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[54] **FIBER BLENDS OF POLYOLEFIN WITH
POLYVINYLPYRIDINES OR QUINOLINES WITH
AND WITHOUT A POLYETHYLENE OXIDE AND
ACID AND DISPERSE DYE VARIEGATED DYEING
THEREOF**
23 Claims, No Drawings

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115.7, DIG. 9; 57/140 BY; 161/62, 169, 179**

[56] **References Cited**
UNITED STATES PATENTS
3,150,917 9/1964 Gagliardi **8/21 D**
3,315,014 4/1967 Coover et al. **260/895**
3,316,328 4/1967 Press **8/168**
3,329,557 7/1967 Magat et al. **161/172**
3,361,843 1/1968 Miller **8/180 UX**
3,530,201 9/1970 Schwarcz **260/857**

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ABSTRACT: This invention relates to a process for dyeing fabrics and textile articles made from polyolefin fibers or two-color or multicolor patterns using a mixture of different classes of dyes in a single dye bath, which may optionally contain an anionic and nonionic surfactant.

FIBER BLENDS OF POLYOLEFIN WITH POLYVINYL PYRIDINES OF QUINOLINES WITH AND WITHOUT A POLYETHYLENE OXIDE AND ACID AND DISPERSE DYE VARIEGATED DYEING THEREOF

The advantages of obtaining a multicolor effect in a single dyeing procedure, as compared to predyeing the individual color components in a number of dyeing steps are obvious. The use of a single dyeing step offers cost advantages as well as flexibility in eliminating the necessity for warehousing the variety of colors needed to assemble the final textile article from predyed components. Synthetic fibers other than the polyolefins, such as those made from polyamides or polyacrylonitriles, can be modified to permit the achievement of multicolor effects in a single dyeing procedure. Polyolefin fibers, however, which some respects offer better properties than the aforementioned fibers, are not available in forms which can be dyed to a multicolor effect using a single dyeing step.

It is an object of this invention to provide a fabric of yarns composed predominantly of a polyolefin capable of being piece-dyed to a multicolor pattern. A further object of this invention is that such dyeing to a multicolor pattern of such fabrics be accomplished in a single dyeing step with a mixture of anionic dyes and disperse dyes. Other objects of our invention will be apparent to one skilled in the art from a consideration of this specification.

These objects can be achieved by assembling a fabric or textile article, such as a carpet pile, from two or more classes of yarns, all of which have been formed from a polyolefin. Two of the classes of fibers are comprised of a major portion of a poly(alpha-olefin), their properties differing only in their dyeing behavior, which is the basis for the classification described in this specification. One class is essentially undyeable with anionic dyes in the process of this invention, while the other one is highly dyeable with anionic dyes, and both classes are susceptible to dyeing with disperse dyes. Exposure of a fabric containing these two or more classes of yarns to a mixture of anionic and disperse dyes will result in the yarns which are essentially undyeable with anionic dyes being dyed substantially only by the disperse dyes. Thus, the fabric achieves a two-color pattern predetermined by the arrangement of the classes of yarns in the fabric. Since anionic and disperse dyes are generally compatible in the dyebath, these fabrics can be dyed to their two-color pattern in a single dyeing step by such a mixture of dyes. Inclusion of pigmented or uncolored poly(alpha-olefin) fiber yarns allows the introduction of still other colors to form said multicolor pattern.

U.S. Pat. No. 3,315,014, discloses the use of blends of polypropylene with 1 to 25 percent vinylpyridine polymers to produce fibers which are dyeable with disperse and anionic dyes. We have found however, that when such fibers (referred to below as "two-component" fibers), contain lower levels of vinylpyridine polymer and are used according to the present invention, they are dyeable only with disperse dyes. This fiber is combined with another polyolefin fiber which is highly dyeable with both anionic and disperse dyes, as described below, to yield the present invention.

The dyeable polyolefin fibers used in this invention comprise the following two classes:

1. A fiber formed from a blend of (A) an alpha-monoolefin polymer and (B) between about 1 and 5 percent by weight of a pyridine-type polymer dye receptor, said fiber being dyeable with disperse dyes and essentially undyeable with anionic dyes in the process used in this invention. This fiber is referred to herein as "two-component fiber."

