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(11) **EP 1 020 300 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
19.07.2000 Bulletin 2000/29

(51) Int Cl.7: **B41M 5/00**

(21) Application number: **00300226.8**

(22) Date of filing: **13.01.2000**

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE**
Designated Extension States:
AL LT LV MK RO SI

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(30) Priority: **13.01.1999 US 115677 P**

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(54) **Ink jet media prepared from water-based formulation**

(57) An ink jet printing medium has a top coat density of between 15 and 30 g/m². The aqueous-based top coat formulation containing at least two aqueous gel forming polymers amounting to between 6 and 13 total weight percent of the formulation where the most hy-

drophilic polymer of the aqueous gel forming polymers is present in a weight ratio of between 4:1 and 2:1 relative to the least hydrophilic of the gel forming polymers. A binder polymer is also present in the formulation between 5 and 15 total weight percent.

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Description

Related Application

5 [0001] This application claims priority of United States Provisional Patent Application 60/115,677 filed January 13, 1999 and is incorporated herein by reference.

Background of the Invention

10 [0002] The present invention relates to ink jet printing media, more particularly to an aqueous coating compound for preparing an ink receiving layer on the media.

Field of the Invention

15 [0003] Printers using sprayable inks, such as ink jet printers, are becoming increasingly common. These printers utilize a small aperture to selectively propel ink in response to a series of electronic commands. Ink jet printers are characterized by high speed and simple operation, making them further adaptable to the use of multiple color/multiple composition inks for computer graphics applications.

20 [0004] With ever increasing demands for print quality, ink jet media, the surfaces onto which the printer applies the ink, have become ever more sophisticated in order to meet image quality requirements. Printed matter derived from an ink jet are expected to have high pixel and color densities as well as being smudge resistant and, to a large extent, archival. In order to meet these requirements, an ink jet medium should readily absorb sprayed ink so as to retain the dimensions of the original ink spot; dry with sufficient speed under normal printing conditions to allow an overlapping ink spot to be applied without bleeding or other deleterious interaction between the two spots; appear optically bright; and be resistant to curl and delamination throughout the printing process.

25 [0005] Ink jet compositions are well known and are generally characterized as being aqueous with lesser amounts of hydrophilic, low vapor pressure solvents such as pyrrolidones, glycols, glycol ethers and the like. As concern about VOCs increase, the use of organic solvents in ink jet compositions is under ever increasing scrutiny. Similarly, ink jet media are increasingly expected to maintain performance requirements with aqueous inks while minimizing the use of organic solvents in the production thereof.

30 [0006] Ink jet media including a support and an ink receiving top coat layer are known to the art. Top coat layers have previously included polyvinyl alcohol, polyvinyl pyrrolidone homopolymer and/or vinyl pyrrolidone copolymer, and a water soluble substance containing aldehyde groups. U.S. Patent 5,569,529 is representative thereof.

35 [0007] These objects, as well as others which shall become apparent on further reading, are largely achieved by the present invention.

Summary of the Invention

40 [0008] An ink jet media top coat formulation is provided comprising water, 4 to 10 total weight percent of a polyvinyl alcohol, 2 to 3 total weight percent polyvinyl pyrrolidone and 5 to 15 total weight percent of a binder polymer where the binder polymer is chosen from a polyalkylene or a latex.

45 [0009] An ink jet medium is provided comprising a substrate having a front side and a back side; a barrier layer coating the front side; and an ink receiving top coat layer thereon having a coat density from 15 to 30 grams per meter squared, said top coat layer comprising: polyvinyl alcohol and polyvinyl pyrrolidone in a weight ratio ranging from 4:1 to 2:1, a binder polymer in a weight ratio to polyvinyl pyrrolidone ranging from 4:1 to 1:1 wherein said binder polymer is selected from a group consisting of: polyethylene, polyethylene copolymer, styrene containing latex, butadiene containing latex, acrylic latex, and acrylic copolymer latex.

