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(71) Applicant: Franchi, Roberto
Via G. Fattori, 25
I-50047 Prato (FI)(IT)

(72) Inventor: Franchi, Roberto
Via G. Fattori, 25
I-50047 Prato (FI)(IT)

(74) Representative: Dr. Ing. A. Racheli & C. C.
Viale San Michele del Carso, 4
I-20144 Milano(IT)

(54) Synthetic yarn and related production procedure.

(57) By means of the spinning of a copolymer made up of varying percentages of polyamide and polyester, a yarn with particular shrinking, dyeing and behavioural characteristics is obtained. This yarn is suitable for clothing and soft furnishing fabrics, textiles in general and for some specific technical uses (such as sailcloth or electric motor coverings). The procedure for obtaining such a yarn is also described.

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SYNTHETIC YARN RELATED PRODUCTION PROCEDURE

The present invention concerns a new synthetic continuous filament yarn obtained by extruding a polyamide/polyester copolymer.

Synthetic yarns are generally produced by melting down a polymer and extruding it through a multi-holed spinneret and then solidifying the obtained filaments. After extrusion, the yarns undergo a drawing or texturising process.

Whether the drawing is hot or cold depends on the type of polymer making up the yarn; cold drawing normally in the case of polyamide, hot drawing normally in the case of polyester.

The yarns prepared by the general method described above have shrinking and dyeing properties and a specific textile behaviour well known to all.

The aim of the present invention is to obtain a synthetic continuous filament yarn which has both polyamide and polyester characteristics and in which the properties described above can be varied, according to the reciprocal proportions of the two components, in such a way as to make them suitable for special articles (such as technical articles, textiles for sails and textiles for electric motor covers) as well as for fabrics in general (such as for clothing and soft furnishings).

This aim is reached by the creation of a synthetic continuous filament yarn composed of varying reciprocal percentages of polyamide and polyester: from 1% to 99% of polyamide and from 99% to 1% of polyester.

The yarn, subject of the invention, is obtained by means of a procedure which involves mixing the two components during the spinning phase in order to obtain the copolymer. Spinning takes place at temperatures generally ranging from 250° to 320°C; that is, between the normal thermal profiles of polyamide and polyester. The pick-up is then either drawn or texturised. Drawing may be done cold (using the technology typical of polyamide) or hot (using the technology typical of polyester), depending on the proportions of the individual components.

Cold drawing is carried out at ambient temperature; hot drawing at between 80° and 170°C.

According to the type of drawing adopted, the drawn yarn subject of the present invention has varying shrinking and dyeing properties and textile behaviour. For example, 50% shrinkage can be obtained if so desired.

The texturisation phase does not change the properties of the yarn except, of course, in terms of morphology.

The invention will now be explained by referring to some examples of manufacture relating to PES/PAM spinning by means of the extrusion and pick-up of the partially oriented yarn (POY) obtained by mixing polyester and polyamide 6 during the polymer fusion phase.

The following polymers are used:

a) Polyester (PES): the base polymer was a full lustre polymer with an intrinsic viscosity η (ETA)/20°C = 0.640 DL^{-1}. Before entering the extrusion phase, this polymer was dried in a continuous plant until chip residual humidity was 30/40 ppm (depending on the length of time in the plant).
The drying plant was a MIAG-type countercurrent vertical tower whose crystalliser was separate from the drier.

b) Polyamide (nylon 6): the base polyester polymer was mixed with a full lustre chip (PAM) whose relative viscosity, determined in 96% sulphuric acid at 20°C, was η (ETA) rel 20°C = 2.70.
This polyamide was previously batch-dried in nitrogen until the residual humidity of the chips was 400 ppm.

The problem of the spinner is to find a system which allows the temperature and speeds of spinning and picking-up to be adjusted to the various stages.

Our mixing method can be carried out by means of all known and used mixing systems, the most common being:

- volumetric dosers for chips or powders;
- gravimetric dosers for chips or powders;
- weight-volumetric dosers for the injection of molten material.

