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PROCESS FOR DYEING FABRIC HAVING POLYPROPYLENE BACKING AND POLYAMIDE PILE YARNS

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3 Claims

ABSTRACT OF THE DISCLOSURE

A process for dyeing a fabric having a polypropylene backing and polyamide pile yarns comprising subjecting the fabric to an aqueous dyebath containing dye normally used with polyamide yarn and at least one member of the group consisting of

1,4-bis(1,3-dimethylbutylamino)anthraquinone,
1-amino-2-(2,4-di-sec-butylphenoxy)-4-hydroxyanthraquinone,
1-phenylazo-4-(2-hydroxy-5-t-butylphenylazo)-benzene,
1,4-bis(sec-butylamino)anthraquinone,
1,4-bis(n-amylamino)anthraquinone,
1,4-bis(isobutylamino)anthraquinone,
1-amino-2-(2-methyl-4-t-butylphenoxy)-4-hydroxyanthraquinone,
1-phenylazo-4-(2-hydroxy-3-methyl-5-t-butylphenylazo)benzene,
1-phenylazo-4-(2-hydroxy-5-nonylphenylazo)benzene,
1-amino-2-(2,4-di-sec-amylphenoxy)-4-hydroxyanthraquinone,
1-amino-2-(2,4-di-t-butylphenoxy)-4-hydroxyanthraquinone, and
1-amino-2-(2,4-di-t-amylphenoxy)-4-hydroxyanthraquinone.

Description of the invention

This invention relates to a process for dyeing a fabric comprising polypropylene backing and non-olefinic tufting fibers in an aqueous dyebath using specific polypropylene dyes combined with dyes normally used with the tufting fibers.

For many uses it is important that the backing of a tufted fabric be dyed a color approximating that of the tufting yarn. This is especially true with tufted carpets in which the tuft frequency is low since an undesirable show through of the contrasting backing can occur, especially if the carpet is bent as around a stairstep.

Most carpet backings are woven jute fabrics which are light brown in color and present the problem of backing show through only when tufting yarns having a color contrasting that of the backing are used. When dyeing of the jute backing is required, it is necessary to carry out the dyeing of the tufting yarn in a separate step, after which the dyebath must be drained, the tufted fabric rinsed and a new dyebath for the backing added.

Light colored backings comprised of synthetic fibers are especially prone to show through and for most uses a dyed backing is required. The problem is aggravated if a relatively non-dyeable synthetic fiber such as polypropylene is used. Use of polypropylene fibers containing dyeability improving additives does not offer an entirely satisfactory solution to this problem since these additives often cause shifts in the face yarn color and consequent shade differences between the backing and pile fibers.

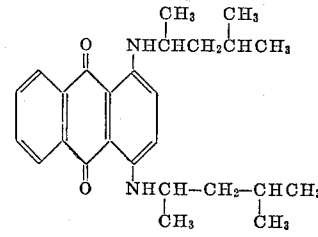
Dyeing of polypropylene fibers containing no additives for improving dyeability requires relatively non-polar dyes which usually have poor fastness properties. As noted in "The Dyeing of Polypropylene for Textiles," American

Dyestuff Reporter, p. 35, Feb. 15, 1965, ". . . no existing class or classes of dyestuffs could provide an adequate range of shades with acceptable fastness properties," most polypropylene dyes are inadequate in fastness. If a tufting yarn other than polypropylene is used, for example nylon, dyeing with polypropylene dyes alone gives undesirable shades on the tufting fibers. Use of a more polar dye suitable for dyeing the pile yarn results in little or no coloration of the polypropylene backing.

It has now been found that combinations of certain "backing" dyes with conventional pile yarn dyes, can be applied from a single aqueous dyebath system to a tufted fabric having a polypropylene backing and non-olefinic pile yarns with substantial elimination of backing show through and other unexpected advantages referred to below. It appears that such "backing" dyes show greater affinity for the polypropylene backing than the tufting yarn, have good leveling properties, dye at approximately the same rate as the tufting yarn dyes, cause no off-shade staining of the tufing yarns, are compatible with most dyeing systems and do not adversely affect the fastness of the dyed tufing yarn.

