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(54) **INKJET TEXTILE PRINTING INK AND INKJET TEXTILE PRINTING METHOD**

(57) The inkjet textile printing ink of the present invention includes a reactive dye or acidic dye, a first acetylene glycol-based surfactant, a second acetylene glycol-based surfactant, ethylene urea, and water and satisfies the following expression (1):

$$\text{Expression (1): } 4 \leq h2 - h1 \leq 7$$

wherein h1 is an HLB value of the first acetylene glycol-based surfactant, and h2 is an HLB value of the second acetylene glycol-based surfactant.

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Description**BACKGROUND OF THE INVENTION****1. Field of the Invention**

[0001] The present invention relates to inkjet textile printing inks and inkjet textile printing methods.

2. Description of Related Art

[0002] As one of textile printing methods adaptable to shortening of delivery time and multiproduct production, there is known an inkjet textile printing method which requires no platemaking. An inkjet textile printing method is a method of forming an image by ejecting minute ink droplets from an inkjet recording head to be landed on a recording medium that is a target for printing. Generally, an inkjet textile printing method includes ejecting an ink from an inkjet head to be landed on a cloth and applying steam on the cloth on which the ink is landed to fix a dye contained in the ink onto the fibers of the cloth. Such an inkjet textile printing method can relatively easily and inexpensively form high definition and high quality images.

[0003] Types of colorants to be used in inkjet textile printing inks, which include acidic dyes, disperse dyes, and reactive dyes, are selected depending on the types of cloths. For example, for formation of an image on a cloth mainly based on cellulose, a reactive dye may be used.

[0004] As an inkjet textile printing ink containing a reactive dye, Japanese Patent Application Laid-Open No. 2010-116566 discloses an inkjet textile printing ink containing a reactive dye, urea, 2-imidazolidinone, and an organic buffering agent.

[0005] However, cloths on which an image has been formed by the inkjet textile printing method using conventional inkjet textile printing inks as disclosed in Japanese Patent Application Laid-Open No. 2010-116566 have a problem in that when the fibers on the surface are twisted by friction during washing, for example, the color tone on the twisted portion becomes faded, and in a severe case, becomes whitened. Such a change in the color tone due to fiber twisting seems to occur because the fibers on the surface of the cloth are twisted and moved to thereby expose the back side portion of the fibers on the surface of the cloth, which back side portion no ink has permeated. That is, the inks permeate only the front side (onto which droplets of the inks are landed) among the fibers on the surface of the cloth and do not permeate up to the back side. Thus, a change in the color tone due to twisting seems to occur.

[0006] Accordingly, it is conceived that, in order to suppress a change in the color tone due to fiber twisting, making the inks likely to permeate inside the cloth is effective. When the inks are made to likely to permeate inside the cloth, however, there is a problem in that the inks are less likely to remain on the surface of the cloth and the surface density of the cloth becomes likely to decrease.

[0007] The present invention has prepared in the view of above situations, and an object of the present invention is to provide an inkjet textile printing ink that can suppress a change in the color tone due to fiber twisting without reducing the surface density on a cloth.

SUMMARY OF THE INVENTION

[0008] An inkjet textile printing ink of the present invention includes a reactive dye or acidic dye, a first acetylene glycol-based surfactant, a second acetylene glycol-based surfactant, ethylene urea, and water, wherein the ink satisfies the following expression (1):

$$\text{Expression (1): } 4 \leq h_2 - h_1 \leq 7$$

wherein h_1 is an HLB value of the first acetylene glycol-based surfactant, and h_2 is an HLB value of the second acetylene glycol-based surfactant.

[0009] An inkjet textile printing method of the present invention includes forming an image on a cloth by ejecting a droplet of the inkjet textile printing ink according to any one of claims 1 to 7 from an inkjet recording head.

BRIEF DESCRIPTION OF DRAWING

[0010] The advantages and features provided by one or more embodiments of the invention will become more fully understood from the detailed description given hereinbelow and the appended drawings which are given by way of

illustration only, and thus are not intended as a definition of the limits of the present invention:

FIG. 1 partially and schematically illustrates an example of the configuration of an inkjet textile printing apparatus.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0011] Hereinafter, one or more embodiments of the present invention will be described with reference to the drawings. However, the scope of the invention is not limited to the disclosed embodiments.

[0012] The present inventors have found that it is possible to suppress a change in the color tone due to fiber twisting without reducing the surface density on a cloth by using an ink in which a first acetylene glycol-based surfactant having a lower HLB value is combined with a second acetylene glycol-based surfactant having a higher HLB value as well as the difference between the HLB values is kept higher than a certain level, the ink also containing ethylene urea.

[0013] This reason is not clear but can be considered as follows.

1) First, ethylene urea contained in the ink, which has a small molecular weight, is likely to appear to the droplet surface of the ink faster than the surfactant when the ink is landed, and then the surface tension of the droplet surface of the ink increases. For this reason, the droplet of the ink landed on the cloth does not permeate the cloth and is likely to remain on the surface of the cloth, immediately after landing.

2) Next, as the time elapses, first, of the acetylene glycol-based surfactants, the first acetylene glycol-based surfactant having a smaller molecular weight diffuses to appear to the surface of the ink liquid. Thereby the surface tension of the droplets of the ink decreases to facilitate permeation of the ink into the cloth.

3) As the time further elapses, of the acetylene glycol-based surfactants, the second acetylene glycol-based surfactant having a larger molecular weight appears to the droplet surface of the ink, and thus the surface tension of the ink increases to delay permeation of the ink into the cloth. Thereby the ink is more likely to remain inside the cloth. Thus, the ink becomes capable of going round to the back side of the fibers, and additionally the ink remaining on the surface of the cloth gradually permeates the fibers.

[0014] That is, the permeation rate of the ink into the cloth after landing on the cloth is changed over time. Specifically, after the ink is allowed to remain on the cloth (see above 1)), first, the permeation rate of the ink is raised (see above 2)), and the permeation rate of the ink is reduced in midstream (see above 3)). Thereby, since the permeation rate of the ink is initially high, the ink quickly permeates in the vicinity of the surface of the cloth. However, the permeation rate of the ink becomes gradually slow in midstream, and the ink is more likely to remain inside the cloth. Thereby, in the vicinity of the surface of the cloth, the ink becomes capable of sufficiently going round not only to the front side of the fibers (the side onto which droplets of the inks are landed) but also to the back side and of permeating. As a result of these, it is possible to allow the ink sufficiently to permeate both the front side and the back side of the fibers in the vicinity of the surface of the cloth. Thus, it is conceived that it is possible to suppress a change in the color tone due to fiber twisting without reducing the surface density. The present invention has been achieved based on such findings.

1. Inkjet Textile Printing Ink

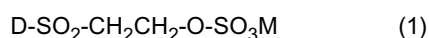
[0015] The inkjet textile printing ink of the present invention includes a reactive dye or acidic dye, a first acetylene glycol-based surfactant, a second acetylene glycol-based surfactant, ethylene urea, and water. The inkjet textile printing ink of the present invention may further contain a water-soluble organic solvent and other additives as required.

