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(54) **PET BI-COMPONENT ELASTIC YARN HAVING DIFFERENT VISCOSITIES AND PREPARATION METHOD THEREFOR**

(57) A kind of PET bicomponent elastic yarn with different viscosities and preparation method thereof is disclosed, wherein the PET bicomponent elastic yarns with different viscosities are extruded from the same spinneret, and a high-viscosity PET melt is divided into two ways: one is directly extruded after distribution; and the other is extruded after distribution by side-by-side composite spinning together with a low-viscosity PET melt, and a ratio of the number of spinneret holes m for direct extrusion to the number of spinneret holes n for extrusion after distribution by side-by-side composite spinning is 1:(6-8); after extrusion, a fully drawn yarn (FDY) is prepared according to an FDY process, finally the PET bicomponent elastic yarn with different viscosities is obtained after a relaxation heat treatment; wherein the prepared bicomponent elastic yarn comprises a high-viscosity PET monofilament and a high-viscosity/low-viscosity PET side-by-side composite monofilament, and the monofilament crimping directions of the bicomponent elastic yarn are randomly distributed. The high-viscosity and low-viscosity PET side-by-side composite fibers in the present invention have low costs, and the problem of

"strip unevenness" does not exist in the application of knitted fabrics.

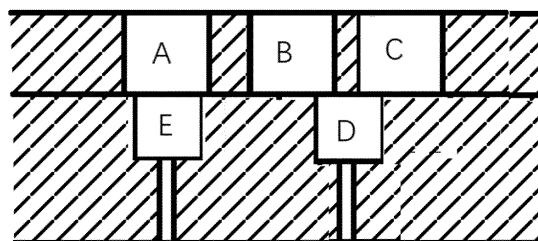


FIG. 1

Description

Technical Field

[0001] The present invention belongs to the field of polyester fiber, and more particularly, relates to a PET bicomponent elastic yarn with different viscosities and preparation method thereof.

Background

[0002] Elastic fibers play an irreplaceable role in clothing fabrics, which make them occupy a very important position in the textile industry, wherein self-crimping fibers prepared by side-by-side compounding have become an important branch of elastic fibers, which is a research hotspot of many scholars at home and abroad.

[0003] At present, there have been many reports on the development and application of bicomponent side-by-side composite fibers, mostly using two polyesters or modified polyesters with different properties through the melt composite spinning method, wherein the composite fibers with PET and PTT as raw materials are the most widely used, and the most representative one is T400 produced by DuPont. This type of composite fibers will have a permanent three-dimensional spiral crimp shape after heat treatment, which makes the fabric have excellent fluffiness, elasticity and coverage, so it is widely used in the field of textile and clothing. However, due to the relatively high price of PTT raw materials, this type of products cannot be produced on a large scale to a certain extent.

[0004] Circular green economy is one of the mainstream of the current world economic development. Due to the increasing shortage of resources and the need for environmental protection, the recycling of fabrics is getting more and more attention. The diversity of polymer materials in fabrics is the most important factor limiting the recycling of fabrics, and the sorting/separation of different types of polymer materials is extremely difficult and costly.

[0005] Patent CN201420425923.7 discloses a PET composite elastic fiber, using PET chips with different viscosities to prepare PET side-by-side composite fibers by adjusting the temperature of the spinning components, wherein the obtained composite fiber has good elasticity and strength, which can be available as polyester elastic yarn products due to low cost, good chemical stability, resistant to chlorine bleaching, and the elasticity and the feel of polyester fabrics can be improved. However, the PET composite fiber with different viscosities is only suitable for producing woven fabrics, and in promoting its wider application in the knitting field, a very difficult problem has arisen: because of the side-by-side bicomponent fiber forming a regular spiral crimp shape during heat shrinkage, the surface of the knitted fabric will appear random "stripe unevenness", especially on plain knitted fabrics.

[0006] Therefore, it is of great significance to develop a PET bicomponent elastic yarn with different viscosities to avoid the random "strip unevenness" in the application of knitted fabrics.

Summary

[0007] The primary object of the present invention is to provide a PET bicomponent elastic yarn with different viscosities and preparation method thereof, so as to solve the problem of random "strip unevenness" in the prior art when the high-viscosity/low-viscosity PET side-by-side composite fiber is applied in knitted fabrics. The present invention "replaces" a part of high-viscosity/low-viscosity PET side-by-side composite fiber with the high-viscosity PET fiber, which breaks the neat left and right spiral shapes of the pure high-viscosity/low-viscosity PET side-by-side composite fiber due to the different shrinkage modes and shapes of the high-viscosity PET fiber and the high-viscosity/low-viscosity PET side-by-side composite fiber, and thus solves the problem of "strip unevenness" formed in the high-viscosity/low-viscosity PET side-by-side composite fiber knitted fabric.

[0008] To this end, the technical schemes of the invention are as follows:

The method for preparing a PET bicomponent elastic yarn with different viscosities, comprising: extruding the PET bicomponent elastic yarns with different viscosities from the same spinneret; wherein a high-viscosity PET melt is divided into two ways: one is directly extruded after distribution; and the other is extruded after distribution by side-by-side composite spinning together with a low-viscosity PET melt; wherein the viscosity of the high-viscosity PET melt and the low-viscosity PET melt is relative, that is, among two PET melts, the one with relatively high viscosity is the high-viscosity PET melt, and the one with relatively low viscosity is the low-viscosity PET melt; wherein a ratio of the number of spinneret holes m for direct extrusion to the number of spinneret holes n for extrusion after distribution by side-by-side composite spinning is 1:(6-8); after extrusion, a fully drawn yarn (FDY) is prepared according to an FDY process, wherein the PET bicomponent elastic yarn with different viscosities is obtained after a relaxation heat treatment.

