

1

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PROCESS OF DRAWING NUB-FREE
POLYAMIDE YARN

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3 Claims

ABSTRACT OF THE DISCLOSURE

A drawing process for polyamide filaments includes the step of raising the water content of the filaments above the equilibrium value of the filaments with the ambient atmosphere prior to drawing. This is accomplished by passing the filaments through a humid atmosphere at room temperature.

The present invention relates to improvements in the drawing of synthetic yarn and more particularly to improvements in drawing, in the solid state, yarn consisting of high molecular weight linear condensation polyamides.

The yarn which consists of continuous filaments and includes both multifilament yarn and monofilament yarn, is thus composed of a high molecular weight synthetic linear condensation polyamide, for example, polyhexamethylene adipamide, but other synthetic linear polyamides may form the material of the filaments, for instance, polyhexamethylene sebacamide, poly-kappa-aminoundecanoic acid, poly-epsilon-caprolactam. By high molecular weight is meant that the molecular weight of the polyamide is sufficiently high for the latter to be fibre-forming.

Yarn consisting of synthetic linear condensation polyamide filaments, for example, a yarn made of polyhexamethylene adipamide, possesses many properties eagerly sought after for textile purposes and, in particular, a high degree of strength expressed as the tenacity at the point of rupture. Such yarn is accordingly manufactured commercially on a large scale, the high tenacity being attained by submitting the filaments to a process of drawing whilst they are in the solid state, a process frequently referred to as cold-drawing. Thus the filaments, in their undrawn condition after being solution-spun or melt-spun from the required polymer, are drawn or elongated in the solid state, commonly by passage between two rolls, the second (or draw roll) revolving at a greater peripheral speed than the first (or feed roll). Between the two rolls the filaments may, if desired, pass round a snubbing pin so as to locate the point at which drawing takes place.

It has long been known that it is generally desirable to handle polyamides in a moist atmosphere and that the presence of water in the atmosphere facilitates the drawing of the filaments. If polyhexamethylene adipamide yarn is surrounded by a moist atmosphere an equilibrium becomes established between the concentration of water in the yarn and that in the atmosphere. In other words, for a given temperature the water content of the yarn depends (when equilibrium has been reached) upon the relative humidity of the atmosphere. For instance the (saturated) vapour pressure of water at 25° C. is 23.8 mm. of mercury. The water content of undrawn polyhexamethylene adipamide yarn in equilibrium therewith is found to be approximately 10%, whereas at a relative humidity of 80% the yarn contains only about 6% of water and at a humidity of 60% only 4% of water.

2

It may be supposed that the presence of water in the (externally dry) yarn assists in the process of drawing in the same way as would the presence of another plasticiser for the polyamide since water is understood to act as a plasticiser. When it is said that the process of drawing is assisted or facilitated, it is meant that the incidence of broken filaments or other faults during drawing is reduced or that the speed of drawing can be increased without impairing the product. If one filament of a multifilament yarn breaks during drawing it may wrap itself round the draw roll and break off and in any case the loose filament ends will exist in the drawn yarn and may form a slub. Should the stress become too severe several filaments or even the whole yarn may rupture. Another fault apt to occur during drawing is that parts of the yarn fail to become drawn to the desired extent, or even at all, in which case lengths of insufficiently drawn or undrawn yarn are found in the bobbin of yarn taken from the drawing machine. In the case of monofilamentous yarn short lengths of undrawn yarn sometimes occur in the form of nodules on the drawn monofilament. These nodules are known as nubs.

For the reasons given above it is the practice to effect the process of drawing in a moist atmosphere. The properties of the resulting yarn are however very sensitive to the ambient conditions. Consequently, in order to obtain yarn having uniform properties along its length, e.g., a uniform denier and a uniform tendency to retract on relaxation, it is necessary to maintain the temperature and relative humidity of the room atmosphere constant or nearly so. For this purpose the atmosphere of the factory where the drawing machines are situated is constantly controlled by air conditioners.

Whilst therefore from the point of view of the drawing process it would be advantageous to increase the figure for relative humidity to which the air is currently adjusted, on practical grounds little change if any is advisable or possible. As soon as the humidity is substantially raised the operatives experience discomfort and the machines commence to rust. The Factories Act moreover, which regulates the working conditions in factories, prescribes a humidity table. Furthermore the heavier burden on the air conditioning plant occasioned by the increased humidification required would constitute an unwelcome addition to the operating costs.

It has now been found feasible to draw polyamide yarn which is in equilibrium with an atmosphere having a degree of relative humidity substantially higher than that of the factory atmosphere. In other words the yarn being drawn has a water content which is substantially higher than that which would be in equilibrium with the water vapour of the ambient atmosphere. This is somewhat surprising on account of the relative rapidity with which polyamide filaments tend to reach equilibrium with the ambient water vapour. Convenient methods have also been discovered for bringing the yarn to be drawn into equilibrium with a suitable humid atmosphere, i.e., an atmosphere of high relative humidity.

Accordingly, the invention consists of a process for drawing in the solid state yarn composed of a high molecular weight synthetic linear condensation polyamide, characterised in that the yarn prior to being drawn is brought into contact with a sufficiently humid atmosphere at room temperature to raise its water content by at least 10% of the value which would be in equilibrium with the water vapour of the ambient atmosphere during drawing at the same temperature.

