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(54) Title: YELLOW INKJET INK HAVING IMPROVED PRINT QUALITY WITH POROUS PHOTO MEDIA

(57) Abstract: The present invention relates to yellow dye-based inkjet inks having improved permanence when jetted onto porous photo media. The inkjet ink includes a mixture of at least two yellow dyes, at least three co-solvents comprising about 18% to about 24% of the composition of the ink by weight, a penetrant, at least one wetting agent, and water,



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YELLOW INKJET INK HAVING IMPROVED PRINT QUALITY
WITH POROUS PHOTO MEDIA

Cross Reference To Related Applications

[0001] Not applicable.

Microfiche Appendix

[0002] Not applicable.

Government Rights in Patent

[0003] Not applicable.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0004] The present invention relates to inkjet inks, and, more particularly, to yellow inkjet inks having improved print quality with porous media.

2. Description of the Related Art

[0005] Thermal inkjet printing, to which this invention relates, is a commonly practiced form of printing. Thermal inkjet printing involves intense heating of an aqueous ink in a small amount in contact with a heating element so the ink is vaporized. The vaporized ink, including solids in the ink, is then expelled through a nozzle and subsequently jetted to an intended substrate, such as, for example, paper.

[0006] The composition of an inkjet ink is traditionally comprised of deionized water, a water-soluble organic solvent, and a colorant. The colorant may be a soluble dye or insoluble pigment. Traditionally, pigment based inks may have some disadvantages as compared to dye based inks as traditional pigment based inks tend to have slightly higher solids and viscosity which may pose to be more difficult for jetting through relatively smaller nozzle printhead designs. For example, due to the insolubility of pigments in water, polymeric dispersants and/or surfactants

are typically added to improve the dispersibility of the pigment. The addition of a polymeric dispersant can increase the viscosity of an ink, and a viscous ink may be more difficult to jet in a printhead.

[0007] Inkjet printers may use dye-based color inks or pigment-based color inks. Dye-based color inks tend to be more saturated and more robust to inkjet pens. In contrast, pigment-based color inks tend to be more permanent and of the quality typically recognized with laser-like printers.

[0008] There is a very limited choice of pigments for use with pigment-based color inks, whereas the number of dyes to be used with dye-based color inks continuously grows.

[0009] A current challenge in the industry is to develop faster drying dye-based inks for use with porous photo media, rather than for use with traditional swellable polymer photo media. However, porous photo media are comprised of inorganic materials that, in conjunction with ozone gasses and light, interact with dyes such that the dyes fade and degrade.

[0010] What is needed in the art is a yellow dye-based inkjet ink that may be used with porous photo media with substantially minimal fading and degradation of the yellow dye.

SUMMARY OF THE INVENTION

[0011] Exemplary embodiments of the present invention provide an inkjet ink comprised of a mixture of two or more yellow dyes, at least three co-solvents comprising about 18% to about 24% of the composition of the ink by weight, a penetrant, at least one wetting agent, and water.

[0012] Various other exemplary embodiments of the present invention include a method of printing using an inkjet ink. The method is comprised of the steps of positioning a porous photo medium substantially adjacent to a printer having a print head retaining an inkjet ink, wherein the inkjet ink is comprised of a mixture of two or more yellow dyes, at least three co-solvents comprising about 18% to about 24% of the composition of the ink by weight, a penetrant, at least

one wetting agent, and water. The inkjet ink is then jetting from the print head onto the porous photo medium.

DETAILED DESCRIPTION OF THE INVENTION

[0013] Porous photo media, as opposed to traditional swellable polymer photo media, tends to allow for faster drying. As such, it is desired to develop dye-based inks that allow greater permanence with the porous photo media. However, as noted above, porous photo media are comprised of inorganic materials that, in conjunction with ozone gasses and light, interact with dyes such that the dyes fade and degrade.

[0014] Permanence, as used herein, refers in part to the ability of a dye to resist the interactions with light, ozone, temperature, and humidity that cause fading and degradation of the dye associated with the media.

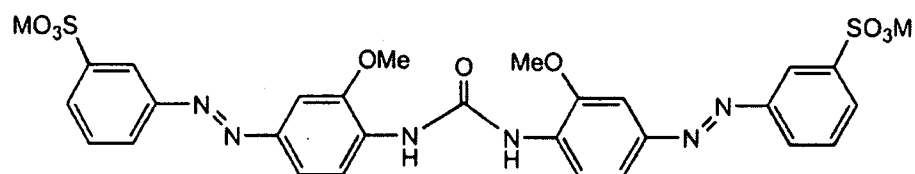
[0015] It has been found that a color inkjet ink having a mixture of two or more yellow dyes, three co-solvents, a penetrant, and a wetting agent has an increased permanence when used with porous photo media.

