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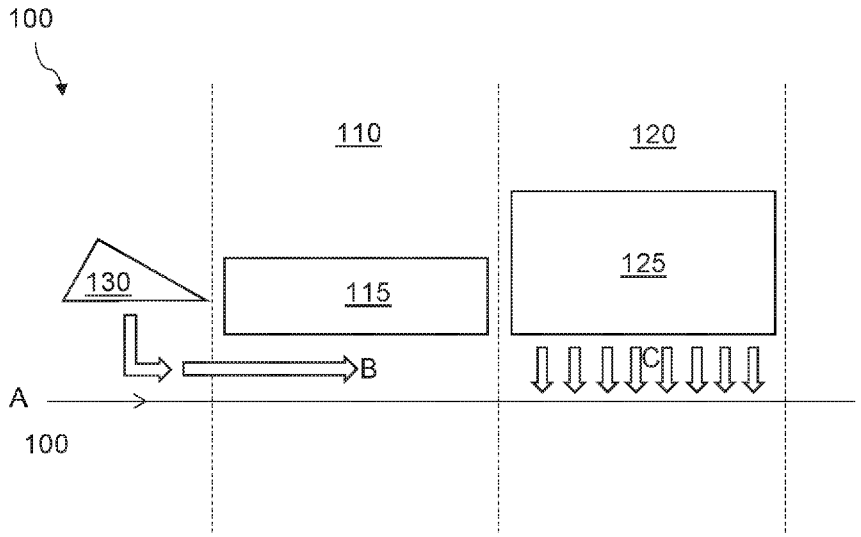


Fig.1

(57) Abstract: Herein is described an inkjet printing system comprising: an aqueous pre-treatment fluid comprising a cationic polymer and a pre-treatment vehicle; an aqueous inkjet ink composition comprising a latex polymer comprising a (meth)acrylate or (meth)acrylamide polymer or copolymer, a pigment and an ink vehicle; and an aqueous inkjet overcoat composition comprising a latex polymer comprising a (meth)acrylate or (meth)acrylamide polymer or copolymer, a wax and an overcoat vehicle.

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Inkjet Printing System

Background

[0001] Inkjet printing with aqueous inks is increasingly being used to print on non-porous flexible and rigid media for signage and other printing applications. It is recognized that inkjet printing of aqueous inks on nonporous media is substantially different than inkjet applications for traditional porous paper-based media. On porous papers, ink drying occurs primarily by ink penetration into the media pore structure, and control of image quality aspects is a strong function of the rate of ink penetration into the media. Thus, optimization of the penetration rate is used for attributes such as optical density and color-to-color bleed. On nonporous media, there is no penetration of the ink into the media, i.e. the colorant remains on the surface of the media, and image quality defects resulting from wetting and ink migration across the nonporous surface are more difficult to control, especially at high printing speeds.

[0002] Durability of aqueous inks on nonporous substrates poses a challenge. Inks need to wet and adhere to a broad range of substrates, have good abrasion and scratch resistance, resist attack by water, cleaning fluids, and solvents, and have good outdoor weatherability. There have been great improvements in the durability of aqueous ink-jet inks through incorporation of certain ink-jet compatible latex polymer dispersions made by emulsion polymerization. When printed as part of an ink-jet ink, a latex component of the ink can form a film on a media surface, entrapping and protecting the colorant within the hydrophobic print film.

Brief Description of the Figures

[0003] Figure 1 is a schematic diagram of a printing system for use in an example of a method of printing.

Detailed Description

[0004] Before the latex polymers, ink compositions, methods and related aspects of the disclosure are disclosed and described, it is to be understood that this disclosure is not restricted to the particular process features and materials disclosed herein because such process features and materials may vary somewhat. It is also to be understood that the terminology used herein is used for the purpose of describing particular examples. The terms are not intended to be limiting because the scope is intended to be limited by the appended claims and equivalents thereof.

[0005] It is noted that, as used in this specification and the appended claims, the singular forms "a," "an," and "the" include plural referents unless the context clearly dictates otherwise.

[0006] As used herein, "co-polymer" refers to a polymer that is polymerized from at least two monomers.

[0007] A certain monomer may be described herein as constituting a certain weight percentage of a polymer. This indicates that the repeating units formed from the said monomer in the polymer constitute said weight percentage of the polymer.

[0008] If a standard test is mentioned herein, unless otherwise stated, the version of the test to be referred to is the most recent at the time of filing this patent application.

[0009] As used herein, the term "about" is used to provide flexibility to a numerical range endpoint by providing that a given value may be a little above or a little below the endpoint. The degree of flexibility of this term can be dictated by the particular variable.

[00010] As used herein, "latex," "latex polymer," or "latex particles" refer to the polymeric masses synthesized from individual monomers, which can be dispersed in a liquid vehicle forming a latex dispersion. The term "latex" generally refers to liquid and polymeric particles that are dispersed within the liquid. However, when a latex (i.e. a latex dispersion including latex polymer particles) is formulated within an ink, the liquid becomes part of the liquid vehicle of the ink, and thus, latex polymer can be described based on the latex particle or latex polymer solids that remain dispersed in the liquid vehicle.

[00011] The term "monomer emulsion" refers to an organic monomer or monomer mix that is emulsified in an aqueous or water phase. Once the organic monomer or monomer mix is polymerized, a latex polymer dispersion is formed.

[00012] The term "latex polymer dispersion" or "latex dispersion" includes both latex particulates as well as the aqueous medium in which the latex particulates are dispersed. More specifically, a latex dispersion is a liquid suspension comprising a liquid (such as water and/or other liquids) and polymeric particulates from 20 nm to 500 nm (preferably from 100 nm to 300 nm) in size (average particle size), and having a weight average molecular weight from about 10,000 Mw to 2,000,000 Mw (preferably from about 100,000 Mw to 300,000 Mw). Such polymeric particulates can comprise a plurality of monomers that are typically randomly polymerized, and can also be crosslinked. When crosslinked, the molecular weight can be even higher than that cited above. The average particle size

(e.g. volume or intensity weighted average particle size) may be determined by dynamic light scattering.

[00013] The term "non-porous" when referring to a substrate, such as a media substrate, includes surfaces that can have relatively poor water permeability and absorption. Vinyl, polypropylene, polyethylene and other plastic sheets or films, metals, coated offset media, glass, certain woods, and other similar substrates are considered to be non-porous. The term "non-porous media" refers to print media which has a Bristow Test of less than 2 ml/m^2 at a contact time of less than 0.5 s. The Bristow Test is known in the art and is summarized below. A test specimen of defined dimensions is affixed to the smooth rim of a wheel free to rotate at a defined constant speed in contact with a stationary test fluid applicator pressing against the test specimen with a defined pressure. The test fluid applicator consists of a test solution storage compartment affixed above a 1 by 15-mm test fluid delivery slot, the slot being positioned so that the long dimension is perpendicular to the direction of rotation of the rim of the wheel, and parallel to the wheel axis. A defined quantity of test fluid is placed through the fluid reservoir, onto the fluid delivery slot. With the wheel with the test specimen affixed rotating at constant speed, the test solution applicator is brought into contact with the rotating test specimen and held in place under defined pressure. The test fluid is transferred from the test solution applicator onto the test specimen in a band whose width, controlled by the applicator slot width is approximately 15 mm, and whose length is function of the absorptive characteristics of the test fluid interaction with the test specimen under the defined test conditions. The amount of liquid absorbed per unit area of test specimen is calculated from the volume of test fluid originally placed in the applicator, and the average width and length of the band created on the test specimen by the transferred test fluid. The time available for the liquid absorption is calculated from the volume of test fluid originally placed in the applicator and applicator geometry.

[00014] As used herein, "ink vehicle" refers to the liquid fluid in which a latex polymer and a pigment are placed to form an ink. Ink vehicles may include a mixture of a variety of different agents, including, for example, surfactants, solvents, co-solvents, buffers, biocides, viscosity modifiers, sequestering agents, stabilizing agents, humectants and water.

[00015] The term "decap" is a measure of how long a printing nozzle may remain inactive before plugging and how many inkjet architecture firings are required to re-establish proper drop ejection.

[00016] The term "(meth)acrylate" is well understood in the art to refer to both acrylates and methacrylates. For example, "cyclohexyl (meth)acrylate" refers to cyclohexyl acrylate and/or cyclohexyl methacrylate. Likewise, the term "cycloaliphatic (meth)acrylate monomer" denotes a cycloaliphatic acrylate monomer and/or a cycloaliphatic methacrylate monomer; and the term "aromatic(meth)acrylate monomer" denotes an aromatic acrylate monomer and/or an aromatic methacrylate monomer.

[00017] The term "(meth)acrylamide" is well understood in the art to refer to both acrylamides and methacrylamides. For example, the term "cycloaliphatic (meth)acrylamide monomer" denotes a cycloaliphatic acrylamide monomer and/or a cycloaliphatic methacrylamide monomer; and the term "aromatic (meth)acrylamide monomer" denotes an aromatic acrylamide monomer and/or an aromatic methacrylamide monomer.

