CONCENTRATED SULFURIC ACID-DYE SOLUTION DYING

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ABSTRACT

Various types of fibers, especially fibers which can ordinarily only be dyed with some difficulty, are dyed in a relatively short period of time at a relatively low temperature by using a dye bath in which the dye is dissolved in concentrated sulfuric acid, and in which a buffering compound, such as an alkali salt of a weak acid, is preferably added.

5 Claims, No Drawings
CONCENTRATED SULFURIC ACID-DYE SOLUTION DYING

BACKGROUND OF THE INVENTION

1. Field of Invention

This invention relates to a process for dyeing natural and synthetic fibers and synthetic polymers at a relatively low temperature and at a relatively accelerated speed.

2. Description of Prior Art

It is well known that retarding agents can be used in a fiber dyeing solution in order to maintain a more uniformly colored fiber. It is also well known that the dye bath can be heated to accelerate the fiber dyeing process and thereby produce a more deeply colored product. In order to dye a difficulty dyeable synthetic fiber, a superheating process or a thermal dyeing process should be employed. The difficulty of this type of process, however, is that the heated dye bath frequently causes fiber damage.

In conventional dyeing processes, a fiber is dyed in a hot dye bath for an extended period of time. Accordingly, it is necessary to use a batch type process in dyeing various fibers, and especially in dyeing the difficulty dyeable synthetic fibers. Although using a batch process has the disadvantage that it is difficult to make the color of fiber uniform, nevertheless, since the dyeing process requires a period of at least 30 minutes to one hour, a continuous system is impractical. In order to dye a difficulty dyeable synthetic fiber, the dye should be diffused into the microstructure of fiber and be fixed to it.

Although various types of accelerators and other agents have been studied in order to obtain a more uniformly and deeply colored product, heretofore, no completely satisfactory technique has been developed.

SUMMARY OF THE INVENTION

It is an object of this invention to provide a quick dyeing process at a relatively low temperature and at a relatively high speed.

It is another object of this invention to provide a continuous process for dyeing fibers at a relatively low temperature and at a relatively high speed to provide a deep, clear color having excellent fastness to light and to washing.

Other objects of this invention will become apparent as the description of the invention proceeds. These and other objects have now been attained by the following process:

A dye which is soluble and non-reactive with sulfuric acid is dissolved in concentrated sulfuric acid. A buffering compound, such as an alkali salt of a weak organic or inorganic acid, is added to the sulfuric acid solution to make a dye bath. An acid-resistant fiber, especially a difficulty dyeable synthetic fiber, is passed through the dye bath at a relatively low temperature and at a relatively high speed, whereby the dye is diffused into the internal microstructure of the fiber. The fiber is then treated with water or an alkali solution in water or an alkali solution bath, so that the dye which has been fused into the fiber's internal microstructure is crystallized out and fixed to the internal microstructure. The fiber is then washed and dried, if necessary, steamed, to obtain a clear, deep color, having excellent fastness to both light and washing.

DETAILED DESCRIPTION OF THE INVENTION

The typical quick dyeing process of this invention consists of the following four steps:

FIRST STEP

A dye which is soluble and resistant to sulfuric acid is mixed with concentrated sulfuric acid and is dissolved by heating. After cooling, a buffering compound such as an alkali salt of a weak acid is added to the solution with intense stirring. Surface active agents, retarding agents, or accelerating agents, can also be added to the dye bath, if desired.

SECOND STEP

An acid-resistant fiber, especially a difficulty dyeable synthetic fiber or a plastic material, is passed through the dye bath in 50° to 60° Centigrade, at a relatively high speed. The dye solution is then uniformly squeezed out, so that up to about 50 percent of the dye solution remains. At this point, the dye is diffused into the internal microstructure of the fiber.

THIRD STEP

The treated fiber is then contacted with water or an alkali solution, so as to cause an acid-base reaction which generates thermal energy. The dye dissolved in sulfuric acid is precipitated by the reaction and is fixed into the internal microstructure of the fiber by thermal energy. All of the remaining dye in the fiber, which is physically absorbed, is then washed out with water.

