Gear crimped jaspe yarns and processes for their manufacture.

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The present invention relates to improved jaspe yarns and to processes for their manufacture.

A jaspe yarn has the general appearance of two differently coloured yarns twisted together; however, it is made by texturing together two continuous filament yarns of different dyeability and then dyeing the textured yarn, generally in fabric form.

Gear crimping of synthetic yarns is well known in the art. A process for drawing and gear crimping an undrawn synthetic yarn is described in British Patent Specification 984 922. The use of undrawn polyamide and polyester yarns is described. Gear crimping of drawn synthetic yarns is also known. The use of undrawn polyester yarn in a draw-gear crimping process is unsatisfactory because of extremely low bulk and breaking of filaments in the process. The use of drawn polyester yarn in a gear crimping process is unsatisfactory because of unacceptably low bulk. The low bulk achieved is particularly apparent in finished fabric made from the crimped yarn.

In our co-pending European patent application number 79302089, there is described a drawn gear-crimped polyester yarn with latent bulk the amount and nature of the bulk being such that the yarn has an initial crimp as defined of at least 1.5%, preferably of above 2%, and a mechanical crimp stability as defined of above 0%. The crimped polyester yarn may be produced by heating a drawable polyester yarn having a birefringence in the range $32 \times 10^{-3}$ to $125 \times 10^{-3}$ inclusive, preferably $35 \times 10^{-3}$ to $125 \times 10^{-3}$ inclusive, crimping the yarn by guiding it between the intermeshing teeth of a set of toothed wheels such that the yarn is caused to follow a sharply zig-zag path, the toothed wheels being rotated at a sufficient speed such that the yarn is drawn by the tension so imparted to the yarn by the toothed wheels and subsequently forwarding the crimped yarn from the toothed wheels under a controlled tension within the range 0.15 to 0.50 g per decitex inclusive based on the decitex of the drawn polyester yarn.

It has now been found possible to produce a drawn gear crimped jaspe yarn having a useful bulk. Compared with conventional false twist crimped yarns, the bulk of the gear-crimped yarns according to the present invention is low; however, the amount and nature of the bulk make the present yarns extremely suitable for the production of fabrics having desirable aesthetics.

According to the present invention, there is provided a drawn gear-crimped yarn with latent bulk characterised in that the yarn is a nodally interlaced gear-crimped composite yarn comprising polyester continuous filaments and polyamide continuous filaments in the weight ratio 90:10 to 10:90 inclusive, the gear-crimped composite yarn having an initial crimp as defined herein of 2% to 12%, preferably 2% to 8%, a mechanical crimp stability as defined herein of above 0% and having 40 to 140 interlaced nodes per metre. Preferably the composite gear crimped yarn has been nodally interlaced to an extent such that the yarn has 70 to 100 nodes per metre.

According to the present invention, there is further provided a process for producing a drawn gear-crimped yarn with latent bulk characterised in that a drawable polyester continuous filament yarn having a birefringence of at least $30 \times 10^{-3}$ and a drawable polyamide continuous filament yarn having a birefringence of at least $30 \times 10^{-3}$ are heated and simultaneously drawn and gear crimped together as a composite yarn by means of toothed draw rolls and the composite yarn is forwarded from the toothed draw rolls under a controlled tension within the range 0.15 to 0.50 g per decitex inclusive based on the decitex of the drawn composite yarn and is subsequently interlaced to have 40 to 140 nodes per metre, the weight ratio of the polyester yarn to the polyamide yarn being in the range 90:10 to 10:90 inclusive.

Initial crimp (EK) and mechanical crimp stability (KB) are defined as follows:

The gear crimped composite yarn with latent bulk is wound at a tension of 1.0 centi-newtons (cN) per tex to form a skein of 1 metre circumference and total decitex of 2500. Thus, for example, 16 wraps are required for a yarn having a decitex of 76. The skein is hung and preloaded with a load of 0.01 cN per tex. The preloaded skein is heated at 120°C for 10 minutes to develop the bulk and is then cooled. The skein is subjected to a force of 1 cN per tex for 10 seconds and its length (Lo) is measured. After an interval of 10 minutes, the length of the skein is remeasured (L1) supporting the pre-load of 0.01 cN per tex. After an interval of 10 minutes, a force of 0.1 cN per tex is applied for 10 seconds and immediately afterwards a high force of 10 cN per tex is applied for 10 seconds. After 20 minutes the length of the skein is measured (L3) under the pre-load of 0.01 cN per tex.

