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2,952,506

PROCESS FOR EVEN AND LEVEL DYEING OF FILAMENT NYLON FABRICS

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20 Claims. (Cl. 8-55)

This invention relates to the even dyeing of textile fabrics, and more particularly to the even and level dyeing of fabrics composed of filaments of a polycarbonamide, more familiarly known as nylon.

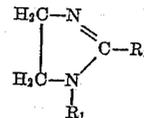
In the past the commercial practice of dyeing the synthetic linear polycarbonamides more familiarly known as nylon has been carried out by means of the dispersed or acetate dyestuffs. These dispersed dyestuffs have great covering power for nylon yarns and are not highly sensitive to the normal variations found in such yarns. However, the dispersed or acetate colors lack fastness to light and to washing. In contrast, the anionic dyestuffs best exemplified by the classes of acid and direct dyes have extremely good fastness to both light and washing on nylon. It has not been commercially feasible to utilize the anionic dyestuffs in the majority of nylon filament dyeings, however, since those dyestuffs are extremely sensitive to variations between different fibers and different parts of the same fibers. Nylon yarns which have been spun at different times or from different lots of polymer demonstrate these variations most clearly. Frequently yarns spun at different times are dyed to different shades with the anionic dyestuffs when dyed by standard dyeing procedures. As a result the nylon fabrics dyed with anionic dyes are often colored in an uneven fashion, showing streaks and shade depth variations in knitted goods, and barré effects, warp streaks and the like in woven goods. The inability to secure even dyeing of nylon yarns and fabrics is believed to be due to slight variations in the chemical compositions of the parent polymers, to variations in orientation due to slight differences in the drawing to which the yarns are subjected either in spinning and processing of the yarn, or in the mechanical action of the textile machinery used in the knitting or weaving of the fabrics, and perhaps to other causes as well. This inability to evenly dye nylon yarns and fabrics with the anionic dyestuffs has curtailed the large scale use of such dyestuffs for dyeing the nylon materials on which they exhibit excellent light and wash fastness properties.

The primary object of the present invention is to provide a new and improved process for dyeing polycarbonamide textile articles. A further object is to provide a process for dyeing nylon yarns evenly and levelly by means of anionic dyestuffs without the resulting streaks and shade depth variation that have previously characterized the use of the anionic dyestuffs for the dyeing of nylon fabrics. Other objects will appear from the description hereinafter.

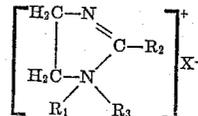
In general the objects of this invention are accomplished by the process of dyeing polycarbonamide textile articles which comprises dyeing the articles in an aqueous dyebath containing an anionic dyestuff selected from the group consisting of direct dyes, acid dyes, acid metallized dyes, and mordant acid dyes and a substituted imidazoline

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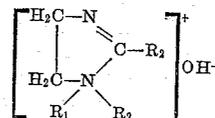
compound selected from the group consisting of (1) a salt of an imidazoline having the general formula



wherein R₁ is selected from the group consisting of alkyl, phenyl, hydroxyalkyl, and carboxyalkyl radicals and R₂ is an open aliphatic chain consisting of from ten to 18 carbon atoms, such as 1-butyl-2-hexadecyl-imidazoline, 1-benzyl-2-hexadecyl - imidazoline, 1-(2-hydroxyethyl)-2-heptadecyl-imidazoline, 1-(2-hydroxyethyl) - 2 - heptadecenyl-imidazoline, and 1-(2-hydroxyethyl)-2-undecyl-imidazoline, (2) a quaternary imidazolium compound having the general formula



wherein R₁ and R₃ are selected from the group consisting of alkyl, phenyl, hydroxyalkyl and carboxyalkyl radicals, R₂ is an open aliphatic chain consisting of from ten to 18 carbon atoms and X is a halogen, such as 1,1-di-(2-hydroxyethyl)-2-heptadecyl - imidazolium chloride, 1,1-di-(2-hydroxyethyl) - 2 - heptadecenyl-imidazolium chloride, 2-tridecyl-1-hydroxyethyl-1-benzyl-imidazolium chloride and 1,1-dibutyl-2-hexadecyl-imidazolium chloride, and (3) a quaternary imidazolium compound having the general formula