[0016] In exemplary embodiments, the inkjet ink may further be comprised of a biocide, such as, for example, PROXEL® GXL (available from Arch Chemicals, Inc. of Norwalk, Connecticut).

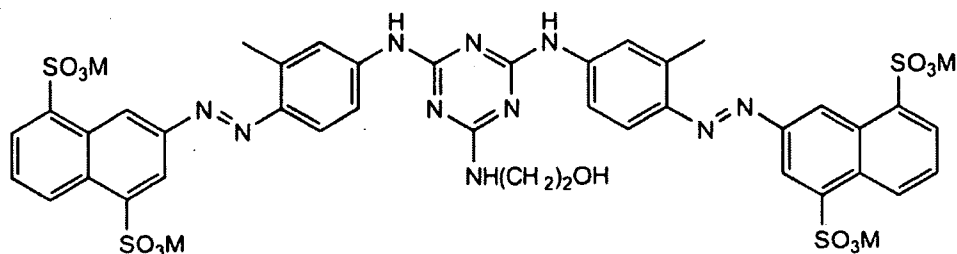
[0017] In the various exemplary embodiments of the present invention, the mixture of two or more yellow dyes of the inkjet ink comprises about 3.0% to about 6.0% of the composition of the ink by weight. In a preferred embodiment, the mixture of two more yellow dyes comprises about 4.0% of the composition of the ink by weight.

[0018] The mixture of two more yellow dyes may include dyes selected from the group consisting of Nippon Yellow JPD LM-NL Liquid (available from Nippon Kayaku Co, Ltd. of

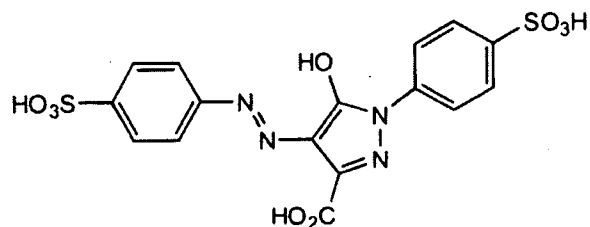
Tokyo, Japan) and one of Direct Yellow 132, Direct Yellow 86, or Acid Yellow 23. The chemical structure of Direct Yellow 132 is:



The chemical structure of Direct Yellow 86 is:



And, the chemical structure of Acid Yellow 23 is:



The Acid Yellow 23 is preferably used a toning dye to improve overall color.

[0019] In an exemplary embodiment, the amount of each of Nippon Yellow JPD LM-NL Liquid and Acid Yellow 23 are about 3.0% and about 0.5%, respectively, by weight of the ink.

[0020] In particular, the color of the Nippon Yellow JPD LM-NL Liquid may be further toned by being combined with one or more of dyes selected from Acid Yellow 3, Acid Red 17, Acid Yellow 23, Acid Yellow 42, Direct Yellow 44, Direct Yellow 50, Direct Yellow 86, Direct

Yellow 173 (available commercially as PROJET® fast Yellow 2 from Fujifilm of Tokyo, Japan), PROJET® Yellow 746 (available commercially from Fujifilm of Tokyo, Japan), and ILFORD® Y1189 (available commercially from Ilford of Marly, Switzerland), and combinations thereof.

[0021] The at least three co-solvents are selected from the group consisting of 1,3-propanediol; 1,2-alkanediol; 1,5-pentanediol; triethylene glycol; and dipropylene glycol.

[0022] In exemplary embodiments, at least two of the three co-solvents are alkanediols and the third co-solvent is a glycol.

[0023] The penetrant is preferably about 1.0% to about 3.5% of the composition of the ink by weight. A exemplary penetrant is 1,2-hexanediol.

[0024] It is preferred that the wetting agent be of about 0.5% to about 1.5% by weight of the inkjet ink. In a more preferred embodiment, the non-ionic silicone surfactant is about 0.75% by weight of the inkjet ink.

[0025] Exemplary wetting agents include polyoxyethylene dimethyl siloxanes, ZONYL® fluorosurfactants, and combinations thereof. A commercially available wetting agent is, for example, SILWET® L-7600 (polyalkylene oxide grafted polydimethylsiloxane from Momentive Performance).

[0026] The polymeric dispersant is preferably about 0.5% to about 2.0% by weight of the inkjet ink, and assists in stabilizing the carbon black pigment and buffering the pH of the inkjet ink.