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\text{Initial crimp (EK)} = \frac{L_0 - L_1}{L_0} \times 100\%
\]

\[
\text{Mechanical crimp stability (KB)} = \frac{L_0 - L_3}{L_0 - L_1} \times 100\%
\]

Initial crimp and mechanical crimp stability values used herein are the mean of EK and KB measurements respectively on at least 5 skeins of yarn.
The above procedure is similar to that described in the German standard DIN 53840 and is conveniently carried out on a Texturmat machine manufactured by Herbert Stein, Munchengladbach, W. Germany.

Initial crimp (EK) is a measure of the percentage reduction in length from the straightened length of a bulked yarn as the result of the bulked structure. Mechanical crimp stability (KB) is a measure of the proportion of bulk remaining after release of a specified high load.

The yarns of the present invention possess a level of bulk which is commercially acceptable and the bulk is sufficiently stable to tension. The advantages of such yarns are particularly apparent in finished fabrics in which the bulk has been developed.

The jaspe yarns of the present invention, when made into fabrics and dyed such as to colour the polyester and polyamide components differently, exhibit an attractive speckled appearance. In order to achieve this appearance, it is important that the gear-crimped composite yarn has been nodally interlaced such that the yarn has 40 to 140 nodes per metre. Composite yarns having less than 40 nodes per metre produce dyed fabrics in which undesirable streaks of each yarn component are seen.

The term yarn as used herein means a monofilament yarn or a multifilament yarn.

The drawable polyester and polyamide feed yarns are made by melt spinning, the spinning conditions being selected such that both yarns have a similar residual draw ratio.

Preferably the decitex of the drawn composite yarn is less than 150 decitex.

The term polyester as used herein means a polyester or a copolyester and the term polyamide means a polyamide or a copolyamide. The polyester and polyamide yarns may contain additives such as antioxidants, stabilisers, antistatic agents, delustrants or colouring materials.

The filament or filaments of the polyester yarn or the polyamide yarn may have a filament cross-section which is circular or non-circular for example trilobal.

The drawable yarn as used herein means a multifilament yarn or a copolymer and the term polyamide filamentary means a polyamide or a copolyamide. The yarn may contain additives such as antioxidants, stabilisers, antistatic agents, delustrants or colouring materials.

The filament may be circular or non-circular for example trilobal.

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yarn below balloon-guide 25 by rotation of the spindle and rotation of a traveller (not shown) around ring 27.

The yarn so produced is a drawn composite yarn having latent bulk. The bulk may be developed by subjecting the yarn in yarn or fabric form, to a thermal treatment.

The following examples illustrate but do not limit the present invention.

Example 1
A 95 decitex 25 filament drawable poly(ethylene terephthalate) yarn having a birefringence of $63 \times 10^{-3}$ and a 27 decitex 7 filament drawable poly(hexamethylene adipamide) yarn having a birefringence of $46.6 \times 10^{-3}$ were drawn and gear crimped by a process as shown diagrammatically in the accompanying drawing. The polyester filaments had a trilobal filament cross-section and the polyamide filaments had a circular filament cross-section. The weight ratio of the polyester filaments to the polyamide filaments was 78:22. The heated metal pin was of circular cross-section having a diameter of 2.22 cm and a temperature of 170°C. The gear wheels were made of stainless steel and had 38 teeth per inch. The intermeshing of the gear wheels was such that the maximum overlap of teeth on the two gears was 0.356 mm.

The speed of the gear wheels was adjusted such that the composite yarn was drawn by the tension imparted to the yarn between the heated pin and the gear wheels. The surface speed of the larger diameter tensioning roll was 840 metres per minute and the ratio of the surface speed of the larger diameter tensioning roll to the surface speed of the feed roll was 1.30. The yarn tension between the gear wheels and the larger diameter tensioning roll was controlled at 31 g, that is at 0.32 g per decitex based on the decitex of the drawn composite yarn.

