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(54) **Antistatic cospun yarn comprising poly(hexamethylene adipamide) filaments containing N-alkyl substituted polyamide and poly(ethylene terephthalate) filaments.**

(57) Fabrics of reduced static propensity are obtained from cospun yarns comprising a major amount, up to 70 weight percent, of poly(ethylene terephthalate) filaments with the remainder being poly(hexamethylene terephthalamide) filaments containing 3 to 10 weight percent of an N-alkyl substituted polycarbonamide, the filaments having a denier of from 1 to 10.

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TITLE MODIFIED
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TITLE

COSPUN 2GT/6,6 CONTAINING ANTISTAT

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to antistatic cospun yarn comprising poly(hexamethylene adipamide) filaments and poly(ethylene terephthalate) filaments and to woven and knitted fabrics made therefrom.

2. Description of the Prior Art

The desirability of reducing the electrostatic propensity of synthetic fibers in textile applications is well known. A recent approach to the solution of this problem has been the incorporation of an N-alkyl substituted polycarbonamide into the filaments as described by Alderson U.S. Patent 3,900,676. This patent suggests that such antistatic filaments may form one component of a cospun yarn. It is an object of this invention to provide a cospun yarn containing only a minor proportion of the modified filaments which is capable of achieving the high level of antistatic protection, as shown by reduced garment cling, that is afforded by yarn composed entirely of the modified filaments.

SUMMARY OF THE INVENTION

This invention provides an antistatic cospun yarn comprising a major amount up to about 70 weight percent of poly(ethylene terephthalate) filaments with the remainder being poly(hexamethylene adipamide) filaments containing 3 to 10 weight percent of an N-alkyl substituted polycarbonamide, the filaments having a denier of from 1 to 10. Knitted and woven fabrics of such yarn are also part of this invention.

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DETAILED DESCRIPTION OF THE INVENTION

The cospun yarn of the invention may be prepared in accordance with the general techniques described in Reese U.S. Patent 3,681,910. Basically, the two fiber-forming polymeric compositions are separately fed to one or more spinning assemblies and extruded to form groups of discrete filaments from each of the polymer compositions in the desired proportions. The filaments are then combined into a single composite yarn and drawn as an integral yarn. The filaments of the yarn are of textile denier, preferably from 1 to 10 denier per filament (dpf).

The two fiber-forming polymeric compositions employed in the present invention are poly(ethylene terephthalate) hereinafter 2GT and poly(hexamethylene adipamide) hereinafter nylon 6,6. The nylon 6,6 to be extruded contains from 3 to 10 weight percent of an N-alkyl substituted polycarbonamide as an antistat modifier. The latter, which is described in more detail below is known to reduce the static propensity of synthetic yarn. The desired yarn desirably contains a major amount of 2GT filaments, preferably about 60% by weight, but no more than 70% by weight. The remaining filaments in the yarn are constituted by the modified nylon 6,6 filaments. Surprisingly it has been found that the static propensity of fabrics of such yarns as shown by cling tests is no greater than that of similar fabrics composed entirely of the modified nylon 6,6 filaments.

The nylon 6,6 filaments contain from about 3 to 10 weight percent of an N-alkyl substituted polycarbonamide modifier in which the tertiary carbonamide groups are an integral part of the polymer molecule. Useful modifiers are those disclosed in Alderson U.S. 3,900,676. The modifier

has a molecular weight of at least about 800 to 5000 and is dispersed throughout the filament substantially as a separate phase in the form of discrete elongated conductive particles aligned essentially parallel to the filament axis, all as described in the aforementioned Alderson patent. The elongated conductive particles should have a ratio of their length, L, to average diameter, D, of at least about 100 as taught in said Alderson patent.

In preparing the products of the present invention, the N-alkyl polycarbonamide may be mixed directly with the fiber-forming nylon 6,6 and then immediately spun into filaments. If desired, it may be combined with polymer flake and then spun into filaments. Less reactive N-alkyl polycarbonamides can be introduced into the autoclave during production of the fiber-forming polycarbonamide. Preferably, the N-alkyl polycarbonamide and fiber-forming nylon 6,6 are mixed in molten condition and immediately spun into filaments.

Useful N-alkyl polycarbonamides are disclosed particularly in column 3 line 7 through line 21 of column 4 of U.S. Patent 3,900,676. In the examples which follow, the modifier employed is the reaction product of a mixture of 80% N,N'-di-n-butyl hexamethylene diamine and 20% of mono-N-butyl hexamethylene diamine and dodecanedioic acid. Stearic acid is employed as a viscosity stabilizer. The modifier had a melting point less than 0°C, a calculated molecular weight of about 2100 and a viscosity of 1100 centistokes at 95°C.

The cospun yarns of the examples which follow were prepared using the general procedures described in the aforementioned Reese patent. One filament group of the mixed filament yarn was 2GT

filaments while the other was nylon 6,6 filaments, the latter having incorporated therein the antistat modifier mentioned above. Two techniques for incorporation of the N-alkyl substituted polycarbonamide are illustrated. In Example I, the modifier was injected into the nylon 6,6 stream shortly before extrusion by injection of the modifier into the screw melter-extruder and mixing before the melt-spinning operation. In Example II, the modifier was combined with the nylon 6,6 in the autoclave in the polymerization cycle.