For example, it is possible to use a spinning plant composed of:

a) a PES/PAM dosing system: a volumetric doser capable of releasing the correct proportion of chips of the two polymers directly into the mouth of the extruder; once the weight of the chips to be dosed from each of the mouths of the doser has been established, an electronic control device ensures that the system continues to keep tile input given to the desired dosage ratio;

b) a horizontal, 90 mm diameter Ø Barmag extruder with five heating zones and an LTM system in front of the auger;

c) a static mixer for homogenising the molten mass, equipped with two heating zones which can be used in the case that greater homogeneity is to be given to the final product;

d) a heated molten polymer distribution spider;

e) a Barmag SP spinning plant composed of: 1) steam-heated diathermic oil spinning heads; 2) sixteen 2.4 cc titration pumps; 3) 32 spinneret packages, each composed of a spinneret, a pre-spinneret with flow distributors, a metal grid filter, a metal sand container and a baffle for the sand container;

f) a cooling chamber with an air flow perpendicular to the path of the thread;

g) an enzyme catalyser located at the base of the cooling chamber, consisting of distribution nozzles and 0.06 cc/revolution dosing pumps;

h) if necessary, interlacing machines before the pick-up;

i) a Barmag SW4SLD lapping machine with a feeding godet, a drawing frame roller and a grooved roller.

EXAMPLE 1

PES/PAM spinning of a 30 filament (85% polyester and 15% polyamide) 135 dtx POY destined for texturisation with a final count of 78 dtx.

The table below shows some of the parameters adopted during the various working phases:

TABLE 1

	WORKING PARAMETERS	30 filaments 135 dtx % polyamide - 15%
DRYING	PES drying air temperature Time spent in drier	165° C 6 hours
EXTRUSION	Extruder head pressure Temperature: Zone 1 Temperature: Zone 2 Temperature: Zone 3 Temperature: Zone 4 Temperature: Zone 5 Mixer temperature Zone 1 Mixer temperature Zone 2 Spinning boiler temperature	130 kgp/cm² 270° C 270° C 270° C 270° C 270° C 270° C 270° C 282° C
FILTRATION AND SPINNERET	Circular spinneret diameter Number of holes Extrusion speed Capillary diameter Capillary height PAK pressure	100 mm 30 16.8 m/i 0.30 mm 0.60 mm 110 kgp/cm²
COOLING	Temperature Speed at outlet Relative humidity	22° C 0.9 m/sec 50%
ENZYMATION	% Emulsion Dosing pump capacity Dosing pump revolutions/minute	12% 0.06 cc/rev 20 rpm
INTERLACING AND PICKUP	Interlacer air pressure Pick-up speed	3.0 atm 3190 m/m

The product obtained by using the method of the present invention is an above-average quality yarn.

EXAMPLE 2

Using the same procedure as in Example 1, PES/PAM spinning of a 30 filament (85% polyester and 15% polyamide) 280 dtx POY destined for texturisation with a final count of 165 dtx.

The table below shows some of the parameters adopted during the various working phases:

TABLE 2

	WORKING PARAMETERS	30 filaments 280 dtx % polyamide - 15%
DRYING	PES drying air temperature Time spent in drier	165° C 3 hours
EXTRUSION	Extruder head pressure Temperature: Zone 1 Temperature: Zone 2 Temperature: Zone 3 Temperature: Zone 4 Temperature: Zone 5 Mixer temperature Zone 1 Mixer temperature Zone 2 Spinning boiler temperature	130 kgp/cm² 285° C 285° C 285° C 280° C 280° C 285° C 285° C 292° C
FILTRATION AND SPINNERET	Circular spinneret diameter Number of holes Extrusion speed Capillary diameter Capillary height PAK pressure	100 mm 30 34.8 m/i 0.30 mm 0.60 mm 120 kgp/cm²
COOLING	Temperature Speed at outlet Relative humidity	22° C 1.2 m/sec 50%
ENZYMATION	% Emulsion Dosing pump capacity Dosing pump revolutions/minute	12% 0.06 cc/rev 35 rpm
INTERLACING AND PICKUP	Interlacer air pressure Pick-up speed	3.0 atm 3190 m/m

Also in this case, it appears that the product obtained by means of the method of the present invention has properties which are superior to those of products produced by previous methods.

