtained through the DSD high-speed spinning process. The characteristics of the hollow fiber were as follows: a fiber type of 60T-4f, a triangular hollow cross-section, a hollowness of 45.0%, a monofilament fineness of 15.0 dtex, and a radius of curvature of 37.0 mm before heat treatment, and a radius of curvature of 7.0 mm after dry heat treatment at 160°C for 3 minutes. The fiber was selected as the raw material for the sheath fiber and the core fiber and was fed by overfeeding at a ratio of sheath filament feeding speed/core filament feeding speed of 20 times, processed into core-sheath type fluffy filaments, and every 6 filaments were combined into one to obtain a fluffy processed tow, and the fluffiness of the fluffy processed tow was tested to be 800 inch³/30 g. See Table 1 for details.

Example 4:

As a raw material, semi-dull polyester chips (T200N manufactured by Toray Fibers (Nantong) Co., Ltd.) were used, and the polyester chips were dried by a pre-crystallization dehumidifying dryer to have a water content of 39 ppm after drying. The dried chips were melted and extruded by a screw and conveyed to a metering pump through a pipe. The polymer accurately metered by the metering pump was conveyed to the spinning pack. The spinneret of the spinning pack was a hollow special spinneret with a cooling distance of 65 mm. The wind speed of the side blowing was 35 m/min, and the hollow polyester fiber was obtained through the DSD high-speed spinning process. The characteristics of the hollow fiber were as follows: a fiber type of 100T-10f, a triangular hollow cross-section, a hollowness of 30.0%, a monofilament fineness of 10.0 dtex, and a radius of curvature of 40.0 mm before heat treatment, and a radius of curvature of 7.8 mm after dry heat treatment at 160°C for 3 minutes. The fiber was selected as the raw material for the sheath fiber and the core fiber and was fed by overfeeding at a ratio of sheath filament feeding speed/core filament feeding speed of 20 times, processed into core-sheath type fluffy filaments, and every 6 filaments were combined into one to obtain a fluffy processed tow, and the fluffiness of the fluffy processed tow was tested to be 650 inch³/30 g. See Table 1 for details.

Example 5:

As a raw material, semi-dull polyester chips (T200N manufactured by Toray Fibers (Nantong) Co., Ltd.) were used, and the polyester chips were dried by a pre-crystallization dehumidifying dryer to have a water content of 39 ppm after drying. The dried chips were melted and extruded by a screw and conveyed to a metering pump through a pipe. The

polymer accurately metered by the metering pump was conveyed to the spinning pack. The spinneret of the spinning pack was a hollow special spinneret with a cooling distance of 65 mm. The wind speed of the side blowing was 50 m/min, and the hollow polyester fiber was obtained through the DSD high-speed spinning process. The characteristics of the hollow fiber were as follows: a fiber type of 100T-20f, a triangular hollow cross-section, a hollowness of 30.0%, a monofilament fineness of 5.0 dtex, and a radius of curvature of 35.0 mm before heat treatment, and a radius of curvature of 6.5 mm after dry heat treatment at 160°C for 3 minutes. The fiber was selected as the raw material for the sheath fiber and the core fiber and was fed by overfeeding at a ratio of sheath filament feeding speed/core filament feeding speed of 20 times, processed into core-sheath type fluffy filaments, and every 6 filaments were combined into one to obtain a fluffy processed tow, and the fluffiness of the fluffy processed tow was tested to be 610 inch³/30 g. See Table 1 for details.

Example 6:

As a raw material, semi-dull polyester chips (T200N manufactured by Toray Fibers (Nantong) Co., Ltd.) were used, and the polyester chips were dried by a pre-crystallization dehumidifying dryer to have a water content of 39 ppm after drying. The dried chips were melted and extruded by a screw and conveyed to a metering pump through a pipe. The polymer accurately metered by the metering pump was conveyed to the spinning pack. The spinneret of the spinning pack was a hollow special spinneret with a cooling distance of 65 mm. The wind speed of the side blowing was 75 m/min, and the hollow polyester fiber was obtained through the DSD high-speed spinning process. The characteristics of the hollow fiber were as follows: a fiber type of 60T-15f, a triangular hollow cross-section, a hollowness of 45.0%, a monofilament fineness of 4.0 dtex, and a radius of curvature of 10.0 mm before heat treatment, and a radius of curvature of 3.5 mm after dry heat treatment at 160°C for 3 minutes. The fiber was selected as the raw material for the sheath fiber and the core fiber and was fed by overfeeding at a ratio of sheath filament feeding speed/core filament feeding speed of 20 times, processed into core-sheath type fluffy filaments, and every 6 filaments were combined into one to obtain a fluffy processed tow, and the fluffiness of the fluffy processed tow was tested to be 480 inch³/30 g. See Table 1 for details.