[0009] Specifically, the present invention "replaces" by dividing the high-viscosity PET melt into two ways, one is directly extruded after distribution, and the other is extruded after distribution by side-by-side composite spinning together with the low-viscosity PET melt, accordingly, the number and positional relationship of distribution holes and guide holes are reasonably set to ensure the smooth division; the present invention controls the ratio of the number of spinneret holes m for direct extrusion

to the number of spinneret holes n for extrusion after distribution by side-by-side composite spinning, to ensure that the proportion of the replaced part to the whole is appropriate, which can effectively solve the problem of "stripe unevenness", and maintain the excellent properties of the high-viscosity/low-viscosity PET side-by-side composite fiber; the present invention distributes all the spinneret holes in concentric circles, and controls the spinneret holes m as much as possible on the inner circle of the concentric circles, which ensures that the high-viscosity PET fiber can be fully penetrated into the high-viscosity/low-viscosity PET side-by-side composite fiber, and breaks the neat left and right spiral shapes of the pure high-viscosity/low-viscosity PET side-by-side composite fiber; in the present invention, by reasonably setting the temperatures of the spinning box I, the spinning box II, and the spinning box III, it can be compatible with the intrinsic viscosity of the high-viscosity PET melt (0.70-0.75 dL/g) and the intrinsic viscosity of the low-viscosity PET melt (0.50-0.55 dL/g), to ensure that the apparent viscosities of the high-viscosity PET component and the low-viscosity PET component extruded from the spinneret are relatively close, thus ensuring the smooth spinning; the present invention uses common single-component spinneret holes and side-by-side composite spinneret holes, without adjusting the shape of the spinneret holes; the present invention uses the FDY process by reasonably setting the technological parameters, and the prepared product is good at crimp property, elasticity and comprehensive properties.

[0010] The principle of the present invention is as follows:

In the prior art, the three-dimensional spiral crimp of the high-viscosity/low-viscosity PET bicomponent side-by-side composite fiber enables to straighten under external stretching, and to return to the initial crimp well when the external force is removed. It is shown that in a bundle of high-viscosity/low-viscosity PET filaments, the crimp shapes have relatively neat left and right spiral yarn segments and random crimp yarn segments, wherein the length and arrangement of each yarn segment are random overall. Due to the different fiber tilt state and mechanical response behavior of each crimp yarn segment, when using bicomponent high-viscosity/low-viscosity PET filaments to weave fabrics, it will cause differences in the reflective effect and the uneven tension of the yarn, and the cloth surface will randomly form bumps or depressions, and the "uneven horizontal stripes" with random changes in light and shade will be found on the surface, that is the so-called "stripe unevenness".

[0011] The combined filament yarn in the present invention is composed of the high-viscosity PET monofilament and the high-viscosity/low-viscosity PET side-by-side composite monofilament, wherein the high-viscosity/low-viscosity PET side-by-side composite monofilament is made into the three-dimensional crimp fiber with neat left and right spiral shapes after relaxation heat treatment, while the high-viscosity PET monofilament does

not have crimp after relaxation heat treatment; the combined filament yarn in the present invention is composed of the high-viscosity PET monofilament and the high-viscosity/low-viscosity PET side-by-side composite monofilament, which is equivalent to replacing the high-viscosity/low-viscosity PET side-by-side composite monofilament with a part of the high-viscosity PET monofilament, thereby breaking the neat left and right spiral shape of the pure high-viscosity/low-viscosity PET bicomponent fibers; in the same bundle of combined filament yarns, the ratio of the number of the high-viscosity PET monofilament (corresponding to the spinneret hole m) to the number of the high-viscosity/low-viscosity PET side-by-side composite monofilament (corresponding to the spinneret hole n) is 1:(6-8), wherein the high-viscosity PET monofilament is to break the neat left and right spiral shape, wherein the high-viscosity/low-viscosity PET side-by-side composite monofilament is to provide elasticity for the combined filament yarn through self-crimping; too many high-viscosity PET monofilaments cannot reflect the performance of composite filaments very well, while too few high-viscosity PET monofilaments cannot play the role of breaking the neat left and right spiral shape, therefore, mixing the high-viscosity PET monofilament and the high-viscosity/low-viscosity PET side-by-side composite monofilament in a specific ratio not only ensures the elasticity of the combined filament yarn, but also breaks the neat left and right spiral shape formed by the high-viscosity/low-viscosity PET side-by-side composite monofilament, which makes the crimp shape of each high-viscosity/low-viscosity PET side-by-side composite monofilament different from other fibers, thereby eliminating the "stripe unevenness".

[0012] The following preferred technology program is presented to give a detailed description for this invention: In the method for preparing a PET bicomponent elastic yarn with different viscosities, wherein the ratio of the mass of the high-viscosity PET melt extruded from the spinneret hole n to the mass of the low-viscosity PET melt extruded from the spinneret hole n is 50:50, and the ratio of the equivalent diameter of the spinneret hole m to the equivalent diameter of the spinneret hole n is 1:1.

wherein the spinneret hole m is a circular, oval, triangular, Y-shaped, cross-shaped, "8"-shaped, rectangular or in-line spinneret hole, and the spinneret hole n is a circular, oval or "8"-shaped spinneret hole, while the present invention uses common single-component spinneret holes and side-by-side composite spinneret holes, without adjusting the shape of spinneret holes.

wherein all the spinneret holes are distributed in concentric circles, and the spinneret holes on the same circle are all m or all n , while the spinneret holes on the outermost circle are all n . wherein all the spinneret holes are distributed in concentric circles, and the spinneret holes on the same circle are all m or all n , while the spinneret holes on the outermost circle are

all n, thus ensuring that the high-viscosity PET monofilament is mixed into the high-viscosity/low-viscosity PET side-by-side composite monofilament, which plays the role of breaking the neat left and right spiral shapes; otherwise, if more high-viscosity PET monofilaments are distributed in the outermost circle, the inner high-viscosity/low-viscosity PET side-by-side composite monofilaments will still have the neat left and right spiral shapes.

wherein the FDY process involves technological parameters: a cooling temperature of 20-25 °C, an interlacing pressure of 0.20-0.30 MPa, a godet roller 1 speed of 2200-2400 m/min, a godet roller 1 temperature of 85-95 °C, a godet roller 2 speed of 3500-3700 m/min, a godet roller 2 temperature of 150-160 °C, and a winding speed of 3430-3610 m/min; wherein the relaxation heat treatment has a temperature of 90-120 °C, and a time of 20-30 minutes.