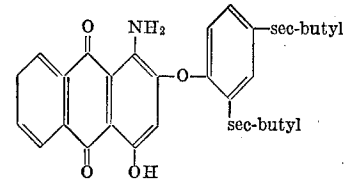
The preferred "backing" dyes of the combination of dyes to be employed in the union dyeing of a polypropylene backed, polyamide pile fabric in accordance with this invention are

1,4-bis(1,3-dimethylbutylamino)anthraquinone



(dye A–1)

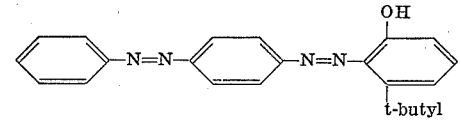
1-amino-2-(2,4-di-sec-butylphenoxy)-4-hydroxyanthraquinone



(dye B–2)

and

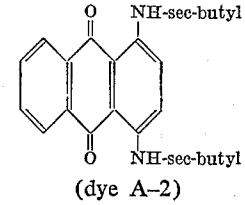
1-phenylazo-4-(2-hydroxy-5-t-butylphenylazo)-benzene



(dye C–1)

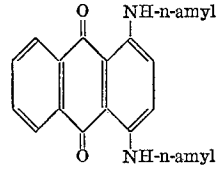
Other "backing" dyes useful in the process of this invention are

1,4-bis(sec-butylamino)anthraquinone



(dye A–2)

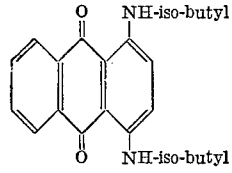
1,4-bis(n-amylamino)anthraquinone



(dye A–3)

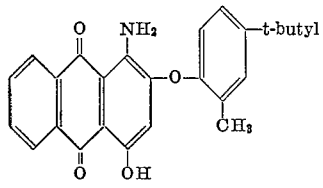
and

1,4-bis(isobutylamino)anthraquinone



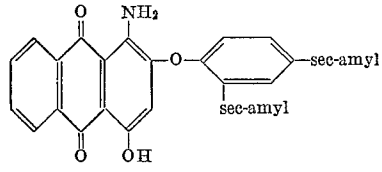
(dye A–4)

1-amino-2-(2-methyl-4-t-butylphenoxy)-4-hydroxy-anthraquinone



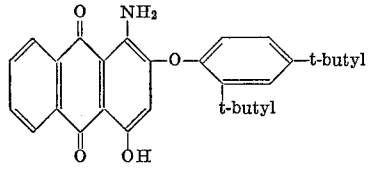
(dye B–1)

1-amino-2-(2,4-di-sec-amylphenoxy)-4-hydroxyanthraquinone



(dye B–3)

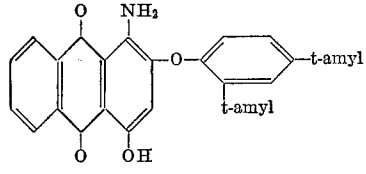
1-amino-2-(2,4-di-t-butylphenoxy)-4-hydroxy-anthraquinone



(dye B–4)

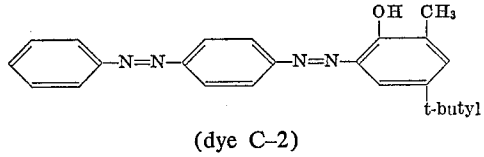
and

1-amino-2-(2,4-di-t-amylphenoxy)-4-hydroxy-anthraquinone



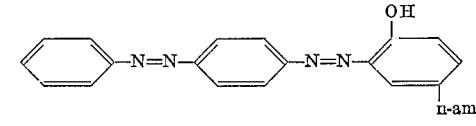
(dye B–5)

1-phenylazo-4-(2-hydroxy-3-methyl-5-t-butylphenylazo) benzene



(dye C–2)

1-phenylazo-4-(2-hydroxy-5-nonylphenylazo)benzene



(dye-C–3)

Many other dyes similar in structure to the above dyes such as

1,4-bis(methylamino)anthraquinone,
1,4-bis(isopropylamino)anthraquinone,
1-amino-2-(4-t-butylphenoxy)-4-hydroxyanthraquinone,
1-amino-2-(4-sec-butylphenoxy)-4-hydroxyanthraquinone,
1-amino-2-(4[1,1-dimethylpropyl]phenoxy)-4-hydroxy-anthraquinone,
1-amino-2-(4-phenoxyphenoxy)-4-hydroxy-anthraquinone,
1-phenylazo-4-(4-hydroxyphenylazo)benzene,
1-phenylazo-4-(3,5-dimethyl-4-hydroxyphenylazo) benzene,
1-o-tolylazo-3-methyl-4-(4-hydroryphenylazo)benzene,
1-(4-dodecylphenylazo)-3-methyl-4-(2-hydroxy-α-naphthylazo)benzene and
bis-(3-methyl-4-[2-hydroxy-5-cyclohexylphenylazo] phenyl)cyclohexylmethane

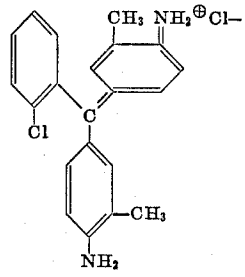
are not useful in the process of this invention because they do not meet one or more of the requirements set out hereinbefore.