2. A fiber formed from a blend of (A) less than 97 percent by weight of an alpha-monoolefin polymer; (B) between about 0.5 and 5 percent by weight of a pyridine-type polymer dye receptor and (C) between about 0.5 and 5 percent by weight of a hydrophilic compound which is a homopolymer or derivative thereof, or copolymer containing ethylene oxide units ($-\text{CH}_2-2-\text{O}-$), in prescribed amounts. The total amount of the B plus C components in said composition is greater than 3 percent by weight. Such fibers are dyeable with anionic and

disperse dyes. These fibers are referred to herein as "three-component fiber" and are described in U.S. Pat. No. 3,530,201.

In the present invention, the fibers used in each class comprise a major portion of inherently undyeable alpha-monoolefin polymers comprising both homopolymers and copolymers of alpha-monoolefins; for example, copolymers with nonterminal olefins or with one or more other alpha-olefins, as well as block copolymers of alpha-olefins with each other and graft copolymers of alpha-olefins with polymers of other alpha-olefins. The class includes polyethylene, polypropylene, poly(3-methyl-1-butene), poly(4-methyl-1-pentene), copolymers of propylene and 4-methyl-1-pentene, and copolymers of any of the foregoing monomers with each other and/or with other copolymerizable monomers. The preferred material is polypropylene, by which we mean any polymer of propylene and any copolymer containing predominantly polymerized propylene together with any other comonomer copolymerized therewith.

The dye receptor compounds, suitable for admixing with said alpha-monoolefin polymers are thermoplastic homopolymers of pyridine-type monocyclic and polycyclic compounds, including quinolines, and their copolymers with each other.

One of the classes of pyridine-type compounds useful for this purpose in this invention are the polymers of vinylpyridines such as: 2-vinylpyridine, 3-vinylpyridine, 4-vinylpyridine, 3-methyl-6-vinylpyridine, 2-ethyl-5-vinylpyridine, 2-methyl-5-vinylpyridine, 2-ethyl-6-vinylpyridine, 2-isopropenylpyridine, etc. Preferred materials of this class for use in this invention are polymers of at least one vinylpyridine compound, by which is meant homopolymers of vinylpyridine compounds such as poly(2-vinylpyridine), poly(4-vinylpyridine), poly(2-methyl-5-vinylpyridine), poly(2-isopropenylpyridine), etc., copolymers of various vinyl-substituted pyridine compounds with each other, such as copolymers of 3-vinylpyridine and 2-methyl-5-vinylpyridine in any desired proportions, copolymers of 2-vinylpyridine with 2-isopropenylpyridine in any desired proportions, copolymers of 4-vinylpyridine with 2-vinylquinoline in any desired proportions, as well as copolymers of three, four, or more of these polymerizable materials. Copolymers of vinylpyridines with other mono-ethylenically unsaturated monomers, such as styrene, ethylene or propylene are also operative in the case of the "2-component fibers."

The (C) component of the "3-component fiber" (anionic dyeable) used in this invention is selected from the following groups of compounds:

1. Polyethylene glycol (also referred to herein as PEG) having a degree of polymerization of at least 4;

2. Copolymers of ethylene oxide with other alkylene oxides, having a degree of polymerization of the ethylene oxide units of at least 4 and containing a minimum of 60 percent by weight ethylene oxide. These compounds are exemplified by the series of block copolymers produced by condensing ethylene oxide with a product formed by the condensation of propylene oxide with propylene glycol (formula of such copolymers: $\text{HO}-(\text{C}_2\text{H}_4\text{O})_x(\text{C}_3\text{H}_6\text{O})_y(\text{C}_2\text{H}_4\text{O})_z\text{H}$ and sold under the trademark "Pluronic"). Other useful copolymers are derived from the polymerization of ethylene oxide and propylene oxide;

3. Derivatives of polyethylene glycol, such as its ethers and esters having a degree of polymerization of ethylene oxide of at least 4 and an ethylene oxide content of at least 60 percent by weight. Examples of such derivatives are: (a) polyethylene glycol alkyl ethers; (b) alkylaryl polyethoxylalcohols sold under the trademark "Iriton" (the octylphenylpolyethoxy ethanol series); (c) polyoxyethylene derivatives of long-chain fatty-acid esters of hexitol anhydrides including sorbitans, sorbides, mannitans and mannides, such as polyethylene glycol hexitol carboxylates, polyoxyethylene sorbitan monolaurate sold under the trademark "Tween 20" and polyoxyethylene sorbitan monostearate; and polyethylene glycol carboxylate

esters such as polyethylene glycol monostearate and polyethylene glycol distearate.