wherein the spinneret hole m comprises a guide hole E, a transition hole and a capillary micropore connected sequentially, the spinneret hole n comprises a guide hole D, a transition hole and a capillary micropore connected sequentially, the guide hole E is connected with a distribution hole A, and the guide hole D is connected with a distribution hole B and a distribution hole C at the same time; wherein the distribution hole A, the distribution hole B and the distribution hole C are located on the distribution plate in the spinning box III; wherein the division is to transport the high-viscosity PET melt through a spinning box I to the distribution hole A and the distribution hole B, while transport the low-viscosity PET melt through a spinning box II to the distribution hole C. wherein the intrinsic viscosity of the high-viscosity PET melt is 0.70-0.75 dL/g, the temperature of the spinning box I is 284-286 °C, the intrinsic viscosity of the low-viscosity PET melt is 0.50-0.55 dL/g, the temperature of the spinning box II is 270-275 °C, the temperature of the spinning box III is 278-283 °C, wherein the temperature of the spinning box III is also the spinning temperature. In order to spin smoothly, it is necessary to ensure that the two components have the same flow state when extruded from the same spinneret, that is, the apparent viscosities of the two melts are close (for the same polymer, the greater the apparent viscosity, the worse the flow property); the apparent viscosity of the high-viscosity PET and the low-viscosity PET can be adjusted by temperature, in the present invention, by reasonably setting the temperatures of the spinning box I, the spinning box II, and the spinning box III, it can be compatible with the intrinsic viscosity of the high-viscosity PET melt and the intrinsic viscosity of the low-viscosity PET melt, wherein the high-viscosity PET is melted at a high temperature and spun at a low temperature, and the low-viscosity PET is melted at a low temperature and spun at a high temper-

ature, so as to reduce the degradation of the low-viscosity PET, although the temperature difference between the two components in the box is large, heat exchange occurs when the two components enter the same composite component, the temperature of the high-viscosity PET component decreasing and the temperature of the low-viscosity PET component increasing, so that the apparent viscosities of the two components extruded from the spinneret hole are close, thus ensuring the smooth spinning.

[0013] The PET bicomponent elastic yarn with different viscosities prepared by any one of the above preparation methods, is composed of a high-viscosity PET monofilament and a high-viscosity/low-viscosity PET side-by-side composite monofilament; wherein the monofilament crimping directions of the PET bicomponent elastic yarn with different viscosities are randomly distributed, wherein the random distribution is a mathematical concept that each fiber has a different crimp shape than other fibers, thus the prepared fabric will not appear "stripe unevenness".

[0014] The following preferred technology program is presented to give a detailed description for this invention: The PET bicomponent elastic yarn with different viscosities comprises mechanical performance indices: a crimp shrinkage of 50-53 %, a crimp stability of 85-87 %, a shrinkage elongation of 93-98 %, and a crimp elastic recovery rate of 95-96 %.

wherein the PET bicomponent elastic yarn with different viscosities comprises mechanical performance indices: a breaking strength of ≥ 2.9 cN/dtex, an elongation at break of 43.0 ± 5.0 %, and a total fineness of 100-200 dtex.

wherein the PET bicomponent elastic yarn with different viscosities is made into knitted fabrics, then test the stripe unevenness degree of the knitted fabrics, the testing process is as follows: first, the knitted fabric image is captured and converted into a grayscale image, and then the parameter D will be calculated after the first processing and the second processing of the grayscale image, using the parameter D characterizes the degree of strip unevenness, where the grayscale image includes the strip shade area, the high gray value area of the non-strip shade area and the low gray value area of the non-strip shade area; the first processing is to change the pixel points in the high gray value area of the non-strip shade area in the grayscale image into pure white points; the second processing is to change the pixel points in the low gray value area of the non-strip shade area in the grayscale image into pure white points; the parameter D is calculated by the formula: $D = \Sigma B / A$, wherein ΣB represents the number of pixel points in the grayscale image when the gray value is 0, and A represents the total number of pixel points

in the grayscale image.

[0015] When the D value is $\geq 3\%$, the knitted fabric can be judged as "stripe unevenness", and when the D value is $\geq 10\%$, the knitted fabric can be judged as serious "stripe unevenness". The test result of the knitted fabric made of the PET bicomponent elastic yarn with different viscosities in the present invention is: the D value of the knitted fabric made of the PET bicomponent elastic yarn with different viscosities is $\leq 1.0\%$; this indicates that the knitted fabric made of the PET bicomponent elastic yarn with different viscosities in the present invention does not have the problem of "stripe unevenness".

[0016] Benefits:

(1) The preparation method of a PET bicomponent elastic yarn with different viscosities in the present invention, wherein the PET bicomponent elastic yarn with different viscosities is composed of the high-viscosity PET fiber and the high-viscosity/low-viscosity PET side-by-side composite fiber, changing the spiral crimp shape of each fiber after the relaxation heat treatment, so that each fiber has a different crimp shape than other fibers;

(2) The preparation method of a PET bicomponent elastic yarn with different viscosities in the present invention solves the problem of "stripe unevenness" formed in the high-viscosity/low-viscosity PET side-by-side composite fiber knitted fabric;

(3) The preparation method of a PET bicomponent elastic yarn with different viscosities in the present invention meets the requirement of circular green economy, and has good comprehensive properties and broad application field.

Brief Description of the Drawing

[0017] FIG. 1 is a schematic diagram of the melt distribution of the present invention, wherein A, B and C are mutually independent distribution holes, and D and E are mutually independent guide holes.

Detailed Description of the Embodiments

[0018] Based on above mentioned method, the following embodiments are carried out for further demonstration in the present invention. It is to be understood that these embodiments are only intended to illustrate the invention and are not intended to limit the scope of the invention. In addition, it should be understood that after reading the contents described in the present invention, those technical personnel in this field can make various changes or modifications to the invention, and these equivalent forms also fall within the scope of the claims attached to the application.

[0019] The crimp shrinkage and crimp stability in the present invention are obtained by testing the tow by using GB6506-2001 "Synthetic fiber- Test method for crimp

contraction properties of textured filament yarns".

[0020] The text methods of the shrinkage elongation (reflecting the degree of elasticity and crimp of textured filament yarns, wherein the fibers are subjected to a light load and then to a heavy load, and the ratio of the difference in length to the curl length is calculated for both loads) and the crimp elastic recovery rate are as follows: Firstly, cut two fiber samples of about 50 cm in length, put them into 100 °C hot water for 30 minutes, take them out and dry them naturally, next intercept a sample of about 30 cm in length, wherein fix one end and load another end with a load of 0.0018 cN/dtex for 30 seconds, and mark it at 20 cm, that is, the initial length l_1 of the sample; then load another end with a load of 0.09 cN/dtex for 30 seconds, and measure the position of the marked point, which is the length l_2 of the sample under heavier load; finally remove the load and let the sample retract for 2 minutes, next add a load of 0.0018 cN/dtex for 30 seconds and measure the position of the marked point, which is the recovery length l_3 ; the shrinkage elongation (CE) and the crimp elastic recovery rate (SR) are calculated as follows:

$$CE = (l_2 - l_1) / l_1;$$

$$SR = (l_2 - l_3) / (l_2 - l_1).$$

Example 1

[0021] A method for preparing a PET bicomponent elastic yarn with different viscosities, comprising:

(1) extruding the PET bicomponent elastic yarns with different viscosities from the same spinneret;

wherein a high-viscosity PET melt with an intrinsic viscosity of 0.75 dL/g is divided into two ways: one is directly extruded after distribution; and the other is extruded after distribution by side-by-side composite spinning together with a low-viscosity PET melt with an intrinsic viscosity of 0.5 dL/g;

wherein a ratio of the number of circular spinneret holes m for direct extrusion to the number of circular spinneret holes n for extrusion after distribution by side-by-side composite spinning is 1:8; wherein the ratio of the mass of the high-viscosity PET melt extruded from the spinneret hole n to the mass of the low-viscosity PET melt extruded from the spinneret hole n is 50:50, and the ratio of the equivalent diameter of the spinneret hole m to the equivalent diameter of the spinneret hole n is 1:1;

wherein all the spinneret holes are distributed in concentric circles, and the spinneret holes on the same circle are all m or all n, while the spin-

neret holes on the outermost circle are all n;
 as shown in figure 1, wherein the spinneret hole m comprises a guide hole E, a transition hole and a capillary micropore connected sequentially, the spinneret hole n comprises a guide hole D, a transition hole and a capillary micropore connected sequentially, the guide hole E is connected with a distribution hole A, and the guide hole D is connected with a distribution hole B and a distribution hole C at the same time; wherein the distribution hole A, the distribution hole B and the distribution hole C are located on the distribution plate in the spinning box III; wherein the division is to transport the high-viscosity PET melt through a spinning box I to the distribution hole A and the distribution hole B, while transport the low-viscosity PET melt through a spinning box II to the distribution hole C; wherein the temperature of the spinning box I is 286 °C, the temperature of the spinning box II is 275 °C, and the temperature of the spinning box III is 283 °C;

(2) after extrusion, the PET bicomponent elastic yarn with different viscosities is prepared by an FDY process (obtaining a fully drawn yarn), and then a relaxation heat treatment;

wherein the FDY process involves technological parameters: a cooling temperature of 25 °C, an interlacing pressure of 0.2 MPa, a godet roller 1 speed of 2300 m/min, a godet roller 1 temperature of 85 °C, a godet roller 2 speed of 3560 m/min, a godet roller 2 temperature of 150 °C, and a winding speed of 3460 m/min; wherein the relaxation heat treatment has a temperature of 104 °C, and a time of 30 minutes; wherein the PET bicomponent elastic yarn with different viscosities is composed of the high-viscosity PET monofilament and the high-viscosity/low-viscosity PET side-by-side composite monofilament; wherein the monofilament crimping directions of the PET bicomponent elastic yarn with different viscosities are randomly distributed; wherein the PET bicomponent elastic yarn with different viscosities comprises mechanical performance indices: a crimp shrinkage of 53%, a crimp stability of 87%, a shrinkage elongation of 98%, a crimp elastic recovery rate of 96%, a breaking strength of 3.1 cN/dtex, an elongation at break of 45%, and a total fineness of 130 dtex. The prepared PET bicomponent elastic yarn with different viscosities is made into the knitted fabric, which is tested for strip unevenness, and the fabric has a D value of 0.51.

Example 2

[0022] A method for preparing a PET bicomponent elastic yarn with different viscosities, comprising:

(1) extruding the PET bicomponent elastic yarns with different viscosities from the same spinneret;

wherein a high-viscosity PET melt with an intrinsic viscosity of 0.73 dL/g is divided into two ways: one is directly extruded after distribution; and the other is extruded after distribution by side-by-side composite spinning together with a low-viscosity PET melt with an intrinsic viscosity of 0.54 dL/g;

wherein a ratio of the number of oval spinneret holes m for direct extrusion to the number of circular spinneret holes n for extrusion after distribution by side-by-side composite spinning is 1:6; wherein the ratio of the mass of the high-viscosity PET melt extruded from the spinneret hole n to the mass of the low-viscosity PET melt extruded from the spinneret hole n is 50:50, and the ratio of the equivalent diameter of the spinneret hole m to the equivalent diameter of the spinneret hole n is 1:1;

wherein all the spinneret holes are distributed in concentric circles, and the spinneret holes on the same circle are all m or all n, while the spinneret holes on the outermost circle are all n;

wherein the spinneret hole m comprises a guide hole E, a transition hole and a capillary micropore connected sequentially, the spinneret hole n comprises a guide hole D, a transition hole and a capillary micropore connected sequentially, the guide hole E is connected with a distribution hole A, and the guide hole D is connected with a distribution hole B and a distribution hole C at the same time; wherein the distribution hole A, the distribution hole B and the distribution hole C are located on the distribution plate in the spinning box III; wherein the division is to transport the high-viscosity PET melt through a spinning box I to the distribution hole A and the distribution hole B, while transport the low-viscosity PET melt through a spinning box II to the distribution hole C; wherein the temperature of the spinning box I is 282 °C, the temperature of the spinning box II is 271 °C, and the temperature of the spinning box III is 278 °C;

(2) after extrusion, the PET bicomponent elastic yarn with different viscosities is prepared by an FDY process (obtaining a fully drawn yarn), and then a relaxation heat treatment;

wherein the FDY process involves technological parameters: a cooling temperature of 20 °C, an

interlacing pressure of 0.25 MPa, a godet roller 1 speed of 2350 m/min, a godet roller 1 temperature of 95 °C, a godet roller 2 speed of 3660 m/min, a godet roller 2 temperature of 160 °C, and a winding speed of 3530 m/min; wherein the relaxation heat treatment has a temperature of 103 °C, and a time of 28 minutes; wherein the PET bicomponent elastic yarn with different viscosities is composed of the high-viscosity PET monofilament and the high-viscosity/low-viscosity PET side-by-side composite monofilament; wherein the monofilament crimping directions of the PET bicomponent elastic yarn with different viscosities are randomly distributed; wherein the PET bicomponent elastic yarn with different viscosities comprises mechanical performance indices: a crimp shrinkage of 52.8%, a crimp stability of 85%, a shrinkage elongation of 95%, a crimp elastic recovery rate of 95.4%, a breaking strength of 3.1 cN/dtex, an elongation at break of 44.2%, and a total fineness of 115 dtex. The prepared PET bicomponent elastic yarn with different viscosities is made into the knitted fabric, which is tested for strip unevenness, and the fabric has a D value of 0.39.

