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3,707,351

TREATMENT FOR IMPROVING POLYPROPYLENE DYEABILITY

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No Drawing. Continuation-in-part of application Ser. No. 733,800, June 3, 1968, which is a continuation-in-part of application Ser. No. 509,426, Nov. 23, 1965, now abandoned. This application Apr. 17, 1970, Ser. No. 29,637

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10 Claims

ABSTRACT OF THE DISCLOSURE

Polypropylene fibers are difficult to dye. The prior art has shown that their dyeability is improved to a certain degree by the incorporation therein of minor amounts of polymeric vinyl pyridines. It has now been found that the dyeability of the modified, i.e., vinyl pyridine-containing polypropylene, is further markedly improved by pre-treatment thereof with an aqueous composition containing from about 0.25% to about 4%, based on the weight of the fiber, of an anionic surface-active agent, such as sodium dodecyl sulfate, and sufficient acid, such as sulfuric or formic acid, to provide a pH no higher than 6 at a temperature of from about 140 to about 250° F. Thus, for example, without the pre-treatment, the modified fibers are only weakly dyeable with dyes, such as Solvent Red 106, a spirit dye, Acid Yellow 42, and acid dye, Rhodamine B, a basic dye, and Vat Jade Green, a vat dye; however, with the pre-treatment the fibers are strongly dyeable with these dyes.

This application is a continuation-in-part of application Ser. No. 733,800 now abandoned, filed June 3, 1968 which, in turn, is a continuation-in-part of application Ser. No. 509,426, filed Nov. 23, 1965, now abandoned.

The invention relates to the dyeing of propylene fibers. More specifically, it relates to a method for improving the dyeability of polypropylene fibers which have been modified with polymeric vinylpyridines and certain derivatives thereof. Still more particularly, it relates to a method for treating such modified polypropylene fibers, prior to the dyeing thereof, whereby their dyeability is markedly improved with various types of dyes.

The use of polypropylene fibers in fabrics and other fibrous materials has been limited by the fact that these materials show little, if any, dye affinity and, therefore, cannot be dyed to deep, attractive shades of color by known dyes and dyeing procedures. The problem is evidently due to the chemically inert, hydrophobic nature of the polypropylene.

Various means have been tried for conditioning the polypropylene to make it more readily dyeable, but none has been entirely successful. One of the more successful approaches has been the incorporation into the polypropylene of a minor amount of a polymeric vinyl pyridine, such as a homopolymer of a specific vinyl pyridine or a copolymer of one or more vinyl pyridines, or a copolymer of a vinyl pyridine with a different vinyl monomer, such as an N-substituted acrylamide; such polymeric "modifying agents" being blended into the polypropylene prior to the melt-spinning thereof.

Although the "modified" polypropylenes exhibit substantially improved dyeability over the unmodified polypropylenes; still, the dyeing falls short of commercial dyeing requirements in the depth of color obtained with most classes of dyes.

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Accordingly, it is an object of this invention to still further improve the dyeability of polypropylene fibers, whereby these fibers can be successfully dyed with various classes of dyes in deep color shades in accordance with commercial requirements using known dyes and conventional dyeing procedures.

In accordance with the present invention, it has now been found that this object is accomplished by subjecting the modified polypropylene, prior to dyeing, to treatment with an aqueous composition containing from about 0.25% to about 4%, OWF, of an anionic surfactant and sufficient acid to provide a pH below about 6, preferably from 1-4, at a temperature of 140-212° F., for a period of from about 10 seconds to about 60 minutes.

The pre-treating composition may be in the form of an aqueous bath in which case the fiber or fabric is immersed therein for the required period, or it may be in the form of a printing paste in which case it is printed on the fabric prior to dyeing.