FOURTH STEP

The washed fiber is dried and heat-treated to fix the dye. Examples of dyes and pigments which may be used for the dye bath of this invention are as follows:

1. Aromatic Condensation Polycyclic Dyes I.

2. Anthraquinone Vat Dyes

3. Indigo-vat Dyes

4. Basic Dyes

5. Anthraquinone Acidic Dyes and Other Acidic Dyes
3,652,200

3


6. Sulfide Dyes

This type of dye is usually dissolved in more than 85 percent, and preferably more than 90 percent, of concentrated sulfuric acid at 60°–65° C. Pyrogren Brilliant Violet R(C.I.53,700), Sulphur Brilliant Green GG(C.I.53,570), Sulfonene Carbon MCF(C.I.53,195), Immediath Corith B Extra(C.I.53,260), Hydron Blue G(C.I.53,640), Katigro Indigo R Extra(C.I.53,440), Thiocol Orange RR(C.I.53,050), Eclipse Red Violet(C.I.53,228), Thiogen Black(C.I.53,290), Chionone Sky Blue 6B(C.I.53,450).

7. Organic Pigment

This type of pigment is usually dissolved in more than 90 percent and preferably 95 percent, concentrated sulfuric acid at 70°–75° C. Heligen Green B(C.I.74,280), Monostaal Fast Blue GS(C.I.74,100), Hansa Yellow R(C.I.12,710), Vulcan Fast Red B(C.I.21,120), Pigment Fast Yellow G(C.I.18,700), Permanent Orange G Extra(C.I.12,060), Vulcansafire Fast Blue GG(C.I.69,800), Phthalogen-Brillian Green IFBB(C.I.74,280), Helio Fast Pink RL(C.I.60,745), Irgalate Orange PG(C.I.121,110).

8. Direct Dyes

This type of dye is usually dissolved in more than 60 percent of sulfuric acid at 60°–80° C. Pontamine Yellow WFB(C.I.19,555), Alizarine Direct Violet EEF(C.I.62,005), Helio Fast Blue BL(C.I.63,005), Benzopurpurine 10B(C.I.123,5022,570), Pyramine Orange R(C.I.24,900), Catechu Brown B(C.I.35,520), Columbia Black FB(C.I.35,730), Diazol Brilliant Green 3G(C.I.28,2802B), (C.I.14,785).

9. Dispersed Dyes

This type of dye is usually dissolved in more than 40 percent of sulfuric acid at 60°–80° C. Cellston Fast Red Violet RN(C.I.11,120), Cibacron Red 3B(C.I.60,710), Celanethrene Fast Pink 3B(C.I.62,015), Sersol Fast Red 3BL(C.I.61,140), Duraol Brilliant Blue CB(C.I.64,500), Dispersol Fast Orange B(C.I.26,080), Setacol Scarlet B(C.I.11,110), Artistt Direct Brown H(C.I.11,100), SRA Rubine B(C.I.11,070), Supracet Fast Violet B(C.I.61,105).

As mentioned above, the dyes are usually dissolved in more than 60 percent concentrated sulfuric acid and preferably more than 80 percent concentrated sulfuric acid. Some types of dyes are insoluble in dilute sulfuric acid or even in concentrated sulfuric acid. In such cases, the material of dye and sulfuric acid should be heated in order to form the solution. Certain types of dye such as anthraquinoloides can be dissolved in more than 90 percent of sulfuric acid by heating.

Suitable buffer compounds which are useful in the present invention include the alkali salts of organic or inorganic acids, such as sodium carbonate, sodium bicarbonate, sodium borate, sodium acetate, sodium tartarate, sodium lactate and the like. When the solubility of the dye in the dye bath is sufficient, the buffering compound added to the dye bath depends upon the solubility of the dye and the type of fiber or polymer. Where wool, polyamide fiber or other material which is less resistant toward sulfuric acid is dyed, the amount of the buffer compound is increased in order to prevent damage.

