United States Patent [19]

Thackrah

[11] **3,744,967**

[45] **July 10, 1973**

[54] **PROCESS FOR DYEING NAPPED FABRICS OF WATER SWELLABLE CELLULOSE FIBERS**

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[22] Filed: **Mar. 22, 1971**

[21] Appl. No.: **127,035**

[52] **U.S. Cl.** ..... **8/54.2,** 8/21 C, 8/93, 8/173

[51] **Int. Cl.** **D06p 3/60**

[58] **Field of Search** ..... 8/21 C, 94, 93, 174, 8/54.2, 173

[56] **References Cited**

UNITED STATES PATENTS

2,828,180	3/1958	Sertorio	8/62
3,656,880	4/1972	Blackwell	8/21 C
2,999,002	9/1961	Dayvault et al.	8/94
2,274,751	3/1942	Sowter et al.	8/174

FOREIGN PATENTS OR APPLICATIONS

1,112,279	5/1968	Great Britain	8/54.2

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[57] **ABSTRACT**

An improved process for dyeing napped fabrics comprising water swellable cellulosic fibers, for example cotton fibers, alone or blended with synthetic fibers, for example polyester fibers, by contacting the cellulosic fibers of the fabric throughout with an aqueous solvent-or solvent solution of a preformed disperse dye of low water solubility, said solvent consisting of ethylene glycol or a derivative thereof which is at least partially miscible with water, has a boiling point above 150°C., and is a solvent for the dye at some temperature up to 225°C., for example diethylene glycol monomethyl ether, the improvement comprising contacting the cellulosic fibers of the napped fabric with water, preformed disperse dye and solvent, removing a substantial part of the water by drying, overspraying the fibers after said removal of water with a water-solvent mixture, heating until the cellulosic fibers are contacted throughout with a solution of the dye, and thereafter fixing the dye and recovering napped fabric having the water swellable cellulosic fibers dyed throughout.

7 Claims, No Drawings

PROCESS FOR DYEING NAPPED FABRICS OF WATER SWELLABLE CELLULOSE FIBERS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention is directed to a process for dyeing napped fabrics of water swellable cellulosic fibers, either alone or in blends or mixtures with synthetic fibers, with preformed dyes.

2. Description of the Prior Art

It is well known in the art that synthetic fibers, for example, fibers prepared from polyesters, polyamides or cellulose acetate, can be dyed with a wide variety of disperse dyes whose solubilities in water vary from very low to moderately high.

Natural fibers such as water swellable cellulosic fibers, especially cotton, are dyed by processes, and with dyes, which usually differ markedly from the processes and dyed employed with synthetic fibers. The conventional methods for dyeing water swellable cellulosic materials may be summarized as follows:

1. A high molecular weight water insoluble dye is formed within the material, either by reacting two smaller components, as in the formation of an azoic dye by a coupling reaction, or by a chemical reaction which renders insoluble a soluble dye precursor, as in vat and mordant dyeing.
2. A water soluble preformed dye having an affinity for the cellulosic material is exhausted onto the material from an aqueous solution by a procedure which involves reducing the solubility of the dye in the aqueous solution, as with direct dyes.
3. A dye containing a substituent which reacts with the cellulose or a modified cellulose may be exhausted onto the material from either an aqueous or non-aqueous solution under conditions such that the dye is chemically bonded to the substrate, as with fiber reactive dyes.
4. Water insoluble pigments are bonded to the cellulose with polymeric materials, as in pigment printing.
5. A finely divided form of a water insoluble dye is incorporated into the cellulose during a manufacturing step, as is sometimes done during spinning of viscose rayon.

None of these conventional procedures can be used to dye cellulose by directly introducing into the material a preformed, nonreactive, water insoluble dye since such dyes have little natural affinity for or substantivity to cellulosic materials.

Representative of the aforesaid processes wherein dyes are formed in situ after a precursor is deposited on or within the cellulose are processes disclosed in U.S. Pat. Nos. 396,692 and 2,069,215 and British Pat. No. 1,071,074. A process employing water soluble preformed dyes for dyeing cellulose is discussed in the Journal of the Society of Dyers and Colourists, 73, 23 (1957).

