ABSTRACT OF THE DISCLOSURE

A mixed yarn is prepared form an elastic fiber, e.g., polyurethane elastomer, and a non-elastic fiber, e.g., polyvinyl alcohol fiber. The elastic fiber is heated at a temperature above 50°C but below the melting or decomposition temperature of the fiber to lower the elongation of the elastic fiber to below 100%. This heat set fiber is converted to a staple fiber, mixed with non-elastic staple fiber, and the mixed fibers are spun into yarn. The yarn is then heat treated at above 50°C and below the melting or decomposition temperatures of the fibers to improve the elasticity of the yarn.

The present invention relates to a process for the manufacture of spinning yarn containing elastic fiber, more particularly mixed yarn composed of elastic staple fiber having an elongation of below 100% and containing segment having melting point below 80°C (fiber A) and other non-elastic fiber (fiber B).

The object of the invention is to facilitate the spinning of the fiber A which is difficult to spin by the conventional process and to restore the elasticity of fiber A after a conventional spinning process to obtain easily spinning yarn such as a mixed yarn having an excellent elasticity.

Hence, in mixing the fibers A and B there have been caused various problems in a conventional spinning technique used nowadays since the fiber A has an extremely great elongation. There have been disadvantages in that technique. For example, it is often impossible to spin since the elongation of fiber A becomes uneven, the fiber is cut, and the fiber twines around a spinning machine. If the mixing of the fibers A and B may be performed easily, it is thought that a wide scope of applications may be developed in connection with the special elastic property of the fiber A. Thus, we have found a process to improve said disadvantages to a great extent and to make easy the manufacture of mixed yarn of fiber A.

To illustrate the invention, it is described with reference to an embodiment. A multi-filament of 400 denier/30 filaments is obtained from a polyurethane elastomer consisting of polyethylene adipate, diphenylmethane 4, 4'-diisocyanate and ethyleneglycol (mole ratio 1:5:4). The resulting multifilament is stretched to 4.1 times in a water bath at about 98°C and thereafter cut into a fiber length of 51 mm. Namely, a staple fiber having a fineness of 3.0 deniers and a fiber length of 51 mm of a monofilament is obtained. The resulting fiber has a strength of 2.1 g./d. and an elongation of 90%.

A mixed yarn having a twist number of 17 and 180 deniers is obtained from 10% of said staple fiber and 90% of Vinylon having a fineness of 3.0 deniers, a strength of 4.7 g./d. and an elongation of 22% under the humidity and temperature condition employed for conventional fiber by a cotton spinning process. The resulting mixed yarn is heat-treated for 1 minute in an air bath at 160°C, the immediate restoration at 10% elongation being 92%. The immediate restoration at 10% elongation before the heat treatment was 66%. When spinning is performed in the manner described above using a mixed yarn containing 10% of said elastic fiber which has not been stretched and has an elongation of 300% and 90% of said Vinylon the elastic yarn is twined around the machine or cut too tight so that it is impossible to spin.

From the fact stated above, it is found that is difficult to spin the fiber A of large elongation in a conventional manner and it is required to decrease the elongation of fiber A to below 100% by stretching at a temperature above 50°C and below the melting or decomposition point of said fiber.

It is necessary to stretch at a temperature above 50°C. If the stretching is performed at a temperature below 50°C, the stretched fiber will still have a large elongation. For example, in the embodiment described above, when the fiber is stretched at 50°C up to 4.1 times is cut, it will have again an elongation of 270% so that the stretching may be rendered impossible as in the original fiber. Additionally, if the stretching according to the invention is performed, the percentage of elastic fiber may be very advantageously increased without any hindrance.

In general, the percentage of elastic fiber in the mixed yarn is suitably 1-50% and more especially it is preferably 2-20%. In the stretching process described above, there may be used an air bath, an inert gas bath, a water bath, a steam bath or an aqueous or inorganic or organic solution containing various chemicals such as swelling agent such as alcohol, or surface active agent etc. The use of a solution results in a more remarkable fixing effect than does use of an air bath. While a mixed yarn is heat treated as such in the above embodiment, when the mixed yarn is treated after weaving a product may be obtained which has a superior elasticity and bulk of that of untreated one. The heat treatment described herein is performed suitably at a temperature above 50°C and below 180°C. While the same heat transfer medium used in the stretching process may be used, the effect according to the invention is displayed well when a temperature equal to or above the temperature employed in the stretching process is applied. Of course, a heat transfer medium different from that used in the stretching process may be used. While a mixed yarn in which the fiber A is used has been mainly illustrated in the above description, the invention is available to not only a mixed yarn but also in heat treating a non-woven cloth using the stretched fiber A as binder for the cloth. Since the fiber stretched and fixed according to the invention maintains a low elongation when it is cut and is in the non-stretched state, the same application of the invention as in the case of mixed yarn can give a similar result in manufacturing a covered yarn using the fiber A.