In its broadest aspects, this invention provides a process for union dyeing in aqueous dye baths a textile composed of polypropylene fiber and non-olefinic fiber, however the most dramatic results are seen in pile fabrics having a polypropylene backing and a polyamide pile. These results are obtained using a combination of polypropylene dyes which may dye both fibers but preferentially polypropylene and other dyes which preferentially dye the other fiber; such dyes dyeing at approximately the same rate and not interfering one with the other with respect to transfer, shade, or fastness on the respective fibers. Preferably, the dyebath also contains a dispersing agent taken from the group consisting of a condensation product obtained by reacting a major portion of ethylene oxide with a minor portion of fatty alcohol, a low molecular weight poly(ethylene oxide) coupled with an anionic surface active agent, a sodium hydrocarbon sulfonate, sodium C_{10}–C_{18} fatty alcohol sulfate and the disodium salt of dodecylated oxydibenzenesulfonic acid, a pH controlling agent taken from the group consisting of acetic acid, hydrochloric acid, sulfuric acid, acetic acid—sodium acetate and sodium phosphate buffers, and optionally a dyeing assistant taken from the group consisting of the sodium salts of ethylenediaminetetraacetic acid, poly (dimethylsiloxane), sodium chloride, sodium sulfate and ammonium sulfate. It is further preferred that the aqueous dyebath is approximately 10–100 times the weight of the tufted fabric being dyed and that the maximum temperature of the dyebath is between 200° F. and the boiling point of the dyebath. One or more "backing" dyes combined with one or more pile yarn dyes may be used to provide a new color resulting from the blending of the various dyes. The dyeings may be advantageously carried out in a single aqueous dyebath.

If a polyamide (nylon) tufted, polypropylene backed pile fabric is to be dyed, the "backing" dyes described above when used with dispersed dyes such as C.I. Disperse Yellow 3 colour index number 11855, C.I. Disperse Orange 26, C.I. Disperse Red 55, Disperse Red 17, Disperse Blue 7 or a blue dye obtained by combining a major amount of 1,4-bis(hydroxyethylamino)-5,8-dihydroxyanthraquinone with a minor amount of 1,4-diamino-2,3-dichloroanthraquinone (hereinafter referred to as dye D–1), or with acid dyes such as C. I. Acid Yellow 135, C.I.

Acid Blue 25 color index number 62055, C.I. Acid Blue 40 color index number 62125, C.I. Acid Red 266 and Acid Red 151 give satisfactory results.

If a pile fabric comprising polypropylene backing tufted with a basic dyeable acrylic tufing yarn is to be dyed, satisfactory results are obtained by using a combination of dyes of tye A, B, and C and basic dyes such as C.I. Basic Yellow 11 color index number 48055 or a dye obtained by combining approximately equal amounts of Basic Blue 4 color index number 51004 and the chloride salt form of the carbinol described in Example I Part A of U.S. Patent 3,032,561 which has the following structure:



prepared as disclosed in German Patent 487,558 (hereinafter referred to as dye D–2).

If a pile fabric comprising polypropylene backing tufted with cotton is to be dyed; satisfactory results are obtained by using combinations of dyes of type A, B, and C and direct dyes normally used to dye cotton such as Direct Blue 218, Direct Yellow 44, Direct Red 37 and Direct Red 31. Similarly, when pile fabrics comprising polypropylene backing tufted with other yarns are to be dyed, satisfactory dyeings are obtained by using dyes of type A, B, and C in combination with dyes normally used with the particular tufting yarn.

The polypropylene used in the backing usually will contain minor amounts of various stabilizers to guard against oxidative, thermal and ultraviolet light degradation and may also contain additives to improve dyeability as long as these dyeability improving additives do not cause shade changes in the polypropylene dyes or interfere with the shade or application of the pile yarn dye.

The following examples will serve to illustrate the scope of the invention but are not intended to be limitative in any way.

Example I

This example demonstrates that the three polypropylene dyes A–1, B–1, and C–1 dye a polypropylene fiber backing preferentially to a nylon tufting yarn.

