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METHOD OF COLORING TEXTILE FABRICS

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This invention relates to the dyeing of textile fabrics with pigmented lacquers, and has particular reference to a new and novel method of dyeing fabrics, in which the dyeing is done by the use of a dye bath comprising a pigmented lacquer containing water emulsified therein.

Textile fabrics are almost universally colored by being treated with a solution of a dyestuff in an aqueous medium; the soluble dyestuff is precipitated in the capillaries of the fibers of the yarns, or is caused to adhere chemically to the textile material. In some cases, water insoluble dyestuffs having an affinity for certain synthetic fabrics are used in solution in other solvents. Since all of these dyestuffs must be capable of conversion from the soluble state to the insoluble state in contact with the fiber, and since they must be resistant to a great variety of deteriorating influences, the problem of providing inexpensive, fast textile colors has always been a pressing one.

The ready availability and low cost of the insoluble pigment colors has prompted many investigators to study the application of these colors for the dyeing of textiles, but with relatively little success. Except where the pigment is incorporated into a spinning solution used for making synthetic fibers, unaided mechanical adhesion of the pigment to the yarns has proven unsuccessful. Attempts to cause the pigment to adhere to the fabric by the use of binders have likewise proven abortive, for a variety of reasons. A principal cause has been the failure of the pigment binders to withstand the severe conditions to which textiles are subjected; the failure of the binder leaves the pigment in mere mechanical contact with the fabric, whence it is easily removed. A second important difficulty has been that of even application of very small quantities of pigment plus binder, so that the fabric is colored uniformly. The problem is presented by the tendency of pigments to flocculate or settle out in highly disperse media, so that uniform application is very difficult.

It has been proposed to dye textile fabrics with pigmented lacquers emulsified as the discontinuous phase of a lacquer-in-water emulsion, using heat-convertible synthetic resins as binder in the lacquer. Such emulsions give satisfactory uniform dyeings on fabrics, when the fabrics are immersed in the bath and the excess color squeezed off. However, the cloth must be heated after the dyeing operation, both to evaporate the water and solvent, and to set the resin. If the fabric is not maintained in a uniform state of tension, or if the drying is done unevenly, the color will tend to migrate and give a streaked appearance. This tendency is considerably aggravated as cloth thickness increases, so that shirting broadcloths and heavier fabrics must be handled with special equipment and with such extreme care that rapid drying is impossible. As a result, emulsion pad dyeing has for the most part been restriced to rather thin fabrics, or to special cases with heavier fabrics.

I have now discovered that cloth may be dyed with pigmented lacquers without migration, while retaining the desirable characteristics of the lacquer in water emulsions, by using for the dye bath an emulsion of an aqueous fluid in a pigmented lacquer, using at least about 20% of water.

Substantially any combination of pigments and binder may be used for very cheap fabrics such as are used for temporary displays, where light-fastness, washability and resistance to dry cleaning fluids are not essential characteristics, or where the stiffness imparted by the pigment binder is not objectionable. In the dyeing of better grade fabrics, however, where these factors are of importance, the pigments and binders must be chosen with care. The pigments must be light-fast, non-bleeding in dry cleaning solvents (petroleum hydrocarbons, carbon tetrachloride, etc.), and resistant to soap, while the binders must also be resistant to the same disintegrating influences, and at the same time bind the pigment to the fabric even when only small amounts of resin are present on the fabric. Heat-convertible synthetic resins are particularly useful, in particular the urea-formaldehyde resins (made from urea, biuret, thio-urea, melamine, and other homologues and derivatives of urea), the heat-convertible phenol-aldehyde resins, and the heat-convertible short oil alkyd resins.