Additional colors can be obtained in the present invention by varying the composition of the "two-component" or "three-component" fibers. Such variation may include: (1) varying the type and/or amount of polyolefin; (2) varying the chemical structure and/or amount of the dye receptor polymer; (3) varying the chemical structure and/or amount of the hydrophilic compound used in the "three-component" fiber. In order to describe the present invention most conveniently, only the achievement of a two-color combination is exemplified herein, but this in no way should be inferred as a limitation of the scope of the present invention.

When a textile article such as a fabric or carpet pile is assembled, whether by weaving, tufting, knitting, felting, hooking or other means, from the two classes of yarns described, which may optionally include uncolored nondye receptor-containing or pigmented polyolefin fibers, and dyed with a mixture of an anionic dye and a disperse dye in the present of a nonionic surfactant or in mixture of a nonionic and an anionic surfactant, only those portions of the fabric made of the "three-component fibers" will be dyed by anionic dyes. These same "three-component fibers" will also be dyed by disperse dyes. On the other hand, the portion of the fabric composed of "two-component fibers" will remain essentially undyed by the anionic dyes, and therefore will only be dyed by disperse dyes. If included in the textile article, the nondye receptor containing yarns will remain undyed. By choosing anionic dyes of certain colors and disperse dyes of different colors, the fabrics containing combinations of the above-described "two-component" and "three-component" yarns can be conveniently dyed to a two-color or multicolor pattern, in a single dyeing step, in which the fabric is exposed to the above mixture of anionic and disperse dyes.

Although the "two-component fiber" is essentially undyeable with anionic dyes by conventional dyeing procedures using a nonionic surfactant in the dyebath, some staining (i.e., a slight takeup of dye on the surface of the fiber) will occur with anionic dyes. This may be undesirable in cases where staining decreases a desired contrast in the color of the two classes of yarns dyed with a mixture of anionic and disperse dyes.

A further feature of the present invention is the discovery of certain surfactant compositions used in the dyeing of articles composed of the above-described polyolefin yarns which are dyeable with anionic and/or disperse dyes. These compositions facilitate the production of multicolor patterns by increasing the color contrasts obtainable with the two classes of fibers previously described. These surfactant compositions are mixtures of anionic and nonionic surfactants which are applied to the yarn in an acidic dyebath.

According to copending Pat. application Ser. No. 705,303, anionic surfactants used in the dyebath greatly enhance the uptake of anionic dyes of both "two-component fibers" and "three-component fibers." Nonionic surfactants have little effect on the dye uptake of the "three-component fiber" and virtually no effect on the dye uptake of the "two-component fiber." Likewise, the nature of the surfactant has in general little, if any effect on the dye uptake of disperse dyes.

Surprisingly, a mixture of anionic and nonionic surfactants increases the dye uptake of the "three-component fiber" while having little or no effect on the dye uptake of the "two-component fiber," when both fibers are dyed simultaneously in the same dyebath. The color contrast obtained in dyeing with this mixture of surfactants is greater than that obtainable with either anionic or nonionic surfactants alone. This is a very important factor in the styling of multicolor pattern fabrics or yarns.

The anionic component of the mixture of surfactants has the general formula (R-A) wherein R represents a hydrophobic group which is either a substituted or unsubstituted alkyl, aryl or alkylaryl group having 6 or more carbon atoms (preferably between 9 and 40 carbon atoms) per A group; and A is an anionic group exemplified by one or more of the fol-

lowing groups: (1) sulfonate; (2) sulfate; (3) phosphate or polyphosphate; (4) carboxylate, etc. The A group can be in the free acid form or in the salt form. Another type of anionic surfactant which can be used is one wherein R may contain a polyoxyalkylene group. Additional operative materials include those generating anionic surfactants in situ during the process of this invention. Examples of anionic surfactants suitable for use in the present invention are:

Commercial Name	Chemical Description
Sodium laurylsulfate	$C_{12}H_{25}SO_3Na$
Sodium tetradecylsulfate	$C_{14}H_{29}SO_3Na$
Sodium cetyl sulfate	$C_{16}H_{33}SO_3Na$
Aerosol TR	Bis(tridecyl)ester of sodium sulfosuccinic acid
Aerosol OT	Diocetyl ester of sodium sulfosuccinic acid
Aerosol AY	Diamyl ester of sodium sulfosuccinic acid
Tergitol 15-S-3A	$C_{12}H_{27}(CH_2-CH_2-O)_3-SO_3-NH_4$
Tergitol 15-S-3S	$C_{12}H_{27}O-(CH_2-CH_2-O)_3-SO_3-Na$
Sandopan 6624	$C_{12}H_{25}O-(CH_2-CH_2-O)_7-CH_2-COONa$
Victawet 35B	(2-ethylhexyl) $_2Na_2(P_3O_{10})_2$
Barisol Super BRM	Aliphatic phosphated ester
Alkapent CC	Aliphatic phosphated ester, acid form
Alkapent M60	Aromatic phosphated ester, acid form
Chemsol 700-S	Modified organic phosphated ester
Chemsol 935-N	Phosphated ester of long chain fatty alcohol
Estranol CP	Alkyl phosphate
Alkapent A	Aliphatic phosphated ester, free acid
Gafac RS-610	Phosphated ester
Gafac LO-529	Sodium salt of a phosphated ester
Zelex UN	Fatty alcohol phosphate
	Diethanolamine salt of a 1:1 mixture of mono- and di-fatty alcohol phosphates (made from the fatty alcohols and P_2O_5)
Solar 25	Coconut oil fatty acid amine condensate
Laureltext 802	Potassium salt of a phosphate alcohol
Rozak BD-100	Phosphated ethoxylated oleyl-alcohol
Fosterge LF Acid	Organo-phospho-acid
Seycopen BB	Phosphated polyalcohol
Crestol	Phosphated complex alcohol
Warcosol NF/3	Complex of sulfonated polyester and phosphated alcohol
Surfactant QS-44	Phosphated ester, free acid
Detergent 9294	Anionic phosphate ester
Seyco Phosphonic Acid	Aromatic phosphated ester, free acid

The nonionic surfactants are the conventional ones represented by the general formula $R-O-X-H$ wherein R represents a hydrophobic group which is either a substituted or unsubstituted alkyl, aryl or alkylaryl group having 6 or more carbon atoms (preferably between 9 and 40 carbon atoms); X represents a nonionic hydrophilic group such as homopolymers of ethylene oxide or propylene oxide or copolymers of these materials with each other, with a degree of polymerization of alkylene oxide units between 1 and 100, preferably between 3 and 50; O and H are oxygen and hydrogen respectively. In addition to the compounds listed above, operative nonionic surfactants in the present invention are copolymers of ethylene oxide with other alkylene oxides, polyoxyalkylene glycol esters, fatty amide condensates, alkanolamides, etc. Some of these nonionic surfactants, such as some of the ester types, may hydrolyze in an acidic dyebath, yielding the free acid, which may behave as an anionic surfactant. Such materials are not recommended for use in the process of this invention as nonionic components of the surfactant mixture. Examples of nonionic surfactants suitable for use in this invention are:

Commercial Name	Chemical Description
Triton X-45	Octylphenol- $(CH_2-CH_2-O)_5-H$
Triton X-100	Octylphenol- $(CH_2-CH_2-O)_8-H$
Triton X-305	Octylphenol- $(CH_2-CH_2-O)_{30}-H$

Tergitol 15-S-9
Plurionics

Tridecyl-O-(CH₂-CH₂-O)₉-H
Ethylene oxide-propylene oxide block
copolymers

The ratio (A/N) of the weight of anionic surfactant (A) to that of the weight of the nonionic surfactant (N) has an effect on the contrast of shades obtainable with the two classes of fibers. This ratio of the weight of A to N depends upon the structure of both anionic and nonionic surfactants, the numerical value of said ratio varying between about 0.1 and 5. A ratio close to 1:1 is often satisfactory in the process of this invention. The total amount of anionic and nonionic surfactant required in the dyebath is between 0.5 and 10 percent owg (on the weight of the goods), preferably between 1 and 6 percent owg.

The dyes suitable for use in this invention fall into two categories. One category is the broad group of anionic dyes, which includes the so-called strong acid dyes, direct dyes, and the premetallized dyes. They dye only the above-described "three-component fibers." The other category is the disperse dyes which dye both the "three-component fibers" and "two-component fibers."