A four ounce per square yard bonded nonwoven polypropylene backing is tufted with nylon carpet yarn to give a 24 ounce per square yard carpet. Samples of this tufted carpet are dyed in separate dye baths with each of the three polypropylene dyes A–1, B–1, and C–1 as follows:

0.025% of each dye (A–1, B–1, and C–1) based on total carpet weight is added separately to solutions containing 0.015% of a condensation product formed from 20 mols of ethylene oxide and 1 mol of C_{18} alcohol and 0.010% of a mixture of sodium C_{10}–C_{18} fatty alcohol sulfates. The total weight of each bath to the sample carpet weight is 50:1. With agitaiton, the temperature of each bath is raised slowly (3° F./min.) to 208° F. and kept at this temperature for one hour. The samples are then removed from each bath and rinsed in running water. They are dried at 250° F. for 20 min. Portions of each carpet are detufted and the reflectances of light from the pile fibers and the detufted backing fibers are measured with a "Color Eye." Alternatively the dyes are extracted with pyridine-water azeotrope (57% pyridine) and the amount of dye determined colorimetrically. The following proportions of color reflectances and concentrations between backing and pile fiber are obtained.

Dye	Reflectance backing/pile	Colorimeter backing/pile
A–1	700/100	1,100/100
B–1	120/100	159/100
C–1	180/100	232/100

Example II

Following the procedure of Example I, a pile fabric comprising bonded nonwoven polypropylene backing and nylon tufting yarn is dyed using dye B–2. Using the procedure outlined in Example I, the following partition of dye between backing and pile fibers is obtained:

Backing/pile ratio	
Dye	B–2
By reflectance	435/100
By colorimeter	470/100

Example III

This example demonstrates a compound dyeing of 20 ounce/yd.² nylon tufted, nonwoven, polypropylene fiber backed carpet using dispersed dyes alone (Sample D) to give a beige carpet with uncolored backing and a similar compound dyeing with the polypropylene dyes A–1, B–1, and C–1 as well as the dispersed dyes (Sample E) to give a beige carpet with a beige backing.

Sample	Percent dye used	Dye
D	0.093	Disperse Yellow 3.
	0.14	Disperse Red 55.
	0.04	D–1.
E	0.077	Disperse Yellow 3.
	0.111	Disperse Red 55.
	0.034	D–1.
	0.012	A–1.
	0.029	B–1.
	0.0158	C–1.

The dyes for Samples D and E are mixed in separate pots at a bath to carpet ratio of 50:1, in solutions containing 0.015% of a condensation product formed from 20 mols of ethylene oxide and 1 mol of C_{18} alcohol and 0.010% sodium C_{10}–C_{18} fatty alcohol sulfate. The dyeing temperatures are as in Example I. Beige carpets of similar hue and depth of shade are obtained from the two dyes. However, whereas Sample D has no color on the backing, Sample E has a beige colored backing closely matching the color of the pile fibers.

Similar dyeings with the three disperse dyes and the three polypropylene dyes A–1, B–1, and C–1 are carried out with concentrations of dye different from those used for Sample D and Sample E to give different colored carpets. For each carpet there is a control with no polypropylene dye, and a test carpet with the polypropylene dyes.

Both control and test carpets are subjected to three tests to measure fading of the color on the pile fiber-ultraviolet light fading, ozone fading, and nitrogen dioxide fading. Ultraviolet light exposure is carried out for 80 standard fadeometer hours using an Atlas Xenotester, Model 60 WR. Ozone fading and nitrogen dioxide fading are determined by exposure to one standard fading cycle. The Samples are rated on a numerical scale from 1 to 5 with the number 5 indicating no fading, number 4 slight fading, and number three a greater degree of fading, and so on. Differences of ½ unit on this scale are not readily discernable and are considered acceptable in the trade.

Color	Sample	UV exposed 80 SFH	O_3 exposed one stand. cycle	NO_2 exposed one stand. cycle
Dark green	F control	5-4	3	4-3
	F test	4	3	4-3
Dark blue	G control	4-3	3	4-3
	G test	4-3	3	3
Brown	H control	4	3	3-2
	H test	4	3	3
Rust	I control	4	3	4-3
	I test	4	3	4-3
Gold	J control	4	3	3
	J test	4	4-3	4-3
Beige	D control	3	3-2	3-2
	E test	4-3	3-2	3
Light green	K control	4-3	3	4-3
	K test	3	3-2	3

These results indicate that the use of dyes A–1, B–1 and C–1 in the test carpets does not reduce the stability of the pile fiber colors upon exposure to light, ozone, or nitrogen dioxide.