1-1. Reactive Dye or Acidic Dye

(Reactive Dye)

[0016] The reactive dye may be either a reactive dye having a vinylsulfone group (hereinbelow, the reactive dye is also referred to as a vinylsulfone-type reactive dye) or a reactive dye having a monochlorotriazine group (hereinbelow, the reactive dye is also referred to as a monochlorotriazine-type reactive dye). From the viewpoint of enjoying the effect of the present invention, a vinylsulfone-type reactive dye, which enables dyeing at high density, is preferred.

[0017] In a vinylsulfone-type reactive dye, the following reaction occurs in the presence of alkali.



[0018] D in the formula (1) represents a pigment base material. Examples of the pigment base material include pyra-

zalone azo-based, γ -acid azo-based, H-acid azo based, anthraquinone-based, and H-acid disazo-based pigment base materials. M in the formula (1) represents a monovalent metal cation. Examples of the monovalent cation include a Na ion.

[0019] In the vinylsulfone-type reactive dye, a vinyl group that is generated from the vinylsulfone-type reactive dye nucleophilically adds to a hydroxyl group on the cloth to thereby react with the cloth.

[0020] The reactive dye has one or two or more vinylsulfone group(s). From the viewpoint of increasing the dyeing affinity to the cloth, the reactive dye may have two functional groups that react with the cloth, and one or more of the two or more functional groups should be a vinylsulfone group(s). Examples of the bifunctional reactive dye having two reactive functional groups include reactive dyes having two vinylsulfone group in one molecule (hereinbelow, the dyes are also referred to as vinylsulfone-type homo-bifunctional reactive dyes) and reactive dyes having one vinylsulfone group and one monochlorotriazine group in one molecule (hereinbelow, the dyes are also referred to as hetero-bifunctional reactive dyes). Reactive dyes having a vinylsulfone group(s) for use in the present invention are preferably vinylsulfone-type homo-bifunctional reactive dyes from the viewpoint of further enhancing their dyeing affinity to a cloth.

[0021] When a hetero-bifunctional reactive dye is used as the reactive dye, the reaction between the reactive dye and a cloth is not only nucleophilic addition reaction described above, and nucleophilic substitution reaction may also occur. This reaction is caused by the nucleophilic substitution reaction of the chloro group of the monochloro-substituted 1,3,5-triazin-2-yl skeleton possessed by the hetero-bifunctional reactive dye with a hydroxyl group of the cloth.

[0022] Examples of the reactive dye having a vinylsulfone group(s) include C.I. Reactive Yellow 15, C.I. Reactive Yellow 37, C.I. Reactive Yellow 42; C.I. Reactive Orange 16, C.I. Reactive Orange 74, C.I. Reactive Orange 107; C.I. Reactive Red 23, C.I. Reactive Red 35, C.I. Reactive Red 106, C.I. Reactive Red 180, C.I. Reactive Red 218; C.I. Reactive Violet 5, C.I. Reactive Blue 19, C.I. Reactive Blue 21, C.I. Reactive Blue 38, C.I. Reactive Blue 229; C.I. Reactive Brown 18; C.I. Reactive Black 5, C.I. Reactive Black 14, and C.I. Reactive Black 31. Of these, C.I. Reactive Black 5, which is a vinylsulfone-type homo-bifunctional reactive dye, is preferred.

(Acidic Dye)

[0023] Acidic dyes are dyes having an acidic group in the molecule. Examples of the acidic group include a sulfone group and a carboxyl group.

[0024] Examples of the acidic dye include

C. I. Acid Yellow 1, 3, 11, 17, 18, 19, 23, 25, 36, 38, 40, 40:1, 42, 44, 49, 59, 59:1, 61, 65, 67, 72, 73, 79, 99, 104, 159, 169, 176, 184, 193, 200, 204, 207, 215, 219:1, 220, 230, 232, 235, 241, 242, 246,
C. I. Acid Orange 3, 7, 8, 10, 19, 22, 24, 51, 51S, 56, 67, 74, 80, 86, 87, 88, 89, 94, 95, 107, 108, 116, 122, 127, 140, 142, 144, 149, 152, 156, 162, 166, 168,
C.I. Acid Red 1, 6, 8, 9, 13, 18, 27, 35, 37, 52, 54, 57, 73, 82, 88, 97, 97:1, 106, 111, 114, 118, 119, 127, 131, 138, 143, 145, 151, 183, 195, 198, 211, 215, 217, 225, 226, 249, 251, 254, 256, 257, 260, 261, 265, 266, 274, 276, 277, 289, 296, 299, 315, 318, 336, 337, 357, 359, 361, 362, 364, 366, 399, 407, 415,
C.I. Acid Violet 17, 19, 21, 42, 43, 47, 48, 49, 54, 66, 78, 90, 97, 102, 109, 126,
C.I. Acid Blue 1, 7, 9, 15, 23, 25, 40, 61:1, 62, 72, 74, 80, 83, 90, 92, 103, 104, 112, 113, 114, 120, 127, 127:1, 128, 129, 138, 140, 142, 156, 158, 171, 182, 185, 193, 199, 201, 203, 204, 205, 207, 209, 220, 221, 224, 225, 229, 230, 239, 258, 260, 264, 277:1, 278, 279, 280, 284, 290, 296, 298, 300, 317, 324, 333, 335, 338, 342, 350,
C.I. Acid Green 9, 12, 16, 19, 20, 25, 27, 28, 40, 43, 56, 73, 81, 84, 104, 108, 109,
C.I. Acid Brown 2, 4, 13, 14, 19, 28, 44, 123, 224, 226, 227, 248, 282, 283, 289, 294, 297, 298, 301, 355, 357, 413,
C. I. Acid Black 1, 2, 3, 24, 24:1, 26, 31, 50, 52, 52:1, 58, 60, 63, 63S, 107, 109, 112, 119, 132, 140, 155, 172, 187, 188, 194, 207, 222.

[0025] With respect to the content of the reactive dye or the acidic dye, from the viewpoint of increasing the image density and the viewpoint of being capable of suppressing a change in the color tone due to fiber twisting and being likely to achieve the effect of the present invention, the content of the reactive dye is preferably 20mass% or more and 40mass% or less, and the content of the acidic dye is preferably 7mass% or more and 15mass% or less, based on the total mass of the ink.

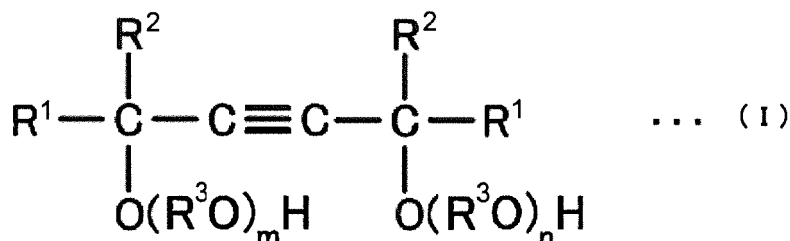
1-2. Acetylene Glycol-Based Surfactant

[0026] The first acetylene glycol-based surfactant and the second acetylene glycol-based surfactant each may be an alkylene oxide adduct of an acetylene glycol compound.

[0027] Although the bonding site for the alkylene oxide group in an alkylene oxide adduct of an acetylene glycol compound is not particularly limited, the alkylene oxide group preferably binds to at least one hydroxy group of the glycol moiety, more preferably binds to both the hydroxy groups.

[0028] That is, the first acetylene glycol-based surfactant and the second acetylene glycol-based surfactant are preferably represented each by the following formula (I).