Some of the strong acid dyes useful in the present invention are typified by the following:

Acid Yellow 23 (C.I. No. 19140)
Acid Orange 7 (C.I. No. 15510)
Acid Red 73 (C.I. No. 27290)
Acid Blue 45 (C.I. No. 63010)
Acid Blue 78 (C.I. No. 62105)

Other useful anionic dyes are the acid metallized dyes, typified by:

Acid Yellow 54 (C.I. No. 19010)
Acid Orange 72 (C.I. No. 18740)
Acid Red 186 (C.I. No. 18810)
Acid Blue 158 (C.I. No. 14880)

Still other anionic dyes are the neutral metallized dyes typified by the following:

Acid Yellow 121 (C.I. No. 18690)
Acid Orange 60 (The half-chrome complex of 1-phenyl-3-methyl-4-(2-hydroxy-5-sulfamoyl phenylazo)-5-pyrazolone)
Acid Red 209
Acid Blue 168

Examples of some of the direct dyes, useful in the present invention are the following:

Direct Yellow 44 (C.I. No. 29000)

the basic teachings of said examples may be varied by one skilled in the art.

EXAMPLE 1

Three parts of a 1:1 copolymer (by weight) of 2-vinylpyridine and 2-methyl-5-vinylpyridine (prepared by suspension polymerization using azo-bis-isobutyronitrile as initiator, and having intrinsic viscosity 0.9, measured in pyridine at 30° C.) were blended in an extruder at 500° F. with 100 parts of isotactic polypropylene (melt index 5-6), and the resultant blend was chopped into pellets and dried. The pellets were then melt extruded at 530° F. into a 156-filament yarn using a conventional melt-spinning apparatus. The resultant yarn was drawn 4:1 at 275° F. and texturized to yield a final yarn of 22 denier/filament. The tenacity of the yarn was 3.1 grams/denier and its elongation at break was 35 percent. This yarn is referred to in the examples herein as the "two-component fiber."

Another yarn, made from a blend of three parts of the 1:1 copolymer of 2-vinylpyridine and 2-methyl-5-vinylpyridine, two parts of polyethylene glycol of 600,000 molecular weight and one hundred (100) parts of isotactic polypropylene was prepared by the same process as described above. This yarn is referred to in the examples herein as "three-component fiber."

Alternate rows of "two-" and "three-component fiber" yarns were tufted into a jute fabric carpet backing in a level pile design.

Six samples of the tufted carpet were then dyed with various combinations of anionic and disperse dyes using the following procedure:

The samples of tufted carpet were first prescoured with an aqueous solution containing 1 percent owg (on the weight of the goods) Triton X-100 (an octylphenol condensate with 9-10 moles of ethylene oxide) and 1 percent owg sodium carbonate for 20 minutes at 180° F., using a 30:1 bath to fiber ratio. The samples were then dyed for 45 minutes in an aqueous dyebath at 200° F. containing 3 percent owg acetic acid, 1 percent owg of a nonionic surfactant having the formula C₁₂H₂₅O(CH₂-CH₂-O)₇H and various combinations of anionic and disperse dyes as listed in table I. The bath to fabric ratio was 30:1. After dyeing, the samples were postscoured for 15 minutes at 160° F. with an aqueous solution of 0.5 percent owg Triton X-100. Dyed carpets having alternate rows of two different colors resulted as described in table I.

TABLE I

Sample	Anionic dye	Percent owg	Disperse dye	Percent owg	Color of the dyed fibers	
					2-component	3-component
1	Vialon Fast Copper R	0.5	Calcosyn Blue RP	0.5	Tan	Brown.
2	Carbolan Green 5GS	0.5	Latyl Orange 3R	0.1	Yellow	Green.
3	Carbolan Blue 2GS	1.0	Calcosperse Yellow 4RL	0.75	Blue	Brown.
4	Neolan Orange SLF	0.75	Foron Blue R	1.0	Blue	Brown.
5	Neonil Orange SFF	0.7	Calcosyn Blue RP	1.5	Blue	Brown.
6	Capracyl Orange R	1.0	Calcosyn Sapphire Blue R	1.0	Yellow	Green.
6	Anthraquinone Blue SKY	0.7	Polydye Yellow GSF	1.0		

1 C.I. No. 26090.

Direct Red 13 (C.I. No. 22155)

Direct Blue 67 (C.I. No. 27925)

Other categories of anionic dyes which are applicable to out invention are the reactive dyes, typified by Reactive Orange 1, and the mordant acid dyes, typified by Mordant Red 3 (C.I. No. 58005).