Where a heavy finish is undesirable on the fabric, the binder content added to the fabric should not exceed about 2½%, and since the fabric retains about an equal weight of dyebath, the binder content of the dyebath should not in such cases exceed 2½%. In such cases, and sometimes even when higher binder concentrations are used, the lacquer phase often becomes so thin in body, particularly when a heat-convertible resin is the binder, that the pigment tends to flocculate and settle out. While the addition of water bodies up the dyebath, it does not prevent the flocculation of the pigment in the lacquer. I have found that the difficulty may be overcome by preparing an original lacquer in which the pigment does not flocculate, and then reducing the total binder content of the lacquer by adding an organic phase to the emulsion containing very little or no binder, with or without water. The added organic phase in such cases consists essentially of a volatile solvent having dissolved therein an emulsifying agent, the solvent being of such a character that

it is only partially miscible with the organic solvent of the lacquer, so that a three-phase emulsion is formed. Such an emulsion is described and claimed in my co-pending application, Serial No. 351,206, filed August 3, 1940. It consists essentially of a water phase in association with a pigmented resin-solvent aggregate, dispersed in a continuous phase consisting essentially of volatile solvent containing sufficient emulsifying agent to make the emulsion stable, and preferably under about 10% non-volatile, based on the weight of this phase.

The emulsion may be applied to the fabric in any desired way which will insure impregnation. Since the water in the emulsions bodies them so that mere immersion is not ordinarily sufficient to insure impregnation, I prefer to pass the fabric to be colored through a pressure applying means to force the material through the fabric.

Typical examples of my invention are the following:

EXAMPLE 1

Alkyd emulsion

A lacquer is made by mixing—

	Parts by weight
Alkyd resin solution—50% in toluene	20
Pine oil	8
Solvesso #3 (hydrogenated petroleum solvent—boiling range 175–210° C.)	28

Into this lacquer is emulsified—

16½% aqueous pulp of Lithosol Blue G. L	20
Water	24
	100

The alkyd resin of this lacquer is glycerol phthalate, modified with 33% soya oil fatty acids; it can be set by heat. It is soluble in aromatic hydrocarbons, and will precipitate on further dilution with aliphatic hydrocarbons, or with mixtures containing substantial quantities of aliphatics. The tendency of this lacquer toward immiscibility with added solvents is increased by pigmentation, as with all resin.

This emulsion may be used to color cloth by passing the cloth with the emulsion through a mangle which forces the emulsion through the cloth. On drying and setting the resin to the insoluble state, a rather stiff cloth is obtained, although the fabric is not as stiff as one obtained with an unemulsified lacquer of similar composition. No migration is observed.

EXAMPLE 2

Reducing emulsions

A lacquer is made by mixing—

	Parts by weight
A solution of— 50 alkyd resin, 15 pine oil, 35 Solvesso #3	1.20
15% rubber solution in Solvesso #2 (hydrogenated petroleum solvent—boiling range 135–177° C.)	1.00
Solvesso #2	22.00

Into this lacquer is emulsified a mixture of—

Sodium chloride	0.15
35% sulfonated tannin solution	0.12
Acetic acid	0.06
Water	75.47
	100.00

The alkyd resin is a 40% drying oil modified glycerol phthalate resin, which is freely soluble in hydrogenated petroleum solvents, as distinguished from the alkyd resin of Example 1.

This unpigmented emulsion contains 0.75% solids; the lacquer phase contains about 3% solids. It may be blended with the pigmented emulsion of Example 1 (13.2% solids—lacquer phase about 18% solids) in ratios of 1 to 1 and higher, to produce a three-phase system in which a low-solids clear lacquer is the outer phase, and water and resin-solvent aggregates bearing pigment are the inner phases. Microscopic examination of the mixture indicates that the two disperse phases are in very close contact with one another. The mixtures are stable. When admixed with the emulsion of Example 1, in ratios of 5 or more to 1.0, pigment dyebaths are obtained which yield soft fabrics, due to the low solids content of the bath.

EXAMPLE 3

Urea resin composition

An emulsion was made from a lacquer containing—

	Parts by weight
Solvent-soluble urea-formaldehyde resin solution (50 resin, 30 butanol, 20 xylene)	12.0
Ethyl cellulose (47% ethoxy—10 centipoise viscosity)	10.0
Butanol	4.0
Solvesso #2	44.0

and an aqueous phase containing—

Benzidine yellow pulp (dry basis)	2.0
Water	28.0
	100.0

The lacquer contains about 23% solids, the emulsion 16%. It can be reduced with the diluting emulsion of Example 2, to give similar results. It may also be reduced with other unpigmented emulsions, such as the following.

EXAMPLE 4

Ethyl cellulose reducing emulsion

	Parts by weight
Ethyl cellulose (47% ethoxy—500 centipoise viscosity)	0.4
Pine oil	2.6
Solvesso #2	25.0
Water	72.0
	100.0

This clear emulsion has 0.4% solids; the lacquer phase has about 1.3% solids.