wherein R₁ and R₂ are selected from the group consisting of hydroxyalkyl, alkali metal-substituted hydroxyalkyl, and alkali metal-substituted carboxyalkyl radicals and R₂ is an open aliphatic chain consisting of from ten to 18 carbon atoms, such as 1,1-di-(2-hydroxyethyl)-2-heptadecyl - imidazolium hydroxide and the disodium salt of 2-undecyl-1-(2-hydroxyethyl)-1-(carboxymethyl) - imidazolium hydroxide. It has now been found that quite even and level dyeings of nylon yarns and fabrics can be achieved by means of the anionic dyestuffs claimed above if the dyeing is carried out in an acidic dyebath containing a substituted imidazoline compound of one of the above-described types.

The amount of the substituted imidazoline compounds which can be used in the process of the present invention can vary between one and ten times the weight of the dyestuffs employed. Many of the anionic dyestuffs suitable for use in the process may be used to dye nylon fabrics evenly and levelly when employing as little as one to two times the weight of the dyestuff of the substituted imidazoline compounds. However, with others of the anionic dyestuffs, although these amounts of the substituted imidazoline compounds give even dyeings from fiber to fiber they may result in uneven dyeings, i.e. unequal penetration as between the fibers. With these dyestuffs both even and level dyeings of nylon fabrics may be achieved by increasing the ratio of the substituted imidazoline compounds to the dyestuff employed to a value of from about 6 to 10 times the weight of the dyestuff. Normally a ratio of approximately 4 to 6 times the weight of the dyestuff for the amount of the substituted imidazoline compounds is preferred.

The synthetic linear polycarbonamides, more familiarly known as nylons, to which the process of this invention is applicable are of the general type described in U.S. Patents 2,071,250; 2,071,253 and 2,130,948. The contemplated polycarbonamides comprise the reaction products of linear polymer-forming compositions containing amide-forming groups, for example reaction materials consisting of bifunctional molecules containing two reactive groups which are complementary to reactive groups in other molecules and which include the complementary amide-forming groups. These polycarbonamides are of two distinct types. Those synthetic linear polycarbonamides which comprise the self-polymerization products of mono-amino monocarboxylic acids containing at least five carbon atoms in the chain separating the amino and carboxyl groups and those synthetic linear polycarbonamides derived from the reaction of suitable diamines with suitable dicarboxylic acids in substantially equimolar amounts. It is to be understood that reference herein to the amino acids, diamines, and dicarboxylic acids is intended to include the equivalent amide-forming derivatives of those reactants. Upon hydrolysis the amino acid polycarbonamides yield the amino acid hydrochloride, and the diamine-dicarboxylic acid polycarbonamides yield the dicarboxylic acid and the diamine hydrochloride. Further, the average number of carbon atoms separating the amide groups in the polycarbonamides is at least two.

These polycarbonamides contain recurring amide groups:



wherein R is a member of the group of hydrogen and monovalent hydrocarbon radicals, as a part of main chain of atoms of the polymer. Particularly useful polycarbonamides in the present invention are the simple unsubstituted polycarbonamides, such as those formed by the reaction of tetramethylene diamine with adipic acid, tetramethylene diamine with suberic acid, tetramethylene diamine with sebacic acid, hexamethylene diamine with adipic acid, hexamethylene diamine with suberic acid, hexamethylene diamine with sebacic acid, or the polymerization product of epsilon-caprolactam. In addition, polymers formed from the reaction of two or more diamines with dicarboxylic acids and/or two or more dicarboxylic acids with diamines are contemplated in the practice of the instant invention.

