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(54) **Melt-colored thick and thin yarn.**

(57) The present invention provides a process for producing a variable denier melt-colored synthetic polymeric filamentous yarn, having a random distribution of light and dark sections, produced without dyeing and exhibiting improved dye lightfastness, which comprises creating a melt-colored polymer mixture, spinning a melt-colored yarn from said synthetic melt-colored polymer mixture, and subjecting said melt-colored synthetic yarn to a thick and thin drawing process to produce a filamentous yarn of variable denier.

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Field of the Invention

The present invention relates to melt-colored synthetic polymer yarn containing fibers or filaments having a random distribution of light and dark sections. More particularly, it relates to fibers or filaments of this type which are produced without dyeing and which correspond to denier fluctuations or variations of random size in the direction of the axis of the fibers or filaments. It also relates to yarns made therefrom, and a method of preparing such yarns.

Background of the Invention

Man-made fibers are generally produced by spinning and drawing. In most instances, the fibers produced by this procedure are substantially uniform in thickness. However, in certain applications, it is important that yarns contain filaments having a variable denier. For instance, such yarns are useful in providing the means of producing variable texture in fabrics made therefrom and the fabrics containing such yarns have an attractive appearance, i.e., a "busy" looking fabric, and a pleasing feel to the touch.

It is known in the art that these variable denier fabrics may be dyed, thus producing mottled or other novelty effects owing to the varying rates and extent to which the dyestuff is taken up by the portions of different denier. While these conventionally dyed thick and thin yarns are currently in high demand, the added step of dyeing after the initial spinning and drawing of these variable denier yarns creates an extra step in the production process and an increased cost factor. Additionally, the problem of dye lightfastness of the fabric becomes a concern when the dye is applied at a post spinning and drawing stage. While fabrics prepared in this manner may be suitable for wearing apparel, they are less suitable as automotive fabrics, upholstery, curtain fabrics and the like.

Therefore, a need exists in the art for a method to produce these variable denier synthetic polymer fibers, filaments, and fabrics made therefrom, exhibiting improved dye lightfastness without the need to be dyed.

Summary of the Invention

The present invention provides a process for producing a variable denier melt-colored synthetic polymeric filamentous yarn, having a random distribution of light and dark sections, produced without dyeing and exhibiting improved dye lightfastness, which comprises creating a melt-colored polymer mixture, spinning a melt-colored yarn from said synthetic melt-colored polymer mixture, and subjecting said melt-colored synthetic yarn to a thick and thin drawing process so as to produce a filamentous yarn of variable denier.

Preferred synthetic polymers include linear terephthalate polyesters (PET), those being polyesters of glycol containing from 2 to 20 carbon atoms and a dicarboxylic acid compound comprising at least about 75% terephthalic acid. The remainder, if any, of the dicarboxylic acid compound may be any suitable dicarboxylic acid. The preferred polyester is poly(ethyleneterephthalate). The feeder yarn utilized to prepare the yarn and filaments of the present invention will have a birefringence in the range of about 0.01 to about 0.05. The preferred melt coloring agent is a colored pigment in a polyethylene carrier. The most preferred melt coloring agent is a colored agent in a PET carrier.

Definitions

The term "fiber" as used herein includes fibers of extreme or indefinite length (i.e., filaments) and fibers of short length (i.e., staple). The term "yarn" as used herein means a continuous strand of fibers.

The term "fabric" as used herein includes a textile structure composed of mechanically interlocked fibers or filaments. The structure can be nonwoven, woven or knitted.

The term "multifilament yarn" as used herein means a yarn comprised of a plurality of individual filaments or strands.

The term "glass transition temperature" (T_g) means the temperature at which an amorphous polymer or the amorphous regions of a partially crystalline polymer changes to or from a hard and relatively brittle state to a more flexible or rubbery condition. At sufficiently low temperatures, all amorphous polymers or amorphous regions of semicrystalline polymers assume characteristics of glasses, such as hardness, stiffness, and brittleness. Polymers in the glassy state are characterized by a low volume coefficient of expansion, when compared with that of the polymer in the fluid state. In this respect, polymers in the glassy state resemble crystalline polymers which are also characterized by a low volume coefficient of expansion.

The temperature interval at which the volume coefficient of expansion of the amorphous polymer changes from a high to a low value is the glass transition temperature range.