EXAMPLE 5

Urea-formaldehyde alkyd paste

A typical water-in-lacquer emulsion may be made as in Example 1 from

	Parts by weight
Urea resin solution of Example 3	5.0
Alkyd resin solution of Example 1	15.0
Pine oil	5.0
Solvesso #3	34.0
20% pulp phthalocyanine green	30.0
Water	11.0

This can be reduced with the unpigmented emulsion of Examples 2 and 4, with results similar to Example 2.

EXAMPLE 6

	Parts by weight
Solvent-soluble melamine-formaldehyde resin (50 resin, 30 butanol, 20 xylene)	4.0
Alkyd resin solution (65 parts alkyd resin of Example 2, 35 parts xylene)	15.5
Solvesso #3	27.5
Benzidine yellow—dry basis, but used as pulp	1.6
Water	51.4

Made as in Example 1; it may be reduced with the unpigmented emulsions of Examples 2 and 4.

All of the above examples may be made by first mixing the pigmented lacquers with the clear lacquers of Examples 2 and 4, provided water is immediately emulsified therein; or the clear lacquers of Examples 2 and 4 may be added to the pigmented emulsions with stirring. These methods, however, lack flexibility, since the colored emulsion and the diluting emulsion may both be made of printing consistency, so they can be mixed in any desired proportions before use.

Obviously the examples may be multiplied indefinitely without departing from the scope of my invention, which is defined in the claims. Obviously, while I have shown only preferred binders in my examples, natural resins, cellulose esters and ethers, natural and synthetic rubber, and other pigment-binding substances may be applied to cloth in the indicated fashion, while avoiding migration. While my method of diluting the emulsions to obtain a low solids content is highly desirable, especially with heat-convertible resins, it is not essential where the pigment may be dispersed without flocculation otherwise, as with high viscosity cellulose derivatives.

I claim:

1. The method of pigment dyeing a fabric while avoiding migration of color on drying, which comprises forcing through the fabric a pigmented emulsion containing at least about 20% of an inner aqueous phase, and an outer continuous lacquer phase, and thereafter drying the fabric.

2. The method of pigment dyeing a fabric while avoiding migration of color on drying, which comprises forcing through the fabric a pigmented emulsion containing at least about 20% of an inner aqueous phase, and an outer continuous lacquer phase, the emulsion containing a heat-convertible synthetic resin to bind the pigment to the fabric, and thereafter heating the fabric to dry it and convert the resin to its insoluble state.

3. The method of pigment dyeing a fabric while avoiding migration of color on drying, which comprises forcing through the fabric a pigmented emulsion containing at least about 20% of an inner aqueous phase, and an outer continuous lacquer phase, the emulsion containing a urea-formaldehyde type resin to bind the pigment to the fabric, and thereafter heating the fabric to dry it and convert the resin to its insoluble state.

4. The method of pigment dyeing a fabric while avoiding migration of color on drying, which comprises forcing through the fabric an emulsion the outer phase of which is a solution consisting essentially of solvent having dissolved therein an agent capable of forming a water-in-lacquer emulsion, and the inner phase of which comprises at least 20% of water based on total emulsion weight, and a pigmented complex of solvent and heat-convertible synthetic resin, the total binder content of the emulsion being not above about 2½%, and thereafter heating the fabric to dry it and convert the resin to its insoluble state.

5. The method of pigment dyeing a fabric while avoiding migration of color on drying, which comprises forcing through the fabric a pigmented emulsion containing at least about 20% of an inner aqueous phase, and an outer continuous lacquer phase, the emulsion containing a heat-convertible synthetic resin to bind the pigment to the fabric, the total binder content of the emulsion being not above about 2½%, and thereafter heating the fabric to dry it and convert the resin to its insoluble state.

6. The method of pigment dyeing a fabric while avoiding migration of color on drying, which comprises forcing through the fabric an emulsion the outer phase of which is a solution consisting essentially of solvent having dissolved therein an agent capable of forming a water-in-lacquer emulsion, and the inner phase of which comprises at least 20% of water based on total emulsion weight, and a pigmented complex of solvent and heat-convertible synthetic resin, and thereafter heating the fabric to dry it and convert the resin to its insoluble state.

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