In the examples which follow, cospinning is achieved by separately metering 2GT and nylon 6,6 containing modifier to two separate inlet ports of a melt spinning assembly designed to accommodate the two streams and keep them separate. The polymers are discharged in a conventional manner through a spinneret. The two groups of filaments merge and are then drawn and wound up in a package. Details are given in the examples.

TEST PROCEDURES

Relative viscosity, RV, of 2GT as used in the following examples is the ratio of the viscosity of a 4.75 weight percent solution of 2GT in hexafluoroisopropanol to the viscosity of the hexafluoroisopropanol per se, measured in the same units at 25°C. The RV of nylon 6,6 is measured as described in U.S. 3,681,910 at column 3, lines 25-30.

Sail Test - this test is performed as described in U.S. 3,900,676 at column 16, lines 11-36.

Keithley Log R - this test is performed as described in AAATC 76-1978 p. 233.

Skein Log R - this test is similar to the yarn log R test in U.S. 3,900,676 except that for Skein Log R, sufficient revolutions were wound to

make a skein with a cross-section of 720,000 denier. The skein is scoured, dried and conditioned at 20% relative humidity for 24 hours. The skein is cut and clamped without spreading between electrodes 2.0 inches apart so that 360,000 denier is between the electrodes. The resistance is measured at 20% relative humidity with a megohmeter under a potential of 210 volts.

EXAMPLE I

Cospun yarns of trilobal 2GT filaments (60% by weight) and trilobal nylon 6,6 filaments (40% by weight) containing antistat modifier were prepared from nylon 6,6 (42 R.V. with 0.02% TiO_2) containing 4.6% by weight of modifier and from 2GT (22 R.V. with 0.1% TiO_2). The polymers were melt spun at 291°C through a single spinneret into a yarn (6 filaments of each polymer) in which the nylon 6,6 filaments had an R.V. of 47.7 and the 2GT filaments an R.V. of 21.5. The extruded filaments were air-quenched. Finish was applied and the filament streams were converged to a feed roll operating at 1564 ypm surface speed and then passed through a steam jet at 200°C to a draw roll operating at a surface speed of 3674 ypm for a draw ratio of 2.35. The drawn yarn was annealed at 138°C in a hot chest (residence time about 0.2 sec.). The drawn yarn was passed through an interlace jet at 55 psig air, treated with a second finish and wound up at 3681 ypm at a tension of 7 grams. The yarn denier was 40, percent elongation was 35.4, tenacity was 3.5 gpd. The nylon 6,6 filaments had a denier of 2.7 while the 2GT filaments had a denier of 4.0. The antistatic performance of skeins and warp knit fabrics from the yarns is reported as Item 1 on Table I below.

EXAMPLE II

A process similar to that used in Example I was performed except that the polymers used were nylon 6,6 (32 R.V. with 0.02% TiO_2) containing 5.25% by weight of modifier and 2GT (22 R.V. with 0.1% TiO_2). The resulting yarn was made up of nylon 6,6 filaments (40% by weight) of 39.5 R.V. and 2GT filaments (60% by weight) of 21.2 R.V. The yarn denier was 40, percent elongation was 42.5, and tenacity was 3.5 gpd. The antistatic performance of the yarn and the performance of warp knit fabrics of such yarns is reported on Table I as Item 2.

Item 3 of Table I represents a cospun trilobal control yarn containing no antistat modifier, but is otherwise similar to Items 1 and 2.

Items 4, 5 and 6 are commercial warp knit fabrics from 40 denier yarn. Item 4 is a trilobal nylon antistatic 13-filament yarn. Item 5 is a quadralobal nylon antistatic 20-filament yarn and Item 6 is a round nylon 13-filament yarn containing no antistat. Items 4 and 5 contain the same modifier as used for Item 1 and at a concentration of 5.25%. Item 7 and 8 represent experiments performed to compare results obtained from nylon 6,6 yarns in which modifier 5.25% concentration was added to 100% of the filaments (Item 7) and nylon 6,6 yarns in which modifier was added at 5.25% concentration to only 50% of the filaments (Item 8). In each case the same modifier was used.

TABLE I

ITEM	SKEIN LOG R	SAIL TEST PRIMARY DECLING MINS. 5 "C" WASH	ANTISTATIC PERFORMANCE KEITHLEY LOG "R" AS REC'D.	5 "C" WASH
1	12.8	3.8	14.7	14.4
2	12.9	3.7	14.6	14.6
3	>14.0*	9.2	17.4	17.0
4	12.9	--	14.6	14.4
5	12.5	5.2	13.0	13.7
6	>14.0*	--	17.1	17.4
7	12.95			
8	13.25			

* The value reported was the upper limit of the instrument capability.

CLAIMS:

1. An antistatic cospun yarn comprising a major amount up to about 70 weight percent of poly(ethylene terephthalate) filaments, the remainder being poly(hexamethylene adipamide) filaments containing 3 to 10 weight percent of an N-alkyl substituted polycarbonamide, the filaments having a denier of from 1 to 10.

2. The yarn of claim 1 comprising about 60 weight percent of poly(ethylene terephthalate) filaments.

3. Fabrics of the yarn of claim 1.