The use of water insoluble dyes for dyeing cellulose acetate is disclosed in U.S. Pat. No. 2,923,593. However, such substrates are considered in the art as nonswellable in the presence of water and the dyeing thereof is recognized as being unlike the dyeing of water swellable cellulosic materials.

The aforesaid processes suffer from a variety of disadvantages, such as complexity of application, inability to achieve a broad spectrum of colors, and low fastness of the dyed cellulose to aqueous washing and/or drycleaning with organic solvents.

The use of dyes of lower water solubility for dyeing cotton is disclosed in British Pat. No. 1,112,279. The process involves the application of dye, water and urea or a structurally related compound to the substrate, followed by heating. In such a process dye utilization frequently is poor and undesirable basic degradation products from the urea or related compound may be formed.

Problems in addition to the above are encountered in the use of prior art dyeing processes for blends or mixtures of cellulosic and synthetic materials. Generally, complex two-stage processes are required and the components of the blend or mixture are dyed in separate steps with different dyes. The amounts of dyes required usually are high, with each component undesirably interfering with the dyeing of the other. The complexity of the two-stage process also is apparent from a consideration of the divergency of operating conditions between conventional dyeing processes for cellulosic and synthetic materials. In contrast to the aforesaid procedures for dyeing cellulose, the usual procedures for dyeing synthetic materials are based on dissolution of water insoluble dyes in the synthetic material.

Representative of prior art on the dyeing of blends of cellulosic and synthetic materials employing a two-stage process is U.S. Pat. No. 3,313,590. Analogous to the dyeing of such blends and confirming the aforesaid distinction between swellable cellulosic materials and nonswellable cellulose acetate, U.S. Pat. No. 3,153,563 discloses a two-stage process wherein the cellulose acetate is dyed with a water insoluble dye without coloring the cellulose which then is dyed in an independent step.

The swelling of cotton fibers and other cellulosic materials by water has long been known. Swelling usually is rapid upon contact with water, but it is facilitated by wetting agents and by heat. The swollen materials are enlarged, more flexible, reduced in strength, and otherwise modified in physical and mechanical properties. Because of their open structure, swollen cellulosic materials can be penetrated by and reacted with low molecular weight water soluble compounds. Valko and Limdi in the Textile Research Journal, 32, 331–337 (1962) report that cotton can be swollen with water containing both high boiling, water soluble, nonreactive compounds of limited molecular weight and a crosslinking agent. The water can be removed with retention of swelling and crosslinking can then be effected. The authors suggest that the technique may be useful not only for the introduction into cotton of water soluble reactive materials (crosslinking agents) but also other reactive materials which are insoluble in water but soluble in said high boiling, water soluble, nonreactive compound. A similar technique is described in U.S. Pat. No. 2,339,913 issued Jan. 25, 1944 to Hanford and Holmes. The cellulosic is swollen with water, the water then is replaced with methanol-benzene and finally with benzene, with retention of swelling. A cellulose-reactive material (crosslinking agent) is added as a benzene solution and crosslinking is effected.

Blackwell, Gumprecht and Starn in Canadian Pat. No. 832,343 disclose a process for dyeing water swellable cellulosic materials with preformed disperse dyes, that is, dyes which do not require an in situ chemical reaction, such as oxidation or reduction, for development of color on the substrate, such as a fabric, which

process comprises contacting a water swellable cellulosic material in any sequence with the following:

1. water in an amount sufficient to swell the cellulose;
2. a preformed dye in an amount sufficient to color the cellulose, a boiling saturated solution of which dye in 0.1 Molar aqueous sodium carbonate exhibits an optical absorbance not in excess of about 30; and
3. a solvent in an amount sufficient to maintain swelling of the cellulose if water is removed, and which
   a. is at least 2.5 weight percent soluble in water at 25°C.,
   b. boils above about 150°C. at atmospheric pressure,
   c. is a solvent for the dye at some temperature in the range of about 0° to 225°C., and
   d. has the formula

$$R(O-\underset{\underset{C_nH_{2n+1}}{|}}{CH}-CH_2)_mR^1 \text{ or } [R(O-\underset{\underset{C_nH_{2n+1}}{|}}{CH}-CH_2)_mO]_xA$$

wherein

n is 0 or 1;

m is a positive whole number;

