United States Patent

Davis et al.

[15] **3,706,195**

[45] **Dec. 19, 1972**

[54] **SYNTHETIC YARNS**

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[22] Filed: **Feb. 8, 1971**

[21] Appl. No.: **113,661**

[30] **Foreign Application Priority Data**

Feb. 13, 1970 Great Britain.....7,102/70

[52] **U.S. Cl.**.....**57/140 BY,** 57/157 AS

[51] **Int. Cl.**.....**D02g 3/04,** D02g 3/44

[58] **Field of Search**.....57/140 R, 140 BY, 157 AS; 161/87 AS; 317/2

[56] **References Cited**

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[57] **ABSTRACT**

A blended fibrous structure comprising synthetic filaments or fibers having a high electrical resistance together with extruded synthetic polyester or polyamide filament, having an extension to break of at least 200 percent, containing between 5 to 20 percent by weight inclusive of conductive carbon black.

5 Claims, No Drawings

SYNTHETIC YARNS

The present invention is concerned with improvements in synthetic fibrous structures, especially yarns having improved antistatic properties obtained by blending the filaments or fibers forming the fibrous structure with fibers having a high electrical conductivity, hereinafter referred to as conductive fibers.

According to the present invention, we provide a blended fibrous structure comprising synthetic filaments or fibers having a high electrical resistance together with as-spun fibers as defined containing between 5 to 20 percent, preferably 5 to 15 percent, by weight inclusive of conductive carbon black.

By an as-spun fiber we mean an extruded synthetic polyester or polyamide filament, having an extension to break of at least 200 percent measured as hereinafter described. In the term "as-spun fibers" we include partially or variably drawn fibers having an extension to break of at least 200 percent at any part along their length.

Suitable as-spun fibers for use in the present invention are polyester fibers such as those derived from poly(ethylene terephthalate) and polyamide fibers such as those derived from poly(hexamethylene adipamide) or polycaproamide.

The as-spun fibers may be present in the blended fibrous structure as continuous filaments or as a monofilament or as discontinuous filaments. It is preferred that the as-spun fibers comprise at least 0.5 percent by weight of the blended fibrous structure although amounts of as-spun fibers as low as 0.1 percent are useful. The upper limit for the amount of as-spun fibers present in the fibrous structure is determined by the conductivity which is desired and by the color which can be tolerated.

By filaments or fibers having a high electrical resistance is meant those filaments or fibers which have electrical resistances of greater than 1.0×10^{10} ohms at 60 percent relative humidity when determined by the method hereinafter described. Examples of such filaments or fibers are those comprising poly(ethylene terephthalate) and poly(hexamethylene adipamide).

For the purpose of the present invention the electrical resistance of a yarn is determined by winding 125 turns of yarn onto a former comprising two parallel stainless steel rods (4 mm. diameter), spaced apart at 1 cm., and measuring the electrical resistance across the rods at 20°C and at a given relative humidity.

Extension to break of as-spun fiber is measured on a conventional Instron tensile tester under the following conditions:

Fiber test length	5 cm
Load	100 g
Crosshead speed	50 cm/min
Chart speed	50 cm/min
Rate of extension	1000%/min
Relative Humidity	66%
Temperature	20°C for polyamide fiber 150°C for polyester fiber

Suitable conductive carbon blacks for use in the present invention are those which exhibit good bulk conductivity and which are capable of being dispersed in polyester or polyamide polymer either per se or in conjunction with dispersing agents. Examples of suitable conductive carbon blacks are the oil furnace blacks Vulcan XC 72R, Vulcan 3X and Vulcan 6F. Examples

of suitable dispersing agents are ethoxylated oleyl and cetyl alcohols or mixtures thereof containing approximately 3.5 moles ethylene oxide per hydroxyl group, sodium salt of condensed naphthalene sulphonate, disodium salt of methylene dinaphthalene sulphonic acid and sulphated alkylphenol adducts.

The blended fibrous structures of the present invention are suitable for the manufacture of fabrics and are especially suitable for the manufacture of carpets. Such fabrics or carpets may contain other yarns in addition to the blended yarns provided that sufficient blended yarn is present to confer antistatic properties to the fabrics or carpets.

