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TEXTILE FINISHING PROCESS

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No Drawing. Continuation-in-part of abandoned application Ser. No. 108,969, Jan. 22, 1971. This application Oct. 31, 1972, Ser. No. 302,443

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ABSTRACT OF THE DISCLOSURE

Fastness properties of acid-dyed polypropylene yarns are improved by applying to the surface of the yarn, following completion of dyeing, a water-insoluble fatty acid ester.

This application is a continuation-in-part of application Ser. No. 108,969 filed Jan. 22, 1971, now abandoned.

This invention relates to the dyeing of synthetic yarns. More specifically, it relates to improvements in the dyeing of polypropylene yarns by means of acid dyestuffs.

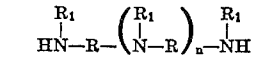
Acid dyeable polypropylene yarn is a relatively new addition to the synthetic fiber class of materials and its advent has significantly broadened the range of utility of polypropylene in the textile field. To induce acid dyeability into polypropylene, it has been necessary to incorporate, into the polymer, basic additives which have affinity for the acid dye while being sufficiently compatible with the polymer to remain dispersed therein. A large number of such additives have been proposed and evaluated in this application. The best of these have been low molecular weight resins containing basic nitrogen such as amino or amido groups.

After dyeing it is frequently necessary or desirable to add finishes, referred to as coning aids and knitting lubricants, to the yarn to reduce static build-up and processing friction. With undyed or pigmented polypropylene it has been customary to employ certain water-soluble surface active materials, particularly highly ethoxylated materials such as, e.g., poly(ethylene glycol) esters, ethoxylated pelargonic acid, ethoxylated imidazoline, or ethoxylated pelargonamide. It has been found, however, that the fastness qualities of the acid dyed yarn are not as good as would be desired when these conventional finishes are employed. Accordingly, it has been necessary to find entire new classes of finishes for use with acid dyed polypropylene yarn. It is the object of this invention to provide such a class of finishes.

In accordance with this invention, it has been found that the fastness properties of an acid dyed polypropylene yarn can be improved if the yarn, following dyeing, is treated with a surface finish comprising a water-insoluble higher fatty acid ester. More precisely, the invention is the improvement in acid dyeing of polypropylene yarn containing a basic nitrogen-containing dyesite which comprises applying to the surface of an acid dyed yarn about 0.2 to 5% by weight, based on the weight of the yarn, of a water-insoluble ester of a fatty acid having 8 to 20 carbon atoms and an aliphatic alcohol having the formula $R(OH)_x$ wherein R is an alkyl group having from 5 to 20 carbon atoms and x is an integer from 1 to 5.

The principal type of additive which is used to induce dyeability in polypropylene yarn and to which this invention is directed is a basic polyamide. Polyamides which can be used for this purpose are reaction products of dicarboxylic acids and polyamines having a minimum of 2 primary or secondary amine groups. Preferably, for reasons of compatibility with the polypropylene, the reactants should each have at least one carbon chain having at least 4 carbon atoms. Exemplary of the dicarboxylyic acids that can be employed are succinic, glutaric,

adipic, pimelic, suberic, axelaic and sebacic acid. A wide selection of polyamines is available for preparing the basic polyamides. Most comonly, the polyamine will be an alkylene diamine, a polyalkylene polyamine or an N-substituted polyakylene polyamine. These materials have the representative structural formula



where R is an alkyl radical of 2 to 6 carbon atoms, R_1 is an alkyl radical of 1 to 6 carbon atoms or hydrogen and n is an integer from 0 to 4. Exemplary polyamines are the di-, tri- tetra-, etc. methylene diamines, diethylene triamine, triethylene tetramine, dipropylene triamine, N,N'-bis(3-aminopropyl)methylamine, and others of the same genre. Another class of polyamines which are frequently employed includes piperazine and its derivatives such as, e.g., N-aminoethyl piperazine. A more complete discussion of this type of dyesite additive can be found in U.S. Pat. 3,433,853 and in British Pat. 1,055,175.