The dyeings on the treated fibers and fabrics are up to four times stronger in color and have greater brightness and purity than those on untreated material. The dyeing improvement is attained with various types of dyes, including both water-soluble and water-miscible dyes, using conventional dyeing methods. Examples of such dyes, identified by their Colour Index names, are the following:

Acid Dyes:

Acid Blue 80 (C.I. 61585)

Acid Red 85 (C.I. 22245)

Acid Red 292

Acid Yellow 15

Acid Yellow 43

Premetallized dyes:

Acid Yellow 54 (C.I. 19010)

Acid Yellow 151

Chrome dyes:

Mordant Blue 1 (C.I. 43830)

Mordant Black 11 (C.I. 14645)

Mordant Red 7 (C.I. 18760)

Direct dyes:

Direct Blue 238

Direct Orange 72

Vat dyes:

Vat Green 1 (C.I. 59825)

Vat Red 1 (C.I. 73360)

Spirit dyes:

Solvent Orange 20

Solvent Red 106

Solvent Yellow 13

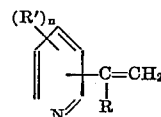
Basic dyes:

Basic Red 30

Basic Violet 18

A special advantageous feature of the pre-treatment process of the invention is the strong affinity it imparts to the fibers for basic and vat dyes.

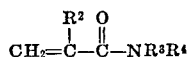
As above indicated, the "modified" polypropylene fibers to which the pretreatment process of the present invention is applicable are those containing a minor amount, generally from 1 to 25%, by weight, of a polymeric vinyl pyridine. More specifically, the polymeric vinyl pyridine can be a homopolymer or a copolymer of a vinyl pyridine of the formula:



wherein R is hydrogen or methyl, R' is an alkyl group of 1-4 carbon atoms and N is an integer from 0 to 4; or it

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can be a copolymer of such a vinyl pyridine with an N-substituted acrylamide of the formula:



wherein R² is hydrogen or an alkyl group of 1-4 carbon atoms, R³ is hydrogen or an alkyl, cycloalkyl aralkyl or aryl group of 1-18 carbon atoms and R⁴ is a member selected from the group consisting of alkyl, cycloalkyl, aralkyl and aryl groups containing 1-18 carbon atoms. Such N-substituted acrylamides include N-isopropylacrylamide, N-isopropylmethacrylamide, N,N-dimethylacrylamide, N-phenylacrylamide, N-cyclohexylacrylamide, N-butylacrylamide, N,N-diethylacrylamide, N-ethylacrylamide, N-methylacrylamide, N-methyl-N-phenylacrylamide, N-dodecylacrylamide, N-propylacrylamide, N-benzylacrylamide, and N-α-naphthylacrylamide.

Typical specific modifier polymers are the following:

Poly(2-vinyl pyridine)
Poly(3-vinyl pyridine)
Poly(4-vinyl pyridine)
Poly(5-ethyl-2-vinyl pyridine)
Poly(2-methyl-5-vinyl pyridine)
Poly(2-methyl-6-vinyl pyridine)
Poly(2,4-dimethyl-6-vinyl pyridine)
Poly(5-propyl-2-vinyl pyridine)
75/25 copolymer 2-methyl-5-vinyl pyridine/N,N-dimethylacrylamide
75/25 copolymer N-isopropylacrylamide/2-methyl-5-vinyl pyridine
85/15 copolymer N-methylmethacrylamide/2-methyl-5-vinyl pyridine
93/7 copolymer N,N-dimethylacrylamide/2-methyl-6-vinyl pyridine
80/15/5 copolymer N-isopropylacrylamide/N-tert-butylacrylamide/2-methyl-5-vinyl pyridine
70/10/15 copolymer N-isopropylacrylamide/N,N-dimethylacrylamide/2-methyl-5-vinyl pyridine
80/10/10 copolymer N-isopropylacrylamide/2-methyl-5-vinyl pyridine/2-vinyl pyridine
75/17/8 copolymer N-methylacrylamide/2-methyl-5-vinyl pyridine/3-vinyl pyridine

The modified polypropylene fibers to which the dyeing treating process of the present invention is applicable and their manner of production are fully described in U.S. Pat. No. 3,315,014.

The acid used in the treating composition can be any acid which does not alter the color of the fiber and which has sufficient water-solubility to provide the required pH therein. Thus, mineral acids, such as sulfuric, hydrochloric and phosphoric acids may be used. Also, organic acids, such as formic, acetic, propionic, butyric, valeric, caproic, heptylic, acrylic, oxalic, malonic, succinic, glutaric, citric, lactic, benzene-sulfonic, o-, m- and p-toluenesulfonic acids and their available anhydrides are suitable.

