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(54) Process for producing a polyamide fibre & novel rough-surfaced polyamide fibres produced by such process.

(57) Melt-spun, rough surfaces, fibres of a fibre-forming polyamide containing at least 10% by weight of another polymer, in preference either polyethylene or polypropylene, which is immiscible in a melt of the fibre-forming polyamide and has a lower melt viscosity than the fibre-forming polyamide at the spinning temperature, such other polymer being present in the melt spun fibres as microfibrils and a process for providing such fibres.

Fig. 1.

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Croydon Printing Company Ltd.

PROCESS FOR PRODUCING A POLYAMIDE FIBRE AND NOVEL ROUGH-SURFACED POLYAMIDE FIBRES PRODUCED BY SUCH PROCESS

This invention relates to the manufacture of synthetic fibres by melt spinning a blend of a fibre-forming polyamide and an immiscible polymer.

Recently there have been disclosures relating to the production of melt-spun polyamide fibres from a fibre-forming polyamide in which another polymer is added to the fibre-forming polyamide before it is spun.

Japanese Patent No 56-85420 (Teijin KK) is concerned with the production of an undrawn polyamide yarn containing between 0.5% and 10% by weight of a bisphenol-type polycarbonate having a degree of polymerisation of 20 or more.

In United States Specification 3 475 898 there is disclosed a blend of polyethylene glycol with a polyamide which is melt spun to form an antistatic filament. From the draw ratios given in the Examples it can be inferred that the wind up speed of the spun filaments was not substantially greater than 1 kilometre/minute.

In European Patent Application 8230573 7.7 we have described a process of melt spinning a fibre-forming thermoplastic polymer at a minimum wind up speed of 1 kilometre per minute in which, before melt spinning, there is added to the fibre-forming polymer, between 0.1% and 10% by weight of another polymer which is immiscible in a melt of the fibre-forming polymer, such other polymer having an average particle size of between 0.5 and 3 microns in the melt with the fibre-forming polymer immediately prior to spinning. Example 4 of this Patent Application is concerned with the prodution of fibres formed from a blend of 6% by weight of polyethylene and nylon 66. A feature of the fibres produced in this Example is that they have a rough, pitted surface.

We have now found that polyamide yarns having a novel rough surface can be produced by melt spinning, at a minimum wind up speed of 2 kilometres per minute, a blend formed from a fibre-forming polyamide and at least 10% by weight but less than 45% by weight of another polymer which is immiscible in a melt of the fibre-forming polyamide, such other polymer having lower melt viscosity than that of the fibre-forming polyamide at the spinning temperature.

By an "immiscible polymer" we mean that at the spinning temperature such a polymer forms a two phase melt with the fibre-forming thermoplastic polymer. Microscopic examination and optical photographs of such a melt show a two phase system in which the immiscible polymer is in the form of circles (indicating spherical particles) dispersed in the continuous, fibre-forming, polymer matrix.

However we wish the term "an immiscible polymer" to exclude a liquid crystal polymer, ie the additive polymers used in the invention do not form an anisotropic melt in the temperature range at which the thermoplastic polymer may be melt spun. This anisotropic condition may form when a liquid crystal polymer is heated or by the application of shear to the polymer, although in the latter case it must persist for a few seconds.

We have said that the blend may include up to 45% by weight of the other polymer, however, the actual proportion of the other polymer which may be used in a particular polymer combination is dependent on phase inversion not incurring ie in this invention we do not contemplate that the proportion of the minor component by weight in the blend shall become the continuous phase in which is dispersed the major component by weight as the discontinuous phase.

We have referred above to the other polymer in the blend having a lower melt viscosity than that of the fibre-forming polyamide, by which we mean that it has a melt viscosity at the spinning temperature less than 25 percent of that of the polyamide.

We also provide, therefore, melt spun, rough-surfaced, fibres of a fibre-forming polyamide containing at least 10%

by weight of the defined other polymer, such other polymer being present in the melt spun fibres as microfibrils. These microfibrils have an aspect ratio ie length/diameter ratio which is very high eg typically greater than 50 and such microfibrils will have diameters of about 0.5 micron.

The process of the invention is suited to the melt spinning of the more common fibre-forming polyamides such as nylon 66 and nylon 6. However, we have found that the process is particularly suited to the melt spinning of nylon 66.

Suitable immiscible polymers are polyolefines, such as polyethylene and polypropylene; and polyethylene glycol.

A feature of the process of the invention is that novel rough surfaced fibres are produced thereby.

