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

(57) Abstract: The present invention relates to magenta dye-based inkjet inks having improved permanence when jetted onto porous photo media. The inkjet ink includes a mixture of at least two magenta 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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**MAGENTA 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 magenta 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 magenta dye-based inkjet ink that may be used with porous photo media with substantially minimal fading and degradation of the magenta dye.

SUMMARY OF THE INVENTION

[0011] Exemplary embodiments of the present invention provide an inkjet ink comprised of a mixture of two or more magenta 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 magenta 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.

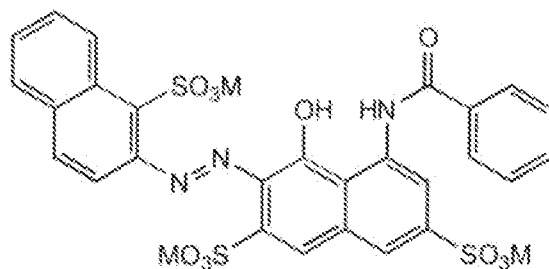
[0015] It has been found that a color inkjet ink having a mixture of two or more magenta dyes, three co-solvents, a penetrant, and a wetting agent has an increased permanence when used with porous photo media.

[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 magenta 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 magenta dyes comprises about 4.0% of the composition of the ink by weight.

[0018] The mixture of two more magenta dyes may include dyes selected from the group consisting of Nippon Magenta JPD LM-1 Liquid (an anthrapyridone disulfonic acid available from Nippon Kayaku Co, Ltd of Tokyo, Japan) and a magenta dye as described in US Patent No.

5,254,160 (available from Lexmark International, Inc. of Lexington, Kentucky), the chemical structure of which is:



wherein M is H, Li, Na, or K. Although the color is visually more appealing with the a magenta dye as described in US Patent No. 5,254,160, the Nippon Magenta JPD LM-1 Liquid is more lightfast on porous media.

[0019] In an exemplary embodiment, the amount of each of Nippon Magenta JPD LM-1 Liquid and a magenta dye as described in US Patent No. 5,254,160 are substantially equal. In another exemplary embodiment, the amount of each dye in the mixture is about 2%.

[0020] In particular, the color of the Nippon Magenta JPD LM-1 Liquid may be toned by being further combined with one or more of dyes selected from Acid Red 35, Acid Red 52, Acid Red 81, Acid Red 92, Acid Red 249, Acid Red 289, Direct Red 289, Direct Red 227, Direct Violet 107 (available commercially as PROJET® Magenta 2 from Fujifilm of Tokyo, Japan), PROJET® Magenta 3BOA (available commercially from Fujifilm of Tokyo, Japan), DUASYN® Magenta NM-SF (available commercially from Clariant of Coventry, Rhode Island), ILFORD® M377 (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 magenta 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

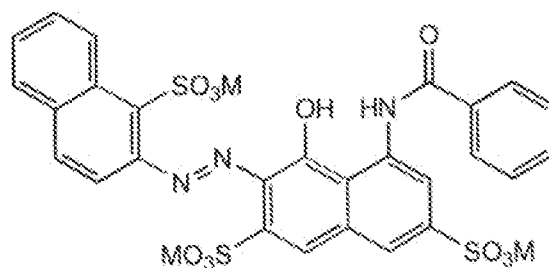
Permanence of Dye with Porous Photo Media		
Ink	Years of Permanence after Exposure to:	
	Ozone (1 ppm or 5ppm)	Xenon LF (80 klux)
Magenta Inkjet Ink	4	8
Commercially Available Magenta-dye Based Inkjet Ink	1	7

[0032] As clearly illustrated above, the present magenta-dye based inkjet ink shows an improvement in permanence when exposed to ozone four times greater than that of commercially available magenta-dye inkjet inks undergoing the same exposure. When exposed to xenon light, the magenta inkjet ink of the present invention showed a permanence 114% greater than that of a commercially available magenta-dye inkjet ink.

[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 magenta 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 magenta 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 magenta dyes includes Nippon Magenta JPD LM-1 Liquid and a magenta dye having the chemical structure:



wherein M is H, Li, Na, or K.

