

UNITED STATES PATENT OFFICE

2,298,841

TEXTILE FINISHING

Robert L. Pyner, Roselle, and Henry C. Paulsen,
Elizabeth, N. J., assignors, by mesne assignments,
to Jasco, Incorporated, a corporation of
Louisiana

No Drawing. Application October 28, 1939,
Serial No. 301,778

3 Claims. (Cl. 8—136)

This invention relates to a method of finishing knitting yarns, knitted fabrics, and similar textile materials. In particular, it relates to a finishing treatment for hosiery fabricated from silks.

In addition to the provision of new textiles, a number of methods for finishing textile materials have been introduced in recent years. These finishing methods involve combinations of textile fibers with substances such as synthetic resins, soaps, and various other compounds for stiffening, waterproofing, reducing shrinkability, reducing creasing, or imparting other desired characteristics to the textiles. Distinct from these developments, processes for strengthening fibers in knitting yarns have also received attention. The application of rubber latex to soft yarns was proposed, but actually not much progress was made with this type of treatment due to a number of reasons, one major difficulty being the lack of affinity of the fiber for the latex, i. e. lack of penetration, another being lack of stability and undesirable effects on the inherent qualities of the textiles.

It is an object of this invention to provide an improved finish for increasing strength and durability of textile fibers in knitting yarns and knitted fibers with preservation of their esthetic qualities, namely, softness, luster, sheerness, smoothness, and elasticity. A further object of this invention is to provide a method of finishing which can be applied very simply without harmful action on the textile treated. In a preferred embodiment, it is intended to provide a method of increasing the life of silk stockings without apparent change in their texture.

The foregoing objects, and others ancillary thereto, are accomplished as follows:

A knitted textile, for example silk hosiery, is immersed into a solution containing a suitable low concentration of a polybutene polymer selected mainly according to its molecular weight. The solvent employed in the solution is selected from the class comprising light naphthas, Stoddard solvent, carbon tetrachloride, ethylene dichloride, and the like. After the textile article is fully wetted so as to allow the treating solution to penetrate the fibers, the article is removed from the treating solution, excess solution is squeezed out, and the article is dried. Thereafter, the finished textile article may be laundered. With due regard for the delicateness of knitted articles, it is found that this simple method of treatment can be carried out manually and without subjecting the fabric to the action

of harmful chemical agents or mechanical abrasion.

The polybutene polymers with suitable properties for satisfactory use in the herein-described finishing treatment are high molecular weight polymers produced by polymerizing butenes at low temperatures; more particularly, they are characterized as being elastic plastics or elastic solids with molecular weights ranging from about 30,000 to 300,000, determined by the Staudinger viscosity method. These high molecular weight polymers are formed by well-known methods from normally gaseous hydrocarbon mixtures containing principally isobutene. Although these polymers are derived essentially from isobutene, they are prepared commercially from mixtures which may include varying percentages of other normally gaseous unsaturated hydrocarbons, e. g., n-butenes.

Important factors in the polymerization processes are the catalytic agents, the temperature of reaction, and the composition of the reactants. Inorganic halides, usually boron fluoride, promote the polymerization of isobutene to higher molecular weight compounds when the reaction is conducted at a temperature below -10°C . To obtain the desired high molecular weight polymers with which the present invention is concerned, the temperature of reaction is preferably below -40°C . The extremely low molecular weight polymers, those with a molecular weight below 30,000, are found less desirable for the finishing treatment in being tacky and in having other undesired effects when applied to knitted fabrics. On the other hand, extremely high molecular weight polymers may tend to make the finish too heavy.

It is to be noted that the well-known volatile solvents, e. g. aliphatic hydrocarbons and chlorinated hydrocarbons boiling in the naphtha or gasoline boiling range, which readily dissolve the high molecular weight polybutenes, are useful in preparing the finishing solution. The solution may be made non-inflammable by using chlorinated hydrocarbon solvents, e. g. 25% to 30% of carbon tetrachloride calculated as per cent of the total naphtha volume may be used together with the naphtha.