The following are examples of some of the disperse dyes which are useful in this invention:

Latyl Yellow 4RL (C.I. No. 26070)
Latyl Orange 3R (Color Index Disperse Orange 21)
Cibacete Brilliant Pink FG (Color Index Disperse Red 55)
Interchem Blue RLF 40 (C.I. No. 61115)

To illustrate the novel textile articles and their methods of preparation, the following examples are given. It should be understood that these examples are merely illustrative and are not to be regarded as limitations to the appended claims, since

EXAMPLE 2

Six samples of the tufted carpet used in example 1 were dyed using the same method and dyes as in example 1, except that 1 percent owg of an anionic surfactant having the formula C₁₂H₂₅O(CH₂-CH₂-O)₇-CH₂-COONa was added to the dyebath. The resultant colors obtained were brighter, and the contrast between the "two-component yarns" and "three-component yarns" in the carpet was more pronounced than were the corresponding results obtained using the nonionic surfactant alone, as was done in example 1.

EXAMPLE 3

Five samples of tufted carpet made according to the procedure described in example 1 were dyed by the procedure described in example 2, using mixtures of different types of

anionic and nonionic surfactants in the dyebath and only an anionic dye, as listed in table II. The resultant dyed carpet samples had rows of "three-component fiber" yarns which were deeply colored, whereas the rows of "two-component fiber" yarns showed little or no uptake of dye.

When these dyeings were repeated on other samples of tufted carpet using either the anionic surfactant or the nonionic surfactant alone (not both), the contrast in color between adjacent rows of "two-component yarns" and "three-component yarns" was not as pronounced as the color contrast obtained in said rows with the use of both the anionic and the nonionic surfactant. When only an anionic surfactant was used, a reduced contrast was observed, which was caused by increased pickup of anionic dye by the "two-component yarn." Reduced contrast was also observed with use of the nonionic surfactant alone, due to reduced dye uptake by the "three-component yarn" in comparison to the uptake with the mixed surfactant system.

TABLE II

Sample	Dye (3% owg)	Anionic surfactant	Amount (percent owg)	Nonionic surfactant	Amount (percent owg)
7	Anthraquinone Blue SKY	Aerosol OT ¹			
8	do.	Fatty alcohol phosphate ²	1	C ₁₂ H ₂₅ O—(CH ₂ —CH ₂ —O) ₆ H	6
9	do.	C ₁₂ H ₂₅ O—(CH ₂ —CH ₂ —O) ₇ —CH ₂ —COONa	1	C ₁₂ H ₂₅ O(CH ₂ —CH ₂ —O) ₆ H	3
10	Capracyl Orange R	Sodium dodecylsulfate	1	Pluronic L-122 ³	3
11	do.	C ₁₂ H ₂₅ O—(CH ₂ —CH ₂ —O) ₇ —CH ₂ —COONa	1	Triton X-305 ⁴	4
			2	Triton X-100 ⁵	2

¹ Dioctyl ester of sodium sulfosuccinic acid.

² Dioethanolamine salt of a 1:1 mixture of mono- and di-fatty alcohol phosphates (made from the fatty alcohols plus P₂O₅).

³ A poly(ethylene glycol)-poly(propylene glycol) block copolymer having a molecular weight of 4,900 and 20% (by weight) poly(ethylene glycol) content.

⁴ Octylphenol condensate with 30 moles of ethylene oxide.

⁵ Octylphenol condensate with 9-10 moles of ethylene oxide.

EXAMPLE 4

Three parts of poly(2-vinylpyridine) (prepared by suspension polymerization as described in example 1) were milled at 320° F. with two parts of the following hydrophilic compounds:

- monomethyl ether of poly(ethylene glycol) (PEG), 550 molecular weight (M.W.);
- octylphenol ether of PEG, 1,320 M.W.;
- polyoxyethylene sorbitan monostearate of 1,350 M.W.;
- ethylene oxide-propylene oxide alternating copolymer of 2,600 M.W. and 75 percent (by weight) ethylene oxide content;
- PEG 400 M.W.