Birefringence (Δn) is obtained in the following manner:

Sodium D rays (wavelength 589 millimicrons) are used as a light source, and the filaments are disposed in a diagonal position. The birefringence (Δn) of the specimen is computed from the following equation:

$$\Delta n = \frac{n \lambda + r}{a}$$

when n is the interference fringe due to the degree of orientation of the polymer molecular chain; r is the retardation obtained by measuring the orientation not developing into the interference fringe by means of a Berek's compensator; a is the diameter of the filament; and λ is the wavelength of the sodium D rays.

Detailed Description of the Preferred Embodiments

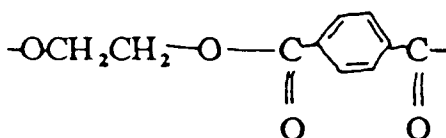
A number of procedures are known in the art for producing filaments having a variable denier. One such method, for example, is that of Stanko et al. U. S. Patent No. 4,906,519. Fiber-forming synthetic polymers suitable for use in the present invention include synthetic polymers having a glass transition temperature (T_g) of at least 30 °C.

Preferred synthetic polymers include linear terephthalate polyesters (PET), i.e., polyesters of a glycol containing from 2 to 20 carbon atoms and a dicarboxylic acid component comprising at least about 75% terephthalic acid. The remainder, if any, of the dicarboxylic acid component may be any suitable dicarboxylic acid such as

sebacic acid,
adipic acid,
isophthalic acid,
sulfonyl-4,4-dibenzoic acid, or
2,8-dibenzofurandicarboxylic acid.

Examples of linear terephthalate polyesters which may be employed include poly(ethyleneterephthalate), poly(butylene terephthalate), poly(ethyleneterephthalate/5-chloroisophthalate)(85/15), poly(ethyleneterephthalate/5-[sodium sulfo] isophthalate)(97/3), or poly(cyclohexane-1,4dimethyleneterephthalate/hexahydroterephthalate) (75/25).

The preferred polyester is poly(ethylene terephthalate), which includes a linear polyester in which at least about 85% of the recurring structural units are ethylene terephthalate units of the following formula:



More preferably, the linear polyester contains at least ninety percent (90%) recurring structural units of ethylene terephthalate. In a particularly preferred embodiment of the process, the polyester is substantially all poly(ethylene terephthalate). Up to 15 mole percent of other copolymerizable ester units other than poly(ethylene terephthalate) can also be present.

The feeder yarn utilized to prepare the yarn and filaments of the present invention must have sufficient molecular orientation (birefringence- n). The amount of birefringence in the feeder yarn will be an amount in the range of from about 0.01 to about 0.05, and, more preferably, from about 0.015 to 0.031, and, most preferably, about 0.018.

In order for the feeder yarn to have sufficient molecular orientation, the take-up speed will generally be in the range of from about 1,600 to about 4,000 meters/minute, preferably, from about 1,800 to about 2,800 meters/minute, and most preferably, about 2,000 meters/minute.

In order to achieve maximum contrast between the thick and thin sections of the yarn, the feeder yarn should be aged for a sufficient amount of time, typically about 24 hours to about 7 days.

The variable denier filaments of the present invention are prepared by drawing, at ambient temperature, i.e., 15°-30°C, the feeder yarn having the above described molecular orientation (birefringence) at a draw ratio of from about 1.27 to about 2.07 and in a draw zone having a length of from about 15.2 to about 300 cm. More preferably, the draw ratio is from about 1.69 to about 1.97 and the draw zone has a length of from about 30.5 to about 81.3 cm. Most preferably, the draw ratio is about 1.97 and the length of the draw zone is 61 cm.

The resulting thick and thin filaments contain slubs which preferably have a length in the range of from about 1.4 inches to 30.9 inches, an average length of slub of from about 9.1 to about 16.2 inches, and occupy from about 16.4 to about 49.8 percent of the longitudinal axis of the filaments. The above-recited percent of occupancy, length of slub, and average length of slub are obtained by measuring 50 feet of at least 10 filaments which have been selected at random.

Melt-coloring agents suitable for use in the present invention are inorganic and organic pigments in a thermoplastic carrier. This carrier can be PET, nylon, polyethylene or any other carrier suitable for pigment dispersion. Examples are carbon black pigment in a PET carrier and navy blue pigment in a PET carrier. The preferred melt coloring agent is a colored pigment in a polyethylene carrier. The most preferred melt coloring agent is a colored pigment in a PET carrier. The yarns comprising the variable denier filaments can be processed into fabrics which find particular use in draperies, upholstery fabrics, and automotive upholstery applications.

