

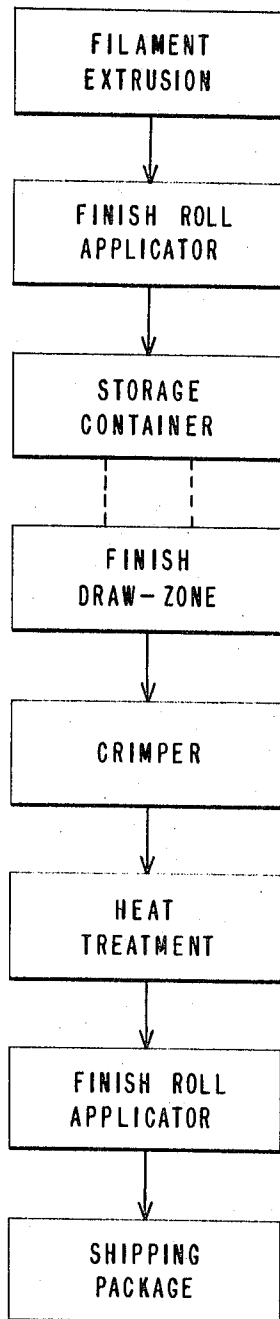
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PROCESS FOR UNIFORM APPLICATION OF FINISH TO POLYESTER YARNS

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PROCESS FOR UNIFORM APPLICATION OF FINISH TO POLYESTER YARNS

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3 Claims

ABSTRACT OF THE DISCLOSURE

In the production of polyester fibers, the method of obtaining fibers having a uniform application of a finish composition containing ionic and nonionic components which includes a three-step application of the finish as follows:

- (a) applying the finish to the fibers after quenching as a moderately dilute aqueous emulsion;
- (b) applying additional finish to the fibers after drawing as a very dilute aqueous finish emulsion; and
- (c) applying to the fibers after crimping a concentrated aqueous emulsion of the finish.

This invention relates to an improved process for the preparation of polyester fibers having antistatic lubricating finish on their surfaces.

In the manufacture of fibers from synthetic linear polymers, an antistatic lubricating finish applied to the fibers is necessary. In addition to facilitating fiber production, the composition functions to provide acceptable performance in subsequent steps leading to yarns suitable for knitting or weaving. As is known, changes in the finish composition can introduce friction and cohesion problems and lead to the production of poor quality yarn. For example, a change in the viscosity of the finish to a higher level can cause poor opening, card loading and high drafting tensions.

In one known process for producing lubricated polyester fibers, the finish is applied in two stages. A first portion is applied to the spun filaments and functions to minimize static production and lubricate the filaments in operations prior to drawing. Then the remainder is applied in a bath in which drawing occurs. After drawing, the filaments are crimped and then heat treated. This handling subsequent to drawing causes undue losses in finish being removed from the fibers. In addition, the high temperatures in heat treating tend to oxidize portions of the finish on the filaments, and accordingly excess finish may be applied to insure sufficient remains after this partial oxidation for subsequent textile processing. Recently it has been discovered that polyesters preferentially absorb nonionic ethylene oxide condensates from a finish bath containing them as well as ionic constituents thereby requiring continuous adjustment of the baths to enable production of filaments having a uniform finish thereon.

In accordance with the present discovery, the foregoing problems are overcome with more economic utilization of the finish composition and the production of a more uniform product, an important commercial consideration. This is accomplished generally by contacting yarn with finish in three stages each of certain concentration relative to the other stages of finish application. More specifically, in this invention there is applied to spun polyester filaments a relatively dilute aqueous finish emulsion consisting essentially of a condensate of ethylene oxide and lauric acid and a salt of a phosphate ester. Thereafter the filaments are passed through a draw bath consisting of a reduced concentration of the emulsion

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and this is followed by exposure of the filaments to a temperature of from about 70° C. to about 180° C. Finally, a substantially higher concentration of the emulsion is applied after the heat treatment. In consequence of this order and character of treatment, minimal losses of finish occur in the normal handling steps, loss of the ethylene oxide condensate from the draw bath is insignificant as is oxidation of it in the heat treatment, and a uniform product is obtained that is well suited to further processing without the need for application of additional lubricant or antistatic agent.