Certain buffer compounds, such as sodium citrate or sodium tartarate are especially desirable in that they tend to improve the solubility of the dye in the dye bath. Usually, the solubility of the dye in concentrated sulfuric acid is decreased by adding inorganic alkali compounds, such as sodium carbonate, sodium bicarbonate, addition of sodium citrate or sodium tartarate or certain other organic compounds, may actually increase the solubility of the dye in the dye bath. The buffering compound generally acts to improve the accessibility of the dye into the internal structure of the polymer or fiber and thereby enhance the diffusion of the dye into the internal structure. Even when nonaqueous dye baths are used, the buffer was observed to enhance diffusion. Usually, an organic type of buffer compound is used together with an organic type of buffer compound. The total amount of buffer compound should be insufficient, however, to tie up all of the sulfuric acid, since sufficient acid should be present to prevent premature precipitation of the dye until the fiber is treated with the neutralization bath.

Other additives may also be added to the dye bath, such as aluminum sulfate, copper sulfate, chromium sulfate, or naphthylamine. Also, nonionic surface active agents may be added, if necessary, such as alkybenzenesulfate, liquid glue or glycerine. Other conventional additives may also be added, if necessary.

The dyeing process of this invention can be used for coloring a wide variety of fibers, films, shaped articles, powders or granules such as polypropylene, polyethylene polyether, polyester, polycrylics, polystyrene, chlorine, polystyrene, and polylamide fibers, as well as animal fibers, such as wool.

The difficulty dyeable synthetic fibers, such as polypropylene, polyethylene, polyether, polycrylics, polystyrene, chlorine, polystyrene, and polylamide fibers, as well as animal fibers, such as wool.

The difficulty dyeable synthetic fibers, which have heretofore only been dyed by thermosol methods, or by high temperature treatments, can be easily dyed by this process.

3. High crystalline synthetic fibers can be dyed by this process to produce deep color effects.

4. Heretofore, only specific dyes were useful for dyeing a difficulty dyeable synthetic fiber. By the present process, however, various types of commercial dyes can be used.

5. Since dyeing time is quite short and dyeing temperature is quite low, the present process does not damage the fibers as frequently occurs by conventional dyeing methods.

The characteristic operations and results of the process of this invention are as follows:

1. Water-insoluble dyes, such as vat dyes, sulfide dyes, organic pigments and water-dispersing dyes can be used by dissolving the dye in concentrated sulfuric acid to form the dye bath. It is indispensable to dissolve the dye so that it can be diffused into the microstructure of the fiber. The water-insoluble dyes which has first been completely dissolved can be maintained in stable condition despite changes in temperature or the addition of additives. The presence of sulfuric acid therefore acts to accelerate the diffusion of the dye molecule by swelling the fiber. Sulfuric acid also acts to accelerate the absorption of the dye or pigment and it accelerates the fixing of the dye in the fiber. This latter effect is obtained by the thermal energy formed by the reaction of sulfuric acid with water or alkali solution.

2. Quick dyeing at low temperatures is achieved by using a concentrated dye bath. In order to quickly diffuse a dye into a fiber, a concentrated dye which is dissolved in the form of a molecule is preferably employed. If the dye bath is formed
from a concentrated sulfuric acid, the dyeability of the dye is increased to a very high level. Moreover, if the concentration of the dissolved dye is high, the level of dyeability is even further increased. Accordingly, dyeing at low temperatures becomes possible.

3. Most of the water-soluble dyes are quickly dissolved in concentrated sulfuric acid and the diffusion of dye depends on the concentration of dye in the dye bath.

4. In order to prevent damage caused by concentrated sulfuric acid, and in order to prevent surface dyeing, a strong alkali salt of organic or inorganic weak acid is added to the dye bath. It is generally desirable to use a buffering agent, although use of such agent is not mandatory. Depending upon the particular dye and the particular type of fiber being treated, a buffering agent should be added to prevent rapid dyeing of the fiber surface or swelling and dissolution of the fiber by the sulfuric acid. When the fiber is dyed on its surface rather than in its internal microstructure, its color brightness can be easily reduced. The buffer compound is also desirable in that it accelerates the fusion of the dye into the internal microstructure of the fiber to give a bright color and actual fixing. Where the dye is not fixed to the main structure, its permanent color can fade from the fiber. Shrinkage, hardening, and deterioration following when the fiber is subsequently washed in water or an alkali solution whereby heat is generated by the acid-base reaction.