Example IV

Following the procedure of Example III, a chocolate brown carpet with uncolored backing (L-control) is obtained using dispersed dyes alone and a chocolate brown carpet with a chocolate brown backing (L-test) is obtained by using dyes A–1, B–2 and C–1 in combination with the dispersed dyes. The following amounts of dye were used:

Sample	Percent dye used	Dye
L-control	0.73	Disperse Yellow 3.
	0.94	Disperse Red 55.
	0.22	Disperse Blue 7.
L-test	0.71	Disperse Yellow 3.
	0.82	Disperse Red 55.
	0.20	Disperse Blue 7.
	0.43	A-1.
	0.275	B-2.
	0.87	C-1.

Both L-Control and L-Test pile yarns had similar hue and depth of shade. Both backing and pile yarn of L-Test had similar hue and depth of shade. Both L-Control and L-Test carpets were subjected to the same three fading tests used in Example III.

Color	Sample	UV exposed 80 SFH	O^3 exposed 1 std. cycle	NO^2 exposed 1 std. cycle
Chocolate-brown.	L-Control	4-3	2-1	3-2
	L-Test	4	4	5-4

The results show that the use of dye B–2 does not reduce the stability of pile yarn colors upon exposure to light, ozone or nitrogen dioxide.

Example V

This example demonstrates the similarity of dye rates of dyes A–1, B–1, and C–1 when used with dispersed dyes on a nylon tufted polypropylene backed carpet.

A 4 ounce per square yard bonded, nonwoven polypropylene backing, tufted with nylon to 25 ounces per square yard is dyed in a 4 ft. wide dye beck, with a dye bath containing the following percentages of dye based on total carpet weight.

	Percent
Disperse Yellow 3	0.093
Disperse Red 55	0.08
D–1	0.04
A–1	0.0024
B–1	0.028
C–1	0.0211

One part of carpet is treated with 50 parts of a bath containing 0.015% of a condensation product formed from 20 mols of ethylene oxide and 1 mol of C_{18} alcohol, and 0.010% of sodium C_{10}—C_{18} fatty alcohol sulfate at a pH of 6.5. Dispersions of the above dyes are added cold and agitated 15 minutes at 100° F. The temperature is raised at 3° F. per minute to 208° F., and dyeing is allowed to proceed for 2.5 hours. Rinse water is added until the rinse is clear of dye and the carpet is dried at 250° F. in a pin frame at 2 yards per minute. The pile and backing dye with good uniformity at approximately the same rate.

Example VI

This example demonstrates the good leveling properties of dyes A–1, B–1, and C–1 when used in combination with dispersed dyes on a nylon tufted, polypropylene backed carpet.

Following the procedure of Example V, if, after two hours at 208° F., a large flap of undyed nylon tufted, nonwoven polypropylene backing, is sewn onto the above carpet and the dyeing is continued for ½ hour, dye transfer occurs so that all pile and all backing fibers are essentially equivalent in shade and depth of hue.

Example VII

Example I is repeated with a carpet consisting of nylon tufted into a backing of woven polypropylene ribbon and the same results are obtained as with a carpet consisting of nylon tufted into bonded, nonwoven polypropylene fiber backing.

Example VIII

This example demonstrates the use of the dyes A–1, B–1, and C–1 with a combination of acid and dispersed dyes to dye a nylon tufted, nonwoven polypropylene backed carpet.

Nylon tufted, nonwoven polypropylene backed carpet is dyed with varying amounts of the following dyes:

Acid Yellow 135
Disperse Orange 136
Acid Blue 25
Acid Blue 40
Acid Red 266

using the procedure of Example I except dyeing time is 90 minutes and the surface active agents in Example I are replaced with 0.25% tetrasodium ethylenediaminetetraacetate, 0.1% poly(dimethylsiloxane)anti-foaming agent, 2.0% of a fatty alcohol sulfonate, 0.5% of a low molecular weight polyethylene oxide coupled with an anionic surface active agent, 0.75% glacial acetic acid and 2.0% ammonium sulfate. The dyeings are uniform, the backing properly colored and no deleterious effects due to the polypropylene dyes are observed.

