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TWO-TONE DYEING OF WOOL AND $CA(OH)_2$ MODIFIED WOOL BLEND WITH SOLUTION OF POLYSULFONATED AND MONOSULFONATED DYES AND ARYL SULFONIC ACID-ALDONE REACTION PRODUCT

Arthur J. I. Harding, 190 S. Park Drive, Spartanburg, S.C. 29302, and Willard L. Morgan and Kermit S. La Fleur, Spartanburg, S.C.; said Harding and said Morgan assignors, by mesne assignments, to Arthur J. I. Harding, Spartanburg, S.C.

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ABSTRACT OF THE DISCLOSURE

Multicolor dyeing process using a mixture of normal wool and wool pretreated with an aqueous dispersion of calcium hydroxide under non-damaging conditions and a mixture of dyestuffs, one of which contains less than 2 sulfonic and reactive groups and one of which contains more than 2.

This invention relates to a novel dyeing process, more particularly to a commercially feasible dyeing process which produces stock dyed effects in yarn, both before and after forming into fabrics.

In the textile industry, stock dyeing, i.e., dyeing of wool in fiber form before the wool is spun into yarn, is widely used because it enables one to achieve effects not ordinarily obtainable when dyeing yarn or fabrics. When yarn or fabrics are dyed by conventional means, a flat, solid shade is obtained because all fibers are dyed to the same degree. Entirely different dyeing effects are obtained if dyed fibers are blended with undyed fibers or fibers another color. However, it is well known that dyed fibers process poorer in gilling and spinning operations than undyed fibers. Much effort has therefore been directed to obtaining such stock dyed effects by dyeing yarn or fabric.

One technique involves blending chlorinated or otherwise damaged wool with untreated or resist-treated wool in yarn or fabric form. Such a procedure is difficult to control and creates shade matching problems, requires specialized treating equipment or processing conditions and the chlorinated or resist-treated wool processes considerably different from the untreated wool and therefore requires special techniques. Also, some such techniques involve considerable loss of wool weight, as in the case of chlorination, or the use of relatively expensive chemicals to obtain a resist on a portion of the wool. Almost invariably the hand or other properties of the treated fibers is adversely affected.

To avoid such limitations, a process has been developed whereby stock, ingrain or fleck effects could be obtained in a single dyebath on fiber, yarn or fabric formed of normal wool by using polysulfonic acid dyestuffs and certain sulfonic acid condensation products, thus avoiding the necessity of processing fibers damaged or whose processing characteritsics have been altered. See U.S. Patent No. 2,999,731. However, this process does not produce the highly contrasting effects which are obtained when wool fibers dyed a dark shade are blended with a large proportion of undyed wool fibers or vice versa, or with wool fibers dyed a sharply contrasting color. It is these contrasting effects which are preferred in many end uses.

According to this invention, it is now possible to achieve sharply contrasting multicolor and color and white dyed effects on wool in yarn, either before or after forming into fabric and piece form, in a single dyebath by dyeing wool yarns consisting essentialy of a mixture of normal wool,

i.e., wool not chemically modified to alter its dye receptivity, and wool alkaline pretreated under conditions whereby the wool fiber is substantially undamaged, in a single dyebath containing a water-soluble condensation product, a suitable acid and a polysulfonic acid dyestuff and preferably also a dyestuff containing less than a total of 2 sulfonic acid and reactive groups, all as defined hereinafter.

Strong alkali can severely damage wool, especially the exterior or cuticle portion and such damaged wool has altered dyeing properties. However, surprisingly it was discovered that wool fibers treated with strong alkali under conditions whereby no significant observable damage has taken place had nevertheless markedly different dyeing properties from normal wool in the dyeing procedure described herein. It will be immediately apparent that such alteration of the dyeing properties of the wool, without significantly adversely affecting its tensile, elongation, hand, and other properties, is a highly desirable result. The fact that no substantial damage has taken place in the alkaline treatment, can be determined by a microscopic examination of the fibers, which should show that the scale structure is retained in a substantially undamaged condition and by tests for dry tensile and elongation, which properties should not be significantly lowered, i.e., at least 90% or more of the properties of corresponding untreated wool. Further indirect proof that no significant damage has taken place can be found in the fact that the wool, if undamaged, behaves substantially the same as normal wool, e.g., in felting shrinkage tests.