The amount of the anionic type of surface-active agent in the treating composition is critical. Thus, it has been found that dyeing improvement commences at 0.25% OWF. On the other hand, where amounts above about 4% are used, the advantages of the treatment process are diminished and may even be lost entirely. It is pointed out that the said stated amounts refer to real surfactant agent. Thus, some surfactive agents as supplied commercially contains less than 100% active ingredient (i.e., real surfactant). Accordingly, the amounts of such materials used should be adjusted to an active ingredient basis.

Any commercially available anionic-type of wetting agent or surface-active agent can be used. Illustrative

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examples of anionic surface-active agents, that can be used in practicing the present invention are the following:

- Sodium salt of sulfated ethanolamide of oleic acid
- Oleic acid amide of the sodium salt of sarcosine
- 5 Highly sulfonated castor oil
- Sulfated hydroxystearic acid
- Sodium and potassium salts of sulfonated esters of dicarboxylic acids
- Sodium sulphate derivative of 2-ethyl hexanol-1
- 10 Sodium palmitoyl methyl taurate
- Sodium salts of sulfated fatty esters
- Sodium and ammonium salts of sulfated monoglycerides
- Monobutyl biphenyl sodium monosulfonate
- Sodium, potassium, ammonium and guanidine salts of
- 15 monoethyl phenyl phenol monosulfonate
- Alkyl aryl sulfonates
- Diamyl ester of sulfosuccinic acid
- Diethyl ester of sodium sulfosuccinic acid
- Dioctyl ester of sodium sulfosuccinic acid
- 20 N-octadecyl disodium sulfosuccinamate
- Sodium alkyl naphthalene sulfonates
- Sodium tetrahydronaphthalene sulfonates
- Sulphonated aliphatic polyesters
- Sodium oleyl methyl taurate
- 25 Salts of sulfonated fatty amides
- Polymerized sodium salts of substituted benzoid long-chain alkyl sulfonic acids
- Sodium dodecyl sulfate
- Sodium sulfated mixed alcohols

30 When the treating composition is employed as a bath the polypropylene material is immersed therein for a period sufficiently long to obtain the desired result. It is usually desirable to maintain the treating bath at an elevated temperature above about 140° F. Generally, the solution temperature while in contact with the polypropylene fibers product is within the range of from about 160° F., to about the atmospheric boiling point. However, temperatures up to about 250° F. may be used

40 at super-atmospheric pressure. The necessary time will usually range from about one hour to as little as about 10 seconds at about the boiling point of the treating bath.

The volume of treating bath should be ample to thoroughly wet the polypropylene fibers. In general, the weight ratio of bath to fibers will be from about 10:1 to about 300:1. Usually, however, it will range from about 10:1 to about 50:1.

50 The treated fiber may be passed directly to the dyeing operation, preferably, but not necessarily, after an intervening wash with warm water. However, if so desired, the treated material, usually after washing, may be dried, at from about room temperature to about 180° F. The dried fibers may be dyed by ordinary dyeing procedures according to the particular type of dye used.

55 As has been indicated, the pre-treatment of the invention includes application of the treating composition in the form of a printing paste. Thus, a printing paste is prepared using the requisite amounts of anionic surface-active agent and acid and ordinary printing gum. The paste is then printed on the polypropylene fabric, including such things as polypropylene rug material, and after steaming, washing and drying, the piece is then dyed. The printed portion dyes much stronger than the unprinted portion, thus giving a pattern effect according to the printing design.

60 The invention is illustrated by the following examples in which all parts and percentages are by weight unless otherwise indicated ("OWF" denotes "on weight of fiber").

EXAMPLE 1

75 Sample A.—A 5-gram skein of "Polycrest® SDR-1," a polypropylene carpet yarn containing 5% of poly(2-methyl-5-vinyl pyridine), was immersed for 15 minutes at 212° F. in a 200 ml. bath containing 5% (OWF) of

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Duponol WA Surfactant, a commercial sodium dodecyl sulfate product containing about 50% of the surface active ingredient, and 5% (OWF) of formic acid. The pH of the treating bath was about 3. The yarn was then rinsed thoroughly in water and dried.

Sample B.—Similar to A above, except that 5 g. of a 5.6% aqueous sulfuric acid solution was used in place of the formic acid.

Sample C.—Similar to B above, but the treatment was for 30 minutes.