Example IX

A dyeing similar to that of Example VIII was carried out using the following amounts of dye:

Sample	Percent dye used	Dye
M	2.0	Acid Red 151.
	0.5	Dispersed Red 17.
	0.011	A-1.
	0.21	B-2.
	0.022	C-1.

The procedure of Example VIII is followed except the surface active agents are replaced with 1.0% of disulfonated alkylated diphenyl ether and 0.5% of a low molecular weight polyethylene oxide coupled with an anionic surface active agent. The dyeings are uniform, the backing properly colored and no deleterious effects due to dyes A–1, B–1, and C–1 are observed.

Example X

This example demonstrates the dyeing of a carpet consisting of a nonwoven polypropylene backing tufted with a basic dyeable acrylic yarn with a combination of basic dyes and dyes A–1, B–1, and C–1.

Basic dyeable acrylic yarn tufted, nonwoven, polypropylene backed carpet is dyed with combinations of basic yellow 11 and the basic dye D–2 as in Example I except the solution contains 0.03% of the condensation product of 20 mols of ethylene oxide and 1 mol of C_{18}

alcohol as the sole surface active agent at a pH of 4.5. Acceptable colors are obtained both on the backing and the pile yarn.

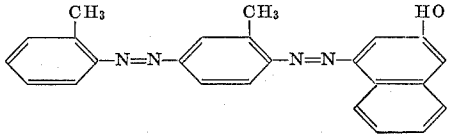
Example XI

This example demonstrates the use of dyes A–1, B–1, and C–1 in combination with cotton direct dyes to dye a cotton tufted, polypropylene backed carpet.

Cotton tufted, nonwoven polypropylene backed carpet is dyed with pairs of dyes from a group consisting of direct blue 218, direct yellow 44, direct red 37 and direct red 31 using the procedure of Example I except the surface active agents of Example I are replaced with 0.03% of the condensation product from 20 mols of ethylene oxide and 1 mol of C_{18} alcohol, 2% sodium chloride and enough acetic acid to adjust the pH to 4.0. Acceptable colors are obtained both on the backing and the pile yarn.

Example XII

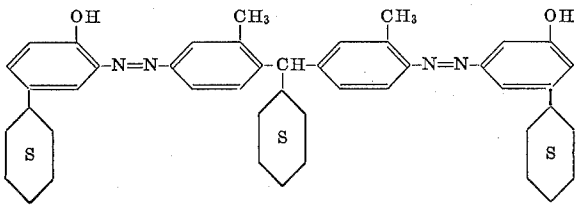
A nylon tufted, polypropylene backed carpet is dyed as in Example I except the single dye used is



This dye is unacceptable because it dyes nylon in preference to polypropylene.

Example XIII

A nylon tufted polypropylene backed carpet is dyed as in Example I except the single dye used is Sudan Yellow GRN (C.I. Solvent yellow 29, No. 21230)



This dye is unacceptable because its dyeing action is blocked in the presence of tufting yarn dyes.

What is claimed is:

1. In a process for dyeing a fabric having a polypropylene backing and polyamide pile yarns the improvement comprising subjecting the fabric to an aqueous dyebath containing dye normally used with polyamide yarn and at least one member of the group consisting of
1,4-bis(1,3-dimethylbutylamino)anthraquinone,
1-amino-2-(2,4-di-sec-butylphenoxy)-4-hydroxyanthraquinone,
1-phenylazo-4-(2-hydroxy-5-t-butylphenylazo)-benzene,
1,4-bis(sec-butylamino)anthraquinone,
1,4-bis(n-amylamino)anthraquinone,
1,4-bis(isobutylamino)anthraquinone,
1-amino-2-(2-methyl-4-t-butylphenoxy-4-hydroxyanthraquinone,
1-phenylazo-4-(2-hydroxy-3-methyl-5-t-butylphenylazo) benzene,
1-phenylazo-4-(2-hydroxy-5-nonylphenylazo)benzene,
1-amino-2-(2,4-disec-amylphenoxy)-4-hydroxyanthraquinone,
1-amino-2-(2,4-di-t-butylphenoxy)-4-hydroxy anthraquinone, and
1-amino-2-(2,4-di-t-amylphenoxy)-4-hydroxyanthraquinone.

2. The process of claim 1 wherein the dyebath is applied at a temperature between 200° F. and its boiling point and in an amount equal to between about 10 and 100 times the weight of the fabric.

3. The process of claim 1 wherein the dyebath contains, as the dye normally used with polyamide yarn, at least one member of the group consisting of Disperse Yellow 3, Disperse Red 55 and Disperse Blue 7.

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