The diameters of the two rolls of the stepped tensioning roll were such that the yarn was overfed from the larger diameter roll to the smaller diameter roll at an overfeed of 3.1%. On leaving the larger diameter tensioning roll, the overfed yarn was nodally interlaced by passing it through an interlacing jet to which air was supplied at an air pressure of 60 pounds per square inch. The interlacing jet had a yarn passageway in the form of a truncated cone and two directly opposed air passageways for directing air into the yarn passageway at right angles to the longitudinal axis of the yarn. The truncated cone form of the yarn passageway caused the major portion of the exhaust air to pass out of the yarn passageway in the same direction as the yarn.

The composite yarn so produced had a decitex of 96 and possessed latent bulk. The yarn had 86 interlaced nodes per metre (mean of 3 visual count measurements on 1 metre lengths of the yarn). The yarn had an initial crimp, measured as hereinbefore described, of 3.4%, a mechanical crimp stability of 27.0%, a breaking load of 347 centi-newtons and an extension to break of 30.9%.

The latent bulk yarn was knitted into fabric which was then dyed at 130°C to colour the polyester and polyamide components differently. Bulk was fully developed in the knitted yarn during the dyeing process. The fabric showed good bulk and an attractive jaspe or speckled appearance.

Example 2
Example 1 was repeated except that the poly(hexamethylene adipamide) feed yarn was a 42 decitex 10 filament yarn having a birefringence of $45.5 \times 10^{-3}$. The weight ratio of the polyester filaments to the polyamide filaments was therefore 69:31. Similar process conditions as in Example 1 were used except that the yarn tension between the gear wheels and the larger diameter tensioning roll was controlled at 37.5 g, that is at 0.35 g per decitex based on the decitex of the drawn composite yarn.

The composite yarn so produced had a decitex of 107 and possessed latent bulk. The yarn had 85 interlaced nodes per metre (mean of 3 visual count measurements on 1 metre lengths of the yarn). The yarn had an initial crimp of 3.4%, a mechanical crimp stability of 32.8%, a breaking load of 370 centi-newtons and an extension to break of 27.5%.

The latent bulk yarn was knitted into fabric which was then dyed as in Example 1. Bulk was fully developed in the knitted yarn during the dyeing process. The fabric showed good bulk and an attractive jaspe or speckled appearance.

Example 3
Example 1 was repeated except that the poly(hexamethylene adipamide) feed yarn was a 56 decitex 13 filament yarn having a birefringence of $45.0 \times 10^{-3}$. The weight ratio of the polyester filaments to the polyamide filaments was therefore 63:37. Similar process conditions as in Example 1 were used except that the yarn tension between the gear wheels and the larger diameter tensioning roll was controlled at 40 g, that is, at 0.34 g per decitex based on the decitex of the drawn composite yarn.

The composite yarn so produced had a decitex of 118 and possessed latent bulk. The yarn had 85 interlaced nodes per metre (mean of 3 visual count measurements on 1 metre lengths of the yarn). The yarn had an initial crimp of 3.7%, a mechanical crimp stability of 48.6%, a breaking load of 433 centi-newtons and an extension to break of 30.1%.

The latent bulk yarn was knitted into fabric which was then dyed as in Example 1. Bulk was fully
developed in the knitted yarn during the dyeing process. The fabric showed good bulk and an attractive jaspe or speckled appearance.

Example 4

Example 1 was repeated except that the poly(hexamethylene adipamide) feed yarn was a 96 decitex 20 filament yarn having a birefringence of $46.0 \times 10^{-3}$. The weight ratio of the polyester filaments to the polyamide filaments was therefore 50:50. Similar process conditions as in Example 1 were used except that the yarn tension between the gear wheels and the larger diameter tensioning roll was controlled at 88 g, that is, at 0.46 g per decitex based on the decitex of the drawn composite yarn. The composite yarn so produced had a decitex of 148 and possessed latent bulk. The yarn had 90 interlaced nodes per metre (mean of 3 visual count measurements on 1 metre lengths of the yarn). The yarn had an initial crimp of 4.1%, a mechanical crimp stability of 44.9%, a breaking load of 523 centi-newtons and an extension to break of 27.6%.