Sample D.—Similar to B above, but the treatment was for 45 minutes.

Sample E.—Similar to B above, but the treatment was for 60 minutes.

Sample F.—Similar to A above, but omitting the anionic agent.

Sample G.—Similar to A above, but omitting the acid.

The skeins of Samples A through G plus an untreated skein were separately dyed as follows: The skein was immersed for one hour at 205° F., in a 200 ml. dyebath containing 1% (OWF) of a commercial preparation of the dye, C.I. Solvent Red 106, and 5% (OWF) of formic acid. The skein was then removed, rinsed in water and scoured for 10 minutes at 180° F. in a 200 ml. bath containing 1% (OWF) of a nonionic detergent and 1% (OWF) of soda ash. The skein was then rinsed and dried.

DYEING RESULTS

The skeins of Samples A through E were dyed strong bright red shades approximately 400% in strength compared with the untreated skein and the skeins of Samples F and G. Thus, it is seen that, for obtainment of the improved dyeing effect, both the anionic surfactant and the acid must be present in the treating bath.

EXAMPLE 2

(A) A skein of Polycrest® SDR-1 yarn, pretreated as described for Sample A of Example 1, and an untreated skein, were each dyed for one hour at 205° F. in a 200 ml. dyebath (40:1 ratio) which contained about 0.2% (OWF) of the basic dye, 1,3,3-trimethyl-2-(p-cyanoethyl-methylaminostyryl)pseudonindolium methosulfate and 2% (OWF) of sodium triphenylphosphate. Each skein was then rinsed in water and scoured 10 minutes at 180° F. in a 40:1 volume bath containing 1% (OWF) of a non-ionic surfactant and 1% (OWF) soda ash.

The treated yarn was dyed a strong bright red color, while the untreated yarn was colored only a pale pink shade.

(B) Dyeings similar to those described in A above were carried out using the red acrylic dye which is the first dye listed in Table 1a, Example 1 of U.S. Patent No. 2,883,373. Similar results were obtained, the treated yarn again being strongly colored, the untreated yarn dyeing only weakly.

(C) Dyeings similar to those of A above were carried out using Rhodamine B (C.I. Basic Violet 10, C.I. 45170). Similar comparable results were obtained, the treated yarn being colored a strong red shade and the untreated yarn a light pink.

EXAMPLE 3

A skein of Polycrest® SDR-1 yarn, which has been scribed for Sample B of Example 1, was dyed in a 40:1 dyebath which contained 5% (OWF) of a commercial preparation of the dye, Vat Jade Green (C.I. Vat Green 1; C.I. 59825), 2 oz./gal. caustic soda and 2 oz./gal. of sodium hydrosulfite.

The dyeing was carried out at 160° F. for 10 minutes. The skein was rinsed and then oxidized in a 40:1 bath containing 0.5% sodium perborate at 160° F. for 5 minutes. It was then rinsed and soaped 10 minutes at the boil in a bath containing 0.1% neutral soap and 0.1% soda ash and then rinsed in water and dried. The result was a

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strong green dyeing. An untreated skein dyed in exactly the same manner was colored only a pale green shade.

EXAMPLE 4

A skein of Polycrest® SDR-1 yarn, pretreated as described for Sample B of Example 1, and also an untreated skein of the yarn were dyed for one hour at 200° F. in a 40:1 dyebath which contained 1% (OWF) of a commercial preparation of the dye, C.I. Direct Blue 238, and 30% (OWF) of sodium chloride, rinsed and dried. The treated yarn was dyed a good blue shade while the untreated yarn remained essentially undyed.

EXAMPLE 5

A skein of Polycrest® SDR-1 yarn, which has been pretreated as described for Sample B of Example 1, was dyed for one hour at the boil in a 40:1 dyebath which contained 2% (OWF) of the commercial preparation of the dye, C.I. Mordant Blue 1 (C.I. 43830), and 2% (OWF) of 56% acetic acid and rinsed. Without being dried, the yarn was then treated for one hour at 205° F. in a 40:1 bath containing 2% (OWF) of potassium bichromate, 5.6% (OWF) of sulfuric acid and 1% (OWF) glucose. The yarn was then rinsed well and dried. The result was a deep blue dyeing.