The following examples, in which all parts and percentages are by weight, illustrate but do not limit the present invention.

EXAMPLE 1

A conductive carbon black, Vulcan XC – 72R, was dispersed in molten polycaproamide in an amount such that the carbon black comprised 10 percent by weight of the mixture. The molten mixture was extruded and wound at 400 ft/min. to yield a 120 denier 5 filament as-spun yarn having an electrical resistance of 5.0×10^4 ohms, and an extension to break of approximately 350 percent. Further, the electrical resistance was independent of the relative humidity. After drawing the as-spun yarn to a draw ratio of 4.0, the electrical resistance increased to 3.2×10^{10} ohms. at 60% R.H. In the latter case, the electrical resistance varied with the relative humidity at which it was measured. A blended yarn having good antistatic properties was obtained by blending poly(hexamethylene adipamide) filaments with the above as-spun yarn, the latter comprising 1 percent by weight of the blended yarn.

EXAMPLE 2

A molten dispersion comprising polycaproamide (90 parts) and Vulcan XC – 72R carbon black (10 parts) was extruded and wound up at 1,420 ft/min to yield a monofilament yarn of denier 14. The resistance of the monofilament on the day of spinning was 6×10^9 ohms. The resistance was then followed through a period of ageing including a cycle of humidity changes with the following results:

1. Yarn kept for 3 days at 60% R.H. — resistance 4×10^8 ohms.
2. Yarn then transferred to 20% R.H. and kept for 5 hours at 20% R.H. — resistance 1×10^8 ohms.
3. Yarn kept for a further 19 hours at 20% R.H. — resistance 8×10^7 ohms.
4. Yarn then returned to 60% R.H. atmosphere and kept for 10 days more at 60% R.H. — resistance 1.2×10^8 ohms.

It can be seen that resistance appears to drop progressively with time up to 14 days after spinning, most of the fall being in the first 3 days. Conditioning the yarn to a lower humidity also lowered the resistance, but the change with R.H. appeared to be reversible. The absence of the usual increase of resistance with falling humidity is a useful property of the synthetic yarns produced according to the invention.

EXAMPLE 3

This example illustrates the significantly improved conductivity of as-spun fibers containing conductive carbon black compared with drawn, but otherwise identical, fibers.

Polycaproamide containing 10% Vulcan XC 72R dispersed therein was extruded at 275° – 280°C and wound up at 400 ft/min under conditions such that as-spun monofilaments of denier 19.5 and 40.0 were obtained. The as-spun monofilaments had an extension to break of approximately 350 percent. The as-spun monofilaments of denier 19.5 and 40.0 had electrical resistances, measured at 20% R.H., of 6.0×10^7 ohms and 4.5×10^6 ohms respectively.

A drawn monofilament of denier 17.3 was obtained by extruding the above polymer composition at 1,000 ft/min and drawing at 50 ft/min to a draw ratio of 4.0 over a hotplate at 120°C.

A drawn monofilament of denier 41.0 was obtained by extruding the above polymer composition at 750 ft/min and drawing under the above conditions.

The drawn monofilaments containing dispersed carbon black had extensions to break of approximately 20 percent.

The drawn monofilaments of denier 17.3 and 41.0 had electrical resistances, measured at 20% R.H., of 1.5×10^{13} ohms and 2.0×10^{13} ohms respectively,

EXAMPLE 4

A 2,450 denier/136 filament poly(hexamethylene adipamide) drawn and crimped yarn was folded with a 25 denier as-spun polycaproamide monofilament containing 10 percent by weight of a conductive carbon black Vulcan XC – 72R. The blended yarn was wound onto a former and its electrical resistance was measured before and after scouring. The unscoured and scoured blended yarn had electrical resistances, measured at approximately 25 percent relative humidity, of 3.2×10^{10} ohms and 7.5×10^5 ohms respectively compared with 2×10^{13} ohms for scoured poly (hexamethylene adipamide yarn).