The following examples present illustrative but non-limiting embodiments of the present invention

Example 1

A PET yarn was produced by melt spinning molten PET and winding up the yarn at different winding speeds ranging from 1600 to 2725 mpm. Carbon black pigment in a concentration range up to 0.25 wt. percent was added to the molten PET prior to spinning. The feeder yarns were then drawn at ambient temperature, using a draw ratio range of 1.69 to 2.07, and a draw zone of 24 inches.

Test Sample	Winding Speed (mpm)	Birefringence	Pigment (wt. %)
1	1600	0.014	0.10
2	2000	0.015	0.10
3	2400	0.023	0.10
4	2725	0.031	0.10
5	1600	0.014	0.17
6	2000	0.015	0.17
7	2400	0.023	0.17
8	2725	0.031	0.17
9	1600	0.014	0.25
10	2000	0.015	0.25
11	2400	0.023	0.25
12	2725	0.031	0.25

The yarns produced at these conditions had a random distribution of light and dark sections without the necessity of dyeing, and showed improved dye lightfastness.

Example 2

A PET yarn was produced by melt spinning molten PET with 0.20 wt. percent navy pigment added to the molten PET prior to spinning. This yarn was wound at 1600 mpm and drawn at ambient temperature at a draw ratio of 2.02 and a draw zone of 24 inches.

Test Sample	Winding Speed (mpm)	Birefringence	Pigment (wt. %)
1	1600	0.014	0.10
2	1600	0.014	0.20
3	1600	0.014	0.25

A yarn with random dark blue and light blue sections was produced, without dyeing, and showing improved dye lightfastness.

Claims

1. A process for producing a variable denier melt-colored synthetic polymeric filamentous yarn comprising creating a melt-colored polymer mixture, spinning a melt-colored yarn from said synthetic melt-colored polymer mixture, and subjecting said melt-colored synthetic yarn to a thick and thin drawing process so as to produce a filamentous yarn of variable denier having a random distribution of light and dark sections, produced without dyeing and which exhibits improved dye lightfastness.
2. A process according to Claim 1 wherein the melt-colored synthetic polymer is pigmented at a concentration up to 5 wt. percent.
3. A process according to Claim 1 wherein said melt-coloring agents are selected from a group comprising carbon black pigment and navy blue pigment.
4. A process according to Claim 1 wherein the melt-colored synthetic polymer of said melt-colored synthetic polymer mixture is a polyester.
5. A process according to Claim 1 wherein said polymer is selected from a group comprising:
poly(ethyleneterephthalate),
poly(butylene terephthalate),
poly(ethyleneterephthalate/5-chloroisophthalate)(85/15),
poly(ethyleneterephthalate/5-[sodium-sulfo] isophthalate)(97/3), or
poly(cyclohexane-1,4dimethyleneterephthalate/hexahydroterephthalate) (75/25).
6. A process according to Claim 1 wherein the preferred melt-colored synthetic polymer of said melt-colored polymer mixture is a linear terephthalate polyester.
7. A process according to Claim 1 wherein said suitable dicarboxylic acids are selected from a group comprising:
sebacic acid,
adipic acid,
isophthalic acid,
sulfonyl-4,4-dibenzoic acid, or
2,8-dibenzofurandicarboxylic acid.
8. A process according to Claim 1 wherein the melt-colored synthetic polymer mixture is spun in a range of from about 1,600 mpm to about 3,000 mpm to form a yarn.
9. A process according to Claim 1 wherein the thick and thin drawing process takes place at ambient temperature.
10. A process according to Claim 1 wherein the ambient temperature is in a range from about 15 °C to about 30 °C.
11. A process according to Claim 1 wherein the take-up speed is in a range of from about 1,600 to about 4,000 mpm.
12. A process according to Claim 1 wherein the take-up speed is more preferably from about 1,800 to

about 2,800 mpm.

13. A process according to Claim 1 wherein said birefringence of said feeder yarn is about 0.01 to about 0.05.

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14. A process according to Claim 1 wherein said birefringence of said feeder yarn is more preferably about 0.015 to about 0.031.

15. A process according to Claim 1 wherein said draw ratio is about 1.27 to about 2.07.

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16. A process according to Claim 1 wherein said draw ratio is more preferably about 1.69 to about 1.97.

17. An article of manufacture containing filamentous yarn produced according to the process of Claim 1.

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