[00018] As used herein, a plurality of items, structural elements, compositional elements, and/or materials may be presented in a common list for convenience. However, these lists should be construed as though each member of the list is individually identified as a separate and unique member. Thus, no individual member of such list should be construed as a de facto equivalent of any other member of the same list solely based on their presentation in a common group without indications to the contrary.

[00019] Concentrations, amounts, and other numerical data may be expressed or presented herein in a range format. It is to be understood that such a range format is used merely for convenience and brevity and thus should be interpreted flexibly to include not just the numerical values explicitly recited as the end points of the range, but also to include all the individual numerical values or sub-ranges encompassed within that range as if each numerical value and sub-range is explicitly recited. As an illustration, a numerical range of "about 1 wt% to about 5 wt%" should be interpreted to include not just the explicitly recited values of about 1 wt% to about 5 wt%, but also include individual values and subranges within the indicated range. Thus, included in this numerical range are individual values such as 2, 3.5, and 4 and sub-ranges such as from 1-3, from 2-4, and from 3-5, etc. This same principle applies to ranges reciting a single numerical value. Furthermore, such an interpretation should apply regardless of the breadth of the range or the characteristics being described.

[00020] Unless otherwise stated, any feature described herein can be combined with any aspect or any other feature described herein.

[00021] The present inventors have found that the printing systems described herein provide inkjet-printed images having improved durability along with maintenance of colour of the inkjet ink composition. The present inventors have also found that print head reliability (e.g. decap performance) and fluidic efficiency can be improved using the printing systems described herein.

[00022] In an aspect there is provided an inkjet printing system comprising:

an aqueous pre-treatment fluid comprising a cationic polymer and a pre-treatment vehicle;

an aqueous inkjet ink composition comprising a latex polymer, a pigment and an ink vehicle; and

an aqueous inkjet overcoat composition comprising a latex polymer, a wax and an overcoat vehicle.

[00023] In an aspect there is provided an inkjet printing system comprising:

an aqueous pre-treatment fluid comprising a cationic polymer and a pre-treatment vehicle;

an aqueous inkjet ink composition comprising a latex polymer comprising a (meth)acrylate or (meth)acrylamide polymer or copolymer, a pigment and an ink vehicle; and

an aqueous inkjet overcoat composition comprising a latex polymer comprising a (meth)acrylate or (meth)acrylamide polymer or copolymer, a wax and an overcoat vehicle.

[00024] In an aspect there is provided a method or printing comprising:

providing a non-porous substrate;

applying an aqueous pre-treatment fluid comprising a cationic polymer and a pre-treatment vehicle to the non-porous substrate to form a pre-treatment layer;

inkjet printing an aqueous ink composition comprising a latex polymer, a pigment and an ink vehicle to the non-porous substrate to form an ink layer; and

inkjet printing an aqueous overcoat composition comprising a latex polymer, a wax and an overcoat vehicle to the non-porous substrate to form an overcoat layer.

[00025] In an aspect there is provided a method or printing comprising:

providing a non-porous substrate;

applying an aqueous pre-treatment fluid comprising a cationic polymer and a pre-treatment vehicle to the non-porous substrate to form a pre-treatment layer disposed on the non-porous substrate;

inkjet printing an aqueous ink composition comprising a latex polymer, a pigment and an ink vehicle to the non-porous substrate to form an ink layer disposed on the pre-treatment layer; and

inkjet printing an aqueous overcoat composition comprising a latex polymer, a wax and an overcoat vehicle to the non-porous substrate to form an overcoat layer disposed on the ink layer.

Inkjet Printing System

[00026] Described herein is an inkjet printing system comprising:

an aqueous pre-treatment fluid comprising: a cationic polymer and a pre-treatment vehicle;

an aqueous inkjet ink composition comprising a latex polymer, a pigment and an ink vehicle; and

an aqueous inkjet overcoat composition comprising a latex polymer, a wax and an overcoat vehicle.

[00027] In some examples, the latex polymer of the ink composition is different to the latex polymer of the overcoat composition.

Aqueous Pre-Treatment Fluid

[00028] The aqueous pre-treatment fluid comprises a cationic polymer and a pre-treatment vehicle. In some examples, the aqueous pre-treatment fluid comprises a cationic polymer, a pre-treatment vehicle and a surfactant.

Cationic Polymer

[00029] As used herein, the term "cationic polymer" refers to an ionic polymer where the specific ions are cationic in nature, e.g. a quaternized polyamine. Polymeric cationic polymers, also referred to as cationic polyelectrolytes, may contain either guanidinium or fully quaternized ammonium functionalities, such as quaternized polyamine copolymers. In some examples, the cationic polymer does not contain primary or secondary ammonium functionalities, such as polyallylamine or polyethylene imine, due to yellowing issues in outdoor exposure. Generally, the weight average molecular weight (Mw) of the cationic polymer allows viscosity less than 25 cP at 25° C, as measured on a Brookfield viscometer. Typical Mw are less than 500,000, for example less than 50,000. In some examples, cationic polymers can have high charge densities to improve fixing efficiencies. As such, cationic charge densities can be higher than 1000 microequivalents per gram cationic

functionality, for example higher than 4000 microequivalents per gram. In some examples, the aqueous pre-treatment fluid comprises a cationic polymer in an amount in the range of about 0.1 wt% to about 25 wt%, for example, 0.5 wt% to about 10 wt%, for example 0.5 wt% to about 5 wt%, or about 1 wt% to about 2.5 wt% by total weight of the aqueous pre-treatment fluid.

[00030] Classes of cationic polymers that can be used include, for example, quaternized polyamines, dicyandiamide polycations, diallyldimethyl ammonium chloride copolymers, quaternized dimethylaminoethyl(meth)acrylate polymers, quaternized vinylimidizol polymers, alkyl guanidine polymers, alkoxylated polyethylene imines, and mixtures thereof. It is to be understood that one or more polycations may be used, and that any desirable combination of the polycations can be used. One or more ions of the cationic polyelectrolytes may be ion-exchanged for a nitrate, acetate, mesylate, or other anion. An example of a suitable cationic polymer is Floquat® FL2350, a quaternized polyamine derived from epichlorohydrin and dimethyl amine, commercially available from SNF Inc.

Surfactant

[00031] The aqueous pre-treatment fluid may comprise non-ionic, cationic, and/or anionic surfactants. In some examples, the surfactant may be present in an amount ranging from 0.01 wt% to 10 wt% by total weight of the pre-treatment fluid, for example 0.01 wt% to 5 wt%. Cationic and nonionic surfactants are generally used, as many anionic surfactants can give solubility issues in the presence of a cationic polymer. For example, suitable surfactants may be selected form alkyl polyethylene oxides, alkyl phenyl polyethylene oxides, polyethylene oxide block copolymers, acetylenic polyethylene oxides, polyethylene oxide (di)esters, dimethicone copolyols, fluoroalkyl polyethylene oxides, and the like. In some examples, the aqueous pre-treatment fluid can include a cationic surfactant, nonionic surfactant, fluorosurfactant, silicone surfactant, and mixtures thereof. In some examples, the aqueous pre-treatment fluid can include a nonionic silicone and/or fluorosurfactant.

Additives

[00032] In some examples the aqueous pre-treatment fluid may comprise additives such as biocides (such as Nuosept™ (Nudex™ Inc.), Ucarcide™ (Union carbide Corp™.), Vancide™ (R.T. Vanderbilt™ Co.), Proxel™ (Lonza™), and combinations thereof), viscosity modifiers, materials for pH adjustment, sequestering agents (such as EDTA (ethylene diamine tetraacetic acid)), preservatives, and the like.

Pre-treatment Vehicle

[00033] The aqueous pre-treatment fluid comprises a pre-treatment vehicle. In some examples, the pre-treatment vehicle comprises water and a co-solvent. In some examples the aqueous pre-treatment fluid comprises a co-solvent in an amount of about 1 to about 50 wt% by total weight of the pre-treatment fluid, for example from about 1 to about 40 wt% of the pre-treatment fluid, or about 5 to about 30 wt% of the total weight of the pre-treatment fluid.

[00034] In some examples, the pre-treatment vehicle comprises a co-solvent having a boiling point ranging from 160° C to 250° C. In some examples, the pre-treatment vehicle comprises a co-solvent having a boiling point ranging from 170° C to 220° C, for example from 170° C to 215° C.

[00035] In some examples, the co-solvent may be selected form organic co-solvents including aliphatic alcohols, aromatic alcohols, diols, glycol ethers, polyglycol ethers, caprolactams, formamides, acetamides, and long chain alcohols. In some examples, the co-solvent may be selected form primary aliphatic alcohols, secondary aliphatic alcohols, 1,2-alcohols, 1,3-alcohols, 1,4-alcohols, 1,5-alcohols, ethylene glycol alkyl ethers, propylene glycol alkyl ethers, higher homologs (C_6-C_{12}) of polyethylene glycol alkyl ethers, pyrrolidinones, N-alkyl caprolactams, unsubstituted caprolactams, both substituted and unsubstituted formamides, both substituted and unsubstituted acetamides, and combinations thereof.