R is H, C_{1-8} alkyl, C_{7-15} aralkyl or alkaryl,

$$R^2\overset{\overset{O}{\|}}{C}-,$$

R^2SO_2-, or

$$R^2O\overset{\overset{O}{\|}}{C}-,$$

wherein R^2 is C_{1-8} alkyl, C_{5-10} cyclo-alkyl, C_{7-15} aralkyl or alkaryl, C_6 aryl, C_{10} aryl, or furfuryl;

R^1 is —OH, $-OR^2$, $-SR^2$, $-NHR^2$, $-NR^2(C_{1-8}$ alkyl), $-NR^2(C_{7-15}$ aralkyl or alkaryl),

$$-O\overset{\overset{O}{\|}}{C}R^2,$$

$-OSO_2R^2$,

$$-O\overset{\overset{O}{\|}}{C}OR^2$$

—NH(phenyl), or —NH(naphthyl), wherein R^2 is as defined above;

x is the number of unsatisfied valencies in A; and

A is $ROCH_2CHORCH_2-$, $-CH_2CHORCH_2-$,

$$-CH_2\underset{|}{C}HCH_2-$$

$-CH_2C(CH_2OR)_3$, $(-CH_2)_{C(CH_2OR)_2}$, —, $(-CH_2)_3CCH_2OR$, $(-CH_2)_4C$, $-CH_2(CHOR)_yCH_2OR$, $-CH_2(CHOR)_yCH_2-$or $-CH_2(CHOR)_{y-z}(-CH)_zCH_2-$in which y is 2, 3 or 4; z is 0, 1 2, 3 or 4 but no greater than y; and R is as defined above;

provided that at some stage during the process the interior of the swollen cellulose is contacted with a solution of the preformed dye in aqueous solvent or solvent.

Particular embodiments of the aforesaid process include those wherein said solution is formed within and/or outside the swollen cellulose and those wherein solution of dye is aqueous dye solvent or dye solvent is achieved by means of heat, by reducing the proportion of water to dye solvent, or by adding an auxiliary solvent. Embodiments of the process also include dyeing at elevated temperatures.

Still other embodiments of the aforesaid process include the dyeing of blends or mixtures of cellulosic and synthetic materials, such as polyamide or polyester, with the same dye. In such a process the cellulose is dyed as described above and the synthetic material is dyed either at the same time or in an independent step of the process.

Conventional vat and disperse dyes can be used in the Blackwell et al. process, but most such dyes are unsatisfactory in commercial operations. The vat dyes usually provide only surface staining because they lack sufficient solubility in the Blackwell et al. solvents and do not penetrate the fiber. Such surface stains can be largely removed by aqueous detergent or drycleaning scour. The conventional disperse dyes, on the other hand, although they may penetrate the fiber, are sufficiently soluble in hot alkali to be removed during aqueous detergent scour.

When a water-insoluble dye is applied by padding to a cellulosic fabric by the action of heat in the absence of a dye solvent, penetration of the fibers by the dye is essentially zero. As a solvent of the type disclosed by Blackwell et al. is added to the pad-bath in increasing amounts, the penetration and hence the fixation of the dye within the cellulose also increases, until a maximum level is reached which is not exceeded by the addition of more solvent. Whether or not this maximum level of fixation is essentially quantitative depends on (a) the amount of dye in the pad-bath, (b) the solubility of the dye in the solvent, and (c) the solvent/cellulose ratio. If a deep shade is desired, enough dye must be carried into the cellulosic fibers by the solvent to produce the desired shade. Thus, the dye must be highly soluble in the solvent at the dyeing temperature.

When a water-insoluble dye is applied by padding to a cellulosic blend fabric, such as a polyester-cotton blend, by the action of heat in the absence of a dye solvent, only the synthetic component of the blend is dyed. Any dye adhering to the cellulosic fibers is removed by scour. As a solvent of the type disclosed by Blackwell et al. is introduced into the dyebath in increasing amounts, the fixation of dye on the cellulosic portion of the blend rises accordingly, producing deeper shades on the cellulose and hence on the blend fabric. At a certain point, enough solvent will be present to cause essentially quantitative fixation of the dye on the fabric. At this point, the distribution of the dye between the blend components will depend on the dye, the solvent and the composition and weight of the fabric itself. If the amount of solvent in the dyebath is increased still further, the total fixation of dye remains about the same, but the distribution of dye shifts in favor of the cellulosic portion.