A non-damaging alkali treatment of wool which will nevertheless alter the dyeing properties of the wool can be achieved by the use of an aqueous solution of a base which provides a pH of greater than 9.5 preferably greater than 10.5, e.g., between about 10.5 and 11.5, but ordinarily below about 12, during the treatment. The simplest such alkaline treatment employs aqueous potassium hydroxide or sodium hydroxide of a concentration below about 1% and preferably below about 0.5%, e.g., about 0.05–0.2 N, preferably about 0.1 N. A boric acid, alkali-metal hydroxide buffer solution which provides a pH between about 10.3–11.0 can also be used. A fairly concentrated solution, e.g., about 8–15%, aqueous solution of tetrasodium pyrophosphate can be used. Calcium hydroxide, calcium chloride, calcium carbonate solutions brought to a pH of about 10.5 to 12, preferably about 11, with a stronger base, e.g., an alkali-metal hydroxide, can also be used. When using calcium hydroxide, a homogeneous solution can be achieved by adding a sugar, e.g., sucrose, to the treating solution. Such a homogeneous system facilitates the removal of the calcium ion from the wool after treatment. The exact pH which should be used will depend upon the treatment temperature and time of treatment. If desired, a reducing agent, e.g., sodium sulfide, sodium bisulfite, etc., can be incorporated in the alkaline solution, but employing such small amounts as will not damage the wool. An elevated temperature is ordinarily required to modify the dyeing properties of the wool in the desired manner at the above pH ranges. As a general rule, a temperature of at least 110° F. is required, with the preferred range being between about 120 and 150° F. If short reaction times are employed, e.g., a few seconds to 5 minutes, somewhat higher temperatures may be required. With finer grades of wool, e.g., 64s quality or better, about 120° F. is the preferred treatment temperature. With the coarser grade wools, e.g., 56s or less, a somewhat higher temperature, e.g., about 140° F., is preferred. Ordinarily, a temperature below about 180° F. should be used to avoid fiber damage with a temperature below about 160° F. being preferred.

The time required to alter the dyeing properties of the

alkaline treated wool to the desired extent, without substantially damaging the wool varies with the selected alkaline material and the pH of the treating bath. With aqueous sodium hydroxide, at a bath pH of about 11, a treating time of less than 4 minutes and preferably less than 2 minutes at 140° F. should be employed. Somewhat longer reaction times are sometimes required when employing bases such as tetrasodium pyrophosphate, buffered boric acid-sodium hydroxide solutions and mixtures of strong and weaker bases, e.g., NaOH—$Ca(OH)_2$ solutions at a bath pH of between about 10.5 and 11. The maximum time is more or less inversely proportional to the pH and temperature so that a reaction time of 30 seconds or less may be necessary at pHs above 11 or at temperatures above 180° F. In any event, at reaction temperature between about 110–150° F., the reaction time should be less than about 15 minutes, and preferably about 10 minutes or less, irrespective of the selected base.

A convenient means of treating the wool involves passing the wool fibers in stock or top form before they are spun into yarn into the alkaline solution heated to the desired temperature, maintaining the wool in the solution for the selected time with sufficient agitation and/or liquor flow to insure uniform distribution of the liquor amongst the fibers, and then promptly thereafter cooling, washing, and/or acid scouring the fibers to insure that the reaction is terminated. The fibers can then be dried by conventional means and, if desired, tinted with a fugitive tint for identification purposes, and treated with lubricating oils and anti-static agents so as to be in proper condition for future processing.

The wool can be in the form of raw stock or roving form, or in yarn form, when yarn is to be plied or otherwise combined with normal wool in piece form before dyeing. Advantageously, the alkaline treatment can be the terminal step in the removal of the wool oils from raw wool stock as there is no significant additional cost involved over conventional processing when the alkaline treatment is employed at that point. Alternatively, the normal wool in yarn or piece, e.g., carpet, form can be discontinuously treated at discrete points with alkali, preferably in paste form to minimize migration, and heated or steamed for a short period of time to alter the dyestuff affinity of the wool at the points of contact with the alkali, in the manner described above.