Fibres of a polyamide produced by extrusion through fine orifices by the melt spinning technique normally possess a smooth shiny surface. Although the cross section of the filamentary fibres may be other than circular, fabrics made from such fibres possess a slick hand and are cold to the touch. In addition if the fibres are made into staple fibres, the smooth surface makes for more difficult working of the staple fibres into spun yarn. The desired fibre cohesiveness is not available. Natural fibres such as wool and cotton have a rough surface which tends to interlock in the spun yarn. The rough surface also provides better heat insulation and lends to a warm-to-the touch quality to fabrics made from such yarn.

Attempts have been made to provide synthetic fibres with a rough surface by either incorporating a particulate filler such as talc, metal whiskers, alumina or silica carbide, silica or a blowing agent in the fibre-forming polymer before it is spun or by rapidly cooling the fibres with water or solvent. The process of the invention provides fibres of a polyamide having a rough surface without recourse to such techniques.

Those fibres of the invention which have been melt spun at wind-up speeds between, say, 2 and 5 kilometres per metre, being partially oriented, may desirably be subjected to a draw-texturing process. Fibres produced by such draw-texturing process retain a rough surface but differing in detail from the fibres produced according to the invention process. Those fibres of the invention which have been melt spun at wind-up speeds in excess of, say, 5 kilometres per minute, being more fully oriented, can be used without further processing.

The invention will now be described with reference to the following Examples. In these Examples the additive polymer is an immiscible polymer and forms a two phase melt with the fibre-forming polymer.

EXAMPLE 1

A commercial grade of polyethylene - Alkathene Grade 23 - was used as the additive polymer. It had a melt flow index of 200 and a melt viscosity of 12 Ns/m^2 at 10^4 N/m^2 and 180°C. The polyamide was a commercial grade of nylon 66 - Imperial Chemical Industries PLC grade 5GS. The viscosity of the nylon was 80 Ns/M^2 at 10^4 N/m^2 and 285°C. 10% by weight of the polyethylene was mixed with the nylon 66 as a chip blend and spun on a laboratory melt spinner at 290°C and a throughput of 110 gm/hr/hole through 9 thou spinneret holes. No quench or conditioner was used. The yarn was wound up at speeds of 2000-6000 mpm.

A scanning electron microscope photograph of the surface of the fibre spun at 3000 mpm showed that it was extremely rough and covered with knobbly protrusions a few microns large. The fibre spun at 6000 mpm also had a rough and irregular surface, covered with fissures about 5μ long and 0.5 μ wide aligned along the fibre axis. Photographs of the spun fibre are shown in Fig 1 (magnification x 600) and Fig 2 (magnification x 3,000). In contrast 100% nylon 66 fibres spun at these wind-up speeds under the same spinning conditions were perfectly smooth cylinders.

The spun yarn did not slough off the bobbin at any wind-up speed even though a conditioner was not used.

The blend yarn containing 10% polyethylene spun at 3000 mpm was draw textured on a Scragg DCS 1000 machine. The draw ratio was 1.35, draw speed 40 mpm, primary heater temperature 190°C and heater length 1.5 m. The textured fibre surface was still rough, and contained fissures about 5-10 µ long and 0.5 µ wide at a small angle to the fibre axis due to twisting during draw texturing, plus other scaly surface features a few microns large. A photograph of the textured fibre (magnification x 3000) is shown in Fig 3.

EXAMPLE 2

A specially prepared grade of low viscosity polypropylene having a melt flow index of 242 was used as the additive polymer this time. The nylon used was the same as in Example 1. 15% by weight of the polypropylene was mixed with the nylon 66 as a chip blend and spun on a laboratory melt spinner under the same spinning conditions as in Example 1. The yarn was wound up at speeds of 1000 - 3000 mpm.

A scanning electron microscope photograph of the surface of the fibre spun at 3000 mpm showed that it was extremely rough, similar in appearance to the fibre spun in Example 1. The spun yarn did not slough off the bobbin at any wind-up speed even though a conditioner was not used.

CLAIMS

1. A process for producing polyamide yarns comprising melt spinning, at a minimum wind up speed of 2 kilometres per minute, a blend formed from a fibre-forming polyamide at least 10% by weight but less than 45% by weight of another polymer which is immiscible in a melt of the fibre-forming polyamide, such other polymer having a lower melt viscosity than that of the fibre-forming polyamide at the spinning temperature.

2. A process as claimed in Claim 1 in which the other, immiscible, polymer is either polyethylene or polypropylene.

3. A melt-spun, rough-surfaced, fibres of a fibre-forming polyamide containing at least 10% by weight of another polymer which is immiscible in a melt of the fibre-forming polyamide and has a lower melt viscosity than the fibre-forming polyamide at the spinning temperature, such other polymer being present in the melt spun fibres as microfibrils.