Polypropylene yarn containing a basic nitrogen-containing dyesite can be dyed with acid dyestuffs. Exemplary of acid dyestuffs that can be used are Acid Yellow 23, (C.I. No. 19140) Acid Orange 7, (C.I. No. 15510) Acid Orange 72, (C.I. No. 18740) Acid Red 73, (C.I. No. 27290) Acid Red 337, Acid Blue 45, (C.I. No. 63010) Acid Blue 78, (C.I. No. 62105) Acid Blue 56 (C.I. No. 62005) and Acid Violet 51 (C.I. No. 62165).

The surface treatment agent which is applied to the polymer is a water-insoluble esterification product of a fatty acid and an aliphatic alcohol. The fatty acid is one having 8 to 20 carbon atoms in either a straight or a branched chain, while the alcohol moiety can have 5 to 20 carbon atoms. Either one of the reactants can be polyfunctional (i.e., more than one carboxyl group or more than one hydroxyl group), but only one should be polyfunctional, as it is preferable for the ester to be nonresinous. Exemplary of the fatty acids whose esters can be employed are caprylic, pelargonic, capric, stearic, lauric, myristic, sebacic, azelaic and suberic. These can be esterified with alcohols such as, e.g., pentanol, octanol, nonanol, dodecanol, tetradecanol, 1,5-pentane-diol, 1,5-nonanediol, neopentyl glycol or 1,3,6-hexanetriol. If the alcohol is polyfunctional it should be fully reacted to assure that there will be little, if any, free hydroxyl to increase the water solubility of the ester.

The fatty acid ester is applied to the yarn surface following completion of acid dyeing. Since the esters are water-insoluble and most acid dyes are applied from aqueous solution, it is apparent that the application of the finish prior to dyeing would hinder the ability of the dye to strike into the yarn.

The surface treatments can be applied in their neat form, if they are liquids, from aqueous emulsion or from solution in organic media. It is preferred to apply them from aqueous emulsion as this technique affords good control over the concentration of finish on the yarn without the hazards and expense encountered with organic solvent systems.

If the finish is added from an emulsion, it is preferred to use emulsifiers which are free of hydroxyl, ethoxyl or other highly hydrophilic groups. Sulfated emulsifiers such as sulfated castor oil, are frequently used. Another preferred class of emulsifiers are the lower alkyl phosphates such as n-butyl or n-propyl phosphate. These materials can also serve as antistatic agents.

It is found that, when using the yarn finishes described in this invention, exceptional fastness properties are exhibited by the dyed yarns. By contrast it is found that materials such as those mentioned above which have conventionally been employed as coning lubricants can actually cause a deterioration of these fastness properties.

These more conventional materials are water-soluble and surface active and, apparently, contribute to solubilization of the dye and dyesite within the polymer with resultant ease of extraction or crocking of the dye.

Fastness properties are demonstrated by the crock fastness, alkaline and acid perspiration fastness and laundry fastness. Crock fastness is measured by standard test AATCC 8–1961, perspiration fastness by AATCC 15–1962 and wash fastness by AATCC 61–1965. These tests are fully described in the American Association of Textile Chemists and Colorists Technical Manual, 1966 Edition.

The following examples are presented to illustrate the improved fastness of polypropylene yarns caused by using as coning lubricants the esters described in this invention. The standard tests mentioned above were employed to determine the fastness properties. Fastness is evaluated by a visual determination of the amount of dye that is transferred from the dyed polymer to another solid or liquid medium. The results of the tests are described with reference to the AATCC Color Transference Chart which rates the transfer of color from the test sample to the other medium. Ratings range from one, representing severe staining of the second medium, to five, representing no staining.