An untreated skein of yarn dyed in exactly the same way was colored only a light blue.

EXAMPLE 6

Five-gram skeins of Polycrest® SDR-1 polypropylene yarn were treated 30 minutes at 212° F. using a procedure similar to that described for Sample B of Example 1, but varying the amount of sodium dodecylsulfate, the anionic agent, used in the form of the commercial product Duponol WA, which contains about 50% of the agent.

The treatments were carried out using anionic agent and acid, based on the weight of the fiber, as follows:

Sample A 0.5% anionic agent plus 5.6% H₂SO₄
 Sample B 1.0% anionic agent plus 5.6% H₂SO₄
 Sample C 2.5% anionic agent plus 5.6% H₂SO₄
 Sample D 4.0% anionic agent plus 5.6% H₂SO₄
 Sample E 5.0% anionic agent plus 5.6% H₂SO₄
 Sample F 5.0% anionic agent plus 5.6% formic acid

After rinsing well, the skeins, along with an untreated one for a control, were dyed using a procedure similar to that described in Example 1. Thus, they were dyed in a 40:1 ratio bath with 1% (OWF) of the commercial preparation of the dye Solvent Red 106 and 5% (OWF) formic acid for one hour at 205° F. The dyeings were then compared for strength of red color. The results are shown in Table I.

TABLE I

	Anionic agent, percent	Color strength of dyed skein, percent
Control—(no treatment).....	0	100
Treatment above:		
Sample A.....	0.5	150
Sample B.....	1.0	200
Sample C.....	2.5	400
Sample D.....	4.0	150
Sample E.....	5.0	100
Sample F.....	5.0	100

¹ Standard.

This shows the criticality of the concentration of the anionic agent in the treating bath and illustrates the fact that above about 4%, the color value decreases rapidly.

7 EXAMPLE 7

Five-gram skeins of Polycrest® SDR-1 yarn, treated as described for Sample B of Example 1, were subjected to further vigorous conditions and treatments, as follows:

Sample A.—Scouring at 180° F. for 10 minutes in a bath containing 1% non-ionic agent and 1% soda ash.

Sample B.—Boiled in water for one hour.

Sample C.—Boiled in 5% (OWF) H₂SO₄ for one hour.

Sample D.—Boiled in 5% (OWF) NaOH for one hour.

Sample E.—Held at 160° F. for one hour in a bath containing 2 oz./gal. each of Na₂S₂O₄ and NaOH.

Sample F.—Boiled one hour in a solution of 5% (OWF) sodium chlorite and 5% (OWF) sulfuric acid.

Sample G.—Kept immersed in water at ambient temperature for 24 hours.

Sample H.—Dried at 160° C. and stored at room temperature for one week.

The skeins from all the treatment Samples A through H were then dyed according to the dyeing procedure described in Example 1. All samples from the extra treatments dyed to a red color about four times as strong in color value as the control skein. Thus, it is seen that the pretreatment of the polypropylene in accordance with this invention produces a durable effect on the fiber which is not altered by conditions often encountered in the practical handling of fibers, fabrics and yarns.

EXAMPLE 8

A two-liter bath was made up as follows:

1900 ml. H₂O

50 ml. 5% aqueous solution of Duponol WA

50 ml. 5% solution H₂SO₄

The above components were thoroughly mixed and 200 ml. portions were used for each experiment described. Eight baths, each containing 250 mg. of Duponol WA which is about 50% by weight of sodium dodecyl sulfate and 250 mg. of H₂SO₄ were prepared. These bath mixtures were brought to boiling and a 5-gram skein of Polycrest® SDR-1 yarn was immersed in each bath. The periods of time for which the yarn was immersed in the baths was varied as follows:

- (1) 10 seconds
- (2) 30 seconds
- (3) 1 minute
- (4) 5 minutes
- (5) 10 minutes
- (6) 15 minutes
- (7) 30 minutes
- (8) 60 minutes

After completion of the time period for the treatment, the yarns were rinsed with warm water and scoured with 1% of a non-ionic agent (OWF) and 1% Na₂CO₃ (OWF) for 10 minutes at 180° F. The yarns were then rinsed and dried. This procedure provided the treated samples for subsequent dyeing.