Most types of anionic dyestuffs function with the process of this invention. The two most common classes of anionic dyestuffs and two which give excellent light and wash fastness when used on nylons are the acid and direct dyes, but other classes of anionic dyestuffs may be employed in this process as well, such as acid metallized and mordant acid or chrome dyes. Thus, at least four of the recognized classes of anionic dyes, the direct dyes, the acid dyes, the acid metallized dyes and the mordant acid or chrome dyes can be successfully applied to nylons by the process of this invention. Examples of certain of the direct dyestuffs which have been successfully employed to dye nylon fabrics levelly and uniformly by the process of this invention include Paper Yellow 3GXA (CI 364), Chrysophenine (CI 365), Chlorantine Fast Yellow 5GLL (CI 346), Calcodur Orange GL (CL 653), Calcodur Red 8BL (CL 278), Triazol Fast Scarlet B (CI 382), Congo Red (CI 370), Diamine Fast Red FA-CF (CI 419), and Diphenyl Violet BV Supra (CI 394). Examples of acid dyestuffs which may be employed include Pontacyl Dark Green (CI 247), Amacid Red 3B (CI 280), Benzyl Red G (CI 275), Brilliant Croceine Scarlet MOO (CI 252), Anthraquinone Violet 3RA (CI 1080) and Alizarin Fast Light Blue C (CI 1088). Examples of mordant acid or chrome dyestuffs which may be used include Omega Chrome Orange G (CI 274), Eriochrome Blue Black R (CI 202), Calco-

chrome Black T (CI 203), Chrome Yellow A (CI 219), and Calcochrome Alizarine Gray 2BLS (Pr. 206). Examples of acid metallized dyestuffs which may be employed include Neolan Blue 2G (Pr. 144), Neolan Navy Blue RLG (Pr. 561), and Chromacyl Black W (Pr. 143). Not all dyestuffs of each class of anionic dyes enumerated will dye nylon yarns or fabrics equally as well, as is well known. However, the best dyes from among each class can easily be selected, and a large number of the dyestuffs in each named class can be effectively utilized to dye nylon materials evenly and levelly by the process of this invention.

The conditions of dyeing employed in the process of the present invention are substantially those of the normal dyeing procedure with the particular classes of anionic dyes employed. That is, with all of the named classes of anionic dyestuffs dyeing is usually carried out at a temperature of from about 200 to about 210° F. and at a pH of from about 2 to about 5.5. The preferred pH with the acid and direct dyestuffs is from about 3 to about 5. The amount of dyestuff employed and the volume of dyebath are the same as those commonly used in the acid and direct dyeing of woolen, cellulosic and other type fibers. The length of time of the dyeing to result in even and level dyeings of nylon is generally from about 1 to about 4 hours.

The mechanics of carrying out the dyeing are not critical and may be varied to suit the normal dyeing practice. That is, the fabric may be entered into the bath cold and the bath slowly raised to dyeing temperature after all the ingredients have been added, or the fabric may be added to the bath first and the dyestuff and substituted imidazoline compound added afterwards. The order of addition of components to the dyebath, is a matter of choice.

Although the process of the present invention does not require the use of other dispersing agents in addition to the dyestuff and the substituted imidazoline compounds referred to above, it is sometimes of advantage in obtaining greater levelling as well as evenness of dyeing to employ in the dyebath in addition to the named ingredients a non-ionic dispersing agent. Such non-ionic dispersing agents as those containing the condensation products of polyglycols with higher fatty acids, higher fatty alcohols, amides of higher fatty acids, or long chain alkyl substituted phenols can be added to the dyebath of the present invention to assist in obtaining more level dyeings on certain nylon constructions. The non-ionic dispersing agents may be used in concentrations of from about 0.1% to about 4%. The use of the non-ionic dispersing agents not only improves the levelness of penetration of the dyes from fiber to fiber but also insures that those fibers on the interior of the skein are evenly dyed with those on the exterior. Consequently, when dyeing certain closely woven fabrics such as taffetas it is preferred to include a non-ionic dispersing agent of the above-described type in the dyebath.