Five parts of each of the milled samples were then milled at 360° F. into separate batches of isotactic polypropylene containing 100 parts each, and the five resultant blends were chopped into pellets and dried. The pellets were then melt extruded at 500° F. into 8-filament yarns, and drawn 4:1 at 275° F. to yield 15 denier/filament "three-component yarns."

A "two-component yarn," containing three parts of poly(2-vinylpyridine) and 100 parts of isotactic polypropylene was prepared similarly.

Skins of the two types of yarns were dyed as in example 1 in a single dyebath containing 1.5 percent owg Capracyl Orange R and 3 percent owg Interchem Blue RLF 40. The "two-component yarn" dyed to a medium blue and the "three-component yarn" dyed to a bluish-brown shade.

EXAMPLE 5

Samples of the "two-component yarns" and "three-component yarns" were prepared and dyed using the procedure described in example 4, with the exception that 1 percent owg of an anionic surfactant having the formula C₁₂H₂₅O—(CH₂—CH₂—O)₇—CH₂—COONa was added to the dyebath. The "two-component yarn" dyed to a medium blue and the "three-component yarn" dyed to a dark brown shade. The resultant colors obtained were brighter and the contrast between the "two-component yarn" and the "three-component yarn" was more pronounced than the corresponding

results obtained using the moniomic surfactant alone as was done in example 4.

It is understood that the textile articles described herein include not only fabrics but other types of filamentary assemblies such as yarns, felts, carpets and the like. In addition to the alpha-monoolefin polymer fibers described herein, optionally fibers made from other synthetic or natural polymers may be included in such assembly. Examples of such polymers are polyamide, polyester, polyacrylonitrile, cotton, wool and silk.

Having thus described our invention, what we claim and desire to protect by Letters Patent is:

1. A filamentary assembly suitable for dyeing to a multicolor pattern through exposure to a mixture of anionic and disperse dyes, said filamentary assembly containing a plurality of synthetic fibers, at least one of said fibers having been formed from a mixture comprising (A) an alpha-monoolefin polymer, and (B) between about 1 and 5 percent by weight on

weight of the fiber of a vinyl pyridine or vinyl quinoline dye receptor polymer, and at least one other fiber having been formed from a mixture comprising (A) less than 97 percent by weight of an alpha-monoolefin polymer, (B) between about 0.5 and 5 percent by weight of a vinyl pyridine or vinyl quinoline dye receptor polymer and (C) between about 0.5 and 5 percent by weight of a hydrophilic compound which is a homopolymer of ethylene oxide, or an alkyl ether or alkyl ester derivative thereof, or copolymer of ethylene oxide with an alkylene oxide other than ethylene oxide, said hydrophilic compound having a degree of polymerization not less than 4 and an ethylene oxide content not less than 60 percent by weight, and wherein the total amount of the (B) and (C) components in said fiber is greater than 3 percent by weight, with the result that said fiber containing (A) and (B) only in said filamentary assembly is dyeable with disperse dyes and said fiber containing (A), (B) and (C) in said filamentary assembly is dyeable with both the anionic and disperse dyes, thereby giving said assembly when dyed with anionic and disperse dyes in a single dye bath a variegated color effect.

2. A filamentary assembly as defined in claim 1 which is a yarn.

3. A filamentary assembly as defined in claim 1 which is a fabric.

4. A carpet which contains the filamentary assembly as defined in claim 1.

5. The filamentary assembly defined in claim 1 in which the alpha-monoolefin polymers in the two- and three-component fibers are selected from the group consisting of: polyethylene, polypropylene, poly(3-methyl-1-butene) or poly(4-methyl-1-pentene).

6. The filamentary assembly defined in claim 5 in which the pyridine-type polymer in the two-component fiber is selected from the group consisting of homopolymers of (a) vinylpyridines, (b) alkylvinylpyridines, (c) vinylquinolines, (d) alkylvinylquinolines, (e) copolymers of vinylpyridine monomers with alkylvinylpyridine monomers, (f) copolymers of vinylpyridine monomers with a monoethylenically unsaturated monomer; and the pyridine-type polymer in the three-component fiber is selected from the group consisting of

homopolymers of (a), (b), (c), (d) and copolymers of (e).