[Formula 1]



[0029] R^1 and R^2 in the general formula (I) each independently represent an alkyl group having 1 or more and 5 or less carbon atoms. The alkyl group may have a linear chain structure or may have a branched structure. Examples of the alkyl group include a methyl group, an ethyl group, a n-propyl group, an isopropyl group, a n-butyl group, an isobutyl group, a sec-butyl group, a tert-butyl group, a pentyl group, an isopentyl group, and a neopentyl group. R^1 and R^2 may be the same or different.

[0030] R^3 in the general formula (I) independently represents an alkylene group having 2 or more and 4 or less carbon atoms. Examples of the alkylene group include an ethylene group and a propylene group, and the alkylene group is preferably an ethylene group.

[0031] m and n in the general formula (I) each represent the number of moles of alkylene oxide added. m for the first acetylene glycol-based surfactant and n for the second acetylene glycol-based surfactant are set such that the HLB values each fall within the range described below. For example, when the alkylene oxide is ethylene oxide, m and n may be set within the range of 0.5 or more and 25 or less, for example, in accordance with the HLB values, and $m + n$ may be set within the range of 1 or more and 50 or less, for example, in accordance with the HLB values.

[0032] When the HLB (Hydrophilic-Lipophilic Balance) value of the first acetylene glycol-based surfactant is set to be h_1 , and the HLB value of the second acetylene glycol-based surfactant is set to be h_2 , the following equation (1) is satisfied:

$$\text{Expression (1): } 4 \leq h_2 - h_1 \leq 7$$

[0033] The expression (1) indicates that the surface tension of the first acetylene glycol-based surfactant is moderately low and the surface tension of the second acetylene glycol-based surfactant is moderately high. The first acetylene glycol-based surfactant having a moderately low surface tension, which has a small amount of ethylene oxide added and a low molecular weight, has a high diffusion rate in the ink. In contrast, the second acetylene glycol-based surfactant having a moderately high surface tension, which has a large amount of ethylene oxide added and a high molecular weight, has a low diffusion rate in the ink.

[0034] In droplets of an ink containing such acetylene glycol-based surfactants, as the time elapses after landing on a cloth, initially, the first acetylene glycol-based surfactant having a low molecular weight diffuses and is localized on the surface of the droplets of the ink. Thereby the surface tension of the droplets of the ink decreases to facilitate permeation of the ink into the fibers. Thereafter, as the time further elapses, the second acetylene glycol-based surfactant having a high molecular weight diffuses and is likely to be localized on the surface of the ink. Thereby the surface tension of the ink increases to delay permeation of the ink into the cloth. Thereby the ink is more likely to remain inside the cloth. Thus, the ink becomes capable of going round to the back side of the fibers, and additionally, the ink remaining on the surface of the cloth gradually permeates the fibers. As a result of these, it is possible to allow the ink sufficiently to permeate both the front side and the back side of the fibers in the vicinity of the surface of the cloth, and thus, it is possible to reduce a change in the color tone due to fiber twisting without reducing the surface density.

[0035] The HLB value (h_1) of the first acetylene glycol-based surfactant is preferably 6 or more and 12 or less, more preferably 7 or more and 11 or less.

[0036] The HLB value (h_2) of the second acetylene glycol-based surfactant is preferably 10 or more and 19 or less, more preferably 11 or more and 16 or less.

[0037] The HLB value is defined by the following expression in accordance with the Griffin method (J. Soc. Cosmetic Chem., 5 (1954), 294), and is a value determined by calculation.

$$\text{HLB value} = 20 \times \text{Total formula weight of hydrophilic moieties} / \text{Molecular weight} \quad (\text{i})$$

[0038] Example of the hydrophilic portion include an alkylene oxide group.

[0039] The HLB value each of the first acetylene glycol-based surfactant and the second acetylene glycol-based surfactant can be adjusted by the amount of alkylene oxide added, for example. For example, in order to increase the HLB value, the amount of alkylene oxide added should be increased, and in order to decrease the HLB value, the amount of alkylene oxide added should be decreased.

[0040] The mass ratio between the first acetylene glycol-based surfactant and the second acetylene glycol-based surfactant contained (first acetylene glycol-based surfactant/second acetylene glycol-based surfactant) is preferably 6/4 to 2/8, more preferably 5/5 to 2/8, still more preferably 4/6 to 2/8. Setting the mass ratio of the second acetylene glycol-based surfactant contained to a certain value or less may allow the ink to be more likely to permeate inside the cloth and reduce a change in the color tone due to fiber twisting because the permeation of the ink is not retarded excessively. Setting the mass ratio of the first acetylene glycol-based surfactant contained to a certain value or less may allow the ink to be further likely to remain inside the cloth and reduce a change in the color tone due to fiber twisting because the permeation of the ink is not facilitated excessively.

[0041] The total content of the first acetylene glycol-based surfactant and the second acetylene glycol-based surfactant is preferably 0.03mass% or more and 2mass% or less based on the total mass of the ink.

[0042] Only one each of the first acetylene glycol-based surfactant and the second acetylene glycol-based surfactant may be contained, or two or more each thereof may be contained. For example, when two or more of the second acetylene glycol-based surfactants is contained, the content of the second acetylene glycol-based surfactants is the total amount of the two or more of the second acetylene glycol-based surfactants.

1-3. Ethylene Urea

[0043] Ethylene urea has a hydrophobic portion constituted by $-\text{CH}_2-\text{CH}_2-$ and a hydrophilic portion constituted by $-\text{NH}-\text{CO}-\text{NH}-$. The hydrophobic portion of ethylene urea is likely to have an affinity for a reactive dye or acidic dye in an ink, and thus the hydrophilic portion on the opposite thereto is likely to orient to the surface of the ink. Thereby the surface tension of the ink may be increased. For this reason, it is possible to retard permeation of the ink into the cloth and to make the ink likely to remain on the surface of or inside the cloth.

[0044] The content of ethylene urea is preferably 1mass% or more and 15mass% or less based on the total mass of the ink. When the content of ethylene urea is 1mass% or more, permeation of the ink into the cloth is likely to be retarded and the ink may be likely to remain on the surface of or inside the cloth. Accordingly, while the surface density is further maintained, a change in the color tone due to fiber twisting becomes much easily suppressed. When the content of ethylene urea is 15mass% or less, permeation of the ink into the cloth is not excessively retarded. Accordingly, the ink is allowed to be likely to permeate inside the cloth, and a change in the color tone due to fiber twisting becomes much easily suppressed. The content of ethylene urea is more preferably 4mass% or more and 12mass% or less based on the total mass of the ink.

1-4. Water-soluble Organic Solvent

[0045] The inkjet textile printing ink of the present invention may further contain a water-soluble organic solvent. The water-soluble organic solvent is not particularly limited, provided that the solvent can dissolve the reactive dyes and acidic dyes.