[00036] In some examples, the co-solvent is selected from an aliphatic alcohol, for example a primary aliphatic alcohol, a secondary aliphatic alcohol or a tertiary aliphatic alcohol. The aliphatic alcohol may be a diol. In some examples, the co-solvent is an aliphatic alcohol containing 10 carbons or less, for example 8 carbons or less or 6 carbons or less. In some examples, the first solvent is an aliphatic alcohol being a diol containing 10 carbons or less, for example 8 carbons or less or 6 carbons or less.

[00037] In some examples, the co-solvent is selected from the group comprising 1,2-propanediol, 1,2-butanediol, ethylene glycol, 2-methyl-2,4-pentanediol, 1,3-butanediol, 2-methyl-1,3-propanediol and 1,3-propanediol. In some examples the co-solvent is selected from the group comprising 1,2-propanediol, 1,2-butanediol, ethylene glycol, 2-methyl-2,4-pentanediol, and 1,3-butanediol. In some examples the first solvent is selected from the group consisting of 1,2-propanediol, 1,2-butanediol, ethylene glycol, 2-methyl-2,4-pentanediol, 1,3-butanediol, 2-methyl-1,3-propanediol and 1,3-propanediol. In some

examples the co-solvent is selected from the group consisting of 1,2-propanediol, 1,2-butanediol, ethylene glycol, 2-methyl-2,4-pentanediol, and 1,3-butanediol. In some examples the co-solvent is 1,2-butanediol.

[00038] In some examples, the aqueous pre-treatment fluid comprises:

about 0.1 wt% to about 25 wt% of a cationic polymer by total weight of the pre-treatment fluid; and

a pre-treatment vehicle comprising water and about 1 to about 50 wt% by total weight of the pre-treatment fluid of a co-solvent having a boiling point in the range of about 170 °C to about 215 °C.

Aqueous Inkjet Ink Composition

[00039] The aqueous inkjet ink composition comprises a latex polymer, a pigment and an ink vehicle.

Latex Polymer of the inkjet ink composition

[00040] The inkjet ink composition comprises a latex polymer.

[00041] Latex polymers can be prepared using any of a number of methods known in the art, including but not limited to emulsion polymerization techniques where co-monomers are dispersed and polymerized in a discontinuous phase of an emulsion. The latexes can also be dispersions of polymer prepared by other techniques known to those in the art.

[00042] The monomers used in the latexes can be vinyl monomers. In some examples, the monomers from which the latex polymer is formed are selected from vinyl monomers, acrylate monomers, methacrylate monomers, styrene monomers, ethylene, vinyl chloride, vinylidene chloride, maleate esters, fumarate esters, itaconate esters and combinations thereof. In some examples, monomers from which the latex polymer is formed may comprise ethyl acrylate; ethyl methacrylate; benzyl acrylate; benzyl methacrylate; propyl acrylate; propyl methacrylate; iso-propyl acrylate; iso-propyl methacrylate; butyl acrylate; butyl methacrylate; hexyl acrylate; hexyl methacrylate; octadecyl methacrylate; octadecyl acrylate; lauryl methacrylate; lauryl acrylate; hydroxyethyl acrylate; hydroxyethyl methacrylate; hydroxyhexyl acrylate; hydroxyhexyl methacrylate; hydroxyoctadecyl acrylate; hydroxyoctadecyl methacrylate; hydroxylauryl methacrylate; hydroxylauryl acrylate; phenethyl acrylate; phenethyl methacrylate; 6-phenylhexyl acrylate; 6-phenylhexyl methacrylate; phenyllauryl acrylate; phenyllauryl methacrylate; 3-nitrophenyl-6-hexyl methacrylate; 3-nitrophenyl-18-octadecyl acrylate; ethyleneglycol dicyclopentyl

ether acrylate; vinyl ethyl ketone; vinyl propyl ketone; vinyl hexyl ketone; vinyl octyl ketone; vinyl butyl ketone; cyclohexyl acrylate; methoxysilane; acryloxypropyhiethyldimethoxysilane; trifluoromethyl styrene; trifluoromethyl acrylate; trifluoromethyl methacrylate; tetrafluoropropyl acrylate; tetrafluoropropyl methacrylate; heptafluorobutyl methacrylate; iso-butyl acrylate; iso-butyl methacrylate; 2-ethylhexyl acrylate; 2-ethylhexyl methacrylate; iso-octyl acrylate; iso-octyl methacrylate; and combinations thereof.

[00043] In some examples, the latex polymer is formed from monomers selected from styrenes, C1 to C8 alkyl methacrylates, C1 to C8 alkyl acrylates, ethylene glycol methacrylates and dimethacrylates, methacrylic acids, acrylic acids, and combinations thereof. Examples of latex polymers that can be used include those prepared using a monomer emulsion of styrene, hexyl methacrylate, ethylene glycol dimethacrylate, and methacrylic acid, which are copolymerized to form the latex.

[00044] In some examples, the monomers from which the latex polymer is formed include acid monomers, such as (meth)acrylic acid monomers. Acidic monomers that can be polymerized in forming latexes include, without limitation, acrylic acid, methacrylic acid, ethacrylic acid, dimethylacrylic acid, maleic anhydride, maleic acid, vinylsulfonate, cyanoacrylic acid, vinylacetic acid, allylacetic acid, ethylidineacetic acid, propylidineacetic acid, crotonoic acid, fumaric acid, itaconic acid, sorbic acid, angelic acid, cinnamic acid, styrylacrylic acid, citraconic acid, glutaconic acid, aconitic acid, phenylacrylic acid, acryloxypropionic acid, aconitic acid, phenylacrylic acid, acryloxypropionic acid, vinylbenzoic acid, N-vinylsuccinamidic acid, mesaconic acid, methacroylalanine, acryloylhydroxyglycine, sulfoethyl methacrylic acid, sulfopropyl acrylic acid, styrene sulfonic acid, sulfoethylacrylic acid, 2-methacryloyloxymethane-1-sulfonic acid, 3-methacryoyloxypropane-1-sulfonic acid, 3-(vinyloxy)propane-1-sulfonic acid, ethylenesulfonic acid, vinyl sulfuric acid, 4-vinylphenyl sulfuric acid, ethylene phosphonic acid, vinyl phosphoric acid, vinyl benzoic acid, 2-acrylamido-2-methyl-1-propanesulfonic acid, combinations thereof, derivatives thereof, and mixtures thereof.

[00045] In some examples, the latex polymer comprises a (meth)acrylate or (meth)acrylamide polymer or copolymer. In some examples, the latex polymer comprises a (meth)acrylate or (meth)acrylate copolymer. A (meth)acrylate or (meth)acrylamide copolymer may contain a (meth)acrylate/(meth)acrylamide component in addition to other components, such as other vinyl monomer components. For example, the latex polymer may comprise a copolymer of a (meth)acrylate monomer and another vinyl monomer, for example another vinyl monomer selected from styrenes, C1 to C8 alkyl methacrylates, C1

to C8 alkyl acrylates, ethylene glycol methacrylates and dimethacrylates, methacrylic acids, acrylic acids, and combinations thereof. For example, the latex polymer may comprise a copolymer of a (meth)acrylamide monomer and another vinyl monomer, for example another vinyl monomer selected from styrenes, C1 to C8 alkyl methacrylates, C1 to C8 alkyl acrylates, ethylene glycol methacrylates and dimethacrylates, methacrylic acids, acrylic acids, and combinations thereof.

[00046] In some examples, the latex polymer comprises a (meth)acrylate polymer being a polymer comprising (meth)acrylate monomers or a (meth)acrylate copolymer being a copolymer comprising (meth)acrylate monomers. In some examples, the latex polymer comprises a (meth)acrylate copolymer comprising (meth)acrylate monomers.

[00047] In some examples, the (meth)acrylate monomers are selected from aliphatic (meth)acrylate monomers, aromatic (meth)acrylate monomers and combinations thereof.

[00048] In some examples, aliphatic (meth)acrylate monomers comprise linear aliphatic (meth)acrylate monomers and/or cycloaliphatic (meth)acrylate monomers.

[00049] In some examples, linear (meth)acrylate monomers comprise alkyl (meth)acrylate monomers (for example C1 to C8 alkyl (meth)acrylate monomers). In some examples, the linear (meth)acrylate monomers comprise alkyl methacrylate monomers (e.g. C1 to C8 alkyl methacrylate monomers). In some examples, the linear (meth)acrylate monomers comprise alkyl methacrylate monomers (e.g. C1 to C8 alkyl methacrylate monomers) and alkyl acrylate monomers (C1 to C8 alkyl acrylate monomers).

[00050] In some examples, the latex polymer comprises a copolymer comprising alkyl (meth)acrylate (e.g. C1 to C8 alkyl (meth)acrylate monomers) and styrene monomers. In some examples, the latex polymer comprises a copolymer comprising alkyl (meth)acrylate (e.g. C1 to C8 alkyl (meth)acrylate monomers), styrene monomers and (meth)acrylic acid monomers.