5. A quick dyeing within as short a period of time as one to one hundred and twenty seconds is possible by the process of this invention.

Conventional dyeing methods have required about one or two hours for dyeing. On the other hand, there are difficulties in dyeing fibers which are dyeable only at high temperatures, or by thermal dyeing. However, by the present process, these difficulties can be avoided. Quick dyeing is now possible for the previously difficult dyeable fibers and is unnecessary to decrease the crystallinity of the fiber in order to render it dyeable as in the prior art. The present process, therefore, is quicker and less costly in terms of labor, heat energy and electrical energy and other costs involved in dyeing a fiber. Furthermore, by the present process, it is now possible to operate continuously rather than batch-wise as in the prior art.

EXAMPLE 1

Process For Dyeing Polypropylene And Polyvinylidenechloride Fiber

First Step: 6 parts of phthalocyanine Blue is mixed with 200 parts of 98 percent concentrated sulfuric acid and is completely dissolved by heating at 65°C. After cooling to 50°C, 50 parts of sodium acetate, and 1 part of glycerine are added and dissolved under intense agitation to form the dye bath.

Second Step: 20 parts of polypropylene fiber fabric is passed through the dye bath prepared by the First Step for 2 minutes under stirring, and then is uniformly squeezed.

Third Step: The polypropylene fiber fabric treated by the Second Step is immersed in cool water, whereby the fiber is finely dispersed and fixed in the fiber. The fabric is washed with water and then is passed through 40 times with weight of 2 percent sodium carbonate solution in order to neutralize the sulfuric acid remaining on the fabric. The fabric is then washed and dehydrated.

Fourth Step: The polypropylene fabric treated by the Third Step is dried in a ventilation drier at 60°C, and then is steam-heated at 115°C for 20 minutes, to complete the fixing and coloring. The clear and deep color polypropylene fabric having excellent fastness to light and washing is obtained by said steps. Polynvinylidene chloride fiber fabric is treated by the same process stated in the First, Second Third and Fourth Steps. The same results are obtained when other water-insoluble vat dyes, sulfide dyes or organic pigments are used instead of phthalocyanine Blue.

EXAMPLE 2

Process For Dyeing Polyester, Polyvinylchloride And Polyethylene Fiber

First Step: 10 parts of Methylene Yellow GCN is mixed with 200 parts of 98 percent concentrated sulfuric acid and is completely dissolved by heating at 50°C. 50 parts of sodium acetate, 1 part of sodium alky benzene sulfonate and 2 parts of aluminum sulfate are added and dissolved under severe agitation.

Second Step: 25 parts of polyester fiber fabric is passed through the dye bath prepared by the First Step for 30 seconds under stirring, and then is uniformly squeezed.

Third and Fourth Steps: The same steps stated in Example 1 are employed.

The clear and deep color polyester fabric having excellent fastness to light and washing is obtained by said steps. Each of polyvinyl chloride fiber fabric and polyethylene fiber fabric is treated by the same process stated in the First, Second, Third and Fourth Steps, except eliminating the steaming step. The same results are obtained in each case. Other water-insoluble vat dyes, sulfide dyes or organic pigments may be used instead of Methylene Yellow GCN with good results.

EXAMPLE 3

Process For Dyeing Polyester And Polyurethane Fiber

First Step: 8 parts of Sulphur Brilliant Green GG is mixed with 200 parts of 90 percent concentrated sulfuric acid and is completely dissolved by heating at 65°C. After cooling to 50°C, 60 parts of sodium acetate, 10 parts of sodium carbonate, and 1 part of a nonionic surface active agent is added and dissolved under intense agitation.

Second Step: 30 parts of polyester fiber fabric is passed through the dye bath prepared by the First Step for 1 minute under stirring, and then is uniformly squeezed.

Third and Fourth Steps: The same steps stated in Example 1 are employed.

A clear color polyester fabric having excellent fastness to light and washing, is obtained by said steps. Polyurethane fiber fabric is treated by the same process stated in the First, Second, Third and Fourth Steps. A clear and deep color polyurethane fabric having excellent fastness to light and washing is obtained. Other water-insoluble vat dyes, sulfide dyes or organic pigments may be used instead of Sulphur Brilliant Green GG, with similar results.