Ideally, the components of a blend fabric are dyed to equal strength in order to obtain a) the maximum levelness of dyeing and b) the minimum degree of frosting of the fabric with wear. Frosting is a well known phenomenon which manifests itself as discolored areas caused by the uneven rate of wear of the components of a blend fabric if the components differ significantly in the shade and strength at which they are dyed. In some instances, however, it is found that the strongest dyeings are obtained on a blend fabric when the cellu-

losic portion is dyed more strongly than the synthetic portion. Such a condition is satisfactory as long as the difference in strength between the blend components is not sufficiently great to render the levelness of dyeing and the frosting characteristics of the fabric unacceptable.

In the aforementioned process of Blackwell et al., it is desirable to use the minimum amount of solvent necessary to achieve a satisfactory dyeing on cellulose or a cellulosic blend fabric, thus reducing (a) the initial cost of the solvent and (b) the problem of recovering the solvent after dyeing is complete. It has been found that the amount of solvent generally required can be reduced if a small amount of boric acid, borax or a mixture thereof is added to the solvent.

Although high fixation of dye on fabrics composed of water swellable cellulosic fibers, such as cotton or rayon fibers, or blends thereof with synthetic fibers, such as polyester or nylon fibers, can be obtained by the aforesaid process of Blackwell et al., certain difficulties may arise when napped (fuzzy) fabrics are dyed, particularly in deep shades, by this process. More specifically, the surface fibers of napped, water swellable cellulose-containing fabrics may be left undyed, giving the material a fuzzy or hairy appearance, and non-uniform dyeings may be obtained. Such effects are undesirable in commercial applications.

OBJECTS AND SUMMARY OF THE INVENTION

It is an object of the present invention to provide a process for dyeing napped fabrics of water swellable cellulosic fibers, continuously if desired, with a broad spectrum of preformed dyes of limited water solubility, said process providing high utilization of the dye. A further object is to provide a process for dyeing such napped fabrics to deep shades of excellent uniformity. A still further object is to provide a process for uniformly dyeing both surface fibers and non-surface fibers in such napped fabrics. Another object is to provide a process for dyeing water swellable cellulosic fibers in admixture or blended with synthetic fibers. Still another object is to provide a process for union dyeing both the cellulosic and synthetic components of a fiber blend or mixture by means of a single dye. Another object is to provide a process for dyeing blends or mixtures of cotton and polyester or cotton and polyamide. A further object is to provide dyed cellulosic fibers, and blends or mixtures thereof with synthetic fibers, which are fast to aqueous washing and/or drycleaning with organic solvents.

In summary, the present invention resides in an improved process for dyeing napped fabrics comprising water swellable cellulosic fibers, for example cotton fibers, alone or blended with synthetic fibers, for example polyester fibers, by contacting the cellulosic fibers of the fabric throughout with an aqueous solvent- or solvent solution of a preformed disperse dye of low water solubility, said solvent consisting of ethylene glycol or a derivative thereof which is at least partially miscible with water, has a boiling point above 150°C., and is a solvent for the dye at some temperature up to 225°C., for example diethylene glycol monomethyl ether, the improvement comprising contacting the cellulosic fibers of the napped fabric with water, preformed disperse dye and solvent, removing a substantial part of the water by drying, overspraying the fibers after said removal of water with a water-solvent mixture, heating until the cellulosic fibers are contacted throughout with a solution of the dye, and thereafter fixing the dye and recovering napped fabric having the water swellable cellulosic fibers dyed throughout.