4. Melt-spun, rough-surfaced, fibres of a fibre-forming polyamide as claimed in claim 3 in which the other, immiscible, polymer is either polyethylene or polypropylene.

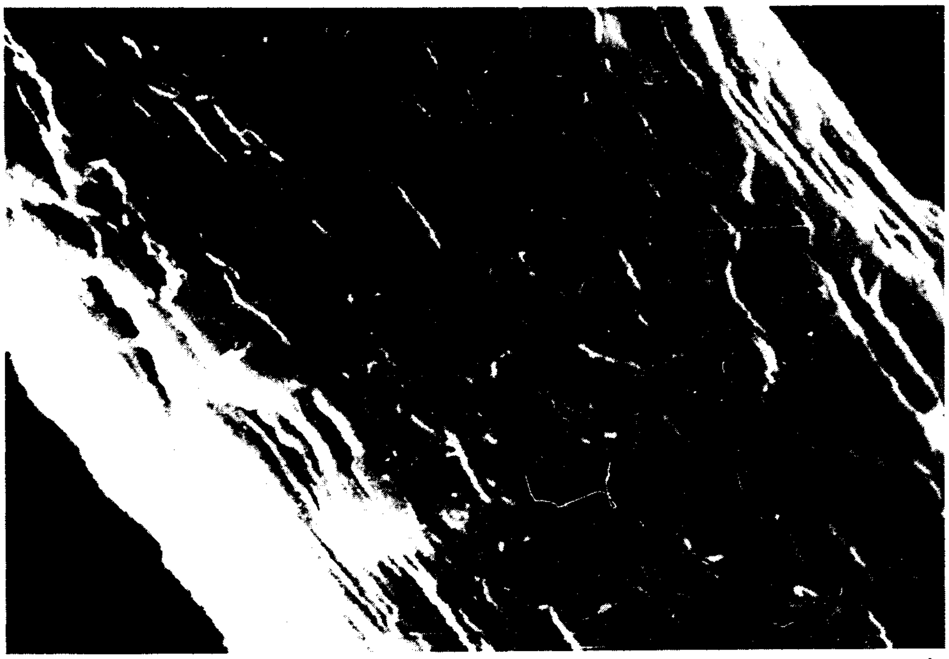

Fig.2.

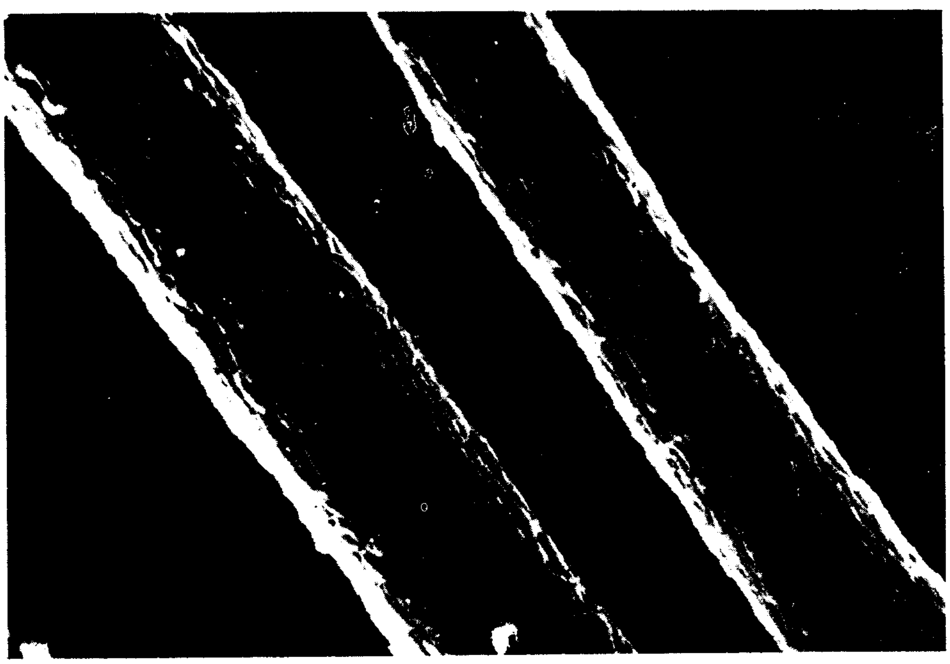

Fig.1.

Fig. 3.