50 [0010] A method of printing is further provided comprising the steps of: applying an aqueous ink as a series of spots to a surface layer of a planar ink jet medium, the surface layer comprising: polyvinyl alcohol and polyvinyl pyrrolidone in a weight ratio ranging from 4:1 to 2:1, a binder polymer in a weight ratio to polyvinyl pyrrolidone ranging from 4:1 to 1:1 wherein said binder polymer is selected from a group consisting of: polyethylene, polyethylene copolymer, styrene containing latex, butadiene containing latex, acrylic latex, and acrylic copolymer latex.

Detailed Description of the Invention

55 [0011] The ink jet media of the present invention is an aqueous formulation for a top coat, ink receiving layer which dries to form a gel layer. The top coat formulation of the present invention is applied to a hydrophobic barrier layer of sufficient thickness and composition to prevent an aqueous dye ink, such as those employed by conventional ink jet

printers, from penetrating therethrough. The barrier layer is supported by a polymeric transparency or a paper supporting substrate. In addition to the barrier layer, further back coats may optionally be employed intermediate between the substrate and barrier layer to, for example, improve curl resistance and lamination properties.

[0012] The top coat formulations employed in the practice of the present invention include a mixture of at least two aqueous, gel forming polymers. The at least two aqueous gel forming polymers selected from polyvinyl alcohol, acrylic resins, polyvinyl acetate, ethylene/vinyl acetate copolymer, starch, polyvinyl butyral, gelatin, casein, polyvinyl pyrrolidone, alginate and polyacrylamide. Preferably, the polymers are polyvinyl alcohol and polyvinyl pyrrolidone. The most hydrophilic polymer being present in a weight ratio of from 4:1 to 2:1 relative to the least hydrophilic gel forming polymer. The total gel forming polymer weight being between 6 and 13% of total formulation weight, with the majority of the top coat formulation being water.

[0013] The formulation also containing a binder polymer for facilitating adhesion to a substrate and/or barrier layer, and/or strengthening the top coat layer. The binder polymer according to the present invention is preferably present from 5 to 15 total weight percent, and illustratively includes latexes such as: SBR latex, NBR latex, acrylic latex, styrene containing latex, butadiene latex, acrylate acrylamide latex, alkylene vinyl acetate copolymers and terpolymers, including those sold under the trade name AIRFLEX (Air Products), copolymers and mixtures thereof, polyolefins including high density polyethylene, low density polyethylene, ultrahigh molecular weight polyethylene, polypropylene (atactic, isotactic, or syndiotactic); poly(vinyl chloride), polytetrafluoroethylene, copolymers of ethylene and acrylic acid, copolymers of ethylene and methacrylic acid, poly(vinylidene chloride), copolymers of vinylidene chloride and vinyl acetate, copolymers of vinylidene chloride and vinyl chloride, copolymers of ethylene and propylene, copolymers of ethylene and butene, poly(vinyl acetate), polystyrene, poly(omega-aminoundecanoic acid), poly(hexamethylene adipamide), and poly(methyl methacrylate). Preferably a binder according to the present invention is a polyethylene, a polyethylene copolymer, a styrene containing latex, a butadiene containing latex, an acrylic latex or an acrylic copolymer latex. The top coat layer formulation optionally further contains a water absorbing pigment, such as silica, salicylic acid, clay, talc, diatomaceous earth, calcium carbonate, calcium sulfate, barium sulfate, aluminum silicate, alumina, zinc oxide, rutile, and other conventional inorganic pigments and zeolites. Other additives optionally included in the top coat layer formulation are: dyes, dispersants, surfactants, and optical brighteners.

[0014] A preferred class of polyvinyl alcohol are the partially hydrolyzed alcohols. More preferable are PVA where between 85 and 95% hydrolysis has occurred. It is appreciated that fully hydrolyzed polyvinyl alcohol is also operative in the present invention. The polyvinyl alcohol being present in a weight ratio relative to polyvinyl pyrrolidone from 4:1 to 2:1.

[0015] The top coat layer formulation is spread onto a barrier layer so as to achieve a dry coating weight of between 15 grams per square meter and 30 grams per square meter. Preferably, the dry coating weight of the top coat layer formulation is between 20 grams per square meter and 25 grams per square meter.