It has also been found that the substituted imidazoline compounds are effective to convert an unevenly dyed nylon fabric to an evenly dyed one by subjecting the dyed fabric to an aqueous treatment therewith. Thus, an unevenly dyed taffeta or chiffon fabric displaying streaks and shade variations throughout the piece can be rendered even and level by treating for several hours in a bath containing one of the substituted imidazoline compounds for example, 1,1 - di - (2-hydroxyethyl)-2-heptadecenyl - imidazolium chloride, in the same general amounts that are used to evenly dye such fabrics by the process of this invention. The bath may be maintained at an acidic pH at or near the boil until the dyeing has become even and level. If such procedure is not sufficient to produce an even and level dyeing of very badly streaked fabrics, it is also possible to treat the fabric in an alkaline bath containing one of the substituted imidazoline compounds and after the dyestuff originally pres-

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ent on the fabric has been substantially removed into solution, then adjusting the pH of the bath to an acidic pH and thereby effecting a redyeing of the fabric with the same dyestuff, but in a completely even and level manner. Although it is not required that such treating baths contain a non-ionic dispersing agent, the presence of such an agent, for example the condensation product of one mole of stearyl alcohol with 20 moles of ethylene oxide is preferred, since less of the substituted imidazoline compound is required when a non-ionic dispersant is also present. By this means previously uneven dyeings can be converted to even dyeings on nylon fabrics and knitted goods.

The applications of the principles of this invention are more particularly illustrated in the examples below. Parts are by weight unless otherwise stated.

EXAMPLE I

A dyebath was prepared containing 0.25% Pontacyl Dark Green G (CI 247), 1.4% of 1,1-di-(2-hydroxyethyl)-2-heptadecenyl-imidazolium chloride, and 5% glacial acetic acid in 40 volumes of water, all percentages being based on weight of the fabric to be dyed. A specially knit nylon tricot was employed in the dyeing. This nylon tricot fabric was made up of seven different samples of nylon yarn, spun and drawn under different conditions so as to display different dyeing rates. The fabric was knit on a 14 gauge machine with 20 ends of each yarn sample knit side by side in the following order: (1) a sample of normal commercial 70 denier, 34 filament nylon yarn, (2) a sample of the same yarn count spun on a pilot plant spinning machine in the normal manner, (3) a sample of the same yarn drawn at a 3.2% higher than normal draw ratio, (4) a sample of the same yarn drawn at a 2.6% lower than normal draw ratio, (5) a sample of the yarn spun from the same batch employing a higher than normal air flow in the spinning machine, (6) a sample of yarn spun from the same batch employing 10° C. lower than normal temperature of the melt entering the spinneret, and (7) a sample of the same commercial 70 denier normally spun nylon yarn as in (1) above. The specially knit tricot fabric employed was knit from yarns having sufficient differences in the spinning and drawing thereof to demonstrate pronounced differences in shade upon dyeing with an acid or direct dyestuff. One part of the specially knit tricot fabric was entered into the bath and the temperature of the bath slowly raised to 200° F. The bath was held at this temperature for 3 hours. The shade depth variations between the seven different yarns making up the tricot fabric were hardly noticeable to the eye. The gray scale ratings of the differences at each knitting junction of the specially knit tricot fabric are based upon the International Geometric Grey Scale of the Society of Dyers and Colorists, wherein a rating of 5 represents negligible shade variation from the next preceding sample or section thereof, a rating of 4 represents noticeable variation, a rating of 3 represents appreciable variation, a rating of 2 represents considerable variation, a rating of 1 represents much variation and a plus or minus indicates slightly more or less than the given rating. The grey scale ratings of the fabric dyed in the above manner are set out in Table I below.