EXAMPLE 4

Process For Dyeing Polycrylic Fiber

First Step: 10 parts of Indanthrene Brilliant Orange RK is mixed with 200 parts of 80 percent concentrated sulfuric acid and is completely dissolved by heating at 60°C. 50 parts of sodium acetate, 20 parts of sodium carbonate and 1 part of nonionic surface active agent is added and dissolved under intense stirring, to make the dye bath.

Second Step: 20 parts of polycrylic fiber fabric is passed through the dye bath for 30 seconds at 60°C. under stirring, and then is uniformly squeezed.

Third and Fourth Steps: The same steps stated in Example 1 are employed.

A clear color polycrylic fabric having excellent fastness to light and washing is obtained by said steps. Other water-insoluble vat dyes, sulfide dyes or organic pigments may be used instead of the Indanthrene Brilliant Orange RK.

EXAMPLE 5

Process For Dyeing Polyester Fiber

First Step: 4 parts of Resoline Red FB is mixed with 200 parts of 60 percent concentrated sulfuric acid and is dissolved by
heating. After cooling to 40° C., 50 parts of sodium tartarate, 100 parts of sodium acetate, 30 parts of sodium bicarbonate, 120 parts of sodium carbonate, 15 parts of sodium sulfate and parts of aniline are added and dissolved under severe agitation to make the dye bath.

Second Step: 25 parts of polyester fiber fabric is passed through the dye bath prepared by the First Step, for 1 minute, under stirring, at 75° C., and then is uniformly squeezed.

Third and Fourth Steps: The same steps stated in Example 1 are employed.

The clear and deep color polyester fabric having excellent fastness to light and washing is obtained by said steps. Each of polyvinylidene chloride fiber, polypropylene fiber, polyester fiber, polyurethane fiber can be dyed with the same process. When dyeing polyvinyl chloride fiber or polyethylene fiber, the treatment in the dye bath should be for 30 seconds instead of 1 minute, and the steaming in the Fourth Step should be omitted. Other dispersion dyes or anthraquinone mulling dyes may be used instead of Roseline Red FB, with similar results.

EXAMPLE 6

Process For Dyeing Various Synthetic Fibers

First Step: 3 parts of Methyl Violet Extra is mixed with 200 parts of 80 percent concentrated sulfuric acid, and is completely dissolved by heating to 80° C. 50 parts of sodium acetate, 20 parts of sodium carbonate and 1 part of sodium alkybenzene sulfonate are gradually added to it under intense agitation to make the dye bath.

Second Step: Where polyvinyl chloride fiber, polyethylene fiber, polyacrylic fiber or polyester fiber is dyed, the dye bath is cooled to 50° C. Where either polyurethane fiber or polyester fiber is dyed, the dye bath is cooled to 65° C. Where polypropylene fiber is dyed, the dye bath is kept at 80° C. 20 parts of each fiber fabric is passed through the dye bath prepared by the First Step for 1 minute under stirring, and is uniformly squeezed.

Third and Fourth Steps: The same steps stated in Example 1 are employed, except when dyeing polyvinyl chloride, or polyethylene fiber, steaming in the Fourth Step is omitted. A clear and deep colored fabric having excellent fastness is obtained in each case. Other basic dyes may be used instead of Methyl Violet Extra with similar results.

EXAMPLE 7

Process For Dyeing Various Synthetic Fibers

First Step: 8 parts of Direct Brilliant Blue RW is mixed with 200 parts of 80 percent concentrated sulfuric acid, and is completely dissolved by heating at 80° C. 30 parts of sodium acetate and 1 part of nonionic surface active agent is mixed and dissolved under intense agitation to make the dye bath.

Second Step: Where polyvinyl chloride fiber, polyurethane fiber, polyethylene fiber or polyacrylic fiber is dyed, the dye bath is cooled to 80° C. 20 parts of each fiber fabric is passed through the dye bath prepared by the First Step for 1 minute under stirring, and is uniformly squeezed.