7. The filamentary assembly defined in claim 6 in which the derivatives of polyethylene glycol are selected from the group consisting of (a) polyethylene glycol alkyl ethers (b) alkylaryl polyethoxy alcohols, (c) polyethylene glycol hexitol carboxylates and (d) polyethylene glycol carboxylates.

8. The filamentary assembly defined in claim 7 which also contains an uncolored nondye receptor containing alpha-monoolefin fiber which is not susceptible to dyeing by said anionic and disperse dyes.

9. The filamentary assembly defined in claim 7 which also contains a pigmented alpha-monoolefin fiber which is not susceptible to dyeing by said anionic and disperse dyes.

10. The filamentary assembly defined in claim 7 in which the pyridine-type dye receptor polymers are selected from the group consisting of

- a. poly(2-vinylpyridine)
- b. poly(2-methyl-5-vinylpyridine)
- c. poly(4-vinylpyridine)
- d. poly(2-vinylquinoline)
- e. the copolymer of 2-vinylpyridine and 2-methyl-5-vinylpyridine
- f. the copolymer of 2-vinylpyridine and styrene in the case of the two-component fibers
- g. the copolymer of 2-methyl-5-vinylpyridine and styrene in the case of two-component fibers

11. The filamentary assembly defined in claim 10 in which the homopolymer of ethylene glycol has a molecular weight between 100,000 and 7,000,000.

12. The filamentary assembly defined in claim 1 in which

- a. the alpha-monoolefin polymer is polypropylene,
- b. the pyridine-type dye receptor polymer is the copolymer of 2-methyl-5-vinylpyridine and 2-vinylpyridine, and
- c. the polyethylene glycol homopolymer has a molecular weight between 100,000 and 7,000,000.

13. The filamentary assembly defined in claim 1 in which

- a. the alpha-monoolefin polymer is polypropylene,
- b. the pyridine-type dye receptor polymer in the two-component fiber is a copolymer of styrene and 2-vinylpyridine, and the pyridine-type dye receptor polymer in the three-component fiber is a copolymer of 2-methyl-5-vinylpyridine and 2-vinylpyridine, and
- c. the polyethylene glycol homopolymer has molecular weight between about 100,000 and 7,000,000.

14. The filamentary assembly defined in claim 1 which has

been contacted with a mixture of anionic and nonionic surfactants under acidic conditions in the mixture of anionic and disperse dyes, to enhance the uptake of anionic dyes by the three-component fiber thus increasing the color contrast between said dyed two-component and three-component fibers thus dyed.

15. The filamentary assembly defined in claim 14 in which the weight ratio of anionic surfactant to nonionic surfactant in the dyebath is between about 0.1 and 5.

16. The filamentary assembly defined in claim 14 in which the total amount of anionic and nonionic surfactants in the dyebath is between about 0.5 and 10 percent on the weight of the goods (owg).

17. The filamentary assembly defined in claim 14 in which the anionic surfactant has the general formula R-A wherein R represents a substituted or unsubstituted alkyl, aryl, or alkylaryl group having at least six carbon atoms and A represents an anionic group selected from (a) sulfonate, (b) sulfate, (c) phosphate, (d) polyphosphate or (e) carboxylate, said group being in free acid or salt form.

18. The filamentary assembly defined in claim 17 in which the nonionic surfactant has the general formula R-O-X-H wherein

- R represents a substituted or unsubstituted alkyl, aryl, or alkylaryl group having six or more carbon atoms,
O represents oxygen,
X represents homopolymers of ethylene oxide, or propylene oxide or copolymers of said oxides with each other, all of said polymers having a degree of polymerization of alkylene oxide units between 1 and 100.
H represents hydrogen.

19. The filamentary assembly defined in claim 17 in which the nonionic surfactant is a copolymer of ethylene oxide and propylene oxide.

20. A process for dyeing the filamentary assembly defined in claim 1 to a multicolor pattern of high-color contrast comprising exposing said filamentary assembly to a mixture of anionic and nonionic surfactants under acidic conditions in the presence of a mixture of anionic and disperse dyes.

21. A process for dyeing as defined in claim 20 in which the filamentary assembly is a yarn.

22. A process for dyeing as defined in claim 20 in which the filamentary assembly is a fabric.

23. A process for dyeing as defined in claim 20 in which the filamentary assembly is contained in a carpet.

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