Example 3

[0023] A method for preparing a PET bicomponent elastic yarn with different viscosities, comprising:

(1) extruding the PET bicomponent elastic yarns with different viscosities from the same spinneret;

wherein a high-viscosity PET melt with an intrinsic viscosity of 0.73 dL/g is divided into two ways: one is directly extruded after distribution; and the other is extruded after distribution by side-by-side composite spinning together with a low-viscosity PET melt with an intrinsic viscosity of 0.55 dL/g;

wherein a ratio of the number of triangular spinneret holes m for direct extrusion to the number of circular spinneret holes n for extrusion after distribution by side-by-side composite spinning is 1:8; wherein the ratio of the mass of the high-viscosity PET melt extruded from the spinneret hole n to the mass of the low-viscosity PET melt extruded from the spinneret hole n is 50:50, and the ratio of the equivalent diameter of the spinneret hole m to the equivalent diameter of the spinneret hole n is 1:1;

wherein all the spinneret holes are distributed in concentric circles, and the spinneret holes on the same circle are all m or all n, while the spinneret holes on the outermost circle are all n; wherein the spinneret hole m comprises a guide

hole E, a transition hole and a capillary micropore connected sequentially, the spinneret hole n comprises a guide hole D, a transition hole and a capillary micropore connected sequentially, the guide hole E is connected with a distribution hole A, and the guide hole D is connected with a distribution hole B and a distribution hole C at the same time; wherein the distribution hole A, the distribution hole B and the distribution hole C are located on the distribution plate in the spinning box III; wherein the division is to transport the high-viscosity PET melt through a spinning box I to the distribution hole A and the distribution hole B, while transport the low-viscosity PET melt through a spinning box II to the distribution hole C; wherein the temperature of the spinning box I is 283 °C, the temperature of the spinning box II is 275 °C, and the temperature of the spinning box III is 279 °C;

(2) after extrusion, the PET bicomponent elastic yarn with different viscosities is prepared by an FDY process (obtaining a fully drawn yarn), and then a relaxation heat treatment;

wherein the FDY process involves technological parameters: a cooling temperature of 21 °C, an interlacing pressure of 0.23 MPa, a godet roller 1 speed of 2300 m/min, a godet roller 1 temperature of 86 °C, a godet roller 2 speed of 3500 m/min, a godet roller 2 temperature of 151 °C, and a winding speed of 3430 m/min; wherein the relaxation heat treatment has a temperature of 120 °C, and a time of 29 minutes;

wherein the PET bicomponent elastic yarn with different viscosities is composed of the high-viscosity PET monofilament and the high-viscosity/low-viscosity PET side-by-side composite monofilament; wherein the monofilament crimping directions of the PET bicomponent elastic yarn with different viscosities are randomly distributed; wherein the PET bicomponent elastic yarn with different viscosities comprises mechanical performance indices: a crimp shrinkage of 52%, a crimp stability of 85.5%, a shrinkage elongation of 96%, a crimp elastic recovery rate of 95.1%, a breaking strength of 3 cN/dtex, an elongation at break of 46%, and a total fineness of 125 dtex. The prepared PET bicomponent elastic yarn with different viscosities is made into the knitted fabric, which is tested for strip unevenness, and the fabric has a D value of 0.68.

Example 4

[0024] A method for preparing a PET bicomponent elastic yarn with different viscosities, comprising:

(1) extruding the PET bicomponent elastic yarns with different viscosities from the same spinneret;

wherein a high-viscosity PET melt with an intrinsic viscosity of 0.7 dL/g is divided into two ways: one is directly extruded after distribution; and the other is extruded after distribution by side-by-side composite spinning together with a low-viscosity PET melt with an intrinsic viscosity of 0.53 dL/g;

wherein a ratio of the number of Y-shape spinneret holes m for direct extrusion to the number of circular spinneret holes n for extrusion after distribution by side-by-side composite spinning is 1:6; wherein the ratio of the mass of the high-viscosity PET melt extruded from the spinneret hole n to the mass of the low-viscosity PET melt extruded from the spinneret hole n is 50:50, and the ratio of the equivalent diameter of the spinneret hole m to the equivalent diameter of the spinneret hole n is 1:1;

wherein all the spinneret holes are distributed in concentric circles, and the spinneret holes on the same circle are all m or all n, while the spinneret holes on the outermost circle are all n;

wherein the spinneret hole m comprises a guide hole E, a transition hole and a capillary micropore connected sequentially, the spinneret hole n comprises a guide hole D, a transition hole and a capillary micropore connected sequentially, the guide hole E is connected with a distribution hole A, and the guide hole D is connected with a distribution hole B and a distribution hole C at the same time; wherein the distribution hole A, the distribution hole B and the distribution hole C are located on the distribution plate in the spinning box III; wherein the division is to transport the high-viscosity PET melt through a spinning box I to the distribution hole A and the distribution hole B, while transport the low-viscosity PET melt through a spinning box II to the distribution hole C; wherein the temperature of the spinning box I is 285 °C, the temperature of the spinning box II is 270 °C, and the temperature of the spinning box III is 280 °C;

(2) after extrusion, the PET bicomponent elastic yarn with different viscosities is prepared by an FDY process (obtaining a fully drawn yarn), and then a relaxation heat treatment;

wherein the FDY process involves technological parameters: a cooling temperature of 23 °C, an interlacing pressure of 0.24 MPa, a godet roller 1 speed of 2250 m/min, a godet roller 1 temperature of 90 °C, a godet roller 2 speed of 3700 m/min, a godet roller 2 temperature of 152 °C, and a winding speed of 3610 m/min; wherein

the relaxation heat treatment has a temperature of 90 °C, and a time of 24 minutes;

wherein the PET bicomponent elastic yarn with different viscosities is composed of the high-viscosity PET monofilament and the high-viscosity/low-viscosity PET side-by-side composite monofilament; wherein the monofilament crimping directions of the PET bicomponent elastic yarn with different viscosities are randomly distributed; wherein the PET bicomponent elastic yarn with different viscosities comprises mechanical performance indices: a crimp shrinkage of 52.5%, a crimp stability of 85.3%, a shrinkage elongation of 97.7%, a crimp elastic recovery rate of 95.5%, a breaking strength of 3.3 cN/dtex, an elongation at break of 40.5%, and a total fineness of 105 dtex. The prepared PET bicomponent elastic yarn with different viscosities is made into the knitted fabric, which is tested for strip unevenness, and the fabric has a D value of 0.72.