The latent bulk yarn was knitted into fabric which was then dyed as in Example 1. Bulk was fully developed in the knitted yarn during the dyeing process. The fabric showed good bulk and an attractive jaspe or speckled appearance.

Comparative Example A

Example 1 was repeated except that the following conditions were used:

- Feed yarns
  - 50 decitex 22 filament drawn poly(ethylene terephthalate) yarn.
  - 40 decitex 10 filament drawn poly(hexamethylene adipamide) yarn.
- Pin temperature: $160^\circ C$
- Surface speed of larger diameter tensioning roll: 532 metres per minute
- Ratio of tension roll surface speed to feed roll surface speed: 1.03
- Yarn tension between gear wheels and tensioning roll: 20 g
- Overfeed to interlacing jet: 1%

The composite yarn so produced had only 31 nodes per metre. Dyed fabric made from the yarn showed undesirable streaks of each yarn component. Attempts to increase the extent of nodal interlacing by increasing the overfeed of the yarn to the interlacing jet led to difficulties in controlling the threadline at interlacing and still produced a dyed fabric with streaks of each yarn component.

Comparative Example B

Example 1 was repeated except that the following conditions were used:

- Feed yarns
  - 333 decitex 30 filament drawable poly-(ethylene terephthalate) yarn of birefringence $27 \times 10^{-3}$
  - 100 decitex 20 filament drawable poly(hexamethylene adipamide) yarn
- Ratio of tension roll surface speed to feed roll surface speed: 1.9
- Yarn tension between gear wheels and tensioning roll: 46 g
- Overfeed to interlacing jet: 1%

The composite yarn so produced had a decitex of 217 and had only 22 nodes per metre. Dyed fabric made from the yarn showed undesirable streaks of each yarn component. Attempts to increase the extent of nodal interlacing by increasing the overfeed of the yarn to the interlacing jet still produced a dyed fabric with streaks of each yarn component.

Claims

1. A drawn gear-crimped yarn with latent bulk characterised in that the yarn is a nodally interlaced gear-crimped composite yarn comprising polyester continuous filaments and polyamide continuous filaments in the weight ratio 90:10 to 10:90 inclusive, the gear-crimped composite yarn having an initial crimp as defined of 2% to 12%, a mechanical crimp stability as defined of above 0%, and having 40 to 140 interlaced nodes per metre.

2. A gear-crimped yarn according to Claim 1 having an initial crimp of 2% to 8% inclusive.

3. A gear-crimped yarn according to either Claim 1 or Claim 2 in which the gear-crimped composite yarn has 70 to 100 nodes per metre.
4. A gear-crimped yarn according to any one of the preceding claims in which at least some of the filaments of the yarn have a non-circular cross-section.
5. A gear-crimped yarn according to any one of the preceding claims in which the polyester is poly(ethylene terephthalate).
6. A gear-crimped yarn according to any one of the preceding claims in which the polyamide is poly(hexamethylene adipamide).
7. A gear-crimped yarn according to any one of the preceding claims in which the drawn composite yarn has a decitex of less than 150.
8. A gear-crimped yarn according to any one of the preceding claims in which the bulk has been developed.
9. A fabric containing a gear-crimped yarn according to any one of the preceding claims.
10. A process for producing a drawn gear-crimped yarn with latent bulk characterised in that a drawable polyester continuous filament yarn having a birefringence of at least $30 \times 10^{-3}$ and a drawable polyamide continuous filament yarn having a birefringence of at least $30 \times 10^{-3}$ are heated and simultaneously drawn and gear crimped together as a composite yarn by means of toothed draw rolls and the composite yarn is forwarded from the toothed draw rolls under a controlled tension within the range 0.15 to 0.50 g per decitex inclusive based on the decitex of the drawn composite yarn and is subsequently interlaced to have 40 to 140 nodes per metre, the weight ratio of the polyester yarn to the polyamide yarn being in the range 90:10 to 10:90 inclusive.