[0046] Examples of the water-soluble organic solvent include

alcohols, such as methanol, ethanol, propanol, isopropanol, butanol, isobutanol, sec-butanol, and t-butanol;

polyhydric alcohols, such as ethylene glycol, diethylene glycol, triethylene glycol, polyethylene glycol, propylene glycol, dipropylene glycol, polypropylene glycol, butylene glycol, hexanediol, pentanediol, glycerin, hexanetriol, thiodiglycol, and 2,2-thiodiethanol;

amines, such as ethanolamine, diethanolamine, triethanolamine, N-methyldiethanolamine, N-ethyldiethanolamine, morpholine, N-ethylmorpholine, ethylenediamine, diethylenediamine, triethylenetetramine, tetraethylenepentamine, polyethyleneimine, pentamethyldiethylenetriamine, and tetramethylpropylenediamine);

amides, such as N,N-dimethylformamide, and N,N-dimethylacetamide;

heterocycles, such as 2-pyrrolidone, N-methyl-2-pyrrolidone, cyclohexylpyrrolidone, 2-oxazolidone, 1,3-dimethyl-2-imidazolidinone, and ϵ -caprolactam; and

sulfoxides, such as dimethyl sulfoxide.

1-5. Other Additives

[0047] The inkjet textile printing ink of the present invention may further contain other additives such as a pH adjuster, a surfactant other than acetylene glycol-based surfactants (other surfactant), a preservative agent, and an anti-mold agent.

[pH Adjuster]

[0048] Examples of the pH adjuster include urea and sodium hydroxide. Of these, urea is preferred because the pH of the ink is likely to be maintained within a predetermined range by combining urea, which has alkali sustained releasability, with a reactive dye having acid sustained releasability.

[0049] The content of the pH adjuster is preferably 1 to 10mass% based on the total mass of the ink. When the content of the pH adjuster is 1mass% or more, the pH of the ink is easily stabilized. When the content is 10mass% or less, thickening of the ink due to decomposition of urea under long-term storage is unlikely to occur, for example, in the case where urea is used, and thus, the long-term storage stability is also unlikely to be impaired. The content of the pH adjuster is more preferably 2 to 5mass% based on the total mass of the ink.

[Other Surfactants]

[0050] Examples of the other surfactants include dialkyl sulfosuccinates, alkyl naphthalene sulfonates, polyoxyethylene alkyl ethers, polyoxyethylene alkyl allyl ethers, polyoxyethylene-polyoxypropylene block copolymers, alkylamines, quaternary ammonium salts, silicon-based surfactants, and fluorine-based surfactants.

[Preservative Agent and Anti-mold Agent]

[0051] Examples of the preservative agent and the anti-mold agent include aromatic halogen compounds (such as Preventol CMK), methylene diisocyanate, halogen-containing nitrogen-sulfur compounds, and 1,2-benzisothiazolin-3-one (such as PROXEL GXL). The preservative agent and the anti-mold agent increase the storage stability of the ink.

1-6. Ink Physical Properties

[0052] The inkjet textile printing ink of the present invention has an ink viscosity at 25°C of preferably 1 to 100 mPa·s, more preferably 1 to 40 mPa·s, still more preferably 5 to 40 mPa·s, particularly preferably 5 to 20 mPa·s from the viewpoint of its injectability from an inkjet recording head. The ink viscosity can be determined with a cone-plate type viscometer, for example, a TVE-33LT viscometer manufactured by TOKI SANGYO CO., LTD.

1-7. Preparation of Inks

[0053] The inkjet textile printing ink of the present invention is produced by way of mixing the reactive dye and acidic dye, first acetylene glycol-based surfactant, second acetylene glycol-based surfactant, ethylene urea, and water mentioned above, and other component as required.

[0054] The inkjet textile printing ink of the present invention can suppress a change in the color tone due to fiber twisting without reducing the surface density on a cloth.

2. Inkjet Textile Printing Method

[0055] The inkjet textile printing method of the present invention includes forming an image on a cloth by ejecting a droplet of the inkjet textile printing ink of the present invention from an inkjet recording head.

[0056] Specifically, the inkjet textile printing method of the present invention includes (1) applying a pretreatment agent to a cloth (pretreatment), (2) ejecting a droplet of a textile printing ink to form an image on the cloth including the pretreatment agent applied thereto (ink application), and (3) heating the cloth having the image formed thereon to fix the image onto the cloth (color development) and may further include (4) drying the cloth after the ink application (preliminary drying), (5) removing the dye and the pretreatment agent that have failed to dye in the cloth (washing), and (6) drying the washed cloth (drying) as required.

2-1. Pretreatment

[0057] Pretreatment is applying a pretreatment agent to a cloth. Examples of a method for applying a pretreatment

agent to a cloth include pad methods, coating methods, spray methods, and inkjet methods. These methods enable application of the pretreatment agent to the cloth. Examples of the cloth including the pretreatment agent applied thereto include cloths having an ink reception layer, described in Japanese Patent Application Laid-Open No. 62-53492, and cloths containing a reduction inhibitor and an alkaline agent, described in Japanese Examined Patent Application Publication No. 3-46589.

[0058] From the viewpoint of obtaining a homogeneous image, natural impurities attached to the cloth (oils and fats, wax, pectin substances, natural pigments, and the like), residues of chemicals used in the cloth production process (such as pastes), or stains attached to the cloth are preferably washed off before a pretreatment agent is applied to a cloth. Detergents for washing the cloth contain an alkaline agent such as sodium hydroxide or sodium carbonate, an anionic or nonionic surfactant, or an enzyme and the like.

[0059] When an inkjet textile printing ink containing a reactive dye is used, the pretreatment agent preferably contains at least a resin component, an alkaline agent, and a hydrotrophy agent.

[0060] The resin component preferably contains a hydrophilic resin (preferably a hydrophilic resin having a hydroxy group). Examples of the hydrophilic resin include natural gums such as guar and locust bean, starches, sodium alginate, seaweeds such as funori, vegetable skins such as pectin acid, cellulose derivatives such as methyl cellulose, ethyl cellulose, hydroxyethyl cellulose, and carboxymethyl cellulose, processed starches such as roasted starch, alpha-starch, carboxymethyl starch, carboxyethyl starch, and hydroxyethyl starch, processed natural gum such as shiratsu gum and roast bean gum, synthetic pastes or emulsions such as alginate derivatives, polyvinyl alcohol and polyacrylic acid esters.

[0061] Examples of the alkaline agent include alkali metal hydroxides such as sodium hydroxide and potassium hydroxide, amines such as mono-, di-, and tri-ethanolamines, alkali metal carbonates or bicarbonates such as sodium carbonate, potassium carbonate, and sodium bicarbonate (sodium hydrogen carbonate), organic acid metal salts such as calcium acetate and barium acetate, ammonia and ammonium compounds, and compounds serving as an alkaline agent under steaming or dry heat, such as sodium trichloroacetate. Of these, sodium carbonate and sodium hydrogen carbonate are preferred. The amount of the alkaline agent to be applied is preferably 0.1 to 10mass%, more preferably 0.5 to 5mass% based on the total mass amount of the cloth. When a moderate amount of the alkaline agent exists in the cloth, the textile printing ink including the reactive dye is reliably allowed to dye in the cloth. Thus, the cloth is preferably allowed to include the alkaline agent in advance.

[0062] When an inkjet textile printing ink containing an acidic dye is used, the pretreatment agent preferably contains at least the resin component mentioned above and a pH adjuster.

[0063] The pH adjuster is more preferably an acid from the viewpoint of easily forming sharp image at a high density. Examples of the pH adjuster as an acid include citric acid, malic acid, and tartaric acid.