The dyeing procedure was carried out by preparing nine identical dyebaths as follows:

- 1% of the commercial dye Solvent Red 106 (OWF)
3% formic acid (OWF)

Using a 40:1 liquid to fiber ratio, each of the above treated skeins (Nos. 1 through 8) and an untreated 5-gram skein which had been scoured with 1% non-ionic agent (OWF) and 1% Na₂CO₃ (OWF) at 180° F. for 10 minutes, were separately dyed for 1 hour at 205° F. At the completion of the dyeing time, the skeins were all rinsed with warm water and after-scoured at 180° F. for 10 minutes with 1% non-ionic agent and 1% Na₂CO₃ (OWF). The skeins were then rinsed and dried.

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The following results, noted visually, are shown in Table II.

TABLE II

Fiber treatment	Shade	Strength, percent
Untreated (control).....	Red dyeing.....	100
1. 10 seconds.....	Brighter red.....	100
2. 30 seconds.....	do.....	300
3. 1 minute.....	do.....	300
4. 5 minutes.....	do.....	350
5. 10 minutes.....	do.....	400
6. 15 minutes.....	do.....	400
7. 30 minutes.....	do.....	400
8. 60 minutes.....	do.....	400

The results show that the treatment is effective even when carried out for very short periods of time at 212° F.

EXAMPLE 9

Five-gram skeins of Polycrest® SDR-1 yarn were each treated for 15 minutes at 212° F. in a 200 ml. bath (40:1 ratio) containing the amounts of real sodium dodecyl sulfate (anionic agent) shown in Table III, and 5% (OWF) of a 5.6% aqueous sulfuric acid solution. The yarn was then rinsed thoroughly in water and dried. The treatments were carried out in triplicate at each concentration of sodium dodecyl sulfonate.

The skeins, plus untreated, skeins were then dyed using three different dyes as follows:

(I) Acid Yellow 42 (C.I. 22910)

(II) AcidRed 85 (C.I. 22245)

(III) Acid Blue 7 (C.I. 42080)

The dyeings were carried out for 1 hour at 205° F. in a 200 ml. bath containing 1% (OWF) of the dye and 5% (OWF) of a 3% solution of formic acid. The skeins were removed, rinsed in water and scoured for 10 minutes at 180° F. in a 20 ml. bath containing 1% (OWF) of a non-ionic detergent and 1% (OWF) of soda ash. The skeins were then rinsed and dried.

The color strengths of dyeings were then recorded from visual observation. The results are shown in Table III.

TABLE III

Percent anionic agent in bath	Color strength (percent) of dyed skein		
	Dye I	Dye II	Dye III
No treatment.....	0	2.5	0
0.025.....	15	10	20
0.06.....	40	20	40
0.075.....	40	20	40
0.1.....	50	50	90
0.125.....	50	50	90
0.25 ¹	100	100	100
0.5.....	200	100	100
1.5.....	350	170	90
2.5.....	350	170	75
4.0.....	100	180	50
5.0.....	100	180	25

¹ Dyeings at this concentration taken as 100% standard for comparison purposes.

It will be seen from Table III that good dyeability improvement is obtained at 0.25% anionic agent in the pretreatment bath and maximum improvement between 0.25% and 4%.

EXAMPLE 10

Effect of time of pretreatment on dyeability

Skins of Polycrest® SDR-1 yarn were subjected to the pretreatment procedure described in Example 9 using 1.5% real sodium dodecyl sulfate as the anionic agent with 5% (OWF) of the designated sulfuric acid solution. The pretreatment was carried out at 140° F., 160° F. and 212° F. varying the time of pretreatment. The skeins were then dyed with the procedure of Example 9 using Dye II.

The dyeings were then observed visually for strength comparisons. Table IV shows the dyeing results obtained.

TABLE IV

Temp., ° F.	Pretreatment		Color strength (percent)
	Time		
None			10
140	5 minutes		100
160	5 minutes		120
212	10 seconds		120
212	30 seconds		120
212	60 seconds		140
212	5 minutes		150
212	10 minutes		150
212	15 minutes		150
212	30 minutes		150
212	60 minutes (total exhaustion)		150

¹ No dyeing. ² Standard.