The thus alkaline treated wool is then blended or otherwise combined with normal wool, i.e., wool which has not been chemically modified to alter its dyestuff affinity, according to conventional techniques, prior to dyeing. For example, the 2 wools can be in the form of separate ends of a plied yarn, or blended and spun as a mixture of fibers into yarn. Preferably the normal and alkali-treated wool each constitutes at least 25% and preferably at least 35% of the yarn. The yarn can be in skein or package form or in piece form, e.g., woven or knited fabric or woven or tufted carpet.

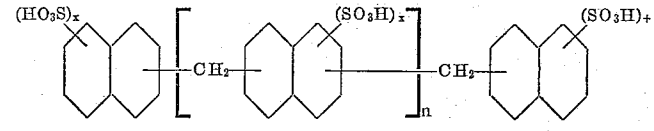
The combined wool in yarn form is then dyed according to this invention in an aqueous dyebath containing

(a) A dyestuff containing at least 2 sulfonic acid groups; and

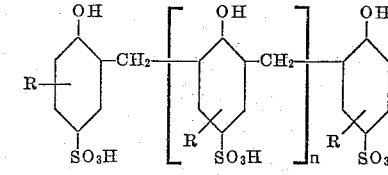
(b) An amount greater than 0.5%, calculated on the weight of the wool, insufficient to reserve the dyestuff, of a water-soluble condensation product of an aryl sulfonic acid and an aldone,

at an initial dyebath pH in the presence of the wool of less than 5.9. Preferably, the dyebath additionally contains a dyestuff containing a total of less than 2 sulfonic acid and reactive groups. The polysulfonic acid dyestuffs contain at least 2 sulfonic acid groups, but preferably 3 or more, e.g., 4, 5 or 6 such groups. The term "sulfonic acid group" excludes those groups in which the sulfonic group is in the form of an inner salt with a basic group. These dyestuffs can additionally contain reactive groups in the molecule. The dyestuffs containing reactive groups, e.g., vinyl sulfone or cyanuric chloride groups, are referred to in the dyeing art as "reactive" dyestuffs. Desirably, the sum of the sulfonic acid groups and reactive groups are at least 3 or 4. Included in the dyestuffs containing 2 or more sulfonic acid groups are those referred to in the dyeing art as acid dyestuffs, milling dyestuffs, direct dyestuffs, cotton dyestuffs and cotton reactive dyestuffs. These dyestuffs are ordinarily supplied commercially in the form of their sodium salt.

The condensation products employed in the process of this invention are generally known as "retrading" or "leveling" agents, usually for dyeing wool. They are characterized chemically as condensation products of aryl, usually carbocyclic, sulfonic acids and an aldone. The term "aldone" as used herein means an aldehydic or ketonic carbonyl compound, e.g., formaldehyde, acetaldehyde, benzaldehyde, benzoin, acetone, etc. These are a well-known and commonly employed class of compounds in the dyeing art. They each possess a sulfonic acid substituted aryl group in the molecule and at least 1 additional acidic group, e.g., phenolic, carboxylic or sulfonic. Compounds within this definition are mono, di, or trisulfonic acid subsituted benzene or naphthalenes which can further be substituted with lower-alkyl, hydroxy, nitro, amino, etc., groups and which have been condensed with an aldone as described above to produce a dimer, trimer or polymer linked by the aldone by a reaction well known in the art. Compounds such as dihydroxy-diphenyl sulfone can also be incorporated in the condensation reaction to produce a mixed condensation product. See U.S. 2,623,-806. These compounds include the condensation products of naphthalene-1 or naphthalene-2-sulfonic acid, or naphthalene-2,7-disulfonic acid and formaldehyde, e.g., those of the formula



and the alkali-metal salts thereof when n is 0, 1, 2 or more, usually 0 or 1, and x is 1 or 2. Others include the condensation product of phenol or cresol sulfonic acid and formaldehyde, e.g., of the formula



and the corresponding alkali-metal salts thereof wherein R is H or CH_3 and n is 0 to 3 or 4. Still others include the condensation products of phenol, cresol, or naphthalene sulfonic acid and benzoin or acetone and their alkali-metal salts.