[0064] These pretreatment agents may further contain a reduction inhibitor, a preservative agent, or a chelating agent, as required. Examples of the reduction inhibitor include sodium m-nitrobenzenesulfonate. The preservative agent of the pretreatment agent may be a preservative agent exemplified as the preservative agent of the inkjet textile printing ink or may be the same as the preservative agent of the inkjet textile printing ink. Examples of the chelating agent should include ethylenediamine tetraacetate, nitrilotriacetate, hexamethaphosphate, pyrophosphate, or methaphosphate.

[0065] The amount (pick-up rate) of the pretreatment agent to be applied, or the amount of the resin component contained in the pretreatment agent are appropriately set depending on the type of the cloth and its application.

[0066] The pretreatment agent applied to the cloth can be heated and dried by use of hot air, a hot plate, a heat roller or the like.

[0067] A fiber material constituting the cloth is not particularly limited provided that the fibers can be dyed in by the inkjet textile printing ink of the present invention.

[0068] When an inkjet textile printing ink containing a reactive dye is used, a cloth is not particularly limited provided that a hydrophilic resin having a hydroxy group or an amino group is applied as the pretreatment agent to the cloth. The cloth preferably contains fibers that can be dyed by a reactive dye, for example, cellulose fibers such as cotton and protein fibers such as silk in respect of increasing the dyeing affinity. The cloth may be any of a woven fabric, a non-woven fabric, and a knitted fabric formed by these fibers. The cloth may be constituted only by fibers that can be dyed by a reactive dye, or may be a blended woven fabric or blend non-woven fabric of rayon, polyurethane, polyester, acryl, or the like.

[0069] When an inkjet textile printing ink containing an acidic dye is used, the cloth is preferably one containing fibers such as cotton, hemp, wool, silk, rayon, vinylon, nylon, acryl, polyurethane, polyester, or acetate. The cloth may be any of a woven fabric, a non-woven fabric, and a knitted fabric formed by these fibers. The cloth may be constituted only by fibers that can be dyed by a reactive dye, such as wool, silk, or nylon-based fibers, from the viewpoint of allowing the acidic dye to properly develop its color, or may be a blended woven fabric or blended non-woven fabric with other fibers.

[0070] The fineness of a fiber constituting the cloth is preferably in the range of 10 to 100 d.

2-2. Ink Application

[0071] Ink application is ejecting a droplet of a textile printing ink from an inkjet recording head toward a cloth to form an image before color development. While the cloth is moved relatively with respect to a head carriage onto which a plurality of inkjet recording heads are loaded, droplets of the inkjet textile printing ink set are allowed to be ejected and be landed on the cloth.

[0072] Ink application is preferably performed by a line scan head-type inkjet textile printing apparatus, in which a line scan head is employed as an inkjet recording head. That is, in a scan head-type inkjet textile printing apparatus, in which a scan head is used as an inkjet recording head, a plurality of droplets is impacted on one point, and thus droplets of the ink that have been already impacted are likely to interact with droplets of the ink that are newly impacted. For this reason, the surface density is likely to increase, and the ink is likely to permeate up to the back side of the fibers. In contrast, with a line scan head-type inkjet textile printing apparatus, only one droplet is impacted on one point, and thus the interaction mentioned above does not function. Accordingly, the surface density is unlikely to increase, and the ink is unlikely to permeate up to the back side of the fibers. In the present invention, even when an image is formed by a line scan head-type inkjet textile printing apparatus, it is possible to make the ink likely to permeate up to the back side of the fibers while the surface density is increased and to reduce a change in the color tone due to fiber twisting by using the inkjet textile printing ink of the present invention.

[0073] The ejection frequency by the line scan head is preferably 10 to 300 kHz.

[0074] The temperature of the front surface of the cloth when the ink droplets are landed is not particularly limited. From the viewpoint of suppressing blurring of the image before color development, the cloth is preferably heated in the range of 35 to 70°C. From the viewpoint of suppressing the variation in the ink viscosity caused by variation in the ink temperature, the ink temperature is preferably kept at 25°C.

2-3. Preliminary Drying

[0075] Preliminary drying is drying the cloth after the ink application. In the preliminary drying, without particular limitation, the cloth is dried preferably for 0.5 to 30 minutes at 150°C or less. Examples of a drying method include an air convection system, a heating roll direct-connecting system, and a radiation system. Specifically, a cloth should be subjected to ink application, and the cloth should be dried under the above conditions by the above method before the cloth is rolled up.

2-4. Color Development

[0076] Color development is heating the cloth after the ink application (after the preliminary drying if included) to allow the reactive dye or acidic dye that does not sufficiently dye in the cloth to dye in the cloth to thereby develop the original hues of the ink.

[0077] From the viewpoint of allowing the reactive dye or acidic dye to robustly dye in the cloth, the color development temperature (heating temperature) is preferably 95°C or more and less than 220°C, more preferably 95°C or more and 190°C or less, still more preferably 100°C or more and 180°C or less, depending the color development method (heating method).

[0078] The color development method (heating method) may be a conventionally-known method and is selected as appropriate depending on the textile printing ink and cloth. Examples of the method include steaming by steam; baking by dry heat, thermosol; and an HT steamer by overheated steam. Of these, a system for allowing the reactive dyes or acidic dyes in an ink to fix the dyes by high-temperature steam (steaming system) and a dry heat system (baking system) are preferred.

[0079] In the steaming system, which employs high-temperature steam, a large amount of liquid water exists when the heating temperature is extremely low. Thus, a reactive dye contained in the ink, for example, becomes likely to form hydrogen bonds with liquid water in addition to the cloth. Then, the dye is likely to flow off with water and may not be able to dye in the cloth sufficiently. Accordingly, for example, from the viewpoint of allowing the reactive dye to robustly dye in the cloth, the heating temperature is preferably 95°C or more, more preferably 100°C or more. For example, cellulosic fibers are preferably treated at 95 to 105°C for 5 to 15 minutes, and amide-based fibers such as silk and wool are preferably treated at 95 to 105°C for 20 to 40 minutes. The cloth including the ink applied thereto may be allowed to develop color immediately or may be allowed to develop color after a lapse of time.

[0080] In the baking system by means of dry heat, from the viewpoint that a sufficient dyeing affinity is easily obtained and degradation of the dyes is suppressed, the heating temperature is preferably 150°C or more and less than 220°C, more preferably 150°C or more and 190°C or less, still more preferably 150°C or more and 180°C or less.

2-5. Washing

[0081] Washing is removing the reactive dye or acidic dye and pretreatment agent that failed to dye in the cloth after the color development of the cloth. Removal of the reactive dye or acidic dye that failed to dye in the cloth can employ a conventionally-known washing method, which is selected as appropriate depending on the textile printing ink, cloth, and the like. For example, cellulose fibers are generally rinsed with water, rinsed with hot water, and then treated in a soaping bath which contains non-ionic detergent. Thereafter, the fibers are rinsed with water and rinsed with hot water. Removal of the unfixed reactive dye or acidic dye is likely to enable washing fastness, water fastness, perspiration fastness, and the like to be satisfactory. When the reactive dye or acidic dye that failed to dye in the cloth exists, washing fastness, water fastness, perspiration fastness, and the like are hardly obtained.

2-6. Drying

[0082] Drying, which follows the washing, is drying the washed cloth. The drying method is not particularly limited and is may be a method for drying the washed cloth by squeezing, airing, or using a drying machine (such as a heat roll or iron).