Table I

Section No.:	Rating
1 -----	—
2 -----	+(4-5)
3 -----	5
4 -----	5
5 -----	5
6 -----	-(4-5)
7 -----	+4

One part of the same specially knit nylon tricot fabric employed above was dyed in a dyebath containing 0.25% Pontacyl Dark Green G (CI 247), and 5% of ammonium

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acetate in 40 volumes of water, the percentages being based on the weight of the fabric dyed, in the same manner as above. The shade depth variations between the seven different yarns composing the specially knit tricot fabric were quite noticeable as between the yarns. The grey scale ratings of the difference at each knitting junction of the yarns dyed in the normal commercial dyebath set out above are recorded in Table II below.

Table II

Section No.:	Rating
1 -----	—
2 -----	+(3-4)
3 -----	-3
4 -----	+3
5 -----	-4
6 -----	-2
7 -----	+2

EXAMPLE II

A dyebath was prepared containing the following ingredients: 0.25% Pontacyl Dark Green G (CI 247), 0.5% of 1,1-(2-hydroxyethyl)-2-heptadecenyl-imidazolium chloride, and 16% glyceryl diacetate in 40 volumes of water, all percentages being based on the weight of the fabric to be dyed. One part of the same specially knit nylon tricot fabric as employed in Example I was entered into the dyebath. The temperature of the bath was raised to 200° F. and held at this temperature for 80 minutes. The sample of the specially knit tricot fabric was levelly and evenly dyed and the shade depth variations were hardly noticeable to the eye.

EXAMPLE III

A dyebath was prepared containing the following ingredients: 0.5% of Pontacyl Dark Green G (CI 247), 2.5% of 1,1-(2-hydroxyethyl)-2-heptadecenylimidazolium chloride, 5% glacial acetic acid and 40 volumes of water, all percentages being based on the weight of the fabric to be dyed. One part of a nylon taffeta fabric was entered into the bath and the temperature of the dyebath was slowly raised to 200° F. and held there for 2½ hours. The taffeta was evenly and levelly dyed and the fabric was well penetrated with the acid dyestuff when treated by the procedure outlined above.

EXAMPLE IV

A dyebath containing the following ingredients was prepared: 0.5% of Diphenyl Brilliant Violet DB (Pr. 35), 1.0% of 1-(2-hydroxyethyl)-2-undecylimidazolium acetate, and 2% glacial acetic acid based on the weight of the fabric to be dyed. One part of nylon taffeta fabric was entered into the dyebath. The temperature of the bath was slowly raised to 200° F. and maintained at this temperature for two hours. The warp streaks present in the fabric were hardly noticeable.

The levelness of dyeing was improved by repeating the above dyeing with the exception of substituting formic acid for acetic acid for pH adjustment and adding 0.25% of the condensation product of 1 mole of stearyl alcohol and 20 moles of ethylene oxide.

EXAMPLE V

A dyebath was prepared containing the following ingredients: 0.25% of Chromacyl Black W (Pr. 143), 1.0% of condensation product of 1 mole of oleyl alcohol condensed with 15 to 20 moles of ethylene oxide, 2.0% of glacial acetic acid, and 2.0% of 1,1-di-(2-hydroxyethyl)-2-heptadecenylimidazolium chloride in 40 volumes of water based upon the weight of the fabric to be dyed. One part of the specially knit nylon tricot fabric containing seven different yarns spun under different conditions was entered into the dyebath. The dyebath was raised slowly to 200° F. and maintained at that temperature for 2 hours. Differences in shade between knit junctions of the specially knit fabric were hardly noticeable.

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EXAMPLE VI

A dyebath was prepared containing the following ingredients: 0.25% Pontacyl Dark Green G (CI 247), 2.0% of formic acid, 2.0% of the condensation product of stearyl alcohol condensed with 20 moles of ethylene oxide, and 2.0% of 1,1-di-(2-hydroxyethyl)-2-heptadecyl-imidazolium hydroxide in 40 volumes of water, all percentages being based on the weight of the fabric to be dyed. One part of the specially knit nylon tricot fabric knit from seven yarns of different dyeing characteristics was entered into the dyebath. The temperature of the dyebath was slowly raised to 200° F. and maintained at that temperature for 2½ hours. The shade variations at the knitting junctions were hardly noticeable to the eye after the dyeing procedure outlined above.