Specific examples of such condensation products are dinaphthylmethanedisulfonic acid, diphenylmethanedisulfonic acid, dihydroxyphenylmethanedisulfonic acid dicresylmethanedisulfonic acid, dihydroxynaphthylmethanedisulfonic acid, dinitronaphthylmethanedisulfonic acid, dichloronaphthylmethanedisulfonic acid, diaminonaphthylmethanedisulfonic acid, dinaphthylmethane-2,7,2',7'-tetrasulfonic acid and the sodium salts of each.

The amount of aryl sulfonic acid-aldone condensation

product employed in the dyebath is at least 0.5%, calculated on the weight of the wool, but less than amount which will reserve the dyestuff employed. An amount between about 1% and 5% is the usual range.

As in conventional acid dyeings, the dyebath will contain an organic or inorganic acid conventionally used in the dyeing art, e.g., acetic acid, formic acid, hydrochloric acid, sulfuric acid, phosphoric acid, lactic acid, citric acid or other strong acid which will provide an intial pH to the dyebath in the presence of the wool of less than 5, e.g., between about 2.8 and 4.9, preferably below about 4.5. If desired, the pH can be varied during the dyeing by employing ammonium sulfate or phosphate and then permit the pH to drift lower during dyeing. The amount of acid to be employed with depend upon the affinity of the dyestuff or dyestuffs employed in the dyeing to the wool in the presence of the condensation product as defined herein. Also, to enhance exhaustion of the dyestuff, additional amounts of acid can be added during the dyeing, according to techniques well known in the art.

The usual dyestuff additives, e.g., Glauber's salt or other materials used as leveling agents or nonionic wetting agents, may be added to the dyebath to facilitate the dyeing process. However, as with other dyeings, such additives may alter somewhat the results obtained. For example, cationics should be avoided and it is preferred to keep these other additives to a minimum.

The effects obtained will, when using a single dyestuff, vary from a tone on tone to a color on white, each of the above effects being within the term "multicolored" as used herein. As stated above, spectacular effects are obtained if the dyebath additionally contains at least 1 of a dyestuff containing less than a total of 2 sulfonic acid and reactive groups. With such a mixture of dyestuffs, a rainbow of colors can be achieved from a single dyebath.

The alkali treated wool has a greater affinity for the polysulfonic acid dyestuff, thus increasing the white or uncolored portion of the dyed yarn when only polysulfonic dyestuffs as employed in the dyebath, so that considerably greater contrast and variations are possible than are obtainable when the comparable process is applied to all normal wool. Also, dyeing rates and degree of dyestuff exhaustion are improved. When the dyestuff contains both a polysulfonic acid dyestuff and one containing less than 2 sulfonic acid and reactive groups a most surprising effect is obtained. If an amount of polysulfonic acid dyestuff is used which will be readily absorbed by the alkali-treated portion of the wool yarn, and if an amount of dyestuff containing less than 2 sulfonic acid and reactive groups is employed which will be readily absorbed by the normal wool, a two-color effect is obtained in which substantially all of the polysulfonic acid dyestuff is absorbed by the alkali-treated wool to produce a solid shade on that wool and substantially all of the dyestuff contained a total of less than 2 sulfonic acid and reactive groups is absorbed by the normal wool to produce a solid shade on that wool, thereby providing a sharply contrasting two-color effect, with the polysulfonic dyestuff also producing a fleck effect on the normal wool when the amount of such dyestuff employed is sufficient to permit a portion to be absorbed by the normal wool in addition to the amount required to dye the treated wool. Also, if the two types of wool are not uniformly blended, e.g., by plying one end of alkali-treated wool yarn with an end of normal wool yarn or by limiting the extent of blending of alkali-treated fibers and untreated fibers, large areas of one color interspersed with large areas of the other color can be obtained, a particularly desirable result in carpets.