Example 7:

As a raw material, semi-dull polyester chips (T200N manufactured by Toray Fibers

(Nantong) Co., Ltd.) were used, and the polyester chips were dried by a pre-crystallization dehumidifying dryer to have a water content of 39 ppm after drying. The dried chips were melted and extruded by a screw and conveyed to a metering pump through a pipe. The polymer accurately metered by the metering pump was conveyed to the spinning pack. The spinneret of the spinning pack was a hollow special spinneret with a cooling distance of 65 mm. The wind speed of the side blowing was 70 m/min, and the hollow polyester fiber was obtained through the DSD high-speed spinning process. The characteristics of the hollow fiber were as follows: a fiber type of 65T-10f, a triangular hollow cross-section, a hollowness of 30.0%, a monofilament fineness of 6.5 dtex, and a radius of curvature of 30.0 mm before heat treatment, and a radius of curvature of 6.0 mm after dry heat treatment at 160°C for 3 minutes. The fiber was selected as the raw material for the sheath fiber and the core fiber and was fed by overfeeding at a ratio of sheath filament feeding speed/core filament feeding speed of 20 times, processed into core-sheath type fluffy filaments, and every 6 filaments were combined into one to obtain a fluffy processed tow, and the fluffiness of the fluffy processed tow was tested to be 580 inch³/30 g. See Table 1 for details.

Example 8:

As a raw material, semi-dull polyester chips (T200N manufactured by Toray Fibers (Nantong) Co., Ltd.) were used, and the polyester chips were dried by a pre-crystallization dehumidifying dryer to have a water content of 39 ppm after drying. The dried chips were melted and extruded by a screw and conveyed to a metering pump through a pipe. The polymer accurately metered by the metering pump was conveyed to the spinning pack. The spinneret of the spinning pack was a hollow special spinneret with a cooling distance of 65 mm. The wind speed of the side blowing was 70 m/min, and the hollow polyester fiber was obtained through the DSD high-speed spinning process. The characteristics of the hollow fiber were as follows: a fiber type of 50T-10f, a triangular hollow cross-section, a hollowness of 30.0%, a monofilament fineness of 5.0 dtex, and a radius of curvature of 20.0 mm before heat treatment, and a radius of curvature of 4.5 mm after dry heat treatment at 160°C for 3 minutes. The fiber was selected as the raw material for the sheath fiber and the core fiber and was fed by overfeeding at a ratio of sheath filament feeding speed/core filament feeding speed of 20 times, processed into core-sheath type fluffy filaments, and every 6 filaments were combined into one to obtain a fluffy processed tow, and the fluffiness of the fluffy processed tow was tested to be 520 inch³/30 g. See Table 1 for details.

Example 9:

As a raw material, semi-dull polyester chips (T200N manufactured by Toray Fibers (Nantong) Co., Ltd.) were used, and the polyester chips were dried by a pre-crystallization dehumidifying dryer to have a water content of 39 ppm after drying. The dried chips were melted and extruded by a screw and conveyed to a metering pump through a pipe. The polymer accurately metered by the metering pump was conveyed to the spinning pack. The spinneret of the spinning pack was a hollow special spinneret with a cooling distance of 65 mm. The wind speed of the side blowing was 25 m/min, and the hollow polyester fiber was obtained through the DSD high-speed spinning process. The characteristics of the hollow fiber were as follows: a fiber type of 60T-4f, a quadrangular hollow cross-section, a hollowness of 45.0%, a monofilament fineness of 15.0 dtex, and a radius of curvature of 42.0 mm before heat treatment, and a radius of curvature of 8.1 mm after dry heat treatment at 160°C for 3 minutes. The fiber was selected as the raw material for the sheath fiber and the core fiber and was fed by overfeeding at a ratio of sheath filament feeding speed/core filament feeding speed of 20 times, processed into core-sheath type fluffy filaments, and every 6 filaments were combined into one to obtain a fluffy processed tow, and the fluffiness of the fluffy processed tow was tested to be 760 inch³/30 g. See Table 1 for details.