[00051] In some examples, the latex polymer comprises a (meth)acrylamide polymer being a polymer comprising (meth)acrylamide monomers or a (meth)acrylamide copolymer being a copolymer comprising (meth)acrylamide monomers. In some examples, the latex polymer comprises a (meth)acrylamide copolymer comprising (meth)acrylamide monomers.

[00052] In some examples, the (meth)acrylamide monomers are selected from aliphatic (meth)acrylamide monomers, aromatic (meth)acrylamide monomers and combinations thereof.

[00053] In some examples, aliphatic (meth)acrylamide monomers comprise linear aliphatic (meth)acrylamide monomers and/or cycloaliphatic (meth)acrylamide.

[00054] In some examples, linear (meth)acrylamide monomers comprise alkyl (meth)acrylamide monomers (for example C1 to C8 alkyl (meth)acrylamide monomers). In some examples, the linear (meth)acrylamide monomers comprise alkyl methacrylamide monomers (e.g. C1 to C8 alkyl methacrylamide monomers). In some examples, the linear (meth)acrylamide monomers comprise alkyl methacrylamide monomers (e.g. C1 to C8 alkyl methacrylamide monomers) and alkyl acrylamide monomers (C1 to C8 alkyl acrylamide monomers).

[00055] In some examples, the latex polymer comprises a copolymer comprising alkyl (meth)acrylamide (e.g. C1 to C8 alkyl (meth)acrylamide) and styrene monomers. In some examples, the latex polymer comprises a copolymer comprising alkyl (meth)acrylamide (e.g. C1 to C8 alkyl (meth)acrylamide monomers), styrene monomers and (meth)acrylic acid monomers.

[00056] In some examples, the latex polymer comprises a copolymer comprising cycloaliphatic (meth)acrylate monomers or cycloaliphatic (meth)acrylamide monomers.

[00057] The present inventors have found that employing a latex polymer comprising cycloaliphatic (meth)acrylate or (meth)acrylamide monomers in the inkjet ink compositions described herein provides further improvements regarding the curing of the latex polymers on, and adhesion to, a wide range of print substrates.

[00058] In some examples, the latex polymer comprises a copolymer comprising aromatic (meth)acrylate monomers or aromatic (meth)acrylamide monomers.

[00059] The terms 'cycloaliphatic' and 'aromatic' are well understood by the skilled person.

[00060] In some examples, the latex polymer is derived from a composition comprising a cycloaliphatic monomer and an aromatic monomer, wherein the cycloaliphatic monomer comprises a cycloaliphatic (meth)acrylate monomer or a cycloaliphatic (meth)acrylamide monomer and the aromatic monomer comprises an aromatic (meth)acrylate monomer or an aromatic (meth)acrylamide monomer. For example; the latex polymer may comprise a

copolymer of a cycloaliphatic monomer and an aromatic monomer, wherein the cycloaliphatic monomer comprises one or more monomers comprising a cycloaliphatic (meth)acrylate monomer or a cycloaliphatic (meth)acrylamide monomer, and the aromatic monomer comprises one or more monomers comprising an aromatic (meth)acrylate monomer or an aromatic (meth)acrylamide monomer. For example, the latex polymer may comprise a copolymer comprising cycloaliphatic monomer units (e.g. cycloaliphatic (meth)acrylate and/or cycloaliphatic (meth)acrylamide units) and aromatic monomer units (e.g. aromatic (meth)acrylate and/or aromatic (meth)acrylamide units).

[00061] The present inventors have found that employing a latex polymer comprising a copolymer comprising cycloaliphatic monomers (such as cycloaliphatic (meth)acrylate or (meth)acrylamide monomers) in combination aromatic monomers (such as aromatic (meth)acrylate or (meth)acrylamide monomers) in the inkjet ink compositions described herein provides further improvements regarding the curing of the latex polymers on, and adhesion to, a wide range of print substrates.

[00062] In some examples, the cycloaliphatic monomer comprises a cycloaliphatic (meth)acrylate monomer or a cycloaliphatic (meth)acrylamide monomer. In some examples, the cycloaliphatic monomer comprises a cycloaliphatic (meth)acrylate monomer. A cycloaliphatic (meth)acrylate monomer is a monomer comprising a cycloaliphatic moiety bonded to, either directly or indirectly, a (meth)acrylate moiety (e.g. by a carbon chain; for example a substituted or unsubstituted carbon chain, for example a saturated or unsaturated carbon chain, such as a C_{1-12} carbon chain, for example a C_{1-10} carbon chain, a C_{1-6} carbon chain, or a C_{1-4} carbon chain, wherein one or more of the carbon atoms may be replaced by a heteroatom such as oxygen, nitrogen or sulfur, for example oxygen). In some examples, the cycloaliphatic monomer comprises a cycloaliphatic (meth)acrylamide monomer. A cycloaliphatic (meth)acrylamide monomer is a monomer comprising a cycloaliphatic moiety bonded to, either directly or indirectly, a (meth)acrylamide moiety (e.g. by a carbon chain, for example a saturated or unsaturated carbon chain, such as a C_{1-12} carbon chain, for example a substituted or unsubstituted carbon chain, for example a C_{1-10} carbon chain, a C_{1-6} carbon chain, or a C_{1-4} carbon chain, wherein one or more of the carbon atoms may be replaced by a heteroatom such as oxygen, nitrogen or sulfur, for example oxygen).

[00063] In some examples, the cycloaliphatic moiety comprises a 5-12 membered aliphatic ring, for example a carbon ring having 5-12 carbon atoms (e.g. a C_5-C_{12} ring), or a 5-12 membered heteroaliphatic ring. In some examples, the cycloaliphatic moiety comprises a C_5-C_{12} ring, a C_5-C_{12} ring may be a single ring (such as cyclopentyl, cyclohexyl

or cycloheptyl groups) or a bicyclic ring (such as decalin). In some examples, the cycloaliphatic moiety comprises a 5-10 membered aliphatic ring, for example a 6-10 membered aliphatic ring.

[00064] In some examples, the cycloaliphatic moiety comprises a carbon ring having 5-10 carbon atoms (e.g. a C_5-C_{10} ring). In some examples, the cycloaliphatic moiety comprises a carbon ring having 6-10 carbon atoms (e.g. a C_6-C_{10} ring).

[00065] In some examples, the cycloaliphatic moiety comprises a substituent, such as an alkyl, heteroalkyl, alkoxy, hydroxyl, cycloaliphatic or aromatic substituent. In some examples, the cycloaliphatic moiety comprises a substituent, such as an alkyl group (for example a C_{1-12} alkyl group, for example C_{1-10} alkyl group, C_{1-6} alkyl group, C_{1-4} alkyl group, or a methyl group), an aryl group (e.g. a C_{5-12} aryl group, for example C_{5-10} aryl group), a heteroalkyl group (e.g. a C_{1-12} heteroalkyl (such as ether containing group), for example C_{1-10} heteroalkyl, C_{1-6} heteroalkyl, C_{1-4} heteroalkyl (e.g. C_{1-4} ether)). In some examples, the cycloaliphatic moiety is an optionally substituted cycloaliphatic moiety, for example optionally substituted with a C_{1-12} alkyl group.

[00066] In some examples, the aromatic monomer comprises an aromatic (meth)acrylate monomer or an aromatic (meth)acrylamide monomer. In some examples, the aromatic monomer comprises an aromatic (meth)acrylate monomer. An aromatic (meth)acrylate monomer is a monomer comprising an aromatic moiety bonded to, either directly or indirectly, a (meth)acrylate moiety (e.g. by a carbon chain, for example a substituted or unsubstituted carbon chain, for example a saturated or unsaturated carbon chain, such as a C_{1-12} carbon chain, for example a C_{1-10} carbon chain, a C_{1-6} carbon chain, or a C_{1-4} carbon chain, wherein one or more of the carbon atoms may be replaced by a heteroatom such as oxygen, nitrogen or sulfur, for example oxygen). In some examples, the aromatic monomer comprises an aromatic (meth)acrylamide monomer. An aromatic (meth)acrylamide monomer is a monomer comprising an aromatic moiety bonded to, either directly or indirectly, a (meth)acrylamide moiety (e.g. by a carbon chain; for example a substituted or unsubstituted carbon chain, for example a saturated or unsaturated carbon chain, such as a C_{1-12} carbon chain, for example a C_{1-10} carbon chain, a C_{1-6} carbon chain, or a C_{1-4} carbon chain, wherein one or more of the carbon atoms may be replaced by a heteroatom such as oxygen, nitrogen or sulfur, for example oxygen).