Example 5

[0025] A method for preparing a PET bicomponent elastic yarn with different viscosities, comprising:

(1) extruding the PET bicomponent elastic yarns with different viscosities from the same spinneret;

wherein a high-viscosity PET melt with an intrinsic viscosity of 0.74 dL/g is divided into two ways: one is directly extruded after distribution; and the other is extruded after distribution by side-by-side composite spinning together with a low-viscosity PET melt with an intrinsic viscosity of 0.53 dL/g;

wherein a ratio of the number of cross-shaped spinneret holes m for direct extrusion to the number of oval spinneret holes n for extrusion after distribution by side-by-side composite spinning is 1:7; wherein the ratio of the mass of the high-viscosity PET melt extruded from the spinneret hole n to the mass of the low-viscosity PET melt extruded from the spinneret hole n is 50:50, and the ratio of the equivalent diameter of the spinneret hole m to the equivalent diameter of the spinneret hole n is 1:1;

wherein all the spinneret holes are distributed in concentric circles, and the spinneret holes on the same circle are all m or all n, while the spinneret holes on the outermost circle are all n; wherein the spinneret hole m comprises a guide hole E, a transition hole and a capillary micropore connected sequentially, the spinneret hole n comprises a guide hole D, a transition hole and a capillary micropore connected sequentially, the guide hole E is connected with a distribu-

tion hole A, and the guide hole D is connected with a distribution hole B and a distribution hole C at the same time; wherein the distribution hole A, the distribution hole B and the distribution hole C are located on the distribution plate in the spinning box III; wherein the division is to transport the high-viscosity PET melt through a spinning box I to the distribution hole A and the distribution hole B, while transport the low-viscosity PET melt through a spinning box II to the distribution hole C; wherein the temperature of the spinning box I is 286 °C, the temperature of the spinning box II is 272 °C, and the temperature of the spinning box III is 280 °C;

(2) after extrusion, the PET bicomponent elastic yarn with different viscosities is prepared by an FDY process (obtaining a fully drawn yarn), and then a relaxation heat treatment;

wherein the FDY process involves technological parameters: a cooling temperature of 24 °C, an interlacing pressure of 0.28 MPa, a godet roller 1 speed of 2265 m/min, a godet roller 1 temperature of 87°C, a godet roller 2 speed of 3580 m/min, a godet roller 2 temperature of 152 °C, and a winding speed of 3460 m/min; wherein the relaxation heat treatment has a temperature of 105 °C, and a time of 25 minutes; wherein the PET bicomponent elastic yarn with different viscosities is composed of the high-viscosity PET monofilament and the high-viscosity/low-viscosity PET side-by-side composite monofilament; wherein the monofilament crimping directions of the PET bicomponent elastic yarn with different viscosities are randomly distributed; wherein the PET bicomponent elastic yarn with different viscosities comprises mechanical performance indices: a crimp shrinkage of 51.6%, a crimp stability of 85.2%, a shrinkage elongation of 94%, a crimp elastic recovery rate of 95.8%, a breaking strength of 3.4 cN/dtex, an elongation at break of 38%, and a total fineness of 100 dtex. The prepared PET bicomponent elastic yarn with different viscosities is made into the knitted fabric, which is tested for strip unevenness, and the fabric has a D value of 0.33.

Example 6

[0026] A method for preparing a PET bicomponent elastic yarn with different viscosities, comprising:

(1) extruding the PET bicomponent elastic yarns with different viscosities from the same spinneret;

wherein a high-viscosity PET melt with an intrinsic

viscosity of 0.72 dL/g is divided into two ways: one is directly extruded after distribution; and the other is extruded after distribution by side-by-side composite spinning together with a low-viscosity PET melt with an intrinsic viscosity of 0.54 dL/g;

wherein a ratio of the number of "8"-shaped spinneret holes m for direct extrusion to the number of oval spinneret holes n for extrusion after distribution by side-by-side composite spinning is 1:6; wherein the ratio of the mass of the high-viscosity PET melt extruded from the spinneret hole n to the mass of the low-viscosity PET melt extruded from the spinneret hole n is 50:50, and the ratio of the equivalent diameter of the spinneret hole m to the equivalent diameter of the spinneret hole n is 1:1;

wherein all the spinneret holes are distributed in concentric circles, and the spinneret holes on the same circle are all m or all n, while the spinneret holes on the outermost circle are all n;

wherein the spinneret hole m comprises a guide hole E, a transition hole and a capillary micropore connected sequentially, the spinneret hole n comprises a guide hole D, a transition hole and a capillary micropore connected sequentially, the guide hole E is connected with a distribution hole A, and the guide hole D is connected with a distribution hole B and a distribution hole C at the same time; wherein the distribution hole A, the distribution hole B and the distribution hole C are located on the distribution plate in the spinning box III; wherein the division is to transport the high-viscosity PET melt through a spinning box I to the distribution hole A and the distribution hole B, while transport the low-viscosity PET melt through a spinning box II to the distribution hole C; wherein the temperature of the spinning box I is 284 °C, the temperature of the spinning box II is 271 °C, and the temperature of the spinning box III is 279 °C;

(2) after extrusion, the PET bicomponent elastic yarn with different viscosities is prepared by an FDY process (obtaining a fully drawn yarn), and then a relaxation heat treatment;

wherein the FDY process involves technological parameters: a cooling temperature of 25 °C, an interlacing pressure of 0.3 MPa, a godet roller 1 speed of 2200 m/min, a godet roller 1 temperature of 85 °C, a godet roller 2 speed of 3700 m/min, a godet roller 2 temperature of 150 °C, and a winding speed of 3610 m/min; wherein the relaxation heat treatment has a temperature of 104 °C, and a time of 20 minutes; wherein the PET bicomponent elastic yarn with different viscosities is composed of the high-vis-

cosity PET monofilament and the high-viscosity/low-viscosity PET side-by-side composite monofilament; wherein the monofilament crimping directions of the PET bicomponent elastic yarn with different viscosities are randomly distributed; wherein the PET bicomponent elastic yarn with different viscosities comprises mechanical performance indices: a crimp shrinkage of 50%, a crimp stability of 85%, a shrinkage elongation of 93%, a crimp elastic recovery rate of 95%, a breaking strength of 3.3 cN/dtex, an elongation at break of 41%, and a total fineness of 105 dtex. The prepared PET bicomponent elastic yarn with different viscosities is made into the knitted fabric, which is tested for strip unevenness, and the fabric has a D value of 0.52.