Third Step: Each fiber fabric treated by the Second Step is immersed in the solution consisting of 2 parts of aluminum sulfate and 100 parts of water at 65° C. for 2 minutes, and then is washed with water and dehydrated by squeezing.

Fourth Step: When dyeing polyvinyl chloride fiber or polyethylene fiber, the treated fabric is dried in a ventilation drier. When dyeing other fibers, the treated fabric is dried in a ventilation drier and then steam-heated at 115° C. for 20 minutes. A clear and deep colored fabric having excellent fastness to light and washing is obtained by said steps in each case. Other direct dyes may be used instead of Direct Brilliant Blue RW with similar results.

EXAMPLE 8

Process For Dyeing Polyamide Fiber With Direct Dye

First Step: 10 parts of Direct Orange R is mixed with and uniformly dispersed in 200 parts of concentrated sulfuric acid, and then the dye is completely dissolved by gradually heating to 80° C. The dye solution is cooled to 60° C. by standing at room temperature, after dissolving. Under severe agitation, 50 parts of sodium acetate, and 120 parts of sodium carbonate are added to the dye solution, and then 0.5 parts of sodium alky benzene sulfonate is mixed with it to make the dye bath.

Second Step: At 60° C., 40 parts of polyamide fiber fabric is passed through the dye bath prepared by the First Step, for 60–60 seconds, whereby the dye is uniformly adsorbed in the fiber, and the wet polyamide fiber fabric is uniformly squeezed so that up to 50 percent, and preferably up to 35 percent of the dye solution remains. Third Step: The polyamide fiber fabric treated by the process of the Second Step, is passed through a water bath to wash it, and to remove the dye which is physically adsorbed on the fiber, sulfuric acid and other components of dye bath. The dye adsorbed in the fiber is thereby stably fixed in the fiber. The treated fabric is passed through 40 times by weight of alkali solution made of 100 parts of water and 1 part of 28 percent of ammonia solution for 2 minutes to neutralize the sulfuric acid remaining on the fabric. Then, it is washed and dehydrated.

Fourth Step: The polyamide fiber fabric treated by the process of the Third Step is dried in a ventilation drier at 60° C., and then is steam-heated at 115° C., for 20 minutes, to completely fix the dye on the fiber and to complete the coloring. The clear orange color polyamide fiber fabric is obtained by the process. Other direct dyes may be used instead of Direct Orange R with similar results.

EXAMPLE 9

Process For Dyeing Polyamide Fiber With Basic Dye

First Step: 5 parts of Rhodamine 5G is mixed with and uniformly dispersed in 200 parts of concentrated sulfuric acid, and then the dye is completely dissolved by gradually heating to 75° C. The dye solution is cooled to 60° C. by standing at room temperature after dissolving. Under intense agitation, 30 parts of sodium acetate, 20 parts of sodium lactate, 75 parts of sodium carbonate, 25 parts of sodium bicarbonate, and 1 part of a nonionic surface active agent, are added to the dye solution, and then 100 parts of water is added to make the dye bath.

Second Step: At 45° C., 40 parts of polyamide fiber fabric is passed through the dye bath prepared by the First Step, for 20–30 seconds, whereby the dye is uniformly adsorbed into the fiber. The wet fabric is then uniformly squeezed so that up to 50 percent, and preferably up to 35 percent of the dye solution remains to prevent color spot.

Third Step: The polyamide fiber fabric treated by the process of the Second Step, is washed with cold water to remove the dye which is physically adsorbed on the fiber, sulfuric acid and other components of the dye bath, so that the dye adsorbed into the fiber is stably fixed in the fiber. The treated fabric is passed through 40 times by weight of alkali solution made of 100 parts of water and 0.3 part of sodium carbonate, for 2 minutes to neutralize the sulfuric acid remaining on the fabric. Then it is washed and dehydrated.

Fourth Step: The same step stated in Example 8 is employed. The clear and deep red color polyamide fiber fabric is obtained by the process. Other basic dyes may be used instead of Rhodamine 5G with similar results.