The concentration of the polymer in the treating solution is adjusted to facilitate penetration of the polymer into the fibers, to avoid excessive deposition of polymer, and to readily permit removal of excess treating agent. The desirable concentrations can be controlled in accordance

with the viscosity of the solutions and depend upon the molecular weight of the polymer and upon the type of solvent employed. The concentration of the polymer is decreased as the molecular weight of the polymer is increased. It has been found that the treating solutions having Saybolt thermo viscosities (Tag Manual, 24th ed., pages 67 to 72) from, say, 400 to 1500 seconds are satisfactory. With a polyisobutene having a molecular weight of 65,000, concentrations of from 0.2% to approximately 2.0% are suitable. When the molecular weight of the polyisobutene is 165,000, concentrations of from 0.1% to 1.0% by weight of the polymer in a naphtha solvent are suitable. With molecular weights other than these, the concentrations will vary in proportion to the molecular weight as indicated in the following table:

Table

Composition	Saybolt thermo vis. secs./60° F.
Light naphtha, 100%.....	220
Light naphtha+0.2% polyisobutene, 65,000 molecular weight.....	450
Light naphtha+0.4% polyisobutene, 65,000 molecular weight.....	685
Light naphtha+0.8% polyisobutene, 65,000 molecular weight.....	1,500
Light naphtha+0.1% polyisobutene, 165,000 molecular weight.....	400
Light naphtha+0.2% polyisobutene, 165,000 molecular weight.....	625
Light naphtha+0.4% polyisobutene, 165,000 molecular weight.....	1,430

In accordance with the above table, the preferred viscosity for the treating solution falls within the approximate limits of 400 to 4,000 seconds Saybolt thermo viscosity.

As an example, a ladies' sheer silk stocking was dipped into a solution of 1% of 65,000 molecular weight polyisobutene in naphtha. After complete penetration of the solution into the fibers of the stocking, excess solution was squeezed out and the stocking was dried. In appearance and feel, no difference was visible between the thus treated stocking and the untreated stocking. A large number of pairs were similarly treated, then subjected to practical wearing tests. The treated stockings were found to have a life more than 400% in excess of that of the similar stockings which were unfinished. Each of the stockings was subjected to tests of strenuous wearing for a period including a number of consecutive days, each stocking being washed every night. Stockings worn in an untreated condition were found to give approximately only 4 to 6 days of satisfactory wear. The treated stockings worn under comparable conditions were found to be satisfactory after more than 20 consecutive days of wearing. During this period of wearing, the treated stockings showed no runs and no noticeable alteration of appearance or texture from the original untreated stockings. In another example, silk stockings were treated with 0.3% of 165,000 molecular weight polyisobutene dissolved in a mixture of carbon tetrachloride and Stoddard solvent. The finished stockings, freed of excess solution and dried, gave similar inspection and wear tests as those obtained with the treated stockings described in the previous example.

Although ordinarily the polybutene finishing for knitted fabrics may be more desirably applied to the fabricated article to avoid changing of established knitting operations, processing, and

knitting machinery, it is to be understood that the finishing treatment may be applied advantageously to knitting yarns or various soft yarns both twisted or slightly twisted. In some operations, the finished yarn may be improved by the lubricating action of the polymer.

The described procedure of finishing knitted fabrics is particularly effective for depositing the high molecular weight polybutene on individual filaments, fibers, or threads in the fabrics evenly and only in limited amounts necessary to give the desired protection without filling the interstices between the fibers or threads. The amount of the polymer taken up by the fibers from the dilute treating solutions apparently reaches an equilibrium or saturation point shortly after the fibers are wetted by the treating solution. In this type of finishing, the formation of a solid coating or continuous layer of the polymer, as is done when waterproofing agents are applied to woven fabrics, would be a serious defect. By properly selecting the polymer and adjusting the treating solution concentration, it is possible to prevent excessive deposition. The very slight increase of weight made by proper finishing of silk hosiery is illustrated by data obtained in treating a three-thread chiffon silk stocking with a 1% solution of 65,000 molecular weight polybutene in naphtha. The increase in weight per square inch of the unstretched stocking fabric made by the applied finish was found to be only 0.00202 gram. This weight increase may vary with the type of fabric treated and with the molecular weight of the polymer but will not vary substantially from the range of about 0.0005 to 0.005 gram per square inch of the unstretched fabric, or from a 0.5% to a 5.0% gain in weight.