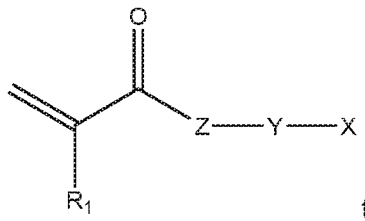
[00067] In some examples, the aromatic moiety comprises a 5-12 membered aromatic ring, for example an aromatic carbon ring having 6-12 carbon atoms (e.g. a C_6-C_{12} ring), or a 5-12 membered heteroaromatic ring. In some examples, the aromatic moiety comprises

a C_5-C_{12} aromatic ring, a C_5-C_{12} aromatic ring may be a single aromatic ring (e.g. benzyl or phenyl), or a bicyclic aromatic ring (e.g. naphthyl). In some examples, the aromatic moiety comprises a 5-10 membered aromatic ring, for example a 6-10 membered aromatic ring.

[00068] In some examples, the aromatic moiety comprises an aromatic carbon ring having 6-10 carbon atoms (e.g. a C_6-C_{10} aromatic ring).

[00069] In some examples, the aromatic moiety comprises a substituent, such as an alkyl, heteroalkyl (including an ether containing group), alkoxy, hydroxyl, cycloaliphatic or aromatic substituent. In some examples, the aromatic moiety comprises a substituent. In some examples, the aromatic moiety may be substituted by an alkyl group, (for example a C_{1-12} alkyl group, for example C_{1-10} alkyl group, C_{1-6} alkyl group, C_{1-4} alkyl group, or a methyl group), an aryl group (e.g. a C_{5-12} aryl group, for example C_{5-10} aryl group), a heteroalkyl group (e.g. a C_{1-12} heteroalkyl (such as ether containing group), for example C_{1-10} heteroalkyl, C_{1-6} heteroalkyl, C_{1-4} heteroalkyl (e.g. C_{1-4} ether)). In some examples, the aromatic moiety is optionally substituted, for example optionally substituted with a C_{1-12} alkyl group.

[00070] In some example, the cycloaliphatic monomer is a cycloaliphatic monomer having the formula (I)



formula (I)

wherein,

R_1 is H or methyl;

Z is O or NR_2, where R_2 is H, alkyl or X';

Y is a bond or a carbon chain, where one or more of the carbon atoms of the carbon chain may be replaced with a heteroatom such as oxygen, sulfur or nitrogen;

X and X' are independently cycloaliphatic moieties.

[00071] In some examples R_2 is alkyl, for example C_{1-12}, C_{1-10}, C_{1-6}, or C_{1-4} alkyl (e.g. methyl or ethyl). In some examples R_2 is an optionally substituted alkyl group. In some examples R_2 is H, an optionally substituted alkyl group or X'. In some examples, R_2 is H or X'. In some examples, R_2 is H.

[00072] In some examples, Y is a bond or a saturated or unsaturated carbon chain. In some examples Y is a bond or a C_{1-12}, for example C_{1-10}, C_{1-6}, or C_{1-4} carbon chain. In some examples, one or more of the carbon atoms of the carbon chain represented by Y is replaced with a heteroatom selected from oxygen, sulfur and nitrogen. In some examples, Y is a bond.

[00073] In some examples, X is a 5-12 membered ring, for example a carbon ring having 5-12 carbon atoms (e.g. a C_5-C_{12} ring), or a 5-12 membered heteroaliphatic ring. In some examples, X is a C_5-C_{12} single ring (such as cyclopentyl, cyclohexyl or cycloheptyl groups) or a bicyclic ring (such as decalin).

[00074] In some examples, X is a carbon ring having 5-10 carbon atoms (e.g. a C_5-C_{10} ring). In some examples, X is a carbon ring having 6-10 carbon atoms (e.g. a C_6-C_{10} ring).

[00075] In some examples, X is substituted, for example with an alkyl, alkoxy, hydroxyl, heteroalkyl, cycloaliphatic or aromatic substituent. In some examples, X is substituted with an alkyl group (for example a C_{1-12} alkyl group, for example C_{1-10} alkyl group, C_{1-6} alkyl group, C_{1-4} alkyl group, or a methyl group),an aryl group (e.g. a C_{5-12} aryl group, for example C_{5-10} aryl group), a heteroalkyl group (e.g. a C_{1-12} heteroalkyl (such as ether containing group), for example C_{1-10} heteroalkyl, C_{1-6} heteroalkyl, C_{1-4} heteroalkyl (e.g. C_{1-4} ether)). In some examples, X is optionally substituted, for example optionally substituted with a C_{1-12} alkyl group.

[00076] In some examples, X' is a carbon ring having 5-12 carbon atoms (e.g. a C_5-C_{12} ring), or a 5-12 membered heteroaliphatic ring. In some examples, X' is a C_5-C_{12} single ring (such as cyclopentyl, cyclohexyl or cycloheptyl groups) or a bicyclic ring (e.g a C6 or C10 fused ring, such as decalin).

[00077] In some examples, X' is a carbon ring having 5-10 carbon atoms (e.g. a C_5-C_{10} ring). In some examples, X' is a carbon ring having 6-10 carbon atoms (e.g. a C_6-C_{10} ring).

[00078] In some examples, X' is substituted, for example with an alkyl, alkoxy, hydroxyl, heteroalkyl, cycloaliphatic or aromatic substituent. In some examples, X' is substituted with an alkyl group (for example a C_{1-12} alkyl group, for example C_{1-10} alkyl group, C_{1-6} alkyl group, C_{1-4} alkyl group, or a methyl group),an aryl group (e.g. a C_{5-12} aryl group, for example C_{5-10} aryl group), a heteroalkyl group (e.g. a C_{1-12} heteroalkyl (such as ether containing group), for example C_{1-10} heteroalkyl, C_{1-6} heteroalkyl, C_{1-4} heteroalkyl (e.g. C_{1-4} ether)). In some examples, X' is optionally substituted, for example optionally substituted with a C_{1-12} alkyl group.

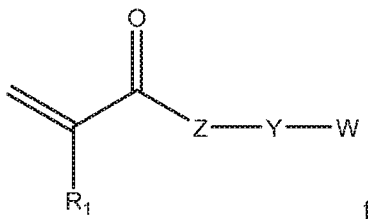
[00079] In some examples, for example when Z is NR_2 and R_2 is X', X and X' may be the same.

[00080] Examples of cycloaliphatic monomers include: cyclohexyl acrylate, cyclohexyl methacrylate, methylcyclohexyl acrylate, methylcyclohexyl methacrylate, trimethylcyclohexyl acrylate, trimethylcyclohexyl methacrylate, and other cycloaliphatic methacrylate and acrylate monomers including ester derivatives of decalinol, hydrogenated bisphenol A and F. In some examples, the latex polymer comprises at least about 50 wt% cycloaliphatic monomers by total weight solids of the latex polymer, for example at least about 55 wt%, or at least about 60 wt% cycloaliphatic monomers by total weight solids of the latex polymer.

[00081] In some examples, the latex polymer comprises up to about 95 wt% cycloaliphatic monomers by total weight solids of the latex polymer, for example up to about 90 wt% cycloaliphatic monomers by total weight solids of the latex polymer.

[00082] In some examples, the latex polymer comprises from about 50 wt% to about 90 wt%, for example from about 60 wt% to about 90 wt% cycloaliphatic monomers by total weight solids of the latex polymer.

[00083] In some example, the aromatic monomer is an aromatic monomer having the formula (II)



formula (II)

wherein,

R_1 is H or methyl;

Z is O or NR_2, where R_2 is H, alkyl or W';

Y is a bond or a carbon chain, where one or more of the carbon atoms of the carbon chain may be replaced with a heteroatom such as oxygen, sulfur or nitrogen;

W and W' are independently aromatic moieties.

[00084] In some examples R_2 is alkyl, for example C_{1-12}, C_{1-10}, C_{1-6}, or C_{1-4} alkyl (e.g. methyl or ethyl). In some examples R_2 is an optionally substituted alkyl group. In some

examples R_2 is H, an optionally substituted alkyl group or W'. In some examples, R_2 is H or W'. In some examples, R_2 is H.

[00085] In some examples, Y is a bond or a saturated or unsaturated carbon chain. In some examples Y is a bond or a C_{1-12}, for example C_{1-10}, C_{1-6}, or C_{1-4} carbon chain. In some examples, one or more of the carbon atoms of the carbon chain represented by Y is replaced with a heteroatom selected from oxygen, sulfur and nitrogen. In some examples, Y is a bond.

[00086] In some examples, W is a 5-12 membered aromatic ring, for example a carbon ring having 6-12 carbon atoms (e.g. a C_6-C_{12} aromatic ring), or a 5-12 membered heteroaromatic ring. In some examples W comprises a C_5-C_{12} aromatic ring, a C_5-C_{12} aromatic ring may be a single aromatic ring (e.g. benzyl or phenyl) or a bicyclic aromatic ring (e.g a fused C6 or C10 aromatic ring, e.g. naphthyl). In some examples, W is a 5-10 membered aromatic ring, for example a 6-10 membered aromatic ring.

[00087] In some examples, W is an aromatic carbon ring having 6-10 carbon atoms (e.g. a C_6-C_{10} aromatic ring).