Example 7

[0027] A method for preparing a PET bicomponent elastic yarn with different viscosities, comprising:

(1) extruding the PET bicomponent elastic yarns with different viscosities from the same spinneret;

wherein a high-viscosity PET melt with an intrinsic viscosity of 0.72 dL/g is divided into two ways: one is directly extruded after distribution; and the other is extruded after distribution by side-by-side composite spinning together with a low-viscosity PET melt with an intrinsic viscosity of 0.5 dL/g;

wherein a ratio of the number of rectangular spinneret holes m for direct extrusion to the number of "8"-shaped spinneret holes n for extrusion after distribution by side-by-side composite spinning is 1:6; wherein the ratio of the mass of the high-viscosity PET melt extruded from the spinneret hole n to the mass of the low-viscosity PET melt extruded from the spinneret hole n is 50:50, and the ratio of the equivalent diameter of the spinneret hole m to the equivalent diameter of the spinneret hole n is 1:1;

wherein all the spinneret holes are distributed in concentric circles, and the spinneret holes on the same circle are all m or all n, while the spinneret holes on the outermost circle are all n; wherein the spinneret hole m comprises a guide hole E, a transition hole and a capillary micropore connected sequentially, the spinneret hole n comprises a guide hole D, a transition hole and a capillary micropore connected sequentially, the guide hole E is connected with a distribution hole A, and the guide hole D is connected with a distribution hole B and a distribution hole C at the same time; wherein the distribution hole A, the distribution hole B and the distribution hole C are located on the distribution plate in the spinning box III; wherein the division is to transport the high-viscosity PET melt through a spinning box I to the distribution hole A and the distribution hole B, while transport the low-viscosity PET melt through a spinning box II to the distribution hole C; wherein the temperature of the spinning box I is 285 °C, the temperature of the spinning box II is 271 °C, and the temperature of the spinning box III is 278 °C;

ning box III; wherein the division is to transport the high-viscosity PET melt through a spinning box I to the distribution hole A and the distribution hole B, while transport the low-viscosity PET melt through a spinning box II to the distribution hole C; wherein the temperature of the spinning box I is 285 °C, the temperature of the spinning box II is 271 °C, and the temperature of the spinning box III is 278 °C;

(2) after extrusion, the PET bicomponent elastic yarn with different viscosities is prepared by an FDY process (obtaining a fully drawn yarn), and then a relaxation heat treatment;

wherein the FDY process involves technological parameters: a cooling temperature of 24 °C, an interlacing pressure of 0.22 MPa, a godet roller 1 speed of 2400 m/min, a godet roller 1 temperature of 88 °C, a godet roller 2 speed of 3550 m/min, a godet roller 2 temperature of 154 °C, and a winding speed of 3480 m/min; wherein the relaxation heat treatment has a temperature of 114 °C, and a time of 23 minutes;

wherein the PET bicomponent elastic yarn with different viscosities is composed of the high-viscosity PET monofilament and the high-viscosity/low-viscosity PET side-by-side composite monofilament; wherein the monofilament crimping directions of the PET bicomponent elastic yarn with different viscosities are randomly distributed; wherein the PET bicomponent elastic yarn with different viscosities comprises mechanical performance indices: a crimp shrinkage of 52%, a crimp stability of 86%, a shrinkage elongation of 96%, a crimp elastic recovery rate of 95.3%, a breaking strength of 2.9 cN/dtex, an elongation at break of 48%, and a total fineness of 116 dtex. The prepared PET bicomponent elastic yarn with different viscosities is made into the knitted fabric, which is tested for strip unevenness, and the fabric has a D value of 0.25.

Example 8

[0028] A method for preparing a PET bicomponent elastic yarn with different viscosities, comprising:

(1) extruding the PET bicomponent elastic yarns with different viscosities from the same spinneret;

wherein a high-viscosity PET melt with an intrinsic viscosity of 0.75 dL/g is divided into two ways: one is directly extruded after distribution; and the other is extruded after distribution by side-by-side composite spinning together with a low-viscosity PET melt with an intrinsic viscosity of 0.51 dL/g;

wherein a ratio of the number of in-line spinneret holes m for direct extrusion to the number of "8"-shaped spinneret holes n for extrusion after distribution by side-by-side composite spinning is 1:6; wherein the ratio of the mass of the high-viscosity PET melt extruded from the spinneret hole n to the mass of the low-viscosity PET melt extruded from the spinneret hole n is 50:50, and the ratio of the equivalent diameter of the spinneret hole m to the equivalent diameter of the spinneret hole n is 1:1;

wherein all the spinneret holes are distributed in concentric circles, and the spinneret holes on the same circle are all m or all n, while the spinneret holes on the outermost circle are all n;

wherein the spinneret hole m comprises a guide hole E, a transition hole and a capillary micropore connected sequentially, the spinneret hole n comprises a guide hole D, a transition hole and a capillary micropore connected sequentially, the guide hole E is connected with a distribution hole A, and the guide hole D is connected with a distribution hole B and a distribution hole C at the same time; wherein the distribution hole A, the distribution hole B and the distribution hole C are located on the distribution plate in the spinning box III; wherein the division is to transport the high-viscosity PET melt through a spinning box I to the distribution hole A and the distribution hole B, while transport the low-viscosity PET melt through a spinning box II to the distribution hole C; wherein the temperature of the spinning box I is 286 °C, the temperature of the spinning box II is 273 °C, and the temperature of the spinning box III is 278 °C;

(2) after extrusion, the PET bicomponent elastic yarn with different viscosities is prepared by an FDY process (obtaining a fully drawn yarn), and then a relaxation heat treatment;

wherein the FDY process involves technological parameters: a cooling temperature of 20 °C, an interlacing pressure of 0.27 MPa, a godet roller 1 speed of 2380 m/min, a godet roller 1 temperature of 89 °C, a godet roller 2 speed of 3600 m/min, a godet roller 2 temperature of 156 °C, and a winding speed of 3520 m/min; wherein the relaxation heat treatment has a temperature of 101 °C, and a time of 29 minutes;

wherein the PET bicomponent elastic yarn with different viscosities is composed of the high-viscosity PET monofilament and the high-viscosity/low-viscosity PET side-by-side composite monofilament; wherein the monofilament crimping directions of the PET bicomponent elastic yarn with different viscosities are randomly distributed; wherein the PET bicomponent elastic

yarn with different viscosities comprises mechanical performance indices: a crimp shrinkage of 52.7%, a crimp stability of 85.8%, a shrinkage elongation of 94%, a crimp elastic recovery rate of 95.1%, a breaking strength of 3.2 cN/dtex, an elongation at break of 43.5%, and a total fineness of 200 dtex. The prepared PET bicomponent elastic yarn with different viscosities is made into the knitted fabric, which is tested for strip unevenness, and the fabric has a D value of 0.67.