To exclude any possibility of doubt it is stated that the expression "humid atmosphere" is used herein with the meaning of an atmosphere containing water vapour.

The employment of the above process for drawing has

been found to be of great practical advantage as will be apparent from the examples which are given below.

In particular it has been observed that when a monofilament of polyhexamethylene adipamide is being drawn with the use of a snubbing pin, the occurrence of nubs is heralded by the neck at which the filament draws down leaving the neighbourhood of the snubbing pin. Provided the neck remains stationary on or very near the snubbing pin no nubs are produced. In the present process of drawing, when a snubbing pin is employed the neck remains on or very near the snubbing pin and the resulting yarn is free of nubs.

It may be observed that the location of the neck in contact with the snubbing pin during drawing, is, in itself, not new because there are other ways, apart from the novel process of the invention, in which the neck can be caused to assume a position on the snubbing pin. This could be achieved, for example, by a reduction in the speed of drawing (though such a course would not be chosen since it would mean a reduced production).

The invention therefore includes a process for drawing, in the solid state and at a neck, by passage between two rolls, the second revolving peripherally faster than the first, yarn composed of a high molecular weight synthetic linear condensation polyamide, wherein the yarn, on its way from the first roll to the second, is passed round a snubbing pin, and draws at a neck, characterised in that the yarn prior to being drawn is brought into contact with a sufficiently humid atmosphere at room temperature in order to raise its water content by at least 10% of the value which would be in equilibrium with the water vapour of the ambient atmosphere during drawing, at the same temperature. In this process of drawing the neck remains on or very near the snubbing pin.

Preferably the humid atmosphere employed in the present process of drawing to raise the water content of the yarn should possess a relative humidity of at least 85%. Especially good results, moreover, are obtained when the water content of the yarn is raised by at least 100% of the value which would be in equilibrium with the ambient atmosphere.

Various methods of bringing the yarn to be drawn into contact with the humid atmosphere may be adopted. Thus the bobbin or cake of undrawn yarn may be enclosed in a suitable box or container lined with bibulous paper or fabric kept saturated with water. The box may be conveniently cubical or cylindrical, the material of which it is constructed being, for instance, aluminum or Perspex (registered trade mark). The water supply can comprise a wick communicating with a reservoir of the like.

It is perhaps important to point out that the application of liquid water to the yarn as for example, by sprinkling, is not suitable for the present purpose. From a practical point of view, such a proceeding would be inefficient and generally unsatisfactory, and is in fact not appropriate to the invention which prescribes a humid atmosphere, that is to say, the water present is in the form of its vapour.

EXAMPLE 1

A monofilament of polyhexamethylene adipamide having a denier of 15 is drawn using a snubbing pin at a draw ratio of 4.7 at 1500 feet per minute. The temperature is 22° C. and the ambient atmosphere has a relative humidity of 57%. The drawn monofilament has numerous nubs and the neck where drawing occurs is ½ inch from the snubbing pin.

The cake of undrawn monofilament is placed in a cylindrical box made of Perspex (Registered trade mark) the atmosphere of which has a relative humidity of 67%. The neck where drawing occurs is now in contact with the snubbing pin and the resulting drawn monofilament has very few nubs. When the relative humidity of the box is raised to 87% the drawn yarn is completely free of

nubs, the neck remaining in contact with the snubbing pin during drawing.

EXAMPLE 2

Polyhexamethylene adipamide yarn having 6 filaments and a total denier of 40 is drawn with a snubbing pin at a ratio of 4.34 in an atmosphere of 65% relative humidity. By enclosing the undrawn yarn in a box wherein the relative humidity is kept at 85% it is possible to obtain yarn completely free from nubs.

What we claim is:

1. In a yarn drawing process comprising continuously feeding in the solid state melt-spun yarn composed of one or more filaments of a high molecular weight synthetic linear condensation polyamide by feed roll means to draw roll means wherein the draw roll revolves at a greater peripheral speed than the feed roll thus withdrawing the yarn at an increased rate and causing elongation thereof, the improvement consisting in bringing the yarn, prior to being drawn, and while at generally room temperature into contact with a humid atmosphere at room temperature and having a relative humidity of at least 85%; whereby the water content of the yarn is raised by at least 10% of the value which is in equilibrium with the water vapour of the ambient drawing atmosphere at the same temperature.

2. In a yarn drawing process comprising continuously feeding in the solid state melt-spun yarn composed of one or more filaments of a high molecular weight synthetic linear condensation polyamide by feed roll means to draw roll means wherein the draw roll revolves at a greater peripheral speed than the feed roll thus withdrawing the yarn at an increased rate and causing elongation thereof, snubbing the movement of said yarn by passing it round a snubbing pin situated between the feed roll means and the draw roll means so that there is a tendency for the point of necking down of the filaments to be localised, the improvement consisting in bringing the yarn prior to being drawn and while at generally room temperature into contact with a humid atmosphere at room temperature and having a relative humidity of at least 85% whereby the water content of the yarn is raised by at least 10% of the value which is in equilibrium with the water vapour of the ambient atmosphere at the same temperature.

3. The drawing process claimed in claim 2, wherein the water content of the yarn is raised by at least 100% of the value which is in equilibrium with the water vapour of the ambient atmosphere at the same temperature.

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