2-7. Inkjet Textile Printing Apparatus

[0083] Hereinafter, an apparatus that performs the ink application and the preliminary drying will be described with reference to the accompanying drawing, but the inkjet recording apparatus used for the inkjet textile printing apparatus is not limited thereto.

[0084] FIG. 1 partially and schematically illustrates an example of the configuration of an inkjet textile printing apparatus. The inkjet textile printing apparatus includes conveying section 2 that conveys cloth P, head carriage 5 loaded with a plurality of inkjet recording heads (not illustrated) that ejects droplets of inkjet textile printing inks to cloth P, and warm-air-adding section 6 that adds warm air to cloth P.

[0085] Conveying section 2 includes adhesive belt 21, support roller 22, conveying roller 23, and nip roller 24. Adhesive belt 21 is held by support roller 22 and conveying roller 23, and is circulated among support rollers 22 and conveying roller 23. Nip roller 24 is disposed so as to face conveying roller 23 with adhesive belt 21 interposed therebetween.

[0086] Head carriage 5 and warm-air-adding section 6 are disposed above cloth P.

[0087] Head carriage 5 includes inkjet recording heads. The type of the inkjet recording head may be either a thermal head or a piezo head. The nozzle diameter of the inkjet recording head is preferably 10 to 100 μm , and more preferably 10 to 50 μm . This is because nozzle clogging hardly occurs due to insoluble matters when the nozzle diameter is 10 μm or more and because the sharpness of the formed image is hardly lowered when the nozzle diameter is 100 μm or less. Further, the size of an ink droplet to be ejected is preferably 4 to 150 pl, more preferably 5 to 80 pl. This is because the ejected ink droplets are hardly influenced by an air stream near the head when the size of the ink droplet is 4 pl or more and because granular feeling of the formed image is hardly conspicuous when the size of the ink droplet is 150 pl or less.

[0088] The inkjet recording head may be a scan head (serial scan head) or may be a line scan head. Of these, from the viewpoint of a high image forming rate and of being likely to achieve the effect of the present invention, the inkjet recording head is preferably a line scan head.

[0089] Warm-air-adding section 6 includes therein fan 6A that blows wind on the cloth and heating element 6B that is capable of controlling the temperature.

[0090] When conveying roller 23 is driven, cloth P disposed on the upper surface of adhesive belt 21 is conveyed to the lower surface of nip roller 24. Cloth P is pressurized by adhesive belt 21 and nip roller 24, and is fixed onto adhesive belt 21. Cloth P fixed on adhesive belt 21 is conveyed to a location below head carriage 5. A plurality of inkjet recording heads loaded in head carriage 5 ejects ink droplets of the inkjet textile printing inks and lands the ink droplets on a certain area (landable area) of the cloth including a pretreatment agent is applied thereon to form an image. Then, temperature-controlled air or warm air is blown from warm-air-adding section 6 to dry the image formed on cloth P.

Examples

[0091] Hereinafter, the present invention will be described specifically by way of Examples, but the present invention is not construed to be limited by these Examples.

1. Materials of Ink

(1) Reactive Dye

5 **[0092]** Reactive Black 5
Reactive Red 218

(2) Acidic Dye

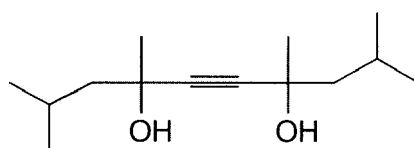
10 **[0093]** C.I. Acid Black 52

(3) First Acetylene Glycol-based Surfactant/Second Acetylene Glycol-based Surfactant

15 **[0094]** An ethylene oxide adduct of an acetylene glycol compound was synthesized by adding ethylene oxide to an acetylene glycol compound represented by the following formula by an existing method.

[Formula 2]

20



25 **[0095]** The ethylene oxide adduct of acetylene alcohol obtained was fractionated by GPC to obtain ethylene oxide adducts AG1 to 8 of the acetylene glycol compound shown in Table 1.

[Table 1]

30

	HLB value
AG1	8
AG2	11
AG3	12
AG4	13
AG5	14
AG6	15
AG7	16
AG8	18

35

40

45 **[0096]** The HLB value each of ethylene oxide adducts AG1 to 8 of the acetylene glycol compound obtained was calculated by the Griffin method from the molecular weight of each fraction obtained by fractionation. Specifically, the HLB value was calculated by the expression (i) mentioned above.

(4) Ethylene Urea

50 **[0097]** Ethylene urea

(5) Water-soluble organic solvent

55 **[0098]** Glycerin (Gly)
Ethylene glycol (EG)

(6) pH Adjuster

[0099] Urea

5 2. Preparation and Evaluation of Ink

2-1. Preparation and Evaluation of Ink Containing Reactive Dye

[0100] (Examples 1 to 26 and Comparative Examples 1 and 7)

10 **[0101]** Inks were prepared by mixing components such that the compositions shown in Tables 2 to 4 were achieved.

[0102] Each of the inks obtained was used to form an image in accordance with the following procedure by the inkjet textile printing method.

<Inkjet Textile Printing Method>

15

(Ink Application)

[0103] The obtained ink was set in a line scan head-type inkjet textile printing apparatus. Then, a solid image of 540 dpi in the main scanning direction $\times$ 540 dpi in the sub scanning direction was formed using the obtained ink on cotton pretreated for reactive dye. Incidentally, dpi represents the number of ink droplets (dots) per 2.54 cm. The ejection frequency was set to 22 kHz.

20

(Color Development)

25 **[0104]** The cloth having the image formed thereon was subjected to steam treatment under conditions of a relative humidity of 100% and a temperature of 103°C for 8 minutes to allow the dyes to be fixed and to develop their color.

<Image Evaluation>

30 **[0105]** Then, in accordance with the following methods, the surface density and back face density of the solid images obtained were measured, and a cloth rubbing test was performed on the images.

(Surface Density, Back Face Density)

35 **[0106]** The surface density L^* and back face density L^* of the solid images obtained were each measured with a Minolta Spectrophotometer CM-2022. A higher L^* value indicates that the density is low, and a lower L^* value indicates that the density is high.

(Cloth Rubbing Test)

40

[0107] A print on which a solid image had been formed was rubbed with a finger on the surface of the solid image 10 times. Thereafter, the state of the solid image was visually observed and evaluated in accordance with the following criteria.

45

A: No variation in the color density is observed

B: The color is faded at the portion where fibers have been displaced (twisted), but the color remains

C: The portion where fibers have been displaced (twisted) is whitened, and the color scarcely remains

50 **[0108]** The evaluation results of the inks of Examples 1 to 8 and Comparative Examples 1 to 4 are shown in Table 2; the evaluation results of Examples 9 to 17 and Comparative Examples 5 to 7 are shown in Table 3; and the evaluation results of Examples 18 to 26 are shown in Table 4.