[00088] In some examples, W is substituted, for example W may be substituted with an alkyl group (for example a C_{1-12} alkyl group, for example C_{1-10} alkyl group, C_{1-6} alkyl group, C_{1-4} alkyl group, or a methyl group),an aryl group (e.g. a C_{5-12} aryl group, for example C_{5-10} aryl group), a heteroalkyl group (e.g. a C_{1-12} heteroalkyl (such as ether containing group), for example C_{1-10} heteroalkyl, C_{1-6} heteroalkyl, C_{1-4} ether). In some examples, W is optionally substituted, for example optionally substituted with a C_{1-12} alkyl group.

[00089] In some examples, W' is a 5-12 membered aromatic ring, for example a carbon ring having 6-12 carbon atoms (e.g. a C_6-C_{12} aromatic ring), or a 5-12 membered heteroaromatic ring. In some examples W' comprises a C_6-C_{12} aromatic ring, a C_6-C_{12} aromatic ring may be a single aromatic ring (e.g. benzyl or phenyl) or a bicyclic aromatic ring (e.g a fused C6 or C10 aromatic ring, e.g. naphthyl). In some examples, W' is a 5-10 membered aromatic ring, for example a 6-10 membered aromatic ring.

[00090] In some examples, W' is an aromatic carbon ring having 6-10 carbon atoms (e.g. a C_6-C_{10} aromatic ring).

[00091] In some examples, W' is substituted, for example, W' may be substituted with an alkyl group (for example a C_{1-12} alkyl group, for example C_{1-10} alkyl group, C_{1-6} alkyl group, C_{1-4} alkyl group, or a methyl group),an aryl group (e.g. a C_{5-12} aryl group, for example

C_{5-10} aryl group), a heteroalkyl group (e.g. a C_{1-12} heteroalkyl (such as ether containing group), for example C_{1-10} heteroalkyl, C_{1-6} heteroalkyl, C_{1-4} ether). In some examples, W is optionally substituted, for example optionally substituted with a C_{1-12} alkyl group.

[00092] In some examples, for example when Z is NR_2 and R_2 is W, W and W' may be the same.

[00093] Examples of aromatic monomers include: 2-phenoxyethyl methacrylate, 2-phenoxyethyl acrylate, phenyl propyl methacrylate, phenyl propyl acrylate, benzyl methacrylate, benzyl acrylate, phenylethyl methacrylate, phenylethyl acrylate, benzhydryl methacrylate, benzhydryl acrylate, N-benzyl methacrylate, N-benzyl acrylate, N,N-diphenyl methacrylamide, N,N-diphenyl acrylamide, naphthyl methacrylate, naphthyl acrylate, phenyl methacrylate and phenyl acrylate.

[00094] In some examples, the latex polymer comprises at least about 1 wt% aromatic monomers by total weight solids of the latex polymer, for example at least about 2 wt%, or at least about 5 wt% aromatic monomers by total weight solids of the latex polymer.

[00095] In some examples, the latex polymer comprises up to about 35 wt% aromatic monomers by total weight solids of the latex polymer, for example up to about 30 wt%, up to about 25 wt%, or up to about 20 wt% aromatic monomers by total weight solids of the latex polymer.

[00096] In some examples, the latex polymer comprises from about 1 wt% to about 35 wt% aromatic monomers by total weight solids of the latex polymer, for example from about 2 wt% to about 30 wt%, or about 5 wt% to about 25 wt% aromatic monomers by total weight solids of the latex polymer.

[00097] In some examples, the composition from which the latex polymer is derived further comprises an alkyl meth(acrylate). In some examples, the composition from which the latex polymer is derived comprises an alkyl methacrylate monomer. In some examples, the composition from which the latex polymer is derived comprises an alkyl acrylate monomer. In some examples, the composition from which the latex polymer is derived comprises an alkyl acrylate monomer and an alkyl methacrylate monomer. In some examples, the alkyl (meth)acrylate may be a C_{1-8} alkyl (meth)acrylate.

[00098] In some examples, the latex polymer comprises an alkyl meth(acrylate) component. In some examples, the latex polymer further comprises an alkyl methacrylate component. In some examples, the latex polymer further comprises an alkyl acrylate

component. In some examples, the latex polymer further comprises an alkyl acrylate component and an alkyl methacrylate component.

[00099] In some examples, the latex polymer comprises from about 0 wt% to about 10 wt%, for example from about 0.1 wt% to about 10 wt% of an alkyl meth(acrylate), for example methyl methacrylate.

[000100] In some examples, the latex polymer comprises a copolymer formed from an alkyl meth(acrylate) monomer, a cycloaliphatic monomer and an aromatic monomer. In some examples, the latex polymer comprises a copolymer formed from an alkyl meth(acrylate) monomer, (meth)acrylic acid, a cycloaliphatic monomer and an aromatic monomer. In some examples, the latex polymer comprises a copolymer formed from a (meth)acrylic acid, a cycloaliphatic monomer and an aromatic monomer.

[000101] In some examples, the composition from which the latex polymer is derived further comprises an acid monomer, for example (meth)acrylic acid monomers or carboxylic acid monomers. In some examples, the composition from which the latex polymer is derived further comprises (meth)acrylic acid. For example, the composition may comprise (meth)acrylic acid in an amount of 0 wt% to about 15 wt%, about 0.1 wt% to about 15 wt%, for example, about 0.25 wt% to about 10 wt%, or about 0.25 wt% to about 6 wt%. In some examples, the composition from which the latex polymer is derived further comprises methacrylic acid. For example, the composition may comprise methacrylic acid in an amount of 0 wt% to about 15 wt%, about 0.1 wt% to about 15 wt%, for example, about 0.25 wt% to about 10 wt%, or about 0.25 wt% to about 6 wt%.

[000102] In some examples, the composition from which the latex polymer is derived further comprises an alkyl meth(acrylate) monomer and/or (meth)acrylic acid. In some examples, the composition from which the latex polymer is derived further comprises an alkyl meth(acrylate) monomer and (meth)acrylic acid.

[000103] In some examples, the latex polymer substantially lacks a styrene component. For example, the latex polymer may comprise less than about 5 wt% styrene by total weight solids of the latex polymer, for example less than about 4 wt%, less than about 3 wt%, less than about 2 wt%, less than about 1 wt%, less than about 0.5 wt%, or less than about 0.1 wt% styrene by total weight solids of the latex polymer. In some examples, the latex polymer lacks a styrene component.

[000104] In some examples, the latex polymer may be prepared by copolymerizing the monomer components with a copolymerizable surfactant (for example surfactants from the

Hitenol® AR series or Hitenol® BC series, e.g. Hitenol® BC-10, BC-30, KH-05 or KH-10) to form a latex dispersion.

[000105] In some examples, the latex polymer is prepared by combining the monomers as an aqueous emulsion with an initiator. In some examples any suitable polymer initiator may be used. In some examples, the initiator may be selected from a persulfate, such as a metal persulfate or an ammonium persulfate. In some examples, the initiator may be selected from a sodium persulfate, ammonium persulfate or potassium persulfate.

[000106] In some examples, the latex polymer has a glass transition temperature of about 20 °C or greater, for example about 30 °C or greater, about 40 °C or greater, about 45 °C or greater, or about 50 °C or greater.

[000107] In some examples, the latex polymer has a glass transition temperature of up to about 100 °C, for example up to about 95 °C, up to about 90 °C, up to about 80 °C, or up to about 70 °C.

[000108] In some examples, the latex polymer has a glass transition temperature in the range of about 20 °C to about 100 °C, for example about 30 °C to about 90 °C, about 50 °C to about 90 °C, or about 55 °C to about 70 °C.

[000109] The glass transition temperature (Tg) of the latex polymer may be estimated using the Fox equation (T. G. Fox, Bull. Am. Physics Soc., Volume 1, Issue No. 3, page 123 (1956)) using the Tg of the homopolymers of each of the monomers forming the copolymer of the latex polymer. The maximum Tg of each of the homopolymers of each of the monomers making up to copolymer of the latex polymer may be taken from literature values (for example as listed in "Polymer Handbook", edited by J. Brandrup, E.H. Immergut, and E.A. Grulke, Wiley Publishers, 4th edition). The glass transition temperature of the latex polymer may also be determined using DSC (differential scanning calorimetry) according to ASTM D3418.

[000110] In some examples, the inkjet ink composition comprises up to about 35 wt% pigment and latex polymer solids by total weight of the composition, for example up to about 30 wt%, about 25 wt% or up to about 20 wt% pigment and latex polymer solids by total weight of the composition.

[000111] In some examples, the inkjet ink composition comprises from about 0.5 wt% to about 35 wt% pigment and latex polymer solids by total weight of the composition, for example from about 1 wt% to about 30 wt%, from about 1 wt% to about 25 wt%, or from

about 2 wt% to about 20 wt% pigment and latex polymer solids by total weight of the composition. The present inventors have found that compositions having a total amount of pigment and latex polymer solids within these ranges may be suitable for inkjet printing, for example for thermal inkjet printing.