It is therefore a preferred embodiment of this invention to employ in the dyebath a polysulfonic acid dyestuff in an amount which is readily absorbed by the alkali-treated wool portion of the yarn, and a dyestuff containing a total of less than 2 sulfonic acid and reactive groups, in an amount which is readily absorbed by the normal wool portion of the yarn.

If desired, the combined wools can, prior to dyeing, be given a pretreatment with acid and formaldehyde or paraformaldehyde or with a sulfonic acid condensation product as described herein in the presence of absence of acetic, formic, hydrochloric or like acid and/or formaldehyde or paraformaldehyde, to enhance the subsequent dyeing effect obtained.

The following preparations and examples are illustrative of the process of this invention but are not to be construed as limiting.

PREPARATION I

To a 0.1 N aqueous solution of sodium hydroxide heated to 140° F. add an amount of New Zealand 44s–50s carpet quality wool fibers which will provide a liquor ratio to wool of about 100:1 or greater. The liquor ratio is not particularly critical but it is preferred to have a liquor ratio of at least 10:1 and preferably at least 20:1. The solution can contain a wetting agent, e.g., Mercerol G.V., Tergitol NPX, nonionic wetting agents. Maintain the wool in the alkaline solution for from about 30 seconds to about 5 minutes while providing sufficient agitation of the wool and/or aqueous solution to ensure a uniform treatment. Remove the wool after the selected time of reaction and immediately wash the wool thoroughly, including an acid scour, to remove all traces of the base. Dry the wool in the conventional manner. Microscopic examination of the fibers can be used to determine the maximum reaction time which may be used, along with tensile and elongation tests.

The effectiveness of the treatment can be determined by dyeing the thus treated wool in fiber form in the presence of an equal weight of normal wool fibers at 200° F. for thirty minutes using 2% formic acid, 2% Synwool S.N., a formaldehyde-naphthalene sulfonic acid condensation product, and 0.5% Procian Black HG, a reactive dyestuff containing at least 2 sulfonic acid dyestuffs, followed by boiling for 15 minutes in the presence of an additional 1% each of Synwood S.N. and formic acid, all amounts calculated on the weight of the wool. In each instance, the alkali-treated wool fibers will be dyed substantially darker than the untreated wool fibers. With wool fibers alkali treated in the above manner for 2 minutes or longer, the untreated wool fibers are substantially undyed.

PREPARATION II

Follow the procedure of Preparation I, using a 1% solution in water of a standard boric acid-sodium hydroxide buffer solution having a pH of about 10.5 at 160° F. Heat the wool in the solution at 160° F. for 5 minutes.

PREPARATION III

Follow the procedure of Preparation I using a 1% dispersion of calcium hydroxide in water, with the solution brought to a pH above 11, if desired, with some sodium hydroxide. Heat to about 120° F. for about 5 minutes or less for fine grade wools and at about 140° F. for 5 minutes or less for lower grade qualities of wool.

PREPARATION IV

Follow the procedure of Preparation III, solubilizing the calcium hydroxide with sufficient sucrose to provide a 10% solution. At a pH of about 11, good essential dyeing effects providing sharp contrast dyeing to the same untreated wool are obtained by heating at 140° F. for 5 minutes. Substantially the same results are obtained when the wool is heated from about 2 to 15 minutes, but damage begins to occur at longer heating times. A lesser alteration of dyeing properties is obtained at a pH of 10.9.

PREPARATION V

Follow the procedure of Preparation IV, but use a 10% solution of tetrasodium pyrophosphate and heat for

5 minutes at 140° F. The temperature can be lowered to about 120° C. if 60s quality or higher wool is substituted.

Example I

In a dyebath with about a 20:1 liquor ratio containing 1.3% Cibacron Brown BR (a polysulfonic acid dyestuff), 0.5% Anthraquinone Blue SWF CI 62,055 (a 1 sulfonic acid dyestuff), 2% Tamol SN (a naphthalene sulfonic acid-formaldehyde condensation product) and 2% of acetic acid, calculated on the weight of the wool, the dyebath having an initial pH of about 4 in the presence of the wool, dye wool singles yarn of about 62–64s quality consisting of a blend of about 50% normal wool fibers and 50% of wool fibers alkaline pretreated for 5 minutes at 120° F. in a 10% aqueous tetrasodium pyrophosphate solution, washed, acid scoured and dried before blending with the normal wool. Bring the solution to the boil in 45 minutes and dye at the boil for one hour or until exhaustion. A sharply contrasting bright blue and orange-brown stock dyed effect is obtained with the alkaline pretreated wool fibers being dyed blue with flecks of brown and the normal wool fibers being dyed orange-brown with an undertone of light blue.