Verständnisse

1. Verstrecktes, zahnradgekräuseltes Garn mit latenter Bauschung, dadurch gekennzeichnet, daß das Garn ein knotenartig verflochtenes, zahnradgekräuseltes Kompositgarn ist, welches endlose Polyesterfilamente und endlose Polyamidfilamente im Gewichtsverhältnis von 90:10 bis 10:90 enthält, wobei das zahnradgekräuselte Kompositgarn eine Anfangskräuselung, wie definiert, von 2 bis 12%, eine mechanische Kräuselungsstabilität, wie definiert, über 0% und 40 bis 140 verflochtene Knoten/m aufweist.
2. Zahnradgekräuseltes Garn nach Anspruch 1, welches eine Anfangskräuselung von 2 bis 8% aufweist.
3. Zahnradgekräuseltes Garn nach einem der Ansprüche 1 oder 2, bei welchem das zahnradgekräuselte Kompositgarn 70 bis 100 Knoten/m aufweist.
4. Zahnradgekräuseltes Garn nach einem der vorhergehenden Ansprüche, bei welchem mindestens einige der Filamente des Garts einen nichtkreisförmigen Querschnitt aufweisen.
5. Zahnradgekräuseltes Garn nach einem der vorhergehenden Ansprüche, bei welchem der Polyester (Poly(äthylenterephthalat)) besteht.
6. Zahnradgekräuseltes Garn nach einem der vorhergehenden Ansprüche, bei welchem das Polyamid aus Poly(hexamethylenadipamid) besteht.
8. Zahnradgekräuseltes Garn nach einem der vorhergehenden Ansprüche, bei welchem die Bauschung entwickelt worden ist.

Reivendications

1. Fil ondulé par engrenage, étiré, à gonflant latent, caractérisé en ce que le fil est un fil composite ondulé par engrenage à entrelacement nodal comprenant des filaments continus de polyester et des
Filaments continus de polyamide dans le rapport en masse de 90:10 à 10:90, inclus, le fil composite ondulé par engrenage ayant une ondulation initiale telle que définie de 2% à 12%, une stabilité à l'ondulation mécanique telle que définie supérieure à 0%, et ayant 40 à 140 noeuds d'entrelacement par mètre.

2. Fil ondulé par engrenage selon la revendication 1 ayant une ondulation initiale de 2% à 8% inclus.

3. Fil ondulé par engrenage selon la revendication 1 ou la revendication 2, dans lequel le fil composite ondulé par engrenage comporte 70 à 100 noeuds par mètre.

4. Fil ondulé par engrenage selon l'une quelconque des revendications précédentes, dans lequel au moins certains des filaments du fil ont une section non circulaire.

5. Fil ondulé par engrenage selon l'une quelconque des revendications précédentes, dans lequel le polyester est du poly(téréphtalate d'éthylène).

6. Fil ondulé par engrenage selon l'une quelconque des revendications précédentes, dans lequel le polyamide est du poly(hexaméthylène adipamide).

7. Fil ondulé par engrenage selon l'une quelconque des revendications précédentes, dans lequel le fil composite étiré présente un titre inférieur à 150 décitex.

8. Fil ondulé par engrenage selon l'une quelconque des revendications précédentes, dans lequel le gonflant a été développé.

9. Étoffe contenant un fil ondulé par engrenage selon l'une quelconque des revendications précédentes.

10. Procédé pour produire un fil ondulé par engrenage, étirable, à gonflant latent, caractérisé en ce qu'un fil étirable de filaments continus en polyester ayant une birefringence d'au moins $30 \times 10^{-3}$ et un fil étirable de filaments continus en polyamide ayant une birefringence d'au moins $30 \times 10^{-3}$ sont chauffés et étirés simultanément et ondulés par engrenage ensemble sous la forme d'un fil composite au moyen de rouleaux d'étirage dentés et le fil composite est avancé des rouleaux d'étirage dentés sous une tension contrôlée dans la plage de 0,15 à 0,50 g par décitex inclus, sur la base du titre du fil composite étiré, et est ensuite entrelacé de façon à comporter 40 à 140 noeuds par mètre, le rapport en masse du fil de polyester au fil de polyamide étant dans la plage de 90:10 à 10:90 inclus.

11. Procédé selon la revendication 10, dans lequel le fil composite ondulé est avancé des rouleaux d'étirage dentés sous une tension dans la plage de 0,20 à 0,40 g par décitex sur la base du titre du fil composite étiré.