EXAMPLE VII

A dyebath was prepared containing the following ingredients: 1.0% Omega Chrome Orange G (CI 247), 2.0% of formic acid, 1.0 percent of 1,1-di-(2-hydroxyethyl)-2-heptadecenyl-imidazolium chloride, and 2.0% of the condensation product of 1 mole of stearyl alcohol condensed with 20 moles of ethylene oxide in 40 volumes of water, all percentages being based on the weight of the fabric to be dyed. One part of a nylon taffeta fabric was entered into the dyebath and the dyebath temperature slowly raised to 200° F. This temperature was maintained for 1 hour and the fabric then washed and dried. The warp streaks normally occurring in nylon taffeta when dyed with chrome dyestuffs were not noticeable to the eye, and the taffeta was evenly and levelly dyed with good penetration.

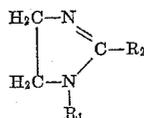
It may be seen from the foregoing examples that the amount of the various anionic dyestuffs applied to the nylon fabrics by the methods of this invention are substantially those same quantities which may be applied by conventional methods. That is, the employment of the substituted imidazoline compound in the dyebath does not act to increase the susceptibility of the nylon fibers or fabrics to dyeing by these dyes, but on the contrary provides a method for applying the same dyes more uniformly and levelly than can be accomplished by the normal methods.

The foregoing description makes evident the fact that this invention provides a practical, economical and commercial process for effecting uniform and level application of the four classes of anionic dyestuffs demonstrating the best light and water fastness on nylon yarns and fabrics. This result has been achieved even though wide variations in the amount of dye absorption exist when these same anionic dyes are applied by conventional dyeing methods.

As many variations within the spirit and scope of this invention will occur to those skilled in art, it is to be understood that the invention is not limited to the specific embodiments thereof except as set forth in the appended claims.

I claim:

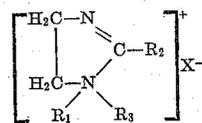
1. A process for evenly dyeing polycarbonamide textile articles which comprises dyeing the article in an aqueous acidic dyebath containing an anionic dyestuff selected from the group consisting of direct dyes, acid dyes, acid metallized dyes, and mordant acid dyes, and from one to ten times the weight of the dyestuff of a substituted imidazoline compound selected from the group consisting of (1) a salt of an imidazoline having the general formula.



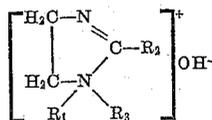
wherein R₁ is selected from the group consisting of alkyl, phenyl, hydroxyalkyl, and carboxyalkyl radicals and R₂ is an open aliphatic chain consisting of from 10 to 18

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carbon atoms, (2) a quaternary imidazolium compound having the general formula



wherein R₁ and R₃ are selected from the group consisting of alkyl, phenyl, hydroxyalkyl and carboxyalkyl radicals, R₂ is an open aliphatic chain consisting of from 10 to 18 carbon atoms and X is a halogen and (3) a quaternary imidazolium compound having the general formula



wherein R₁ and R₃ are selected from the group consisting of hydroxyalkyl, alkali metal substituted-hydroxyalkyl and alkali metal-substituted carboxyalkyl radicals, and R₂ is an open aliphatic chain consisting of from 10 to 18 carbon atoms.

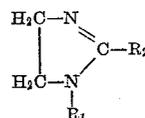
2. A process as defined in claim 1 wherein the anionic dyestuff is a direct dye.