It is obvious that it is possible to spin different compositions of the two products by appropriately modifying speeds and temperature.

In each case, the resulting product will have different dyeing, tactile and shrinking characteristics.

More details concerning each of the aspects characterising the said yarn are given below.

DYEING

This can be done by means of a simple polyester dye, a simple polyamide dye or by using both. In each case, the results will be different in terms of colour and intensity, and these results can be varied by changing the proportions of the two products in the composition of the yarn.

It should be noted that polyamide melts in formic acid. When a fabric made partially or wholly with this yarn is immersed in formic acid, part of the polyamide content is lost and this results in a fabric which has a different weight and feel from that of the untreated raw material. Furthermore, various dyeing effects can be obtained by varying the length of time in which the formic acid is left to act.

The use of such yarns, handled with imagination by an expert technician, provides the opportunity for greater creativity in an extremely wide range of fields, particularly that of fabrics for clothing or soft furnishings.

SHRINKAGE

As previosly stated, this yarn can be drawn by using either polyamide (cold drawing) or polyester (hot drawing) technologies, with clear-cut differences in terms of behaviour. These differences not only relate to the well-known differences in dyeability produced by the two techniques but also to the possibility of managing (or rather, controlling) the mechanical behaviour (shrinkage) of the yarn for the successive fixing phase.

In practice, it is possible to obtain varying degrees of shrinkage (from almost zero to about 50%) according to the proportion of the two components in the final composition and according to whether the yarn is hot or cold drawn.

In practice, this characteristic of the yarn could find appropriate technical application in yarns of fabrics for clothing or soft furnishings, where the characteristics mentioned above could lead to lower weaving costs (because the yarn is shrunk during the subsequent finishing phase of the completed fabric, reaching the desired compactness downstream of the weaving process) or could give the finished product a different and more original appearance (thanks to the effects of shrinking and dyeing).

"FEEL" AND TOUCH

It is well known that two similar fabrics (one made of 100% polyamide and the other of 100% polyester) have a completely different "feel".

Fabrics made from the new yarn fall between these two extremes in accordance with the different proportions of the two components.

Furthermore, it is possible to obtain a yarn (and therefore a fabric) which is softer to the touch and more similar to those composed of microfibres, with obvious savings in terms of production.

As is known, microfibres are individual fibres with a count of less than 1 denier making up a continuous filament or tufted yarn.

In our case, without needing to produce microfibre threads and while maintaining a higher individual fibre count, a higher-quality, softer "feel" can be obtained.

Claims

1. A synthetic continuous filament yarn composed of a polyamide/polyester copolymer consisting of varying proportions of polyamide (from 1% to 99%) and polyester (from 99% to 1%).
2. A synthetic yarn as described in Claim 1, characterized in that it is destined for special uses (such as technical articles and fabrics for clothing, soft furnishings and textiles in general) according to the reciprocal percentages of its individual components and the drawing and/or texturising technology adopted.
3. A procedure for obtaining the yarn described in Claims 1 and 2, characterized in that it involves mixing melted polyamide and polyester in order to obtain the copolymer, the heating of the said copolymer during the spinning phase to temperatures generally between 250° and 320°C, and the drawing of the pick-up in order to obtain the yarn of the present invention.
4. A procedure as described in Claim 3, characterized in that the drawing phase may be either cold or hot according to the percentages of the components of the copolymer and according to the desired characteristics of the yarn itself.
5. A procedure according to either of Claims 3 or 4, characterized in that the drawing phase can be substituted or followed by a texturisation phase.
6. A synthetic discontinuous filament yarn composed of the same copolymer described in Claims 1 and 2 which maintains the characteristics of the continuous filament yarn, particularly as far as dyeing is concerned.