Example 10:

As a raw material, conventional polytrimethylene terephthalate chips (i.e., common 3GT) were used, and the polytrimethylene terephthalate was dried by a pre-crystallization dehumidifying dryer to have a water content of 30 ppm after drying. The dried chips were melted and extruded by a screw and conveyed to a metering pump through a pipe. The polymer accurately metered by the metering pump was conveyed to the spinning pack. The spinneret of the spinning pack was a hollow special spinneret with a cooling distance of 65 mm. The wind speed of the side blowing was 35 m/min, and the hollow polyester fiber was obtained through the DSD high-speed spinning process. The characteristics of the hollow fiber were as follows: a fiber type of 100T-10f, a triangular hollow cross-section, a hollowness of 30.0%, a monofilament fineness of 10.0 dtex, and a radius of curvature of 38.0 mm before heat treatment, and a radius of curvature of 7.5 mm after dry heat treatment at 160°C for 3 minutes. The fiber was selected as the raw material for the sheath fiber and the core fiber and was fed by overfeeding at a ratio of sheath filament feeding speed/core filament feeding speed

of 20 times, processed into core-sheath type fluffy filaments, and every 6 filaments were combined into one to obtain a fluffy processed tow, and the fluffiness of the fluffy processed tow was tested to be 630 inch³/30 g. See Table 1 for details.

5 Example 11:

As a raw material, conventional polybutylene terephthalate chips (i.e., common PBT) were used, and the polybutylene terephthalate was dried by a pre-crystallization dehumidifying dryer to have a water content of 33 ppm after drying. The dried chips were melted and extruded by a screw and conveyed to a metering pump through a pipe. The polymer accurately metered by the metering pump was conveyed to the spinning pack. The spinneret of the spinning pack was a hollow special spinneret with a cooling distance of 65 mm. The wind speed of the side blowing was 35 m/min, and the hollow polyester fiber was obtained through the DSD high-speed spinning process. The characteristics of the hollow fiber were as follows: a fiber type of 100T-10f, a triangular hollow cross-section, a hollowness of 30.0%, a monofilament fineness of 10.0 dtex, and a radius of curvature of 36.0 mm before heat treatment, and a radius of curvature of 7.0 mm after dry heat treatment at 160°C for 3 minutes. The fiber was selected as the raw material for the sheath fiber and the core fiber and was fed by overfeeding at a ratio of sheath filament feeding speed/core filament feeding speed of 20 times, processed into core-sheath type fluffy filaments, and every 6 filaments were combined into one to obtain a fluffy processed tow, and the fluffiness of the fluffy processed tow was tested to be 600 inch³/30 g. See Table 2 for details.

Example 12:

As a raw material, cationic modified polyethylene terephthalate chips were used, and the cationic modified polyethylene terephthalate was dried by a pre-crystallization dehumidifying dryer to have a water content of 30 ppm after drying. The dried chips were melted and extruded by a screw and conveyed to a metering pump through a pipe. The polymer accurately metered by the metering pump was conveyed to the spinning pack. The spinneret of the spinning pack was a hollow special spinneret with a cooling distance of 65 mm. The wind speed of the side blowing was 35 m/min, and the hollow polyester fiber was obtained through the DSD high-speed spinning process. The characteristics of the hollow fiber were as follows: a fiber type of 100T-10f, a triangular hollow cross-section, a hollowness of 33.0%, a monofilament fineness of 10.0 dtex, and a radius of curvature of 33.0 mm before

heat treatment, and a radius of curvature of 6.4 mm after dry heat treatment at 160°C for 3 minutes. The fiber was selected as the raw material for the sheath fiber and the core fiber and was fed by overfeeding at a ratio of sheath filament feeding speed/core filament feeding speed of 20 times, processed into core-sheath type fluffy filaments, and every 6 filaments were combined into one to obtain a fluffy processed tow, and the fluffiness of the fluffy processed tow was tested to be 610 inch³/30 g. See Table 2 for details.