From Table IV, it is seen that even at 140° F., at 5 minutes, a good dyeing results. There is excellent improvement even at 10 seconds at 212° F. The color strength increases up to about 5 minutes. Above 5 minutes, the increase in strength improvement begins to level off and the strength increase with time becomes less significant.

EXAMPLE 11

A printing gum was made up as follows:

2.5 grams Duponol WA

37.5 grams of a 5.6% H₂SO₄ solution

60.0 grams Superclear gum (a solution of refined natural gums)

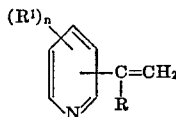
100.0 grams total

This printing gum was screen printed on a piece of Polycres[®] SDR-1 fabric. The printed piece was hot air dried at 160° F. The piece was then steamed for 15 minutes without pressure and rinsed with hot water. At this stage, the piece was uniformly white. It was then dyed in a dyebath containing 1% (OWF) of the commercial dye Solvent Red 106 and 1.5% (OWF) formic acid for 15 minutes at 212° F. It was taken from the bath, rinsed and scoured for 10 minutes at 160° F. with 1% soda ash and 1% Decersol NI (a condensate of nonylphenol with an average of 9.5 moles of ethylene oxide). The piece was rinsed and dried. The printed portion dyed much stronger than the unprinted. This gave a patterned effect.

I claim:

1. A method for improving the dyeability of a polypropylene fiber containing from 1 to about 25% by weight of a polymeric modifier selected from the group consisting of:

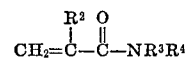
(a) homopolymers of vinyl pyridine monomers having the formula:



wherein R is a member selected from the group consisting of hydrogen and methyl, R¹ is a lower alkyl group, and n is an integer from 0 to 4,

(b) copolymers of at least two vinyl pyridine monomers having said formula (a), and

(c) copolymers of vinyl pyridine monomers having said formula (a) with N-substituted acrylamide monomers having the formula:



wherein R² is a member selected from the group consisting of hydrogen and lower alkyl, R³ is a member selected from the group consisting of hydrogen, alkyl, cycloalkyl, aralkyl and aryl groups containing 1-18 carbon atoms, and R⁴ is a member selected from the group consisting of alkyl, cycloalkyl, aralkyl and aryl groups containing 1-18 carbon atoms; which comprises treating said fiber prior to dyeing with an aqueous composition containing (a) from about 0.25% to about 4%, based on the weight of the fiber, of an anionic surfactant and (b) 0.125% to about 5.6% of a water soluble acid to provide a pH in said composition 6 at a temperature of from about 140° F. to about 250° F. for a period of from about 10 seconds to about 60 minutes.

2. A method according to claim 1 wherein said polymeric modifier is a homopolymer of a vinyl pyridine monomer.

3. A method according to claim 1 wherein said polymeric modifier is a copolymer of at least two vinyl pyridine monomers.

4. A method according to claim 1 wherein said polymeric modifier is a copolymer of a vinyl pyridine and an N-substituted acrylamide monomer.

5. A polypropylene fiber treated according to the method of claim 2 wherein said vinyl pyridine monomer is selected from the group consisting of 2-vinyl pyridine, 3-vinyl pyridine, 4-vinyl pyridine, 2-methyl-5-vinyl pyridine, 5-ethyl-2-vinyl pyridine, 2-methyl-6-vinyl pyridine, 2,4-dimethyl-6-vinyl pyridine and 5-propyl-2-vinyl pyridine.

6. A polypropylene fiber treated according to the method of claim 3 wherein at least one of said vinyl pyridine monomers is selected from the group consisting of 2-vinyl pyridine, 3-vinyl pyridine, 4-vinyl pyridine, 2-methyl-5-vinyl pyridine, 5-ethyl-2-vinyl pyridine, 2-methyl-6-vinyl pyridine, 2,4-dimethyl-6-vinyl pyridine and 5-propyl-2-vinyl pyridine.

7. A method according to claim 1 wherein the fiber is immersed in the treating composition.

8. A method according to claim 1 wherein a fabric or rug composed of the fiber is printed with a printing paste containing the treating composition.

9. A method according to claim 1 wherein said acid is formic acid.

10. A method according to claim 1 wherein said acid is sulfuric acid.

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DONALD LEVY, Primary Examiner

U.S. Cl. X.R.

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