The process will be readily understood upon considering it in conjunction with the accompanying flow diagram drawing. Referring to the drawing, the process can be carried out by extruding filaments into room temperature air to cool or quench and solidify the filaments. The filaments are then converged to a bundle and passed across the face of a rotating roll partially immersed in antistatic lubricating finish. Preferably filaments from a plurality of positions are combined into a tow and forwarded to a storage container. The finish provides lubrication that prevents the filaments from being damaged in their frictional contact with guides, pins, rolls and the like. Also, the finish composition reduces the formation of static which would otherwise be generated by this frictional contact. The elimination of static is especially important for laydown in the storage container to avoid interfilament entanglement of adjacent tow sections and thus lead to deterioration of tow quality.

Several ends of tow are combined to form a larger tow having, for example, a total denier of 875,000 and this larger tow is then drawn in a heated aqueous draw bath. The incoming yarn contains finish composition and since the drawn product must carry the finish composition, processing is facilitated by drawing in an aqueous bath of the finish composition. In the draw bath the finish concentration is a fraction of that applied to the as-quenched filaments. The concentration of the draw bath is determined by processing needs between the point of emergence of the filaments from the bath and a point just prior to packaging. In the usual practice, this is established by the amount of finish composition required for good crimp control when the filaments are crimped. The amount can be expected to vary depending on the composition being used, but it can be as low as 0.02 percent, by weight of the filaments, or lower.

In a preferred practice, the draw system is operated as follows: Tow is withdrawn from a storage source and passed through a trough containing the very dilute finish emulsion and then to the feed rolls of the draw zone. Between the feed and draw rolls, hot 98° C. dilute finish emulsion is sprayed on the ribbon of tow, thereby additionally serving to heat the tow for drawing purposes. Drawn tow is pulled to the crimper by another set of rolls which simultaneously rid the tow of excess finish liquid.

However drawn, the tow filaments containing the minimum acceptable amount of finish, are passed to the crimper, and then heat treated in a relaxed state. After heat treatment, a relatively concentrated finish composition is applied and the filaments are collected for shipping.

In a typical process, the first finish emulsion contains on the order of 0.5 percent solids (active components), the second is about half that concentration and the final emulsion applied after heat treatment is on the order of 25 or more times as concentrated as the first emulsion. Of course, these emulsion concentrations would be varied to accord with yarn speed and desired amount of finish to be on the yarn at any given time.

Considering the low concentration in the draw zone, an additional advantage can be observed. After initiating the process, the draw zone concentration tends to rise be-

cause yarn entering already has significant finish to it and thereby contributes finish to that bath. Consequently, no additional finish need to be added to the draw zone sources, and instead it can be operated with a bleed from the bath (or trough and spray supply) and addition of but water is practiced to maintain desired concentration.

The process of this invention can be used with any finish composition containing at least two ingredients one of which is preferentially absorbed from an aqueous bath by polyester fibers. For example, combinations of ionic compounds with nonionic ethylene oxide condensates, e.g. fatty alcohols or fatty acids having about 12 to 18 carbon atoms in their alkyl chains condensed with from about 9 to 25 mols of ethylene oxide for each mol of fatty alcohol or acid, are the usual compositions used. The ionic compound can be of the anionic or the cationic type and can be present in the composition to provide antistatic, softening, emulsification and like properties to the composition. Preferred ionic compounds are the salts of partial phosphate esters such as, for example, the salts formed from alkali metal hydroxides, ammonia and amines. Preferred salts are those of the alkanol amines such as diethanol and triethanol amine, morpholine and the like. The partial esters are mono- or diorthophosphate esters, or their mixtures, of one or more fatty alcohols having between 8 and 18 carbon atoms in their alkyl chain. Such esters can be prepared as shown in U.S. Patent No. 2,676,122. If desired, small amounts of other agents such as bactericides, antioxidants, buffering agents and the like may be added.

Any fiber-forming polyester polymer can be used in practicing the present invention. Such polymers are well known and the manner of making them and forming filaments is described in the technical literature, to which reference can be made. Typical of the available disclosures are the U.S. Patents to Griffing and Remington 3,018,272 and to Whinfield and Dickson 2,465,319.

The discovery is described further in the following examples in which parts and percentages are by weight.