As the fiber A to be used in the invention, so-called polyurethane elastomer or a fiber consisting of mainly polyurethane elastomer is suitable and other elastomer containing segment having a melting point of below 80°C may be used. The polyurethane elastomer consists of polyurethane having generally a melting point below 80°C, polycosaycane and chain extender such as polyethylene glycol, water etc. As the fiber B to be used in the invention, use may be made of a generally commercially available fiber, for example, polyvinyl alcohol fiber such as Vinylon, polyester fiber, acryliclonitrile fiber, polyamide fiber such as nylon, silk, wool, cotton, viscose rayon, cupra rayon, acetate rayon, acetate oxide, vinyl or vinly chloride copolymer, polyethylene or polypropylene or the mixture of these two or more fibers.
Example 1
A multi-filament of 400 deniers/40 filaments is obtained from a polyurethane elastomer consisting of polyurethane adipate (molecular weight: 2,000; melting point: 25°C), diphenylmethane 4,4'-diisocyanate and ethylene glycol (mole ratio 1:5:4). The resulting multi-filament is stretched to 3.4 times in a water bath at 98°C, the length of the bath being 1 m, and the time of passage being 5 seconds, and the stretched fiber is cut into a staple fiber having a fineness of 3.0 deniers and a fiber length of 51 mm. The staple has a strength of 2.65 g/d and an elongation of 87%. 5% of said staple and 95% of Vinylon having a fineness of 3.0 deniers, a strength of 4.7 g/d, and an elongation of 22% are subjected to a cotton spinning process under the temperature and humidity conditions employed for conventional fiber to obtain a mixed yarn having a twist number of 17 and 180 deniers. In this case, said elastic fiber can be spun without any hindrance. On the other hand, when said elastic fiber which has not been stretched is mixed, the elongation is too great and it twines around the machine so that a uniform mixed yarn cannot be obtained.

The resulting mixed yarn is treated for 30 minutes in the air at 110°C. The mixed yarn so-treated shows an immediate elastic recovery of 87% at 10% elongation. However, its immediate elastic recovery before heat treatment is 60%.

Example 2
A multi-filament of 1,200 deniers/100 filaments is obtained from a polyurethane elastomer consisting of poly(caprolactone having a molecular weight of 1,500 and a melting point of 60°C, tolylene diisocyanate and ethylene glycol. The resulting multi-filament is stretched to 510% in a water bath at 98°C containing 3% of synthetic wax emulsion, the length of the bath being 1 m, and the time of passage being 5 seconds. Thereafter, the filament is cut into lengths of 51 mm. From 7% of the staple and 93% of mixed fiber staple consisting of 50 parts of nylon and 50 parts of polyethylene and having a fineness of 20 deniers, a fiber length of 50 mm, and a crimp number of 7.2 turns/25 mm, a random web is formed at a humidity of 65% and temperature of 20°C. The web is punched with needles and nylon is dissolved uniformly with 20% solution of calcium chloride in methanol. On treating for 20 minutes with boiling water, the methanol solution of calcium chloride is removed and the elastic yarn having been stretched may be shrunk to yield an elastic base cloth. On the other hand, the base cloth obtained by washing the methanol solution with water at 40°C has less elasticity compared with said base cloth.

Example 3
A multi-filament of 1,200 deniers/100 filaments is obtained from a polyurethane elastomer consisting of polytetramethylene glycol, diphenylmethane diisocyanate and 1,4-butanediol. The resulting multifilament is stretched to 350% between rollers and fixed in n-butyl alcohol at 90°C, the length of the bath being 1 m, and the time of passage being 3 seconds. The stretched and fixed filament has an elongation of 81% whereas is had an elongation of 513% before stretching. The resulting filament is cut into staple fiber having lengths of 51 mm. From 5% of this staple and 95% staple fiber consisting of polyethylene terephthalate having a fineness of 3.0 deniers and a fiber length of 51 mm., a mixed yarn is obtained in the same manner as in Example 1. The resulting mixed yarn is heat-treated for 2 minutes in an air bath at 150°C. The heat-treated mixed yarn has more elasticity and bulk compared with the yarn before heat treatment.

What we claim is:
1. A process for the manufacture of a mixed spinning yarn containing elastic fiber and non-elastic fiber which comprises stretching and heat setting an elastic fiber having a melting point below 80°C. At a temperature above 50°C, and below the melting or decomposition temperature of said fiber to lower the elongation of the elastic fiber below 100%, converting the elastic fiber to staple fiber, mixing the elastic staple fiber with a non-elastic stable fiber, spinning the mixed fibers into a mixed yarn, and heat treating the mixed yarn at a temperature above 50°C. And below the melting or decomposition temperatures of both fibers to improve elasticity.
2. A process according to claim 1, wherein the elastic fiber is polyurethane elastomer.
3. A process according to claim 1, wherein the heat treating step is carried out at a temperature between 80-180°C.
4. A process according to claim 1, wherein the mixed yarn contains about 1-50% of elastic staple fiber.
5. A process according to claim 1, wherein the mixed yarn contains about 2-20% of elastic staple fiber.

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CERTIFICATE OF CORRECTION
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It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 4, line 20 after "fiber" insert --consisting essential of a polyurethane elastomer derived from polyglycol--; and line 21, after "80°C." insert --, polyisocyanate and a diol chain extender--.

SIGNED AND SEALED
JUL 28 1970

(SEAL)

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