[0027] An optional polymeric dispersant can be added to assist in stabilizing the compatibility with a carbon black pigment ink in a Cyan-Magenta-Yellow-Black (CMYK) inset. When CMYK inks are printed in substantially close proximity to each other, each ink needs to be compatible and not destabilize adjacent inks. In the present exemplary embodiments, the CMY dye inks may be printed along with a black pigmented ink without destabilizing any of the CMY

dye inks or the black pigmented ink due to the presence of the polymeric dispersant in the CMY dye inks.

[0028] In exemplary embodiments of the present invention, the polymeric dispersant may be selected from dispersants set forth in, for example, any of US Patent Nos. 5,719,204; 5,994,427; 6,063,834; 6,267,807; 6,896,724; and 6,984,701, all incorporated by reference.

[0029] One or more buffers may also be included in the inkjet ink composition. Exemplary embodiments of the one or more buffers include triethanolamine (TEA), N,N-bis(2-hydroxyethyl)tuarine or N,N-bis(2-hydroxyethyl)-2-aminoethane sulfonic acid (BES), or combinations thereof.

[0030] Several exemplary inkjet inks according to the present invention were formulated and evaluated using a standard printhead and porous photo paper in the form of Perfectfinish Glossy Photo Paper (available from Lexmark International, Inc. of Lexington, Kentucky). The same printing was conducted using a commercially available yellow dye-based inkjet ink. Each ink was evaluated for its permanence against the effects of ozone and xenon light.

[0031] In Table 1, the permanence of each dye-based ink on porous photo media is compared. The numbers shown represents the number of years of permanence according to the criteria of 40% density loss and assuming the exposure level of 78 ppm-hr/yr for ozone and 1.1 Mlux-hr/yr for light fade.

TABLE 1

Permanence of Dye with Porous Photo Media		
Ink	Years of Permanence after Exposure to:	
	Ozone (1 ppm or 5ppm)	Xenon LF (80 klux)
Yellow Inkjet Ink	7	15
Commercially Available Yellow-dye Based Inkjet Ink	4	33

[0032] As clearly illustrated above, the present yellow-dye based inkjet ink shows an improvement in permanence when exposed to ozone one and three quarters greater as compared to commercially available yellow-dye inkjet inks undergoing the same exposure.

[0033] While this invention has been described with respect to at least one embodiment, the present invention can be further modified within the spirit and scope of this disclosure. This application is therefore intended to cover any variations, uses, or adaptations of the invention using its general principles. Further, this application is intended to cover such departures from the present disclosure as come within known or customary practice in the art to which this invention pertains and which fall within the limits of the appended claims.

WHAT IS CLAIMED IS:**1. An inkjet ink comprising:**

a mixture of at least two yellow dyes;

at least three co-solvents comprising about 18% to about 24% of the composition of the ink by weight;

a penetrant;

at least one wetting agent; and

water.

- 2. The inkjet ink according to claim 1, wherein the at least two yellow dyes comprise about 3.0% to about 6.0% of the composition of the ink by weight.**
- 3. The inkjet ink according to claim 1, the mixture of at least two yellow dyes includes Nippon Yellow JPD LM-NL Liquid and one of Direct Yellow 132, Direct Yellow 86, or Acid Yellow 23.**
- 4. The inkjet ink according to claim 3, wherein the amount of the Nippon Yellow JPD LM-NL Liquid is about 3% by weight of the ink, and the amount of one of Direct Yellow 132, Direct Yellow 86, or Acid Yellow 23 is about 0.5% by weight of the ink.**
- 5. The inkjet ink according to claim 3, wherein the Nippon Yellow JPD LM-NL Liquid is toned with one or more of Acid Yellow 3, Acid Red 17, Acid Yellow 23, Acid Yellow 42, Direct Yellow 44, Direct Yellow 50, Direct Yellow 86, Direct Yellow 173, PROJET® Yellow 746, and ILFORD® Y1189.**
- 6. The inkjet ink according to claim 1, wherein the at least three co-solvents are selected from the group consisting of 1,3-propanediol; 1,2-alkanediol; 1,5-pentanediol; triethylene glycol; and dipropylene glycol.**