[0016] The barrier layer is a hydrophobic polymeric material illustratively including polyolefins, polyesters, polyethers or the like. Preferably, the barrier layer is composed of polyethylene. The barrier layer may be extruded onto a supporting substrate to form a comparatively thick layer or alternatively, is applied as a thin coating onto the substrate. The preferred barrier layer coat weight for an extruded layer is from 10 grams per square meter to 30 grams per square meter whereas for a thin coated barrier layer the coat weight is from 3 grams per square meter to 10 grams per square meter. Preferably, the back side of the supporting substrate has an additional barrier layer applied thereto. Optionally, an additional top coat layer is applied to the back side barrier layer.

[0017] The invention is illustrated in greater detail in the following examples which are intended only to illustrate the invention and not in any way limit the scope of the appended claims. Unless otherwise noted, the percentages therein and throughout the application are by weight.

Example 1

[0018] An ink receiving top coat layer of the following composition is prepared:

	Wt. %
Water	50.1
Polyvinyl pyrrolidone PVP K-90	2.2
Polyvinyl alcohol Airvol 205 (25% total solids in water)	25.3
Polyethylene Dispersion WE4-25 (25 wt. % dispersion in water)	21.8
Optical Brightener Leucophor L Concentrate	0.6

[0019] Polyvinyl alcohol (Airvol 205) which was obtained from Air Products is mixed with water for 5 minutes. Polyvinyl

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pyrrolidone, obtained from International Specialty Products, is then added and mixed until the polymer is completely dissolved. Polyethylene dispersion WE4-25, obtained from Chemcor, is an ethylene/acrylic polymer acid dispersion which is then added and mixed for 10 minutes or until the copolymer is fully dispersed. An optical brightener, obtained from Clariant (Leucophor L), is then added and the mixture stirred for an additional 10 minutes to insure uniformity. The mixture is then coated onto a transparent polyethylene barrier having a coat weight of 28 g/m² using a conventional coater operating at 60 ft/min. at a drying temperature of 120°C. The resulting top coat layer had a coating weight of 20 g/m² and a high gloss finish.

[0020] The resulting glossy ink jet media showed satisfactory resolution, color density, and demonstrates little or no spreading of ink using a conventional aqueous based ink jet printer.

Example 2

[0021] Both sides of a substrate paper is coated with a barrier layer of polyethylene having a coat weight of 3 g/m² and then dried. The resulting top barrier layer is coated with a top coat formulation having the following composition:

Composition Wt. %							
Component	2a	2b	2c	2d	2e	2f	2g
Water	58.8	61.0	45.1	37.9	47.9	50.4	43.8
Polyvinyl pyrrolidone PVP-K90	2.2	2.2	2.5	2.5	2.5	2.5	2.0
Polyvinyl alcohol Airvol 205 (25% in water)	25.3	25.3	40.0	29.0	29.0	29.0	16.0
Acrylic Copolymer CARBOSET CR-781 (41.5% in water) Source: B.F. Goodrich	13.1	--	11.8	25.4	--	--	32.6
Styrene/Butadiene Latex RAP 456NA Latex (50% in water) Source: Dow Chemical	--	10.9		--	--	12.5	
Silica Syloid 221 (17% in water) Source: Grace-Davison	--	--		5.0	5.0	5.0	5.0
Optical Brightener Leucophor L	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Coating Weight g/m ²	20	25	15	20	25	20	30

[0022] The mixing and application conditions are the same as in Example 1. Compositions 2A-2C represent glossy ink jet printing media and the compositions of Examples 2D-G represent matte finish ink jet printing media upon drying.

Example 3

[0023] The compositions of Example 2 are reproduced except [please fill in polymer and source of hypothetical substitute for PVP] replaces polyvinyl pyrrolidone, resulting in comparable quality ink jet media.

Example 4

[0024] The compositions of Example 2 are reproduced except [please fill in polymer and source of hypothetical substitute for PVA] replaces polyvinyl alcohol, resulting in comparable quality ink jet media.

Example 5

[0025] Print quality of ink jet media of the present invention is tested using a Hewlett Packard HP Desk Jet 500C bubble jet printer. The optical density is determined using a conventional reflection densitometer.