Example 13:

As a raw material, semi-dull polyester chips (T200N manufactured by Toray Fibers (Nantong) Co., Ltd.) were used, and the polyester chips were dried by a pre-crystallization dehumidifying dryer to have a water content of 39 ppm after drying. The dried chips were melted and extruded by a screw and conveyed to a metering pump through a pipe. The polymer accurately metered by the metering pump was conveyed to the spinning pack. The spinneret of the spinning pack was a hollow special spinneret with a cooling distance of 10 mm. The wind speed of the side blowing was 35 m/min, and the hollow polyester fiber was obtained through the DSD high-speed spinning process. The characteristics of the hollow fiber were as follows: a fiber type of 100T-10f, a triangular hollow cross-section, a hollowness of 40.0%, a monofilament fineness of 10.0 dtex, and a radius of curvature of 12.0 mm before heat treatment, and a radius of curvature of 3.6 mm after dry heat treatment at 160°C for 3 minutes. The fiber was selected as the raw material for the sheath fiber and the core fiber and was fed by overfeeding at a ratio of sheath filament feeding speed/core filament feeding speed of 20 times, processed into core-sheath type fluffy filaments, and every 6 filaments were combined into one to obtain a fluffy processed tow, and the fluffiness of the fluffy processed tow was tested to be 490 inch³/30 g. See Table 2 for details.

Example 14:

As a raw material, semi-dull polyester chips (T200N manufactured by Toray Fibers (Nantong) Co., Ltd.) were used, and the polyester chips were dried by a pre-crystallization dehumidifying dryer to have a water content of 39 ppm after drying. The dried chips were melted and extruded by a screw and conveyed to a metering pump through a pipe. The polymer accurately metered by the metering pump was conveyed to the spinning pack. The spinneret of the spinning pack was a hollow special spinneret with a cooling distance of 60 mm. The wind speed of the side blowing was 35 m/min, and the hollow polyester fiber was

obtained through the DSD high-speed spinning process. The characteristics of the hollow fiber were as follows: a fiber type of 100T-10f, a triangular hollow cross-section, a hollowness of 37.0%, a monofilament fineness of 10.0 dtex, and a radius of curvature of 30.0 mm before heat treatment, and a radius of curvature of 6.1 mm after dry heat treatment at 160°C for 3 minutes. The fiber was selected as the raw material for the sheath fiber and the core fiber and was fed by overfeeding at a ratio of sheath filament feeding speed/core filament feeding speed of 20 times, processed into core-sheath type fluffy filaments, and every 6 filaments were combined into one to obtain a fluffy processed tow, and the fluffiness of the fluffy processed tow was tested to be 600 inch³/30 g. See Table 2 for details.

Example 15:

As a raw material, semi-dull polyester chips (T200N manufactured by Toray Fibers (Nantong) Co., Ltd.) were used, and the polyester chips were dried by a pre-crystallization dehumidifying dryer to have a water content of 39 ppm after drying. The dried chips were melted and extruded by a screw and conveyed to a metering pump through a pipe. The polymer accurately metered by the metering pump was conveyed to the spinning pack. The spinneret of the spinning pack was a hollow special spinneret with a cooling distance of 90 mm. The wind speed of the side blowing was 35 m/min, and the hollow polyester fiber was obtained through the DSD high-speed spinning process. The characteristics of the hollow fiber were as follows: a fiber type of 100T-10f, a triangular hollow cross-section, a hollowness of 32.0%, a monofilament fineness of 10.0 dtex, and a radius of curvature of 34.0 mm before heat treatment, and a radius of curvature of 9.5 mm after dry heat treatment at 160°C for 3 minutes. The fiber was selected as the raw material for the sheath fiber and the core fiber and was fed by overfeeding at a ratio of sheath filament feeding speed/core filament feeding speed of 20 times, processed into core-sheath type fluffy filaments, and every 6 filaments were combined into one to obtain a fluffy processed tow, and the fluffiness of the fluffy processed tow was tested to be 720 inch³/30 g. See Table 2 for details.