EXAMPLE 5

A 620 denier/52 filament as-spun yarn was prepared by extruding polycaproamide containing 10 percent by weight of a conductive carbon black Vulcan XC – 72R. The as-spun yarn had an electrical resistance of 10^5 ohms after scouring and rinsing.

The as-spun yarn was crimped to 14 crimps per inch in a staple stuffing box and the crimped yarn was converted to 4 inch staple fiber by cutting. The latter was blended with 12 d.p.f. crimped poly(hexamethylene adipamide) staple fiber to give 0.5, 1.0 and 2.0 percent of fiber containing carbon black in the blended yarn. Blending was carried out at the yarn spinning stage in the conventional woollen process to give 2 fold 55's Drewsbury count staple yarn, 3½ t.p.i. Z twist in singles and 2¾ t.p.i. S twist in folded yarn.

The blended yarns containing 0.5, 1.0 and 2.0 percent of carbon-containing fibers had electrical resistances, measured at 25 percent relative humidity after scouring and rinsing, of 1.8×10^9 ohms, 3.4×10^8 ohms and 3.2×10^8 ohms respectively.

The blended yarns were used to construct loop pile and cut pile carpets which exhibited good antistatic properties.

EXAMPLE 6

A conductive carbon black, Vulcan XC – 72R, was dispersed in molten poly(ethylene terephthalate) in an amount such that the carbon black comprised 10 percent by weight of the mixture. The molten mixture was extruded and wound up at 500 ft/min to yield a 120 denier 5 filament as-spun yarn having an electrical resistance, measured at 20 percent relative humidity, of 3.3×10^5 ohms after scouring and rinsing.

This yarn was then folded with a 2450 denier 136 filament poly(hexamethylene adipamide) drawn crimped yarn, and the blended yarn wound onto a former. The electrical resistance of the blended yarn was measured on this former, before and after scouring and was found to be 1.7×10^6 ohms and 1.2×10^6 ohms respectively at approximately 20% R.H. This compares with 2.0×10^{13} ohms for scoured poly(hexamethylene adipamide), at the same R.H.

EXAMPLE 7

Example 6 was repeated except that poly(hexamethylene adipamide) was used instead of poly(ethylene terephthalate), The 120 denier 5 filament as-spun yarn had an electrical resistance, measured at 20 percent relative humidity, of 1.0×10^{10} ohms after scouring and rinsing.

This yarn was then folded with a 2,450 denier 136 filament poly(hexamethylene adipamide) drawn, crimped yarn. The blended yarn was wound onto a former and its electrical resistance measured before and after scouring. The unscoured and scoured blended yarn had electrical resistances, measured at approximately 20% R.H. of 6.0×10^{10} ohms and 2.0×10^{10} ohms respectively compared with 2×10^{13} ohms for scoured poly(hexamethylene adipamide) yarn at the same R.H.

We claim:

1. A blend of filaments or fibers comprising synthetic filaments or fibers having a high electrical resistance together with other filaments or fibers containing 5 to 20 percent by weight conductive carbon black, said other filaments or fibers being made of extruded synthetic material selected from the group consisting of polyesters and polyamides and having an extension to break of at least 200 percent.

2. A blend as in claim 1 wherein said other filaments or fibers contain 5 to 15 percent by weight conductive carbon black.

3. A blend as in claim 2 containing at least 0.5 percent by weight of said other filaments or fibers.

4. A carpet containing yarns made of the blend of claim 3.

5. A yarn made of a blend of synthetic filaments or fibers having a high electrical resistance of greater than 1.0×10^{10} ohms at 60 percent relative humidity together with 0.1 to 2.0 percent by weight of other filaments or fibers containing 5 to 20 percent by weight conductive carbon black, said other filaments or fibers being made of extruded synthetic material selected from the group consisting of polyesters and polyamides and having an extension to break of at least 200 percent.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,706,195 Dated December 19, 1972

Inventor(s) Anthony Charles Davis and Brian Franklyn Amos

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

Title page, line 72, read as follows:

--[72] Inventors: Anthony Charles Davis; Brian Franklyn Amos, both of Pontypool, England--

Signed and sealed this 10th day of July 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

Rene Tegtmeyer
Acting Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334