DETAILED DESCRIPTION OF THE INVENTION

As already indicated above, the invention resides in an improved process for dyeing napped fabrics comprising water swellable cellulosic fibers. A significant feature of the process of this invention is that the fibers of the napped fabric are contacted twice with water and solvent, the first time in the conventional manner according to the process of Blackwell et al., the second time as a water-solvent overspray after removal of a substantial part of the water first applied. A critical feature of the present invention, therefore, is the inclusion of the water-solvent overspray. The relative amounts of water and solvent in the overspray and the total amount of the overspray are also critical. If excessive water is present, or if the quantity of water-solvent overspray is excessive, the dyeings are weakened. On the other hand, if insufficient solvent is present in the overspray, the improvement of the invention may not be realized, and in fact, the dyeing may be inferior to that obtained without the overspray.

The following description is intended to demonstrate one embodiment of the present invention wherein the aforesaid critical limitations are included. The description is based upon a padding operation. The napped fabric comprising water swellable cellulosic fibers is padded with a dyebath comprising:

1. an aqueous dispersion of a water insoluble, preformed disperse dye, sufficient water being present to swell the cellulosic fibers;
2. about 50–300 grams per liter of a solvent which is ethylene glycol or a derivative thereof which is at least partially miscible with water, has a boiling point above 150°C., and is a solvent for the dye at some temperature up to 225°C.;
3. optionally, up to about 15 grams per liter of boric acid.

The padded fabric is dried, using conventional procedures, until a substantial part of the water is removed; it then is oversprayed to about 2.5–20 percent pickup, based on the weight of fabric, with a water-solvent mixture containing about 5–20 weight percent of the solvent. Optionally, the water-solvent mixture can contain up to 1 weight percent boric acid. Finally, the fabric is heated for at least about 30 seconds, preferably 0.5–3 minutes, at 150°–225°C. until the cellulosic fibers are contacted throughout with a solution of the dye. The dye is then fixed within and throughout the fibers by precipitating same and the dyed napped fabric is recovered.

The overspraying of the fabric, after removal of a substantial part of the water, can be carried out by passing the padded, dried fabric between two rows of nozzles which are arranged so that aqueous solvent can be directed uniformly across its width onto both sides of the fabric.

In a more generalized description, the present invention comprises an improved process for dyeing napped fabrics comprising water swellable cellulosic fibers which increase in size and flexibility upon exposure to water, at high utilization of dye, with a colored preformed dye which has limited water solubility and does not require oxidation, reduction, hydrolysis or other

chemical modification for fixation or development of color, which improved process comprises

A. contacting the water swellable cellulosic fibers in any sequence, including simultaneously, with:

1. water in an amount sufficient to swell the cellulosic fibers;
2. a colored preformed disperse dye of low water solubility, in an amount sufficient to color the cellulosic fibers;
3. a solvent in an amount sufficient to maintain swelling of the cellulose if water is removed, which solvent is ethylene glycol or a derivative thereof which is at least 2.5 weight percent soluble in water at 25°C., boils above 150°C. at atmospheric pressure, and is a solvent for the dye at some temperature up to 225°C.;

B. drying the fibers to remove a substantial part of the water;

C. overspraying the fibers to about 2.5–20 percent pickup, based on the weight of fabric, with a water-solvent mixture containing about 5–20 weight percent solvent;

D. heating until the fibers are contacted throughout with a solution of the preformed dye in solvent or solvent-water;

E. fixing said preformed dye throughout the cellulosic fibers by precipitating same; and

F. recovering napped fabric having uniformly dyed cellulosic fibers.

The solvents and the dyes which are useful herein include the solvents and the dyes described by Blackwell et al. The solvents also may be described by the formulas recited hereinabove. Although the present invention is useful in any embodiment of the aforesaid Blackwell et al. process, it is especially useful in padbath embodiments; it includes within its embodiments the dyeing of blend fabrics having water swellable cellulosic fibers and synthetic fibers, for example, cotton-polyester blend fabrics.

The following examples reflect dyeing processes employing dye, water and solvent, as described above, and in addition, boric acid. The incorporation of small amounts of boric acid, borax or a mixture of the two into the pad-bath has the effect of producing stronger dyeings on the cellulosic component and weaker shades on the polyester component of blend fabrics, the total dye fixation remaining about the same. The overall visual effect may be a net increase, no noticeable difference or a net decrease in shade strength on the blend fabric depending on the dye, the solvent, the quantities of solvent and boric acid in the padbath and the composition and weight of the fabric itself. The use of boric acid or borax is not part of this invention and the following-described processes still provide the benefits of the invention in the absence of such materials.