55

[Table 2]

Composition	Unit		Comparative Example 1	Example 1	Comparative Example 2	Example 2	Example 3	Example 4	Example 5	Comparative Example 3	Comparative Example 4	Example 6	Example 7	Example 8		
	Reactive dye	Reactive black 5	Parts by weight	25	25	25	25	25	25	25	25	25	25	25		
		Type	-	AG1	AG1	AG1	AG1	AG1	AG1	AG1	AG1	AG1	AG2	AG2	AG2	
			HLB	-	8	8	8	8	8	8	8	8	11	11	11	
	Second acetylene glycol-based surfactant	Content	Parts by weight	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
		Type	-	AG2	AG3	AG4	AG5	AG5	AG5	AG6	AG7	AG5	AG6	AG6	AG8	
			HLB	-	11	12	13	14	14	14	15	16	14	15	15	18
	Ethylene urea	Content	Parts by weight	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
		Δ HLB	-	3	4	5	6	6	6	7	8	3	4	4	7	
			Parts by weight	8	8	0	4	4	4	12	8	8	8	8	8	8
Evaluation	Urea	Parts by weight					3						8			
		Ethylene glycol	Parts by weight	20	20	20	20	17	20	20	20	20	20	12	20	
			Glycerin	Parts by weight	10	10	10	10	10	10	10	10	10	10	10	10
	Water	Parts by weight	36.5	36.5	44.5	40.5	40.5	32.5	36.5	36.5	36.5	36.5	36.5	36.5		
		Total	Parts by weight	100	100	100	100	100	100	100	100	100	100	100	100	
	Surface density (L')		20	18	20	17	16	16	16	17	16	19	17	16	17	
		Cloth rubbing test		C	A	C	A	A	A	A	B	C	A	A	A	A
			Back face density (L')		22	23	22	23	23	23	24	27	25	25	26	27

[Table 3]

Composition	Unit		Comparative Example 5	Example 9	Comparative Example 6	Example 10	Example 11	Example 12	Example 13	Example 14	Example 15	Example 16	Example 17	Comparative Example 7	
	Reactive dye	Reactive black 5	25	25	25	25	25	25	25	25	25	25	25	25	
	First acetylene glycol-based surfactant	AG1 (HLB VALUE = 8)	0.5	0.45	0.3	0.3	0.3	0.3	0.1	0.2	0.4	0.1	0.075	0	
	Second acetylene glycol-based surfactant	AG4 (HLB VALUE = 13)	0	0.15	0.2	0.2	0.2	0.2	0.15	0.3	0.6	0.4	0.425	1	
	ΔHLB		5	5	5	5	5	5	5	5	5	5	5	5	
	Ethylene urea		8	8	0	4	4	12	8	8	8	8	8	8	
	Urea						5								
	Water-soluble organic solvent	Ethylene glycol	20	20	20	20	15	20	20	20	20	20	20	20	20
		Glycerin	10	10	10	10	10	10	10	10	10	10	10	10	10
	Water		31.5	31.4	39.5	35.5	35.5	27.5	31.75	31.5	31	31.5	31.5	31.5	31
Total		100	100	100	100	100	100	100	100	100	100	100	100	100	
Evaluation	Surface density (L')		19	17	19	18	17	17	17	17	16	17	16	16	
	Cloth rubbing test		C	B	C	A	A	A	B	A	A	A	B	C	
	Back face density (L')		21	22	21	22	22	22	23	23	24	24	25	27	

[Table 4]

Composition	Unit	Example 18	Example 19	Example 20	Example 21	Example 22	Example 23	Example 24	Example 25	Example 26
		15	20	25	40	-	-	-	-	-
Composition	Reactive dye	Reactive Black 5	Reactive Red 218							
	First acetylene glycol-based surfactant									
	Second acetylene glycol-based surfactant									
Evaluation	Surface density (L')	24	19	17	15	35	32	31	30	28
	Cloth rubbing test	B	A	A	A	B	A	A	A	A
	Back face density (L')	27	25	23	20	43	40	42	38	36

[0109] As shown in Tables 2 to 4, it can be seen that, in Examples 1 to 26, in each of which an ink containing a first acetylene glycol-based surfactant and a second acetylene glycol-based surfactant and having a difference between the HLB values of the surfactants of 4 or more and 7 or less is used, it is possible to suppress a change in the color tone due to fiber twisting in the cloth rubbing test without reducing the surface density.

[0110] Particularly, it can be seen that, in the case where the difference between the HLB values is not excessively large, the change in the color tone due to fiber twisting in the cloth rubbing test may be further reduced while the surface density is maintained (comparison between Examples 1 and 5).

[0111] It can be also seen that it is possible to further reduce a change in the color tone in the cloth rubbing test when the mass ratio between the first acetylene glycol-based surfactant and the second acetylene glycol-based surfactant contained (W1:W2) is 6:4 to 2:8 (comparison between Examples 9 and 14 to 17).

[0112] It can be also seen that further addition of urea as the pH adjuster additionally increases the surface density (comparison between Examples 2 and 3, comparison between Examples 6 and 7, and comparison between Examples 10 and 11). It is conceived that this is because the dyeing affinity of the reactive dye is improved by adjusting the pH of the ink within a more appropriate range.

[0113] It can be also seen that the effect of enabling the change in the color tone to be suppressed in the cloth rubbing test becomes more marked by setting the dye concentration to 20mass% or more (comparison between Examples 18 to 21 and comparison between Examples 23, 24, 26, and 27). It is conceived that this is because, with a higher image density, the back side face of the fibers, which the ink does not permeate, is likely to be conspicuous when exposed.

[0114] In contrast, it can be seen that, in Comparative Examples 1, in which an ink having a difference between the HLB values of less than 4 is used, the surface density is low and a change in the color tone occurs in cloth rubbing test. It is conceived that this is because the ink permeated too fast due to the excessively low HLB value of second acetylene glycol-based surfactant and thus the amount of the ink remaining in the vicinity of the surface was small. In contrast, it can be seen that, in Comparative Examples 3 and 4, in each of which an ink having a difference between the HLB values of more than 7 is used, the back face density is low and a change in the color tone occurs in the cloth rubbing test. It is conceived that this is because the ink permeated too slow due to the excessively high HLB value of the second acetylene glycol-based surfactant and thus the ink was unlikely to permeate inside the cloth. It can be seen that, in Comparative Examples 2 and 6, in each of which an ink containing no ethylene urea is used, a change in the color tone occurs in the cloth rubbing test. It is conceived that this is because the surface tension of the ink did not sufficiently increase and thus the ink was unlikely to permeate inside the cloth.

2-2. Preparation and Evaluation of Ink Containing Acidic Dye

(Examples 27 to 31 and Comparative Examples 8 to 10)

[0115] Inks were prepared by mixing components such that the compositions shown in Table 5 were achieved.

[0116] An image was formed using each ink obtained in the same manner as in Example 1 except that a silk cloth pretreated for acidic dye was used. Then, in accordance with the same method as mentioned above, the surface density and back face density of the images obtained were measured, and a cloth rubbing test was performed.

[0117] The evaluation results of the inks of Examples 27 to 31 and Comparative Examples 8 to 10 are shown in Table 5.