In order to prevent excessive and uneven deposition of polymer on the fibers after the fabric is removed from the treating solution, it is generally desirable to squeeze out excess solution adhering to the fibers prior to drying of the fabric. This squeezing out of the excess solution can be accomplished by applying pressure to the fabric manually or by some such slight wringing action which does not cause undue abrasion to the fiber and leaves the fabric in a slightly damp condition, before the drying of the wetted fabric. Following the removal of excess treating solution, the damp fabric may be stretched on a form. In some instances the drying is preferably accomplished by whirling the fabric in air or a warm drying atmosphere, or, with the aid of vacuum in order to increase the evaporation rate of the solvent.

After finishing a sheer silk hose according to the method of this invention, the applied polymer is invisible to the naked eye, and when the finished fabric is viewed through a microscope the finished fibers are observed to have less fuzziness or broken filaments than untreated fibers, indicating that the ordinarily occurring loose end filaments are bonded or set closer to the main thread or fiber by a thin film of the protective polymer finish.

The polybutene or iso-olefin polymers having molecular weights above 30,000 are found to have a number of advantageous properties for the purpose of the present invention. In general, these polymers are very stable, being more resistant to heat, ultraviolet light and mechanical action than ordinary rubber. They are also more resistant to oxygen, acids and alkali, and can withstand the action of washing. The polybutenes are linear polymers which have a high

hydrogen to carbon ratio, approaching 2.0. With a molecular weight above 30,000, they have a low iodine number, less than 10, which tends to approach zero as the molecular weight of the polymer is increased. They are odorless and tasteless, when pure. They are translucent or white, tough, and elastic. Their combination with the textile fibers as obtained by the present invention permits the finished fabric to retain the desirable appearance of the untreated fiber. Form fitting knitted articles are found to benefit from greater elasticity imparted to the fabric by the finish. It is to be noted that the finishing treatment with the polybutenes is made with great ease, showing that the textile fibers have a suitable affinity for these polymers.

The procedure of this invention is not limited to the finishing of natural silks but is equally applicable to artificial silks known as rayons, e. g. those of viscose, nitrocellulose, cuprammonium, and cellulose acetate types. It is also adapted for finishing many types of knitted garments and fabrics including thin and lacy fabrics, embroidery, veiling, crocheting, knitted gloves, knitted ties, knitted scarves, and knitted underwear. Furthermore, it is applicable to textiles made from all of the commonly used animal and vegetable fibers, e. g. wool and cotton and their commonly used parchmientised or mercerised products.

The present invention is not to be limited to any specific examples which have been presented for the purpose of illustration, nor to any theory on the action of the materials described. Various obvious modifications are intended to come within the scope of this invention defined in the following claims.

We claim:

1. A method of finishing sheer knitted silk fabric to increase its strength and durability with preservation of texture and appearance, which comprises immersing said fabric into a dilute solution of solid polybutene polymers having molecular weights in the range from about 65,000 to 165,000 dissolved in a volatile organic solvent in a concentration from about 0.1% to 2%, removing excess of said solution from said fabric, and drying the thus treated fabric to remove any remaining solvent and to leave said polymers evenly deposited on the fibers of the knitted fabric in an amount within the limits of about 0.5% to 5.0% by weight of the thus treated fabric.

2. A method of finishing the knitted fabric of silk hosiery to increase its strength and durability with preservation of texture and appearance, which comprises immersing the silk hosiery into a dilute solution of solid polybutene polymers having molecular weights in the range of about 65,000 to 165,000 dissolved in a volatile organic solvent in a concentration from about 0.1% to 2.0%, squeezing out excess of said solution from the stocking fabric, and drying the thus treated fabric to remove any remaining solvent and to leave said polymers evenly deposited on the fibers of said fabric in an amount within the limits of about 0.5% to 5.0% by weight of the fabric in the silk hosiery thus treated.

3. The method as described in claim 2, in which said volatile solvent comprises naphtha hydrocarbons and a non-inflammable chlorinated aliphatic hydrocarbon.

ROBERT L. PYNER.
HENRY C. PAULSEN.