Example 16:

As a raw material, semi-dull polyester chips (T200N manufactured by Toray Fibers (Nantong) Co., Ltd.) were used, and the polyester chips were dried by a pre-crystallization dehumidifying dryer to have a water content of 39 ppm after drying. The dried chips were melted and extruded by a screw and conveyed to a metering pump through a pipe. The

polymer accurately metered by the metering pump was conveyed to the spinning pack. The spinneret of the spinning pack was a hollow special spinneret with a cooling distance of 110 mm. The wind speed of the side blowing was 35 m/min, and the hollow polyester fiber was obtained through the DSD high-speed spinning process. The characteristics of the hollow fiber were as follows: a fiber type of 100T-10f, a triangular hollow cross-section, a hollowness of 30.0%, a monofilament fineness of 10.0 dtex, and a radius of curvature of 38.0 mm before heat treatment, and a radius of curvature of 12.5 mm after dry heat treatment at 160°C for 3 minutes. The fiber was selected as the raw material for the sheath fiber and the core fiber and was fed by overfeeding at a ratio of sheath filament feeding speed/core filament feeding speed of 20 times, processed into core-sheath type fluffy filaments, and every 6 filaments were combined into one to obtain a fluffy processed tow, and the fluffiness of the fluffy processed tow was tested to be 620 inch³/30 g. See Table 2 for details.

Example 17:

As a raw material, semi-dull polyester chips (T200N manufactured by Toray Fibers (Nantong) Co., Ltd.) were used, and the polyester chips were dried by a pre-crystallization dehumidifying dryer to have a water content of 39 ppm after drying. The dried chips were melted and extruded by a screw and conveyed to a metering pump through a pipe. The polymer accurately metered by the metering pump was conveyed to the spinning pack. The spinneret of the spinning pack was a hollow special spinneret with a cooling distance of 150 mm. The wind speed of the side blowing was 35 m/min, and the hollow polyester fiber was obtained through the DSD high-speed spinning process. The characteristics of the hollow fiber were as follows: a fiber type of 100T-10f, a triangular hollow cross-section, a hollowness of 25.0%, a monofilament fineness of 10.0 dtex, and a radius of curvature of 44.0 mm before heat treatment, and a radius of curvature of 14.5 mm after dry heat treatment at 160°C for 3 minutes. The fiber was selected as the raw material for the sheath fiber and the core fiber and was fed by overfeeding at a ratio of sheath filament feeding speed/core filament feeding speed of 20 times, processed into core-sheath type fluffy filaments, and every 6 filaments were combined into one to obtain a fluffy processed tow, and the fluffiness of the fluffy processed tow was tested to be 550 inch³/30 g. See Table 2 for details.

Example 18:

As a raw material, semi-dull polyester chips (T200N manufactured by Toray Fibers

(Nantong) Co., Ltd.) were used, and the polyester chips were dried by a pre-crystallization dehumidifying dryer to have a water content of 39 ppm after drying. The dried chips were melted and extruded by a screw and conveyed to a metering pump through a pipe. The polymer accurately metered by the metering pump was conveyed to the spinning pack. The spinneret of the spinning pack was a hollow special spinneret with a cooling distance of 65 mm. The wind speed of the side blowing was 90 m/min, and the hollow polyester fiber was obtained through the DSD high-speed spinning process. The characteristics of the hollow fiber were as follows: a fiber type of 100T-10f, a triangular hollow cross-section, a hollowness of 35.0%, a monofilament fineness of 10.0 dtex, and a radius of curvature of 18.0 mm before heat treatment, and a radius of curvature of 3.9 mm after dry heat treatment at 160°C for 3 minutes. The fiber was selected as the raw material for the sheath fiber and the core fiber and was fed by overfeeding at a ratio of sheath filament feeding speed/core filament feeding speed of 20 times, processed into core-sheath type fluffy filaments, and every 6 filaments were combined into one to obtain a fluffy processed tow, and the fluffiness of the fluffy processed tow was tested to be 510 inch³/30 g. See Table 2 for details.

Example 19:

As a raw material, semi-dull polyester chips (T200N manufactured by Toray Fibers (Nantong) Co., Ltd.) were used, and the polyester chips were dried by a pre-crystallization dehumidifying dryer to have a water content of 39 ppm after drying. The dried chips were melted and extruded by a screw and conveyed to a metering pump through a pipe. The polymer accurately metered by the metering pump was conveyed to the spinning pack. The spinneret of the spinning pack was a hollow special spinneret with a cooling distance of 65 mm. The wind speed of the side blowing was 50 m/min, and the hollow polyester fiber was obtained through the DSD high-speed spinning process. The characteristics of the hollow fiber were as follows: a fiber type of 100T-10f, a triangular hollow cross-section, a hollowness of 28.0%, a monofilament fineness of 10.0 dtex, and a radius of curvature of 28.0 mm before heat treatment, and a radius of curvature of 4.5 mm after dry heat treatment at 160°C for 3 minutes. The fiber was selected as the raw material for the sheath fiber and the core fiber and was fed by overfeeding at a ratio of sheath filament feeding speed/core filament feeding speed of 20 times, processed into core-sheath type fluffy filaments, and every 6 filaments were combined into one to obtain a fluffy processed tow, and the fluffiness of the fluffy processed tow was tested to be 530 inch³/30 g. See Table 2 for details.