3. A process as defined in claim 1 wherein the anionic dyestuff is an acid dye.

4. A process as defined in claim 1 wherein the anionic dyestuff is an acid metallized dye.

5. A process as defined in claim 1 wherein the anionic dyestuff is a mordant acid dye.

6. A process for evenly dyeing filament polycarbonamide fabrics which comprises dyeing the fabrics in an aqueous acidic dyebath containing an anionic dyestuff selected from the group consisting of direct dyes, acid dyes, acid metallized dyes, and mordant acid dyes and from one to ten times the weight of the dyestuff of a salt of an imidazoline having the general formula

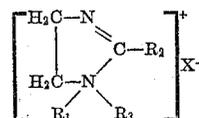


wherein R₁ is selected from the group consisting of alkyl, phenyl, hydroxyalkyl, and carboxyalkyl radicals, and R₂ is an open aliphatic chain consisting of from 10 to 18 carbon atoms.

7. A process as described in claim 6 wherein the dyebath is maintained at a pH of from 2.0 to 5.5 and a temperature of from 200° to 210° F. and the dyeing is carried out for 1 to 4 hours.

8. A process as described in claim 6 wherein the salt of the imidazoline is 1-(2-hydroxyethyl)-2-undecyl-imidazolium acetate.

9. A process for evenly dyeing filament polycarbonamide fabrics which comprises dyeing the fabrics in an aqueous acidic dyebath containing an anionic dyestuff selected from the group consisting of direct dyes, acid dyes, acid metallized dyes, and mordant acid dyes and from one to ten times the weight of the dyestuff of a quaternary imidazolium compound having the general formula



wherein R₁ and R₃ are selected from the group consisting of alkyl, phenyl, hydroxyalkyl, and carboxyalkyl radicals, R₂ is an open aliphatic chain consisting of from ten to 18 carbon atoms, and X is a halogen.

10. A process as described in claim 9 wherein the dyebath is maintained at a pH of from 2.0 to 5.5 and a

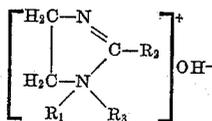
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temperature of from 200° to 210° F. and the dyeing is carried out for one to four hours.

11. A process as described in claim 9 wherein the quaternary imidazolium compound is 1,1-di-(2-hydroxyethyl)-2-heptadecenyl-imidazolium chloride.

12. A process as defined in claim 9 wherein the quaternary imidazolium compound is 1,1-di-(2-hydroxyethyl)-2-undecyl-imidazolium chloride.

13. A process for evenly dyeing filament polycarbonamide fabrics which comprises dyeing the fabrics in an aqueous acidic dyebath containing an anionic dyestuff selected from the group consisting of direct dyes, acid dyes, acid metallized dyes, and mordant acid dyes and from one to ten times the weight of the dyestuff of a quaternary imidazolium compound having the general formula



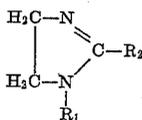
wherein R_1 and R_3 are selected from the group consisting of hydroxyalkyl, alkali metal-substituted hydroxyalkyl and alkali metal-substituted carboxyalkyl radicals and R_2 is an open aliphatic chain consisting of from 10 to 18 carbon atoms.

14. A process as described in claim 13 wherein the dyebath is maintained at a pH of from 2.0 to 5.5 and a temperature of from 200° to 210° F. and the dyeing is carried out for 1 to 4 hours.

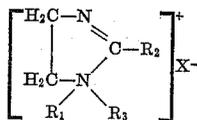
15. A process as described in claim 13 wherein the quaternary imidazolium compound is 1,1-di-(2-hydroxyethyl)-2-heptadecyl-imidazolium hydroxide.

16. A process as described in claim 13 wherein the quaternary imidazolium compound is the disodium salt of 1-(2-hydroxyethyl)-1-carboxyethyl undecyl-imidazolium hydroxide.