7. The inkjet ink according to claim 1, wherein two of the at least three co-solvents are alkanediols and the third co-solvent is a glycol.
8. The inkjet ink according to claim 1, wherein the wetting agent is about 0.5% to about 1.5% of the composition of the ink by weight.
9. The inkjet ink according to claim 1, wherein the wetting agent is selected from the group consisting of polyoxyethylene dimethyl siloxanes, ZONYL® fluorosurfactants, and combinations thereof.
10. The inkjet ink according to claim 1, further comprising one or more buffers selected from the group consisting of triethanolamine (TEA), N,N-bis(2-hydroxyethyl)tuarine or N,N-bis(2-hydroxyethyl)-2-aminoethane sulfonic acid (BES), or combinations thereof.
11. The inkjet ink according to claim 1, further comprising a biocide.
12. The inkjet ink according to claim 1, wherein the penetrant is a 1,2-alkanediol.
13. The inkjet ink according to claim 1, further comprising a dispersant as about 0.5% to about 2.0% by weight of the inkjet ink.
14. A method of printing using an inkjet ink, the method being comprised of the steps of:
 - positioning a porous photo medium substantially adjacent to a printer having a print head retaining an inkjet ink, wherein the inkjet ink is comprised of
 - a mixture of at least two yellow dyes;
 - at least three co-solvents comprising about 18% to about 24% of the composition of the ink by weight;
 - a penetrant;
 - at least one wetting agent; and
 - water;
 - jetting the inkjet ink from the print head onto a porous photo medium.

15. The method of printing using an inkjet ink according to claim 14, wherein the mixture of at least two yellow dyes comprises about 3.0% to about 6.0% of the composition of the ink by weight.
16. The method of printing using an inkjet ink according to claim 14, the mixture of at least two yellow dyes includes Nippon Yellow JPD LM-NL Liquid and one of Direct Yellow 132, Direct Yellow 86, or Acid Yellow 23.
17. The method of printing using an inkjet ink according to claim 16, wherein the amount of the Nippon Yellow JPD LM-NL Liquid is about 3% by weight of the ink, and the amount of one of Direct Yellow 132, Direct Yellow 86, or Acid Yellow 23 is about 0.5% by weight of the ink.
18. The method of printing using an inkjet ink according to claim 14, wherein the at least three co-solvents are selected from the group consisting of 1,3-propanediol; 1,2-alkanediol; 1,5-pentanediol; triethylene glycol; and dipropylene glycol.
19. The method of printing using an inkjet ink according to claim 14, wherein the wetting agent is about 0.5% to about 1.5% of the composition of the ink by weight.
20. The method of printing using an inkjet ink according to claim 14, wherein the wetting agent is selected from the group consisting of polyoxyethylene dimethyl siloxanes, ZONYL® fluorosurfactants, and combinations thereof.
21. The method of printing using an inkjet ink according to claim 14, further comprising one or more buffers selected from the group consisting of triethanolamine (TEA), N,N-bis(2-hydroxyethyl)tartrine or N,N-bis(2-hydroxyethyl)-2-aminoethane sulfonic acid (BES), or combinations thereof.
22. The method of printing using an inkjet ink according to claim 14, wherein the inkjet ink is further comprised of a dispersant as about 0.5% to about 2.0% by weight of the inkjet ink.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 10/41882

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - C09D 11/00 (2010.01)

USPC - 106/31.6

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

USPC - 106/31.6, 31.43, 31.58; 347/100

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
IPC(8) - B41J 2/01; C09D 11/02 (2010.01) - search terms below

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Google, Google Patent, PubWEST (PGPB, USPT, USOC, EPAB, JPAB)

Inkjet, ink, dye, pigment, Nippon Yellow JPD LM-NL, Direct Yellow, Acid Yellow, solvents, penetrant, 1,2-alkanediol, surfactant, polyoxyethylene dimethyl siloxane, buffer, triethanolamine (TEA), fluorosurfactants, biocide, porous photo media.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 7,066,991 B2 (Blease et al.), 27 June 2006 (27.06.2006) entire document especially col 4, ln 26-40; col 5, ln 3-8; col 5, ln 9-11; col 5, ln 32-37; (col 5, ln 23; col 4, ln 15-21; col 4, ln 55-61; col 4, ln 7; col 6, ln 1-2.	1-22
Y	US 2009/0148978 A1 (Hampden-Smith et al.), 11 June 2009 (11.06.2009). Para [0038].	1-22
Y	US 7,553,360 B2 (Koganehira et al.), 30 June 2009 (30.06.2009) entire document especially col 5, ln 31-32; col 4, ln 48-67 to col 5, ln 1-4; col 8, ln 26-27; col 4, ln 1-19; col 6, ln 5-7; col 7, ln 57-58; col 11, ln 58	8-10, 12-22
A	US 2004/0155947 A1 (Ozawa et al.) 12 August 2004 (12.08.2004) entire document	1-22

☐ Further documents are listed in the continuation of Box C.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

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Date of mailing of the international search report

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