EXAMPLE 1

A fuzzy (napped) twill fabric made of 65/35 polyester/cotton fibers was padded at about 60 percent pickup with a bath containing

the navy blue disazo dye obtained by coupling p-nitroaniline to α-naphthylamine and thence to N,N-diethyl-m-toluidine (15% paste)	100 grams
"Superclear" thickener (25% solution)	60 grams
methoxypolyethylene glycol, M.W. 550	75 grams
butyl carbitol	25 grams
boric acid	4.8 grams
water	to 1 liter.

The padded fabric was passed at a rate of 2 yards per minute between two 1,000 watt infrared lamps, with each lamp shining on opposite surfaces of the fabric from a distance of about 3 inches. The fabric was then passed through a circulating air oven, at 120°C., with a hold-up time of 1 minute.

The fabric was then divided into portions and each was sprayed on one side with aqueous solvent formulations of various concentrations and at various loadings. The portions of fabric were then cured for 90 seconds at 213°C., rinsed in water, scoured in 1 percent "Duponol" RA anionic detergent for 1 minute, rinsed in water and dried. The fabric samples were dyed a deep navy blue shade.

The solvent formulations used were:

a) methoxypolyethylene glycol, M.W. 350	100%;
b) methoxypolyethylene glycol, M.W. 550	56.2%
butyl carbitol	18.7%
boric acid	3.6%
water	to 100%(by weight).

Each of these formulations was dissolved in water to the extent of 2.5, 5, 10 and 20 percent. The loading of these aqueous solvent solutions on the padded, dried fabric varied from 2.5 to 20 percent, based on the weight of the fabric, in 32 different experiments. As a standard, one sample of the padded fabric from above, without the overspray, was cured as described. The resulting dyed portions from overspraying with either of the two aqueous solvent systems showed essentially the same results which were as follows:

1. The dyed fabric samples which had been oversprayed with 5% aqueous solvent showed a marked improvement in the dyeing of the surface fibers only at the lower end of the loading range (2.5–5 percent).
2. As the concentration of solvent in the overspray formulation was increased, so did the loading range over which a distinct improvement in dyeing of surface fibers was noted.
3. The best results were obtained at lower loading with higher solvent concentrations.
4. At solvent concentrations of 2.5 percent in the overspray formulation, the dyeing of surface fibers was worse than the standard.
5. The overspray procedure improved the uniformity of shade and had little or no effect on the overall strength of the dyed fabric.

EXAMPLE 2

Example 1 was repeated except as follows. The still-moist padded fabric, after passing between the infrared lamps, was oversprayed on both sides with aqueous solvent and passed over a series of 12 revolving smooth-surfaced drums increasing stepwise in temperature from 100°C. to about 150°C. The average contact time on each drum was about 18 seconds. The overspray was carried out with 5–20 percent aqueous solutions of solvent formulation (b) as described in Example 1. The loading varied from 2.5–5 percent. The fabric was cured and scoured as previously described.

Considerable improvement in the dye coverage of the surface fibers was obtained in each case. When the overspray was applied after the hot drums, surface coverage was slightly poorer but uniformity of shade was improved.

EXAMPLE 3

The blend fabric described in Example 1 was padded at about 60 percent pickup with a dyebath containing

the dye of Example 1 (15% paste)	53.7 grams
1,4-diaminoanthraquinone-2,3-dicarbox-(N-octyl)-imide (15% paste)	37 grams
the monoazo dye obtained by coupling 2-nitro-4-toluidine to benzoylacet-α-naphthamide (15% paste)	10.3 grams
"Keltex" S thickener (1% solution)	150 ml.
methoxypolyethylene glycol, M.W. 550	131 grams
boric acid	8.4 grams
water	to 1 liter.

The padded fabric was predried in an infrared dryer and then dried over hot drums as described in Example 2. The dried fabric was sprayed with the following formulation

methoxypolyethylene glycol, M.W. 550	75 grams
butyl carbitol	25 grams
boric acid	4.8 grams
water	to 1 liter.