[Table 5]

		Unit	Comparative Example 8	Comparative Example 9	Example 27	Example 28	Example 29	Example 30	Example 31	Comparative Example 10	
Composition	Acidic dye	Parts by weight	9	9	7	15	9	9	9	9	
	First acetylene glycol-based surfactant	-	AG1	AG1	AG1	AG1	AG1	AG1	AG1	AG1	
		HLB	8	8	8	8	8	8	8	8	
		Content	Parts by weight	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
	Second acetylene glycol-based surfactant	-	AG2	AG3	AG3	AG3	AG5	AG5	AG6	AG7	
		HLB	11	12	12	12	14	14	15	16	
		Content	Parts by weight	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
	Δ HLB	-	3	4	4	4	6	6	7	8	
	Ethylene urea	Parts by weight	8	0	8	8	4	4	12	8	8
		Water-soluble organic solvent	Parts by weight	27	27	29	21	27	27	27	27
Glycerin	Parts by weight		10	10	10	10	10	10	10	10	10
	Water	Parts by weight	45.5	53.5	48.5	45.5	49.5	41.5	45.5	45.5	45.5
Total		Parts by weight	100	100	100	100	100	100	100	100	100
		Surface density (L ⁻¹)	-	20	21	18	16	17	16	17	19
Evaluation	Cloth rubbing test	-	C	C	B	A	A	A	B	C	
		Back face density (L ⁻¹)	22	23	25	21	22	25	23	25	25

[0118] As shown in Table 5, it can be seen that, in Examples 27 to 31, in each of which an ink containing a first acetylene glycol-based surfactant and a second acetylene glycol-based surfactant and having a difference between the HLB values of the surfactants of 4 or more and 7 or less is used, it is possible to suppress a change in the color tone due to fiber twisting in the cloth rubbing test without reducing the surface density.

[0119] In contrast, it can be seen that, in Comparative Examples 8, in which an ink having a difference between the HLB values of less than 4 is used, the surface density is low and a change in the color tone occurs in cloth rubbing test. In contrast, it can be seen that, in Comparative Example 10, in each of which an ink having a difference between the HLB values of more than 7 is used, the back face density is low and a change in the color tone occurs in the cloth rubbing test. It can be seen that, in Comparative Example 9, in which an ink containing no ethylene urea is used, a change in the color tone occurs in the cloth rubbing test.

Industrial Applicability

[0120] According to the present invention, it is possible to provide an inkjet textile printing ink that can suppress a change in the color tone due to fiber twisting without reducing the surface density.

[0121] Although embodiments of the present invention have been described and illustrated in detail, it is clearly understood that the same is by way of illustration and example only and not limitation, the scope of the present invention should be interpreted by terms of the appended claims.

Reference Signs List

[0122]

P Cloth
 2 Conveying section
 21 Adhesive belt
 22 Support roller
 23 Conveying roller
 24 Nip roller
 5 Head carriage
 6 Warm-air-adding section
 6A Fan
 6B Heating element

Claims

1. An inkjet textile printing ink comprising a reactive dye or acidic dye, a first acetylene glycol-based surfactant, a second acetylene glycol-based surfactant, ethylene urea, and water, wherein the ink satisfies the following expression (1):

$$\text{Expression (1): } 4 \leq h_2 - h_1 \leq 7$$

wherein h_1 is an HLB value of the first acetylene glycol-based surfactant, and h_2 is an HLB value of the second acetylene glycol-based surfactant.

2. The inkjet textile printing ink according to claim 1, wherein h_1 is 6 or more and 12 or less, and h_2 is 10 or more and less than 19.
3. The inkjet textile printing ink according to claim 1 or 2, wherein the mass ratio between the first acetylene glycol-based surfactant and the second acetylene glycol-based surfactant contained is the first acetylene glycol-based surfactant/the second acetylene glycol-based surfactant = 6/4 to 2/8.
4. The inkjet textile printing ink according to any one of claims 1 to 3, wherein the total content of the first acetylene glycol-based surfactant and the second acetylene glycol-based surfactant is 0.03mass% or more and 2mass% or less based on the total mass of the inkjet textile printing ink.

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5. The inkjet textile printing ink according to any one of claims 1 to 4, wherein the content of ethylene urea is 1mass% or more and 15mass% or less based on the total mass of the inkjet textile printing ink.
6. The inkjet textile printing ink according to any one of claims 1 to 5, wherein the content of the reactive dye is 20mass% or more and 40mass% or less based on the total mass of the inkjet textile printing ink.
7. The inkjet textile printing ink according to any one of claims 1 to 5, wherein the content of the acidic dye is 7mass% or more and 15mass% or less based on the total mass of the inkjet textile printing ink.
8. An inkjet textile printing method comprising forming an image on a cloth by ejecting a droplet of the inkjet textile printing ink according to any one of claims 1 to 7 from an inkjet recording head.
9. The inkjet textile printing method according to claim 8, wherein the cloth comprises a cellulose fiber or a protein fiber.
10. The inkjet textile printing method according to claim 8 or 9, wherein the inkjet recording head is a line scan head.

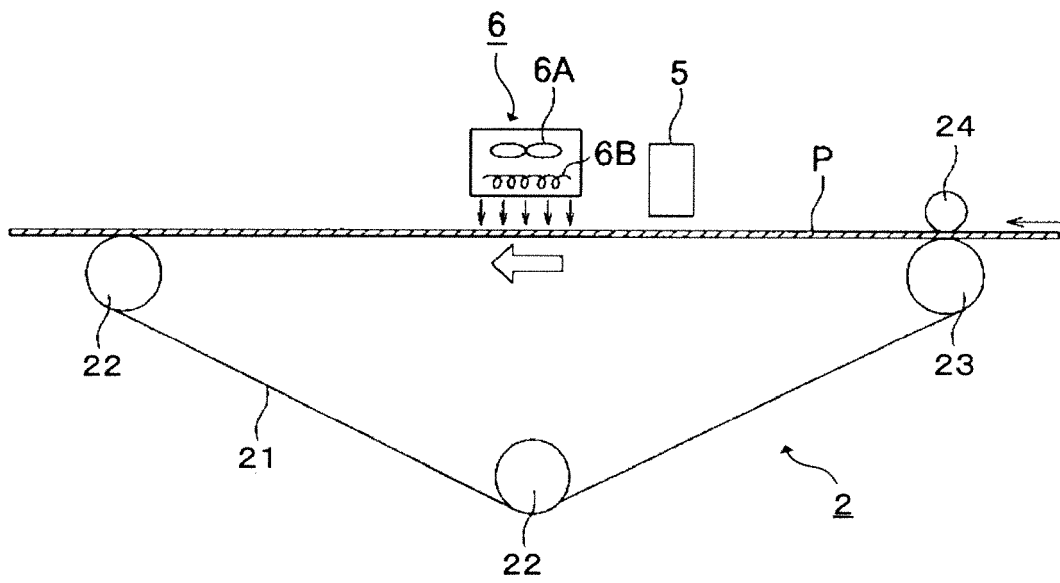


FIG. 1



EUROPEAN SEARCH REPORT

Application Number
EP 18 20 0962

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 6 432 186 B1 (TANIGUCHI MAKOTO [JP]) 13 August 2002 (2002-08-13) * column 5, line 44 - column 6, line 43; example A6 *	1-10	INV. D06P5/30 D06P1/613
A	JP 2017 110096 A (NIPPON KAYAKU KK) 22 June 2017 (2017-06-22) * paragraphs [0011], [0016] - [0018], [0040]; claims *	1-10	
A	EP 1 721 944 A1 (SAMSUNG ELECTRONICS CO LTD [KR]) 15 November 2006 (2006-11-15) * claims; example 5 *	1-10	
A	EP 2 889 344 A1 (SEIKO EPSON CORP [JP]) 1 July 2015 (2015-07-01) * claims *	1-10	
			TECHNICAL FIELDS SEARCHED (IPC)
			D06P
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 6 March 2019	Examiner Blas, Valérie
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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