Comparative example 1:

As a raw material, semi-dull polyester chips (T200N manufactured by Toray Fibers (Nantong) Co., Ltd.) were used, and the polyester chips were dried by a pre-crystallization dehumidifying dryer to have a water content of 39 ppm after drying. The dried chips were melted and extruded by a screw and conveyed to a metering pump through a pipe. The polymer accurately metered by the metering pump was conveyed to the spinning pack. The spinneret of the spinning pack was a common round hole spinneret with a cooling distance of 65 mm. The wind speed of the side blowing was 25 m/min, and the polyester fiber was obtained through the DSD high-speed spinning process. The characteristics of the fiber were as follows: a fiber type of 56T-24f, a solid circular cross-section, a monofilament fineness of 2.3 dtex, and no crimping property before and after heat treatment. The fiber was selected as the raw material for the sheath fiber and the core fiber and was fed by overfeeding at a ratio of sheath filament feeding speed/core filament feeding speed of 20 times, processed into core-sheath type fluffy filaments, and every 6 filaments were combined into one to obtain a fluffy processed tow, and the fluffiness of the fluffy processed tow was tested to be 240 inch³/30 g. See Table 3 for details.

Since the cross-section of the fiber was solid, the obtained fiber did not have curl, had a small fluffiness, and was not suitable for use as fiberfill instead of feather.

Comparative example 2:

As a raw material, semi-dull polyester chips (T200N manufactured by Toray Fibers (Nantong) Co., Ltd.) were used, and the polyester chips were dried by a pre-crystallization dehumidifying dryer to have a water content of 39 ppm after drying. The dried chips were melted and extruded by a screw and conveyed to a metering pump through a pipe. The polymer accurately metered by the metering pump was conveyed to the spinning pack. The spinneret of the spinning pack was a hollow special spinneret with a cooling distance of 90 mm. The wind speed of the side blowing was 35 m/min, and the hollow polyester fiber was obtained through the DSD high-speed spinning process. The characteristics of the hollow fiber were as follows: a fiber type of 100T-10f, a triangular hollow cross-section, a hollowness of 10.0%, a monofilament fineness of 10.0 dtex, and a radius of curvature of 40.0 mm before heat treatment, and a radius of curvature of 10.0 mm after dry heat treatment at 160°C for 3 minutes. The fiber was selected as the raw material for the sheath fiber and the core fiber and

was fed by overfeeding at a ratio of sheath filament feeding speed/core filament feeding speed of 20 times, processed into core-sheath type fluffy filaments, and every 6 filaments were combined into one to obtain a fluffy processed tow, and the fluffiness of the fluffy processed tow was tested to be 310 inch³/30 g. See Table 3 for details.

- 5 Since the hollowness of the fiber was too small, although it had a radius of curvature, it was not light in weight and had a small fluffiness, and was not suitable for use as fiberfill instead of feather.

Comparative example 3:

- 10 As a raw material, semi-dull polyester chips (T200N manufactured by Toray Fibers (Nantong) Co., Ltd.) were used, and the polyester chips were dried by a pre-crystallization dehumidifying dryer to have a water content of 39 ppm after drying. The dried chips were melted and extruded by a screw and conveyed to a metering pump through a pipe. The polymer accurately metered by the metering pump was conveyed to the spinning pack. The
15 spinneret of the spinning pack was a hollow special spinneret with a cooling distance of 5 mm. The wind speed of the side blowing was 35 m/min, and spinning was performed through the DSD high-speed spinning process. Since the cooling distance was too short, although the spinning could be performed, the phenomenon of broken filaments and floating filaments was serious, and the feasibility of production was low. See Table 3 for details.