Claims

1. A method for preparing a PET bicomponent elastic yarn with different viscosities, comprising: extruding the PET bicomponent elastic yarns with different viscosities from the same spinneret;

wherein a high-viscosity PET melt is divided into two ways: one is directly extruded after distribution; and the other is extruded after distribution by side-by-side composite spinning together with a low-viscosity PET melt;

wherein a ratio of the number of spinneret holes m for direct extrusion to the number of spinneret holes n for extrusion after distribution by side-by-side composite spinning is 1:(6-8);

after extrusion, a fully drawn yarn (FDY) is prepared according to an FDY process, wherein the PET bicomponent elastic yarn with different viscosities is obtained after a relaxation heat treatment.

2. The method of claim 1, wherein the ratio of the mass of the high-viscosity PET melt extruded from the spinneret hole n to the mass of the low-viscosity PET melt extruded from the spinneret hole n is 50:50, and the ratio of the equivalent diameter of the spinneret hole m to the equivalent diameter of the spinneret hole n is 1:1.

3. The method of claim 1, wherein the spinneret hole m is a circular, oval, triangular, Y-shaped, cross-shaped, "8"-shaped, rectangular or in-line spinneret hole, and the spinneret hole n is a circular, oval or "8"-shaped spinneret hole.

4. The method of claim 1, wherein all the spinneret holes are distributed in concentric circles, and the spinneret holes on the same circle are all m or all n, while the spinneret holes on the outermost circle are all n.

5. The method of claim 1, wherein the FDY process involves technological parameters: a cooling temperature of 20-25 °C, an interlacing pressure of

0.20-0.30 MPa, a godet roller 1 speed of 2200-2400 m/min, a godet roller 1 temperature of 85-95 °C, a godet roller 2 speed of 3500-3700 m/min, a godet roller 2 temperature of 150-160 °C, and a winding speed of 3430-3610 m/min; wherein the relaxation heat treatment has a temperature of 90-120 °C, and a time of 20-30 minutes. 5

6. The method of claim 5, wherein the spinneret hole m comprises a guide hole E, a transition hole and a capillary micropore connected sequentially, the spinneret hole n comprises a guide hole D, a transition hole and a capillary micropore connected sequentially, the guide hole E is connected with a distribution hole A, and the guide hole D is connected with a distribution hole B and a distribution hole C at the same time; wherein the distribution hole A, the distribution hole B and the distribution hole C are located on the distribution plate in the spinning box III; wherein the division is to transport the high-viscosity PET melt through a spinning box I to the distribution hole A and the distribution hole B, while transport the low-viscosity PET melt through a spinning box II to the distribution hole C. 10 15 20 25

7. The method of claim 6, wherein the intrinsic viscosity of the high-viscosity PET melt is 0.70-0.75 dL/g, the temperature of the spinning box I is 284-286 °C, the intrinsic viscosity of the low-viscosity PET melt is 0.50-0.55 dL/g, the temperature of the spinning box II is 270-275 °C, the temperature of the spinning box III is 278-283 °C. 30

8. A PET bicomponent elastic yarn with different viscosities prepared by the method of claim 1-7, wherein the PET bicomponent elastic yarn with different viscosities comprises a high-viscosity PET monofilament and a high-viscosity/low-viscosity PET side-by-side composite monofilament; wherein the monofilament crimping directions of the PET bicomponent elastic yarn with different viscosities are randomly distributed. 35 40

9. The PET bicomponent elastic yarn with different viscosities of claim 8, wherein the PET bicomponent elastic yarn with different viscosities comprises mechanical performance indices: a crimp shrinkage of 50-53 %, a crimp stability of 85-87 %, a shrinkage elongation of 93-98 %, and a crimp elastic recovery rate of 95-96 %. 45 50

10. The PET bicomponent elastic yarn with different viscosities of claim 8, wherein the PET bicomponent elastic yarn with different viscosities comprises mechanical performance indices: a breaking strength of ≥ 2.9 cN/dtex, an elongation at break of 43.0 ± 5.0 %, and a total fineness of 100-200 dtex. 55

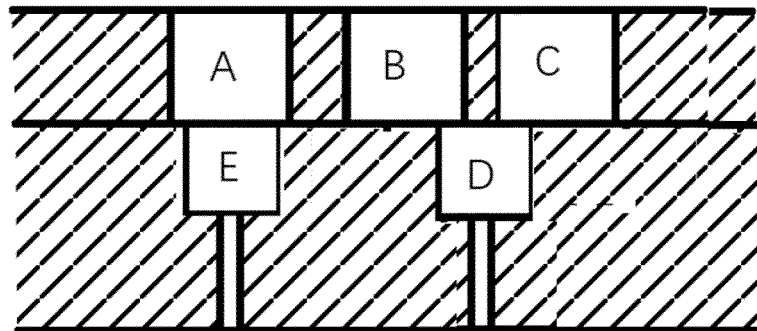


FIG. 1

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2020/095508

A. CLASSIFICATION OF SUBJECT MATTER

D01D 5/32(2006.01)i; D01D 5/22(2006.01)i; D01D 5/253(2006.01)i; D01D 4/02(2006.01)i; D01D 10/02(2006.01)i;
D01F 8/14(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

D01D D01F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNABS; CNTXT; VEN; CNKI; EPTXT; USTXT; WOTXT: 恒力, 聚酯, 弹, 组分, 卷曲, 弯曲, 粘度, 黏度, PET, polyester, elast+, crimp+, viscos+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 111041578 A (JIANGSU HENGLI CHEMICAL FIBRE CO., LTD.) 21 April 2020 (2020-04-21) claims 1-10	1-10
PX	CN 111118617 A (JIANGSU HENGLI CHEMICAL FIBRE CO., LTD.) 08 May 2020 (2020-05-08) description, paragraphs [0007]-[0035]	1-10
Y	CN 104141178 A (JIANGSU SHENGHONG SCIENCE AND TECHNOLOGY CO., LTD. et al.) 12 November 2014 (2014-11-12) claim 2	1-10
Y	JP H02221415 A (MITSUBISHI RAYON CO.) 04 September 1990 (1990-09-04) description, page 2, upper-left column, paragraph 5 - upper-right column, paragraph 1	1-10
A	JP H02221414 A (MITSUBISHI RAYON CO.) 04 September 1990 (1990-09-04) entire document	1-10
A	CN 106149071 A (WANG, Jiaming) 23 November 2016 (2016-11-23) entire document	1-10

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Date of the actual completion of the international search

24 August 2020

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Name and mailing address of the ISA/CN

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2020/095508

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CN	106149071	A	23 November 2016	CN	106149071	B 06 November 2018

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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