If the yarn is in the form of a 2-ply yarn with one end consisting entirely of the alkaline-pretreated wool fibers and the other end consisting entirely of normal wool fibers, a novelty effect is obtained with a predominantly blue end spiraling around a predominantly orange-brown end.

The same stock dyed and novelty spiral effects are obtained when such yarns are knitted or woven into fabric before dyeing.

If the arylsulfonic acid-formaldehyde condensation product is omitted from the above dyeings, a faint two-tone effect is obtained which is distinctly different from the highly contrasting effect obtained in the presence of the condensation product.

Example II

Substantially the same effect is obtained as in Example I when the alkaline-pretreated wool fibers have been treated in the above described manner with an aqueous solution containing 5% $CaCl_2$, 5% Na_2CO_3 and 2% Na_2S, rather than tetrasodium pyrophosphate.

Example III

Follow the procedure of Example II, using carpet woven from 2-ply yarn, one end of which consists of normal 44–48s New Zealand carpet quality wool and one of which consists of 44–48s New Zealand wool which has been alkaline pretreated for 5 minutes at 140° F. in an aqueous solution containing 5 parts of a standard NaOH-boric acid standard buffer solution containing 12.40 g. of boric acid and 4 g. of NaOH per liter, plus 5 parts of a 0.1 N solution of NaOH per liter to bring the pH to 11, plus 2% of Na_2S. Dye in a carpet piece dyeing machine with constant rotation of the carpet in open width form through the liquor. Bring to the boil in 45 minutes and dye at the boil until substantial exhaustion of the dyestuff is achieved.

The carpet is dyed a brilliant two-color effect caused by the spiraling of the plies of the yarn, one color being a bright blue on the normal wool and the other an orange-brown with a bluish tone on the alkaline pretreated wool.

Example IV

Dye a 2-ply yarn, formed of 64s quality normal wool blended in about a 50:50 mixture with 64s quality wool alkaline-pretreated at 140° F. for 5 minutes in an aqueous solution of 1% $Ca(OH)_2$ and 10% sucrose having a pH of about 11, in a dyebath at about a 20:1 liquor ratio containing the following ingredients, the percentages being calculated on the weight of the wool:

	Percent
Procian Orange G (a polysulfonic acid dyestuff)	0.14
Anthraquinone Blue SWF (CI 62,055) (a one sulfonic acid dyestuff)	0.2
Phosphoric acid	3
Tamol SN (a naphthalene sulfonic acid-formaldehyde condensation product)	1
Paraformaldehyde	1

The dyebath has an initial pH below 4 in the presence of the wool. Bring to the boil in about 45 minutes and dye at the boil to dyestuff exhaustion. A stock dyed effect of a bright light blue mixed with a bluish orange is obtained. If the yarn consists of one end of normal wool and one end of alkaline-pretreated wool, a spiral effect is obtained with the normal wool end being dyed a light blue and the pretreated wool end being an orange with a bluish tint.

If the Tamol SN is omitted, an overall blue effect tinged with orange is obtained in the case of the blended yarn and a slight two-tone effect is obtained in the case of the normal wool end plied with the alkaline pretreated wool end.

Example V

Dye fabric knit from singles yarn, formed of a 50:50 mixture of 64s quality normal wool and alkaline-pretreated 64s quality wool, in a dyebath containing the following ingredients, the percentages being calculated on the weight of the wool:

	Percent
Pyrazol Red 7 BSW (CI 35,780) (a 6 sulfonic acid dyestuff)	1.35
Anthraquinone Blue SWF (CI 62,055) (a one sulfonic acid dyestuff)	0.25
Tamol SN (a naphthalene sulfonic acid-formaldehyde condensation product)	2
Phosphoric acid	3
Paraformaldehyde	1

The initial dyebath pH is below 4. Dye in the manner described above. A striking burgundy mixed with reddish blue stock dyed effect is obtained. If the yarn is 2 ply with one end normal and the other end alkaline-pretreated wool, the normal wool end is dyed a bright blue tinged with red and the pretreated wool end is dyed a burgundy.