4. The inkjet ink according to claim 3, wherein the amount of each of the Nippon Magenta JPD LM-1 Liquid and the magenta dye having the identified chemical structure is substantially equal.
5. The inkjet ink according to claim 3, wherein the Nippon Magenta JPD LM-1 Liquid is toned with one or more of Acid Red 35, Acid Red 52, Acid Red 81, Acid Red 92, Acid Red 249, Acid Red 289, Direct Red 289, Direct Red 227, Direct Violet 107 PROJET® Magenta 3BOA, DUASYN® Magenta NM-SF, or ILFORD® M377.

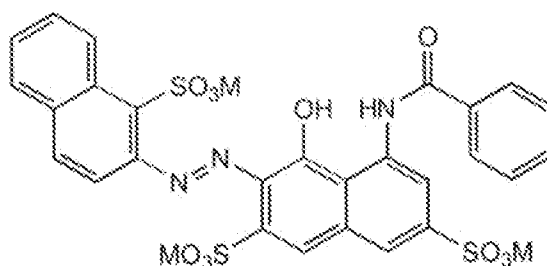
6. The inkjet ink according to claim 1, wherein the at least three co-solvents are selected from the group consisting of 1,3-propanediol; 1,2-alkanediol; 1,5-pentanediol; triethylene glycol; and dipropylene glycol.
7. The inkjet ink according to claim 1, wherein two of the at least three co-solvents 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)tiuarine 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 print 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 magenta 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 magenta 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 magenta dyes includes Nippon Magenta JPD LM-1 Liquid and a magenta dye having the chemical structure



wherein M is H, Li, Na, or K.

17. The method of printing using an inkjet ink according to claim 16, wherein the amount of each of the Nippon Magenta JPD LM-1 Liquid and the magenta dye having the identified chemical structure is substantially equal.
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)tuarine 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 10/41883

A. CLASSIFICATION OF SUBJECT MATTER

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

USPC - 106/31.6,31.49,31.43,31.58;347/100

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)

IPC: C09D 11/00 (2010.01)

USPC: 106/31.6,31.49,31.43,31.58;347/100

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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

(USPT, PGPB, EPAB, JPAB); Google Patent, Google Scholar

Search terms on extra sheet

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ---- Y	US 2004/0048745 A1 (Kitamura et al.) 11 Mar 2004 (11.03.2004) (Abstract, para [0005], [0011], [0037], [0038], [0047], [0057]-[0060], [0062], [0082], [0083], [0085], [0087], [0088], [0089], [0090], [0092], [0093], [0108], [0135], [0140]).	1-2, 6-8, 10-11, 13-15, 18-19 and 21-22 ----- 3-5, 9, 12, 16-17 and 20
Y	US 5,254,160 A (Beach et al.) 19 Oct 1993 (19.10.1993) (Col. 2, ln 19-48).	3-5, 16-17
Y	US 2007/0259989 A1 (Berge et al.) 08 Nov 2007 (08.11.2007) (para [0082], [0097], [0098], [0099], [0125]).	9, 12, 20
X	US 2004/0072923 A1 (Matsunami et al.) 15 Apr 2004 (15.04.2004) (para [0075], [0080], [0081]).	1-2, 6-8, 10-11, 13-15, 18-19 and 21-22

☐ 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

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"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

Date of the actual completion of the international search

23 Aug 2010 (23.08.2010)

Date of mailing of the international search report

30 SEP 2010

Name and mailing address of the ISA/US

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PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 10/41883

continued from box B

Search terms:

magenta, inkjet, jetink, ink jet, direct red, direct violet, acid red, 3boa, NM-SF, LM-i, LM1, biocide, zonyl, dispersant, surfactant, penetrant, triethanolamine, taurine, BES, 2-aminoethane sulfonic, composition, polyoxyethylene dimethyl siloxane, fluorosurfactant, fluorochemical, 1,2-alkanediol, alkanediol, 1,3-propanediol, trimethylene glycol, 1,3-trimethylene glycol, propanediol, triethylene glycol, triglycol, ethylenedioxydiethanol, diglycol, diethylene glycol, 1,5-propanediol, pentylene glycol, pentamethylene glycol, pentanediol, hexylene glycol, hexanediol, butanediol, octanediol, propylene glycol