[0026] The composition of the present invention can be coated onto a variety of substrates including polymers such as PET, polypropylene and the like. The compositions can also be coated onto paper. As is known in the art, subcoatings and adhesion layers may be employed to facilitate the use of various substrates. The compositions of the present invention are most preferably used for ink jet imaging, but can also be employed for other uses where an ink-receptive surface is required.

[0027] There will be various modifications, improvements and applications of the disclosed invention that will be apparent to those skilled in the art, and the present application is intended to cover such embodiments. Although the present invention has been described in the context of certain preferred embodiments, it is intended that the full scope of these be measured by reference to the scope of the following claims.

Claims

1. An ink jet media top coat formulation comprising:

water;
from 6 to 13 total weight percent of at least two aqueous gel forming polymers comprising a most hydrophilic polymer and a least hydrophilic polymer wherein the most hydrophilic polymer is present in a weight ratio of between 4:1 to 2:1 relative to the least hydrophilic polymer and said at least two aqueous gel forming polymers are selected from a group consisting of: polyvinyl alcohol, acrylic resins, polyvinyl acetate, ethylene/vinyl acetate copolymer, starch, polyvinyl butyral, gelatin, casein, polyvinyl pyrrolidone, alginate and polyacrylamide, and
from 5 to 15 total weight percent of a binder polymer selected from a group consisting of: SBR latex, NBR latex, acrylic latex, styrene containing latex, butadiene latex, acrylate acrylamide latex, alkylene vinyl acetate copolymers and terpolymers, high density polyethylene, low density polyethylene, ultrahigh molecular weight polyethylene, atactic polypropylene, isotactic polypropylene, syndiotactic polypropylene, poly(vinyl chloride), polytetrafluoroethylene, copolymers of ethylene and acrylic acid, copolymers of ethylene and methacrylic acid, poly(vinylidene chloride), copolymers of vinylidene chloride and vinyl acetate, copolymers of vinylidene chloride and vinyl chloride, copolymers of ethylene and propylene, copolymers of ethylene and butene, poly(vinyl acetate), polystyrene, poly(omega-aminoundecanoic acid), poly(hexamethylene adipamide), and poly(methyl methacrylate).

2. The top coat formulation of claim 1 wherein the most hydrophilic polymer is polyvinyl alcohol.

3. The top coat formulation of claim 1 wherein the least hydrophilic polymer is polyvinyl pyrrolidone.

4. An ink jet medium comprising:

a substrate having a front side and a back side;
a barrier layer coating the front side; and
the formulation of claim 1 applied at a dried coat density of from 15 to 30 grams per meter squared.

5. An ink jet media top coat formulation comprising:

water,
from 4 to 10 total weight percent of polyvinyl alcohol,
from 2 to 3 total weight percent polyvinyl pyrrolidone, and
from 5 to 15 total weight percent of a binder polymer.

6. An ink jet medium comprising:

a substrate having a front side and a back side;
a barrier layer coating the front side; and
an ink receiving top coat layer thereon having a coat density from 15 to 30 grams per meter squared, said top

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coat layer comprising: polyvinyl alcohol and polyvinyl pyrrolidone in a weight ratio ranging from 4:1 to 2:1, a binder polymer in a weight ratio to polyvinyl pyrrolidone ranging from 4:1 to 1:1.

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7. The ink jet medium of claim 9 wherein said barrier layer has a density from 1 to 40 grams per meter squared.
8. A method of printing comprising: the steps of applying an aqueous ink to a surface layer of a planar ink jet medium, the surface layer comprising: polyvinyl alcohol and polyvinyl pyrrolidone in a weight ratio ranging from 4:1 to 2:1, a binder polymer in a weight ratio to polyvinyl pyrrolidone ranging from 4:1 to 1:1.
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9. A formulation as claimed in any of claims 1 to 9 for use as an ink jet media top coat.
10. A formulation according to claim 1 substantially as described herein in any of the examples.

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Application Number
EP 00 30 0226

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The present search report has been drawn up for all claims			
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EPO FORM 1503 03.92 (P04C01)

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