17. A process for evenly dyeing polycarbonamide textile articles which comprises dyeing the article in an aqueous acidic dyebath containing an anionic dyestuff selected from the group consisting of direct dyes, acid dyes, acid metallized dyes, and mordant acid dyes, from 0.1 percent to 4.0 percent of a non-ionic dispersing agent selected from the group consisting of the condensation products of polyglycols with higher fatty acids, the condensation products of polyglycols with higher fatty alcohols, and long chain alkyl-substituted phenols, and from one to ten times the weight of the dyestuff of a substituted imidazoline compound selected from the group consisting of (1) a salt of an imidazoline having the general formula



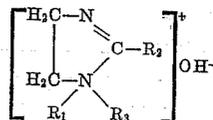
wherein R_1 is selected from the group consisting of alkyl, phenyl, hydroxyalkyl, and carboxyalkyl radicals and R_2 is an open aliphatic chain consisting of from 10 to 18 carbon atoms, (2) a quaternary imidazolium compound having the general formula



wherein R_1 and R_3 are selected from the group consisting of alkyl, phenyl, hydroxyalkyl and carboxyalkyl radicals, R_2 is an open aliphatic chain consisting of from 10 to 75

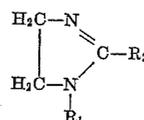
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18 carbon atoms and X is a halogen and (3) a quaternary imidazolium compound having the general formula



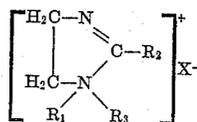
wherein R_1 and R_3 are selected from the group consisting of hydroxyalkyl, alkali metal substituted-hydroxyalkyl and alkali metal-substituted carboxyalkyl radicals, and R_2 is an open aliphatic chain consisting of from 10 to 18 carbon atoms.

18. A process for evenly dyeing filament polycarbonamide fabrics which comprises dyeing the fabrics in an aqueous acidic dyebath containing an anionic dyestuff selected from the group consisting of direct dyes, acid dyes, acid metallized dyes, and mordant acid dyes, from 0.1 percent to 4.0 percent of a non-ionic dispersing agent which is a condensation product of ethylene oxide with a higher fatty alcohol, and from one to ten times the weight of the dyestuff of a salt of an imidazoline having the general formula



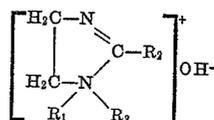
wherein R_1 is selected from the group consisting of alkyl, phenyl, hydroxyalkyl, and carboxyalkyl radicals, and R_2 is an open aliphatic chain consisting of from 10 to 18 carbon atoms.

19. A process for evenly dyeing filament polycarbonamide fabrics which comprises dyeing the fabrics in an aqueous acidic dyebath containing an anionic dyestuff selected from the group consisting of direct dyes, acid dyes, acid metallized dyes, and mordant acid dyes, from 0.1 percent to 4.0 percent of a non-ionic dispersing agent which is a condensation product of ethylene oxide with a higher fatty alcohol, and from one to ten times the weight of the dyestuff of a quaternary imidazolium compound having the general formula



wherein R_1 and R_3 are selected from the group consisting of alkyl, phenyl, hydroxyalkyl, and carboxyalkyl radicals, R_2 is an open aliphatic chain consisting of from 10 to 18 carbon atoms, and X is a halogen.

20. A process for evenly dyeing filament polycarbonamide fabrics which comprises dyeing the fabrics in an aqueous acidic dyebath containing an anionic dyestuff selected from the group consisting of direct dyes, acid dyes, acid metallized dyes, and mordant acid dyes, from 0.1 percent to 4.0 percent of a non-ionic dispersing agent which is a condensation product of ethylene oxide with a higher fatty alcohol, and from one to ten times the weight of the dyestuff of a quaternary imidazolium compound having the general formula



wherein R_1 and R_3 are selected from the group consisting of hydroxyalkyl, alkali metal-substituted hydroxyalkyl and alkali metal-substituted carboxyalkyl radicals and R_2 is an open aliphatic chain consisting of from 10 to 18 carbon atoms.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 2,952,506

September 13, 1960

Dimitri D. Dellis

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 5, lines 55 and 56, for "proceeding" read
-- preceding --; column 7, line 19, for "247" read -- 274 --.

Signed and sealed this 11th day of April 1961.

(SEAL)
Attest:

ERNEST W. SWIDER

Attesting Officer

ARTHUR W. CROCKER
Acting Commissioner of Patents