EXAMPLE 10

Process For Dyeing Polyamide Fiber With Acidic Dye

First Step: 5 parts of Fast Red B is mixed with and uniformly dispersed in 200 parts of 80 percent concentrated sulfuric acid, and then the dye is completely dissolved by gradually heating to 70° C. The dye solution is cooled to 60° C. by standing at room temperature, after dissolving. Under intense agitation, 150 parts of sodium acetate, 200 parts of sodium carbonate, 1 part of a nonionic surface active agent, are added to form the dye bath.
Second Step: At 50°C, 30 parts of polyamide fiber fabric is passed through the dye bath prepared by the First Step, for 15–30 seconds, whereby the dye is uniformly adsorbed into the fiber and then the wet fabric is uniformly squeezed so that up to 50 percent, and preferably up to 35 percent of the dye solution remains to prevent color spotting.

Third and Fourth Steps: The same steps stated in Example 8 are employed. A bright and deep color polyamide fiber fabric is obtained by the process. Other acidic dyes may be used instead of the Fast Red B with similar results.

EXAMPLE 11
Process For Dyeing Polyamide Fiber With Dispersion Dye
First Step: 3 parts of Resalone Blue FBL is mixed with 20 parts of 60% concentrated sulfuric acid and is dissolved by heating. After cooling to 60°C, 120 parts of sodium acetate, 30 parts of sodium tartrate, and 150 parts of sodium carbonate are added and dissolved under intense agitation to make the dye bath.

Second Step: 40 parts of polyamide fiber fabric is passed through the dye bath prepared by the First Step for 30 seconds, under constant stirring at 60°C, and then is uniformly squeezed as described in Example 10.

Third and Fourth Steps: The same steps stated in Example 8 are employed. A bright and deep shade color polyamide fabric having excellent fastness to light and washing is obtained by said steps. Other dispersion dyes may be used instead of Resalone Blue FBL with similar results.

EXAMPLE 12
Process For Dyeing Animal Fiber With Vat Dye
First Step: 7 parts of Ponsol Golden Orange 3G is mixed with and uniformly dispersed in 200 parts of 96 percent concentrated sulfuric acid, and then the dye is completely dissolved by gradually heating to 70°C. The dye solution is cooled to 50°C by standing at room temperature. Under intense agitation, 50 parts of sodium acetate, 20 parts of sodium carbonate and 0.5 part of nonionic surface active agent are added to it to make the dye bath.

Second Step: 30 parts of wool fabric is passed through the dye bath prepared by the First Step, for 30 seconds, at 60°C, whereby the dye is uniformly adsorbed into the fiber, and is uniformly squeezed so that up to 50 percent of the dye solution remains to prevent color spotting.

Third Step: The wool fabric treated by the process of the Second Step, is washed with cold water to remove the dye which is physically adsorbed on the fiber, sulfuric acid and other components of dye bath, whereby the dye adsorbed into the fiber is solidified and stably fixed in the fiber. The treated fabric is passed through 40 times by weight of alkali solution made of 100 parts of water and 1 part of 28 percent of ammonium solution for 2 minutes at room temperature to neutralize the remaining sulfuric acid and is then washed and dehydrated.

Fourth Step: The wool fabric treated by the process of the Third Step is dried in a ventilation drier, and then is steam-heated at 115°C for 20 minutes to fix the dye on the fiber and to complete the coloring. A clear and deep blue colored wool fabric is obtained by the process. Other vat dyes may be used instead of Ponsol Orange 3G with similar results.

EXAMPLE 13
Process For Dyeing Wool With Sulfinic Dye
First Step: 6 parts of Carbanol Blue LB is mixed with and uniformly dispersed in 200 parts of 90 percent concentrated sulfuric acid, and then the dye is completely dissolved by gradually heating to 60°C. The dye solution is cooled to 50°C by standing at room temperature. Under intense agitation, 30 parts of sodium acetate, 20 parts of sodium lactate, and 20 parts of sodium borate are gradually added and 1 part of liquid acetyl-glue is added to form the dye bath.

Second Step: 30 parts of wool fabric is passed through the dye bath prepared by the First Step, for 30–60 minutes, 70°C, and is uniformly squeezed so that up to 50 percent of the dye solution remains to prevent color spotting.

Third and Fourth Steps: The same steps stated in Example 10 are employed. A clear and deep green colored wool fabric is obtained by the process. Other sulfide dyes may be used instead of Carbanol Blue LB with similar results.