EXAMPLE 1

A 260 denier 24 strand polypropylene yarn was package dyed to a 3% merpacyl Red G shade (Acid Red 337). The polypropylene contained about 4% by weight of a polyamide dyesite comprising principally the reaction product of adipic acid and N,N'-bis(aminopropyl)piperazine. Dyeing was effected by a typical acid dyeing procedure (as described in U.S. Pat. 3,433,853).

To the surface of the dyed yarn was added about 1.9% tridecyl stearate by weight, based on the weight of the yarn, as a coning lubricant. The lubricant was added by drawing the yarn over a kiss roller in a pan of undiluted tridecyl stearate. The yarn was then rewound on a cone in the conventional manner.

The dyed yarn was then knitted into a plain jersey fabric and this fabric was subjected to the crock fastness, perspiration fastness and wash fastness tests.

Parallel tests were conducted with controls of the same yarn not treated with coning lubricant (A) and with about 2.1% of a conventional, water-soluble coning lubricant, 9-ethoxyl pelargonic acid (B). Results are shown in Table I.

EXAMPLE 2

A 124 denier 8 filament yarn prepared from polypropylene containing about 4% of a polyamide dyesite comprising the reaction product of sebacic acid, hexamethylene diamine and N,N'-bis(3-aminopropyl)methyl amine was dyed using conventional acid-dyeing methods with a 3% (on weight of the fiber) concentration of Acid Red 73. 2.3% ethyl hexyl stearate, by weight of the yarn, was applied to the surface of the dyed yarn as a coning lubricant. The yarn was then woven into a fabric and this fabric was subjected to the crock fastness, perspiration fastness and wash fastness tests.

The results are shown in Table I.

EXAMPLE 3

A 260 denier 22 filament yarn, prepared from polypropylene containing about 4% of a polyamide dyesite comprising the reaction product of azelaic acid, hexamethylene diamine and N'-aminoethyl piperazine was dyed using conventional acid-dyeing methods with a 3% (on weight of the fiber) concentration of Acid Blue 56. 2.7% hexadecyl stearate was applied to the surface of the dyed yarn as a coning agent. The yarn was then knit into a plain jersey fabric and this fabric was subjected to crock fastness, perspiration fastness and wash fastness tests.

The results are shown in Table I.

TABLE I

Example No.	Crock fastness	Perspiration fastness	Wash fastness
Control A (no finish)	4	3	3
Control B	3	2	2
1	5	4	4
2	5	4	4
3	4	4	4

EXAMPLES 4–7

Example 1 was repeated using a range of concentrations of other fatty acid esters as the coning lubricant and testing the fastness of dyed yarns treated therewith. Results are as follows:

Ex. No.	Ester	Concentration, percent	Crock fastness	Perspiration fastness	Wash fastness
4	Hexadecyl stearate	0.2–4.1	5	4	4
5	2-ethylhexyl stearate	0.5–4.8	5	4	3
6	Neopentyl glycol dipelargonate.	0.8–4.2	4	3	3
7	n-Pentyl caprylate	1.0–3.9	5	4	3

What I claim and desire to protect by Letters Patent is:

1. In the acid dyeing of a yarn of polypropylene containing a basic nitrogen-containing dyesite, the improvement which comprises applying to the surface of the dyed yarn about 0.2 to 5% by weight, based on the weight of the yarn, of a water-insoluble ester of a fatty acid having 8 to 20 carbon atoms and an aliphatic alcohol having the formula $R(OH)_x$ wherein R is an alkyl group having from 5 to 20 carbon atoms and x is an integer from 1 to 5.

2. The process of claim 1 where the yarn to be treated is one containing a polyamide dyesite.

3. The process of claim 2 wherein the polyamide dyesite comprises a reaction product of adipic acid and N,N'-bis(aminopropyl)piperazine.

4. The process of claim 3 where the water-insoluble ester is tridecyl stearate.

5. The process of claim 3 where the water-insoluble ester is 2-ethyl hexyl stearate.

6. The process of claim 3 where the water-insoluble ester is neopentyl glycol dipelargonate.

References Cited

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8—180, 74; 260—857