[000112] In some examples, the inkjet ink composition comprises at least about 3 wt% latex polymer by total weight of the composition, for example at least about 5 wt% latex polymer by total weight of the composition. In some examples, the inkjet ink composition comprises up to about 25 wt% latex polymer by total weight of the composition, for example up to about 20 wt%, or up to about 15 wt% latex polymer by total weight of the composition. In some examples, the inkjet ink composition comprises from about 3 wt% to about 25 wt%, for example about 5 wt% to about 25 wt% latex polymer by total weight of the composition.

Pigment

[000113] The inkjet ink composition comprises a pigment.

[000114] The term "pigment" can include particulate dispersible colorants that can be suspended or dispersed in a liquid vehicle in accordance with embodiments of the present invention. The pigment itself can be a self-dispersed pigment or a non-self-dispersed pigment.

[000115] The term "pigment" can include particulate dispersible colorants that can be suspended or dispersed in a liquid vehicle in accordance with embodiments of the present invention. The pigment itself can be a self-dispersed pigment or a non-self-dispersed pigment.

[000116] The pigment may include black pigments, white pigments, cyan pigments, magenta pigments, yellow pigments, or the like. Suitable inorganic pigments include, for example, carbon black. However, other inorganic pigments may be suitable such as titanium oxide, cobalt blue ($CoO\text{-}Al_2O_3$), chrome yellow ($PbCrO_4$), and iron oxide. Suitable organic pigments include, for example, azo pigments including diazo pigments and monoazo pigments, polycyclic pigments (e.g., phthalocyanine pigments such as phthalocyanine blues and phthalocyanine greens, perylene pigments, perinone pigments, anthraquinone pigments, quinacridone pigments, dioxazine pigments, thioindigo pigments, isoindolinone pigments, pyranthrone pigments, and quinophthalone pigments), insoluble dye chelates (e.g., basic dye type chelates and acidic dye type chelate), nitropigments, nitroso pigments, and the like. Representative examples of phthalocyanine blues include copper phthalocyanine blue and derivatives thereof (Pigment Blue 15). Representative

examples of quinacridones include Pigment Orange 48, Pigment Orange 49, Pigment Red 122, Pigment Red 192, Pigment Red 202, Pigment Red 206, Pigment Red 207, Pigment Red 209, Pigment Violet 19 and Pigment Violet 42. Representative examples of anthraquinones include Pigment Red 43, Pigment Red 194 (Perinone Red), Pigment Red 216 (Brominated Pyranthrone Red) and Pigment Red 226 (Pyranthrone Red). Representative examples of perylenes include Pigment Red 123 (Vermillion), Pigment Red 149 (Scarlet), Pigment Red 179 (Maroon), Pigment Red 190 (Red), Pigment Violet 19, Pigment Red 189 (Yellow Shade Red) and Pigment Red 224. Representative examples of thioindigoids include Pigment Red 86, Pigment Red 87, Pigment Red 88, Pigment Red 181, Pigment Red 198, Pigment Violet 36, and Pigment Violet 38. Representative examples of heterocyclic yellows include Pigment Yellow 1, Pigment Yellow 3, Pigment Yellow 12, Pigment Yellow 13, Pigment Yellow 14, Pigment Yellow 17, Pigment Yellow 65, Pigment Yellow 73, Pigment Yellow 74, Pigment Yellow 151, Pigment Yellow 117, Pigment Yellow 128 and Pigment Yellow 138, Pigment Yellow 155, Pigment Yellow 83, and Pigment Yellow 213. Such pigments are commercially available in either powder or press cake form from a number of sources including, BASF™ Corporation, Engelhard™ Corporation and Sun Chemical™ Corporation.

[000117] Examples of black pigments that can be used include carbon pigments. The carbon pigment can be almost any commercially available carbon pigment that provides acceptable optical density and print characteristics. Carbon pigments suitable for use in the present system and method include, without limitation, carbon black, graphite, vitreous carbon, charcoal, and combinations thereof. Such carbon pigments can be manufactured by a variety of known methods such as a channel method, a contact method, a furnace method, an acetylene method, or a thermal method, and are commercially available from such vendors as Cabot™ Corporation, Columbian Chemicals Company, Degussa AG™, and E.I. DuPont™ de Nemours and Company. Suitable carbon black pigments include, without limitation, Cabot pigments such as MONARCH™ 1400, MONARCH™ 1300, MONARCH™ 1100, MONARCH™ 1000, MONARCH™ 900, MONARCH™ 880, MONARCH™ 800, MONARCH™ 700, CAB-O-JET™ 200, CAB-O-JET™ 300, REGAL™, BLACK PEARLS, ELFTEX™, MOGUL™, and VULCAN™ pigments; Columbian pigments such as RAVEN™ 7000, RAVEN™ 5750, RAVEN™ 5250, RAVEN™ 5000, and RAVEN™ 3500; Degussa pigments such as Color Black FW 200, RAVEN™ FW 2, RAVEN™ FW 2V, RAVEN™ FW 1, RAVEN™ FW 18, RAVEN™ S160, RAVEN™ FW S170, Special Black™ 6, Special Black™ 5, Special Black™ 4A, Special Black™ 4, PRINTEX™ U, PRINTEX™ 140U, PRINTEX™ V, and PRINTEX ™140V.

[000118] Similarly, a wide variety of colored pigments can be used with the inkjet ink composition, therefore the following listing is not intended to be limiting. For example, colored pigments can be blue, brown, cyan, green, white, violet, magenta, red, orange, yellow, as well as mixtures thereof. The following color dispersions are available from Cabot™ Corp. CABO-JET™ 250C, CABO-JET™ 260M, and CABO-JET™ 270Y. The following color pigments are available from BASF™ Corp.: PALIOGEN™ Orange, PALIOGEN™ Orange 3040, PALIOGEN™ Blue L 6470, PALIOGEN™ Violet 5100, PALIOGEN™ Violet 5890, PALIOGEN™ Yellow 1520, PALIOGEN™ Yellow 1560, PALIOGEN™ Red 3871K, PALIOGEN™ Red 3340, HELIOGEN™ Blue L 6901F, HELIOGEN™ Blue NBD 7010, HELIOGEN™ Blue K 7090, HELIOGEN™ Blue L 7101F, HELIOGEN™ Blue L6900, L7020, HELIOGEN™ Blue D6840, HELIOGEN™ Blue D7080, HELIOGEN™ Green L8730, HELIOGEN™ Green K 8683, and HELIOGEN™ Green L 9140. The following pigments are available from Ciba-Geigy Corp.: CHROMOPHTAL™ Yellow 3G, CHROMOPHTAL™ Yellow GR, CHROMOPHTAL™ Yellow 8G, IGRAZIN™ Yellow 5GT, IGRALITE™ Rubine 4BL, IGRALITE™ Blue BCA, MONASTRAL™ Magenta, MONASTRAL™ Scarlet, MONASTRAL™ Violet R, MONASTRAL™ Red B, and MONASTRAL™ Violet Maroon B. The following pigments are available from Heubach Group™: DALAMAR™ Yellow YT-858-D and HEUCOPHTHAL™ Blue G XBT-583D. The following pigments are available from Hoechst Specialty Chemicals™: Permanent Yellow GR, Permanent Yellow G, Permanent Yellow DHG, Permanent Yellow NCG-71, Permanent Yellow GG, Hansa Yellow RA, Hansa Brilliant Yellow 5GX-O2, Hansa Yellow-X, NOVOPERM™ Yellow HR, NOVOPERM™ Yellow FGL, Hansa Brilliant Yellow 10GX, Permanent Yellow G3R-01, HOSTAPERM™ Yellow H4G, HOSTAPERM™ Yellow H3G, HOSTAPERM™ Orange GR, HOSTAPERM™ Scarlet GO, HOSTAPERM™ Pink E, Permanent Rubine F6B, and the HOSTAFINE™ series. The following pigments are available from Mobay Corp.: QUINDO™ Magenta, INDOFAST™ Brilliant Scarlet, QUINDO™ Red R6700, QUINDO™ Red R6713, and INDOFAST™ Violet. The following pigments are available from Sun Chemical Corp.: L74-1357 Yellow, L75-1331 Yellow, and L75-2577 Yellow. Other examples of pigments can include Normandy Magenta RD-2400, Permanent Violet VT2645, Argyle Green XP-111-S, Brilliant Green Toner GR 0991, Sudan Blue OS, PV Fast Blue B2GO1, Sudan III, Sudan II, Sudan IV, Sudan Orange G, Sudan Orange 220, Ortho Orange OR 2673, Lithol Fast Yellow 0991 K, Paliotol Yellow 1840, Lumogen Yellow D0790, Suco-Gelb L1250, Suco-Yellow D1355, Fanal Pink D4830, Cinquasia Magenta, Lithol Scarlet D3700, Toluidine Red, Scarlet for Thermoplast NSD PS PA, E. D. Toluidine Red, Lithol Rubine Toner, Lithol Scarlet 4440, Bon Red C, Royal Brilliant Red RD-8192, Oracet Pink RF, Lithol Fast Scarlet L4300, and white TIPURE R-101. These pigments are available from commercial sources such as Hoechst Celanese

Corporation™, Paul Uhlich, BASF, American Hoechst™, Ciba-Geigy™, Aldrich™, DuPont™, Ugine Kuhlman of Canada™, Dominion Color Company™, Magruder™, and Matheson™. Examples of other suitable colored pigments are described in the Colour Index, 3rd edition (The Society of Dyers and Colourists, 1982).