If the Tamol SN is omitted a substantially solid reddish purple shade is obtained.

Example VI

Follow the procedure of Example III, dyeing woven carpet formed of the 2-ply yarn described therein, the alkaline-pretreated wool end being pretreated with a 1% $Ca(OH)_2$, 10% sucrose solution for 5 minutes at 140° F., in a dyebath containing the following ingredients, the percentages being calculated on the weight of the wool:

	Percent
Cibacron Brilliant Blue BR (a polysulfonic acid reactive dyestuff; see J. Panchartek et al., "Aromatisch and Diazound Verbindungen XXXIX," Czech. Chem. Com., 25 (10), October 1960, pp. 2783–2798)	1.35
Xylene Fast Yellow (CI 18,900) 2GP (a one sulfonic acid dyestuff)	0.3
Tanasol D (the acid form of a naphthalene sulfonic acid-formaldehyde condensation product)	0.5
Acetic acid	5

The initial dyebath pH is less than 4.5 in the presence of the wool. Dye in the manner described in Example III. The normal wool end of the yarn is dyed a greenish yellow and the alkaline pretreated wool end is dyed a bright blue, producing a striking 2-color effect on the carpet.

Example VII

Follow the procedure of Example IV, using a dyebath containing:

	Percent
Procian Black HG (a polysulfonic acid dyestuf); see J. Panchartek et al., supra.	0.5
Tamol SN (a naphthalene sulfonic acid)	2
Formic acid	2

The dyed yarn has a stock dyed blue-gray and white effect. The white effect can be enhanced by adding wool brighteners, preferably those containing less than 2-sulfonic acid groups, or other dyestuffs or materials with little tintoral properties which have a greater affinity for the normal wool than the alkaline pretreated wool.

Example VIII

To a carpet woven of 44–48s quality normal wool apply a solution of 1% $Ca(OH)_2$, 10% sucrose and 2% Keltex sodium alginate by a rotating circular nylon brush which picks up the solution and then presses against a bar so as to splatter the solution onto the face of the carpet, thereby covering about ⅓–½ of the surface of the carpet. Steam the carpet at 212° F. for ten minutes or less, wash thoroughly, including an acid scour, and dye the carpet in a dyebath described in Example IV, V, VI or VII. Speckled color and white and 2-color effects are obtained.

What is claimed is:

1. In a process for obtaining novel multicolor effects in wool in a single dyebath which comprises the step of dyeing a mixture of wool, consisting essentially of a mixture of normal wool having normal dyeing properties and of wool pretreated to enhance its receptivity to dyestuffs, in an aqueous dyebath containing

(a) a dyestuff containing a total of at least 3 sulfonic acid and reactive groups,

(b) a dyestuff containing a total of less than 2 sulfonic acid and reactive groups, and

(c) an amount, greater than 0.5 percent calculated on the weight of the wool, which is insufficient to reserve the dyestuff, of a water-soluble condensation product of an aryl sulfonic acid and an aldone,

at an initial dyebath pH in the presence of the wool of less than 5, the improvement which comprises using as the wool having enhanced receptivity to dyestuffs, wool treated with an aqueous dispersion of calcium hydroxide at a pH above 9.5 but below 12 at a temperature from 110° to 180° F. for less than 15 minutes, under conditions whereby the scale structure of the fibers is retained in a substantially undamaged condition and the fibers have a dry tensile strength and an elongation which are at least about as high as corresponding untreated wool.

2. A process according to claim 1 wherein the wool is pre-treated with calcium hydroxide at a temperature from 120° to 150° F.

3. A process according to claim 2 wherein the wool is pre-treated at a pH between about 10.5 and 11.5.

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DONALD LEVY, *Primary Examiner.*

MORRIS WOLK, NORMAN G. TORCHIN,

Examiners.