EXAMPLE 14
Process For Dyeing Wool With Acidic Dye
First Step: 6 parts of Brilliant Orange RN is mixed with and uniformly dispersed in 200 parts of 80 percent concentrated sulfuric acid, and then the dye is completely dissolved by gradually heating to 65°C. Under intense agitation, 50 parts of sodium acetate, 30 parts of sodium tartrate and 0.5 part of nonionic surface active agent are gradually added, and dissolved, to form the dye bath.

Second Step: 35 parts of a wool fabric is passed through the dye bath prepared by the First Step for 30 minutes, at 60°C, and is uniformly mangled so that up to 50 percent of the dye solution remains to prevent color spotting.

Third and Fourth Steps: The same steps stated in Example 10 are employed. A deep, clear orange colored wool fabric is obtained by the process. Other acidic dyes may be used instead of Brilliant Orange RN with similar results.

EXAMPLE 15
Process For Dyeing Wool With Basic Dye
First Step: 3 parts of crystal Violet 6B is mixed with and uniformly dispersed in 200 parts of 80 percent concentrated sulfuric acid, and then the dye is completely dissolved by gradually heating to 70°C. After cooling to 50°C at room temperature, 50 parts of sodium acetate, 20 parts of sodium lactate, 10 parts of sodium bicarbonate and 0.5 parts of nonionic surface active agent are gradually added and dissolved under intense agitation, to make the dye bath.

Second Step: 35 parts of wool fabric is passed through the dye bath prepared by the First Step, for 30 minutes, at 60°C, and is uniformly squeezed so that up to 50 percent of the dye solution remains to prevent color spotting.

Third and Fourth Steps: The same steps stated in Example 10 are employed. A clear and deep orange colored wool fabric is obtained by the process. Other basic dyes may be used instead of Crystal Violet 6B, with similar results.

EXAMPLE 16
Process For Dyeing Wool With Direct Dye
First Step: 6 parts of Oxamine Red is mixed with and uniformly dispersed in 200 parts of 80 percent concentrated sulfuric acid, and then the dye is completely dissolved by gradually heating to 70°C. After cooling to 50°C at room temperature, 50 parts of sodium acetate and 20 parts of sodium carbonate are added, and moreover 0.5 part of sodium alky benzene sulfonate is added and dissolved under severe agitation to make the dye bath.

Second Step: 30 parts of wool fabric is passed through the dye bath prepared by the First Step for 30 minutes, at 60°C, and uniformly squeezed so that up to 50 percent of the dye solution remains to prevent color spotting.

Third and Fourth Steps: The same steps stated in Example 10 are employed. A clear and deep red colored wool fabric is obtained by the process. Other direct dyes may be used instead of Oxamine Red, with similar results.

What is claimed is:
1. A process for quick dyeing which comprises:
   preparing a dye bath for dissolving into sulfuric acid 60 a dye which is soluble and non-reactive with said acid, passing a fiber or film, through said dye bath whereby the
3,652,200

dye is diffused into the internal structure of said fiber or film, contacting said treated substance with water or an alkali solution whereby the dye is solidified and fixed into the internal structure of said fiber or film, and, washing and drying said fiber or film.

2. The process of claim 1, wherein an alkali salt of a weak inorganic or organic acid of more than 40 percent concentration by weight of solution buffering compound is added to the dye bath.

3. The process of claim 1, wherein the dye bath is maintained at a temperature of up to about 70°C.

4. The process of claim 1, wherein sodium citrate or sodium tartarate is added to said dye bath containing the sulfuric acid and the inorganic buffering compound.

5. A process for quick dyeing which comprises preparing a dye bath by dissolving into sulfuric acid of more than 60 percent concentration, a dye which is soluble and non-reactive with said acid, passing a fiber or film through said dye bath whereby the film is diffused into the internal structure of said substance, wherein said dye bath is maintained at a temperature of up to about 70°C, contacting said treated fiber or film with water or an alkali solution so as to generate sufficient thermal energy to fix the dye into the internal structure of the fiber or film, washing and drying said fiber or film.

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