20

Comparative example 4:

- As a raw material, semi-dull polyester chips (T200N manufactured by Toray Fibers (Nantong) Co., Ltd.) were used, and the polyester chips were dried by a pre-crystallization dehumidifying dryer to have a water content of 39 ppm after drying. The dried chips were
25 melted and extruded by a screw and conveyed to a metering pump through a pipe. The polymer accurately metered by the metering pump was conveyed to the spinning pack. The spinneret of the spinning pack was a hollow special spinneret with a cooling distance of 65 mm. The wind speed of the side blowing was 110 m/min, and spinning was performed through the DSD high-speed spinning process. Since the wind speed of the side blowing was
30 too fast, although the spinning could be performed, serious fiber vibration led to serious broken filaments and floating filaments, and the feasibility of production was low. See Table 3 for details.

Comparative example 5:

As a raw material, semi-dull polyester chips (T200N manufactured by Toray Fibers (Nantong) Co., Ltd.) were used, and the polyester chips were dried by a pre-crystallization dehumidifying dryer to have a water content of 39 ppm after drying. The dried chips were melted and extruded by a screw and conveyed to a metering pump through a pipe. The polymer accurately metered by the metering pump was conveyed to the spinning pack. The spinneret of the spinning pack was a hollow special spinneret with a cooling distance of 200 mm. The wind speed of the side blowing was 70 m/min, and the hollow polyester fiber was obtained through the DSD high-speed spinning process. The characteristics of the hollow fiber were as follows: a fiber type of 100T-10f, a triangular hollow cross-section, a hollowness of 15.0%, a monofilament fineness of 10.0 dtex, and a radius of curvature of 65.0 mm before heat treatment, and a radius of curvature of 23.0 mm after dry heat treatment at 160°C for 3 minutes. The fiber was selected as the raw material for the sheath fiber and the core fiber and was fed by overfeeding at a ratio of sheath filament feeding speed/core filament feeding speed of 20 times, processed into core-sheath type fluffy filaments, and every 6 filaments were combined into one to obtain a fluffy processed tow, and the fluffiness of the fluffy processed tow was tested to be 350 inch³/30 g. See Table 3 for details.

Since the cooling distance was too large, the radius of curvature of the obtained fiber was too large to reflect the three-dimensional effect of the fiber, resulting in small fluffiness.

Comparative example 6:

As a raw material, semi-dull polyester chips (T200N manufactured by Toray Fibers (Nantong) Co., Ltd.) were used, and the polyester chips were dried by a pre-crystallization dehumidifying dryer to have a water content of 39 ppm after drying. The dried chips were melted and extruded by a screw and conveyed to a metering pump through a pipe. The polymer accurately metered by the metering pump was conveyed to the spinning pack. The spinneret of the spinning pack was a hollow special spinneret with a cooling distance of 65 mm. The wind speed of the side blowing was 20 m/min, and the hollow polyester fiber was obtained through the DSD high-speed spinning process. The characteristics of the hollow fiber were as follows: a fiber type of 100T-10f, a triangular hollow cross-section, a hollowness of 12.0%, a monofilament fineness of 10.0 dtex, and a radius of curvature of 55.0 mm before heat treatment, and a radius of curvature of 20.0 mm after dry heat treatment at 160°C for 3

minutes. The fiber was selected as the raw material for the sheath fiber and the core fiber and was fed by overfeeding at a ratio of sheath filament feeding speed/core filament feeding speed of 20 times, processed into core-sheath type fluffy filaments, and every 6 filaments were combined into one to obtain a fluffy processed tow, and the fluffiness of the fluffy processed tow was tested to be 350 inch³/30 g. See Table 3 for details.

Since the wind speed of the side blowing was too small, the radius of curvature of the obtained fiber was too large to reflect the three-dimensional effect of the fiber, resulting in small fluffiness.