In three separate runs, the fabric was sprayed to the extent of 5, 10 and 15 percent pickup, respectively. Each sample was cured at 210°C. for 135 seconds and scoured as in Example 1. The material was dyed a deep blue shade. Fuzz coverage was better in each case than a standard (not oversprayed) sample.

EXAMPLE 4

Example 3 was repeated except that the padbath contained only 87 grams of the glycol and 5.6 grams of boric acid and, in addition, contained 29 grams of butyl carbitol. The padded fabric was treated as in Example 3, with essentially the same fuzz coverage results, although the dyeings of Example 3 were somewhat smoother.

EXAMPLE 5

A cotton poplin fabric was padded at about a 70% pickup with a dyebath containing

the dye of Example 1 (15% paste)	100 grams
"Superclear" thickener (25% solution)	60 ml.
methoxypolyethylene glycol, M.W. 550	151 grams
butyl carbitol	50 grams
boric acid	9.6 grams
water	to 1 liter.

The padded fabric was predried in an infrared dryer and then dried over hot drums, as described in Example 2. Samples of the padded dried fabric were then oversprayed to about a 10 percent loading with 5, 10 and 15 percent aqueous solutions of the solvent formulations (a) and (b) described in Example 1. The material was cured at 213°C. for 90 seconds and scoured as described in Example 1. In each case, the dye coverage of the surface fibers was significantly better than a sample that was not oversprayed with aqueous solvent before curing.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In an improved process for dyeing napped fabrics comprising water swellable cellulose fibers by contacting the cellulose fibers of the fabric throughout with an aqueous solvent- or solvent solution of a preformed disperse dye of low water solubility, and solvent consisting of ethylene glycol or a derivative thereof which is at least partially miscible with water, has a boiling point above 150°C., and is a solvent for the dye at some temperature up to 225°C., the improvement comprising:

A. contacting the cellulose fibers of the napped fabric with water, preformed disperse dye and solvent;

B. removing a substantial part of the water by drying;

C. overspraying the fabric to about 2.5 to 20 weight percent pickup, based on the weight of fabric, with a water-solvent mixture containing about 5–20 weight percent solvent, which solvent is ethylene glycol or a derivative thereof

D. heating until the cellulose fibers are contacted throughout with a solution of the dye; and

E. fixing the dye and recovering napped fabric having the water swellable cellulose fibers dyed throughout.

2. The process of claim 1 wherein the cellulosic fibers are contacted with water, dye, solvent and boric acid.

3. The process of claim 1 wherein the water swellable cellulose fibers are cotton fibers.

4. In an improved process for dyeing napped fabrics comprising water swellable cellulose fibers by contacting the cellulose fibers of the fabric throughout with an aqueous solvent- or solvent solution of a preformed disperse dye of low water solubility, said solvent consisting of ethylene glycol or a derivative thereof which is at least partially miscible with water, has a boiling point above 150°C., and is a solvent for the dye at some temperature up to 225°C., the improvement comprising:

A. padding the napped fabric with a dyebath comprising:

1. an aqueous dispersion of a water insoluble preformed disperse dye, sufficient water being present to swell the cellulose fibers; and

2. about 50–300 grams per liter of a solvent which is ethylene glycol or a derivative thereof which is at least partially miscible with water, has a boiling point above 150°C., and is a solvent for the dye at some temperature up to 225°C.;

B. removing a substantial part of the water by drying;

C. overspraying the fabric to about 2.5–20 weight percent pickup, based on the weight of fabric, with a water-solvent mixture containing about 5–20 weight percent solvent which solvent is ethylene glycol or derivatives thereof;

D. heating the fabric for at least 30 seconds at 150°–225°C. until the cellulose fibers are contacted throughout with a solution of the dye; and

E. fixing the dye within and throughout the fibers by precipitating same and recovering dyed napped fabric.

5. The process of claim 4 wherein the dyebath contains up to 15 grams per liter of boric acid and heating is carried out for 0.5–3 minutes.

6. The process of claim 5 wherein the water-solvent mixture contains up to 1 weight percent boric acid.

7. The process of claim 4 wherein the water swellable cellulose fibers are cotton fibers.

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