THERMAL STABILIZATION OF POLYAMIDE FIBERS

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ABSTRACT
A process for producing a thermally stable aromatic polyamide fiber fabric by treating the relaxed fabric with a silicone emulsion and then placing the fabric under tension while exposing it to a temperature of about 80°F.

1 Claim, No Drawings
This invention relates to a process for treating polyamide fibers. More particularly, this invention concerns itself with a process for preventing thermal shrinkage of fabric materials made from aromatic polyamide fibers.

The thermal shrinkage of synthetic fabrics during manufacture as well as during certain uses, for example under exposure to high temperatures or to fires, constitutes a serious problem in the textile field. Numerous methods have been suggested in attempting to solve this problem. However, although some of these attempts at solving the problem of shrinkage have been successful, the resultant fabric material loses its softness and flexibility due to the agents utilized in treating the fabric material.

A problem often encountered in the utilization of synthetic fabrics, especially of the aromatic polyamide type, concerns itself with the fact that these materials, upon exposure to an elevated temperature environment, shrink and become very stiff and boardy unless they receive a suitable pretreatment.

With the present invention, however, it has been found that the tendency for polyamide fiber textiles to shrink during exposure to high temperatures or fire can be overcome with no loss of flexibility in the final product. In this invention, aromatic polyamide fabrics in a relaxed condition are first scoured with a detergent solution, rinsed, and dried. The fabric is then treated with a silicone solution, held to fixed length and width dimensions by being mounted on a rigid frame and then heat treated or "set". The heat treated fabric is then removed from the frame and machine washed and dried. The resultant product is soft and flexible. It can be re-exposed to heat at 400°F to 800°F while in a relaxed condition with negligible shrinkage and no loss in softness or flexibility.

SUMMARY OF THE INVENTION

In accordance with this invention, it has been found that the successful pretreatment of polyamide fiber textiles can be accomplished by a process which involves treating the relaxed fabric with a silicone solution followed by a heat treatment while the fabric is held under fixed length and width dimensions. In brief, the fabric material is first scoured and dried. It is then soaked in a relaxed condition with a silicone emulsion and dried while in its relaxed state. The silicone-treated fabric is then mounted on a pin frame at fixed length and width, and exposed to a temperature of 800°F for a period of time. The heat-treated material is then removed from the frame. The resulting fabric is soft and flexible and, if re-exposed to elevated temperatures while relaxed, the shrinkage is negligible and the flexibility is retained. Continuous processing of long length of fabric can be accomplished by use of a conventional textile finishing mill tenter frame. Here the silicone pre-treated fabric is held at fixed length and width on the tenter frame while passing continuously through the tenter frame oven, whereby each increment of cloth attains the requisite temperature for the proper period of time to assure fabric setting.

Accordingly, the primary object of this invention is to provide a process for pre-treating synthetic textile fabrics of the polyamide type. Another object of this invention is to provide a process for inhibiting the shrinkage of polyamide textile fibers while still retaining fabric flexibility.

Still another object of this invention is to provide a process for producing a thermally stable aromatic polyamide fiber fabric that will not shrink or distort when exposed relaxed to temperatures in the range of about 400°F to 800°F. The above and still other objects and advantages of the present invention will become more readily apparent upon consideration of the following detailed disclosure thereof.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The invention provides a process for pre-treating aromatic polyamide fiber fabrics of the type sold under the name Nomex and made by E. I. du Pont de Nemours and Co., Inc. of Wilmington, Delaware. The polyamide fibers of the Nomex type are chemically defined as aromatic polyamides. The process provides a means for producing thermally stable fabrics which do not shrink and retain their flexibility even when exposed to a high temperature environment up to 800°F. The process consists of first treating the fabric material with a silicone emulsion followed by exposing the fabric, suitably held in a pin frame at fixed length and width so as to prevent the shrinkage of the fabric, to such a temperature and for such a time as would cause the fabric to shrink if it were not so restrained.

For the purpose of illustrating the invention, the following detailed example is presented.

EXAMPLE

A relaxed panel, 60 inches in length and 24 inches in width, of Nomex type polyamide fiber fabric is first scoured for 30 minutes at 60°C in an aqueous solution of 2 grams per liter of Tergitol non-ionic NPX detergent, chemically defined as a nonylphenol and 0.5 grams per liter of sodium tetrapropylphosphate, followed by a water rinse. The panel is then desized by a further immersion for 30 minutes at 80°C in an aqueous solution of 1.5 grams per liter of Rhozyme PF mix 564, suitably buffered. The mix 564 is made by Rhom and Haas Co of Philadelphia and is chemically defined as a proteolytic enzyme. The fabric is then rinsed again for 30 minutes at 50°C in several changes of clear water and air-dried at 95°C. The scoured and dried relaxed fabric is then soaked in a 10 percent by volume solution of 5:1 mixture of (1) a Silicone Emulsion ET-4-0206 made by the Dow Corning Corporation of Midland, Michigan and defined chemically as a dimethyl polyisiloxane; and (2) catalyst 22A made by the Dow Corning Corporation of Midland, Michigan and defined chemically as a metal organic salt. The silicone-treated fabric is then allowed to drain for 2 minutes, then dried and cured relaxed in air at 300°F for 15 minutes. The dried, silicone-treated fabric is then mounted on a pin frame and is held at a fixed length of 60 inches and a fixed width of 24 inches in a manner such that the fabric panel is straightened by tension but the individual fabric yarns are not stretched in either direction, i.e., no "slack" is evident. It is then exposed while still mounted in the pin frame to a temperature of 800°F for
45 seconds in a circulating hot-air oven. The heat-treated panel is then removed from the frame and is machine-washed and tumble-dried. The resulting fabric is soft and flexible. When exposed to temperatures in the range of 400° to 800°F, when relaxed, the resulting fabric displays negligible shrinkage while retaining softness and flexibility.

While the principle of this invention has been described with particularity, it should be understood that various modifications can be made without departing from the spirit of the invention, the scope of which is defined by the appended claims.

What is claimed is:

1. A process for treating an aromatic polyamide fiber material comprising the steps of (1) soaking said material in its relaxed state in a 10 percent by volume of a silicone solution composed of a 5:1 mixture of a dimethyl polysiloxane and a metal organic salt catalyst; (2) drying said soaked material in a relaxed state in air at about 300°F for about 15 minutes; (3) holding said material under tension at a fixed length and width dimension while simultaneously exposing it to a temperature of about 800°F for about 45 seconds; and (4) relieving the heat treated material of tension.