Example

Two parts (90.8 kilograms) of the material obtained by condensing one mol of lauric acid with 11 mols of ethylene oxide, and one part (45.4 kilograms) of the diethanol amine salt of an alkyl orthophosphate are stirred together to achieve a homogeneous blend. The alkyl phosphate is a partial ester of a mixture of alcohols consisting of 27.0 parts of octyl alcohol, 15.9 parts of decyl alcohol and 10.7 parts of a commercial grade of lauryl alcohol that contains a small amount of other fatty alcohols. The partial ester, which contains both the mono- and dialkyl esters, is neutralized with diethanol amine. The blend is added, with stirring, to water heated to a temperature of 60° C. to form Emulsion I. Emulsion I has a solids concentration of 15%. Emulsion II and III are prepared by diluting portions of Emulsion I with water to obtain, respectively, 0.50 and 0.25% solids.

A melt of polyethylene terephthalate is spun in the usual manner to filaments, which are quenched and then converged into a thread bundle. After convergence, the filaments pass over a roll rotating in a trough containing Emulsion II whereby there is applied to the filaments 0.025% solids, based on the weight of the filaments. The filaments are then forwarded along with filaments from other spinning positions similarly treated, as a tow, to a storage container. The phosphate salt serves to prevent the formation of static upon sliding contact of the filaments with guides, pins and rolls. The ethylene oxide condensate serves to provide lubrication for the filaments both by its lubricating action and by serving as a diluent for the paste-like phosphate antistat.

Eighteen ends of the tow are combined to form a larger tow consisting of 388,800 filaments and having a total denier of about 875,000. This tow is then fed to a draw zone where it is drawn about 3.2× and Emulsion III,

heated to a temperature of 98° C., is applied. After drawing, excess finish is removed from the tow by pull rolls and the filaments are fed to a stuffer-box crimper operating to apply about 8.0 crimps per inch (3.15 crimps per centimeter). The crimped tow, which contains 0.02% finish solids, is placed on an endless belt which carries it through a relaxer oven heated to a temperature of 140° C. The tow is heated for a period of 5 minutes to reduce the moisture content of the tow and the residual shrinkage of the filaments. The resulting relaxed product is then passed over a roll rotating in a trough containing Emulsion I where it picks up an additional 0.06% solids based on the weight of the filaments. Tow produced in this manner contains a much more uniform finish composition. The tow is highly suitable for cutting into staple fibers which can be converted to yarn without difficulties attributable to a nonuniform composition.

From the foregoing discussion and description it is apparent that the present discovery provides a simplified but highly effective method of obtaining polyester fibers having a uniform finish thereon. While the discovery has been described with reference to specific details, it will be apparent that changes can be made without departing from its scope.

What is claimed is:

1. In the production of synthetic fibers of polyester polymer, the method of obtaining filaments having a uniform application of finish composition comprising

- (a) extruding polyester filaments from a melt of polyester polymer;
- (b) quenching the filaments;
- (c) converging the quenched filaments to a yarn;
- (d) applying to the quenched filaments a finish composition of ionic and nonionic components consisting essentially of a condensate of lauric acid and 9 to 25 mols of ethylene oxide and a salt of a partial ester of orthophosphoric acid and an alcohol containing 8 to 18 carbon atoms in a moderately dilute aqueous emulsion that contains about 0.25 to about 1 percent active finish components;
- (e) collecting the treated filaments;
- (f) thereafter passing the filaments to a draw zone and drawing the filaments and applying additional finish as a very dilute aqueous finish emulsion having a concentration of about 0.5 the finish concentration in step (d) to the filaments;
- (g) passing the filaments to a crimping zone and crimping the drawn filaments;
- (h) applying additional finish as a concentrated aqueous finish emulsion having a concentration of at least about 25 times the concentration of the emulsion in step (d) to the crimped filaments;
- (i) and collecting the resulting filaments.

2. The process as in claim 1 wherein the finish concentration in step (f) is maintained by the addition of water.

3. A method in accordance with claim 1 in which the crimped filaments are heated in a relaxed state, and the concentrated aqueous finish of step (h) is applied after said heat treatment.

References Cited

UNITED STATES PATENTS

2,456,283	12/1948	Jefferson	252—8.9
2,653,113	9/1953	Banigan	260—924
2,875,019	2/1959	Spohn et al.	264—168
3,216,186	11/1965	Opfell.	
3,259,681	7/1966	Bull et al.	
3,296,063	1/1967	Chandler	264—211

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