Table 1

Item		Example 1	Example 2	Example 3	Example 4	Example 5	Example 6	Example 7	Example 8	Example 9	Example 10
Main process of spinning	Polymer	Common PET	Common PET	Common PET	Common PET	Common PET	Common PET	Common PET	Common PET	Common PET	Common 3GT
	Spinneret form	Hollow	Hollow	Hollow	Hollow	Hollow	Hollow	Hollow	Hollow	Hollow	Hollow
	Cooling distance (mm)	65	65	65	65	65	65	65	65	65	65
	wind speed of side blowing (m/min)	25	40	40	35	50	75	70	70	25	35
Fiber properties	Cross-section form	Hollow	Hollow	Hollow	Hollow	Hollow	Hollow	Hollow	Hollow	Hollow	Hollow
	Shape of hollow part	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Quadrangular	Triangular
	Fiber variety	300T-20f	150T-10f	60T-4f	100T-10f	100-20f	60T-15f	65T-10f	50T-10f	60T-4f	100T-10f
	Hollowness (%)	20.0	30.0	45.0	30.0	30.0	45.0	30.0	30.0	45.0	30.0
	Monofilament fineness (dtex)	15.0	15.0	15.0	10.0	5.0	4.0	6.5	5.0	15.0	10.0
	Radius of curvature (mm)	50.0	42.0	37.0	40.0	35.0	10.0	30.0	20.0	42.0	38.0
Fluffiness of fluffy processed tow (inch ³ /30g)	Radius of curvature after heat treatment (mm)	10.0	8.5	7.0	7.8	6.5	3.5	6.0	4.5	8.1	7.5
		390	600	800	650	610	480	580	520	760	630

Table 2

Item		Example 11	Example 12	Example 13	Example 14	Example 15	Example 16	Example 17	Example 18	Example 19
Main process of spinning	Polymer	Common PBT	Cationic PET	Common PET	Common PET	Common PET	Common PET	Common PET	Common PET	Common PET
	Spinneret form	Hollow	Hollow	Hollow	Hollow	Hollow	Hollow	Hollow	Hollow	Hollow
	Cooling distance (mm)	65	65	10	60	90	110	150	65	65
	wind speed of side blowing (m/min)	35	35	35	35	35	35	35	90	50
Fiber properties	Cross-section form	Hollow	Hollow	Hollow	Hollow	Hollow	Hollow	Hollow	Hollow	Hollow
	Shape of hollow part	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular
	Fiber variety	100T-10f	100T-10f	100T-10f	100T-10f	100T-10f	100T-10f	100T-10f	100T-10f	100T-10f
	Hollowness (%)	30.0	33.0	40.0	37.0	32.0	30.0	25.0	35.0	28.0
	Monofilament fineness (dtex)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Fluffiness of fluffy processed tow (inch ³ /30g)	Radius of curvature (mm)	36.0	33.0	12.0	30.0	34.0	38.0	44.0	18.0	28.0
	Radius of curvature after heat treatment (mm)	7.0	6.4	3.6	6.1	9.5	12.5	14.5	3.9	4.5
		600	610	490	600	720	620	550	510	530

Table 3

Item		Comparative example 1	Comparative example 2	Comparative example 3	Comparative example 4	Comparative example 5	Comparative example 6
Main process of spinning	Polymer	Common PET	Common PET	Common PET	Common PET	Common PET	Common PET
	Spinneret form	Circular	Hollow	Hollow	Hollow	Hollow	Hollow
	Cooling distance (mm)	65	90	5	65	200	65
	wind speed of side blowing (m/min)	25	35	35	110	70	20
Fiber properties	Cross-section form	Solid	Hollow	—	—	Hollow	Hollow
	Shape of hollow part	—	Triangular			Triangular	Triangular
	Fiber variety	56T-24f	100-10f			100T-10f	100T-10f
	Hollowness (%)	—	10.0			15.0	12.0
	Monofilament fineness (dtex)	2.3	10.0			10.0	10.0
	Radius of curvature (mm)	—	40.0			65.0	55.0
	Radius of curvature after heat treatment (mm)	—	10.0			23.0	20.0
Fluffiness of fluffy processed tow (inch ³ /30g)		240	310			350	350

CLAIMS

1. A hollow polyester filament, wherein the filament has a cross-sectional hollowness ranging from 20.0% to 45.0%, and the filament has a three-dimensionally crimped shape in a natural state, and the crimped shape has a radius of curvature ranging from 10.0 mm to 50.0 mm.
2. The hollow polyester filament according to claim 1, wherein the filament has a monofilament fineness ranging from 4.0 dtex to 15.0 dtex.
3. The hollow polyester filament according to claim 2, wherein the filament has a monofilament fineness ranging from 5.0 dtex to 10.0 dtex.
4. The hollow polyester filament according to claim 1 or 2, wherein the filament has a radius of curvature ranging from 3.5 mm to 10.0 mm after dry heat treatment at 160°C for 3 minutes.
5. The hollow polyester filament according to claim 1 or 2, wherein the polyester is selected from the group consisting of polyethylene terephthalate, polytrimethylene terephthalate, polybutylene terephthalate or a modified polymer thereof.