[000119] In some examples, the inkjet ink composition comprises at least about 0.1 wt% pigment by total weight of the composition, for example, at least about 0.3 wt% pigment by total weight of the composition. In some examples, the inkjet ink composition comprises up to about 30 wt% pigment by total weight of the composition, for example, up to about 20 wt% pigment by total weight of the composition, or up to about 15 wt% pigment by total weight of the composition. In some examples, the inkjet ink composition comprises from about 0.1 wt% to about 30 wt%, for example 0.3 wt% to about 30 wt% pigment by total weight of the composition.

[000120] In some examples, the inkjet ink composition comprises an amount of pigment and an amount of latex polymer, such that the ratio of the amount of pigment to amount of latex by weight is in the range of about 0.1:15 to 10:5.

Ink Vehicle

[000121] The ink vehicle of the inkjet ink composition comprises water. The water, or a portion of the water, of the ink vehicle may be introduced to the ink vehicle as a latex polymer emulsion is combined with the first and second solvents of the ink vehicle. In some examples, additional water may be added to the inkjet ink composition.

[000122] The inkjet ink composition comprises water. In some examples, the inkjet ink composition comprises at least about 20 wt%, for example at least about 30 wt%, at least about 40 wt%, or at least about 50 wt% by total weight of the composition. In some examples, the inkjet ink composition comprises up to about 90 wt% water, for example up to about 85 wt%, up to about 80 wt%, or up to about 75 wt% by total weight of the composition. In some examples, the inkjet ink composition comprises water in an amount from about 20 wt% to about 85 wt% by total weight of the inkjet ink composition, for example about 30 wt% to about 80 wt%, about 40 wt% to about 80 wt%, or from about 50% to about 75% water.

[000123] In some examples, the ink vehicle comprises water and a co-solvent (for example a blend of co-solvents). In some examples, the inkjet ink composition comprises the co-solvent in an amount of at least about 1 wt%, for example at least about 5 wt%, or at least about 10 wt% by total weight of the composition. In some examples, the inkjet ink

composition comprises the co-solvent in an amount up to about 50 wt%, for example up to about 40 wt%, or up to about 35 wt% by total weight of the composition. In some examples the inkjet ink composition comprises a co-solvent in an amount of about 1 to about 50 wt% by total weight of the composition, for example from about 5 to about 40 wt% of the composition, or about 10 to about 35 wt% of the total weight of the composition.

[000124] In some examples, the ink vehicle comprises a co-solvent having a boiling point ranging from 160°C to 285°C. In some examples, the ink vehicle comprises a co-solvent having a boiling point ranging from 170°C to 250°C, for example from 170°C to 220°C, or 170°C to 215°C. In some examples, the ink vehicle comprises a co-solvent having a boiling point of about 215°C or less.

[000125] In some examples, the co-solvent may be selected form organic co-solvents including aliphatic alcohols, aromatic alcohols, diols, glycol ethers, polyglycol ethers, caprolactams, formamides, acetamides, and long chain alcohols. In some examples, the co-solvent may be selected form primary aliphatic alcohols, secondary aliphatic alcohols, 1,2-alcohols, 1,3-alcohols, 1,4-alcohols, 1,5-alcohols, ethylene glycol alkyl ethers, propylene glycol alkyl ethers, higher homologs (C_6-C_{12}) of polyethylene glycol alkyl ethers, pyrrolidinones, N-alkyl caprolactams, unsubstituted caprolactams, both substituted and unsubstituted formamides, both substituted and unsubstituted acetamides, and combinations thereof.

[000126] In some examples, the co-solvent comprises a first solvent having a boiling point of about 215 °C or less and a second solvent having a boiling point of at least about 220 °C.

[000127] In some examples, the ink vehicle of the inkjet ink composition comprises a first solvent having a boiling point of about 212 °C or less, for example about 210 °C or less, for example about 205 °C or less. In some examples, the first solvent has a boiling point of at least about 170 °C, for example at least about 175 °C, at least about 180 °C, or at least about 185 °C. In some examples, the first solvent has a boiling point in the range of about 170 °C to about 215 °C. In some examples, the first solvent has a boiling point in the range of about 180 °C to about 215 °C, for example about 185 °C to about 215 °C, or about 185 °C to about 210 °C.

[000128] In some examples, the first solvent is selected from an aliphatic alcohol, for example a primary aliphatic alcohol, a secondary aliphatic alcohol or a tertiary aliphatic alcohol. The aliphatic alcohol may be a diol. In some examples, the first solvent is an

aliphatic alcohol containing 10 carbons or less, for example 8 carbons or less or 6 carbons or less. In some examples, the first solvent is an aliphatic alcohol being a diol containing 10 carbons or less, for example 8 carbons or less or 6 carbons or less.

[000129] In some examples, the first solvent is selected from the group comprising 1,2-propanediol, 1,2-butanediol, ethylene glycol, 2-methyl-2,4-pentanediol, 1,3-butanediol, 2-methyl-1,3-propanediol and 1,3-propanediol. In some examples the first solvent is selected from the group comprising 1,2-propanediol, 1,2-butanediol, ethylene glycol, 2-methyl-2,4-pentanediol, and 1,3-butanediol. In some examples the first solvent is selected from the group consisting of 1,2-propanediol, 1,2-butanediol, ethylene glycol, 2-methyl-2,4-pentanediol, 1,3-butanediol, 2-methyl-1,3-propanediol and 1,3-propanediol. In some examples the first solvent is selected from the group consisting of 1,2-propanediol, 1,2-butanediol, ethylene glycol, 2-methyl-2,4-pentanediol, and 1,3-butanediol. In some examples the first solvent is 1,2-butanediol.

[000130] In some examples, the inkjet ink composition comprises at least about 1 wt% of the first solvent by total weight of the composition, for example, at least about 5 wt%, at least about 10 wt%, or at least about 15 wt% by total weight of the composition.

[000131] In some examples, the inkjet ink composition comprises up to about 40 wt% of the first solvent by total weight of the composition, for example up to about 30 wt%, or up to about 20 wt% by total weight of the composition.

[000132] In some examples, the inkjet ink composition comprises the first solvent in an amount of from about 1 wt% to about 40 wt% by total weight of the composition, for example from about 5 wt% to about 40 wt%, about 10 wt% to about 30 wt%, or from about 15 wt% to about 20 wt% by total weight of the composition.

[000133] In some examples, the ink vehicle of the inkjet ink composition comprises a second solvent having a boiling point of at least about 220 °C, for example at least about 225 °C. In some examples, the second solvent has a boiling point up to about 285 °C, for example up to about 280 °C. In some examples, the second solvent has a boiling point in the range of about 220 °C to about 285 °C, for example about 225 °C to about 285 °C.

[000134] In some examples the second solvent is selected from alcohols (including aliphatic alcohols and aromatic alcohols), esters, glycol ethers, di- and trialkylene glycols, amides, lactams and sulfones. In some examples the solvent is selected from aliphatic alcohols (including primary, secondary and tertiary aliphatic alcohols, including diols), aromatic alcohols, esters, glycol alkyl ethers (such as alkylene glycol alkyl ethers, including

di-, tri- and tetra- alkylene glycol alkyl ethers), glycol aryl ethers (such as alkylene glycol aryl ethers, including di- and tri- alkylene glycol aryl ethers), di- and tri-alkylene glycols, lactams (such as 2-pyrrolidinone) and sulfones (such as sulfolane).

[000135] In some examples, the second solvent is selected from aliphatic alcohols containing 20 carbons or less (for example aliphatic alcohols containing 10 carbons or less), esters containing 20 carbons or less (for example esters containing 12 carbons or less), glycol alkyl ethers, such as alkylene glycol alkyl ethers, containing 20 carbons or less (for example esters containing 12 carbons or less, or 10 carbons or less), glycol aryl ethers, such as alkylene glycol aryl ethers, containing 20 carbons or less (for example esters containing 12 carbons or less, or 10 carbons or less) such as glycol phenyl ethers (e.g. alkylene glycol phenyl ethers) containing 20 carbons or less, lactams and cyclic sulfones.

[000136] In some examples the second solvent is selected from the group comprising ethylene glycol 2-ethylhexyl ether, dipropylene glycol n-butyl ether, diethylene glycol n-butyl ether, propylene glycol phenyl ether, 2-pyrrolidinone, tripropylene glycol methyl ether (such as Dowanol™ TPM), 2,2,4-trimethyl-1,3-pentanediol monoisobutyrate, triethyl citrate, tripropylene glycol n-propyl ether, tripropylene glycol n-butyl ether (such as Dowanol™ TPnB), tetraethylene glycol dimethyl ether, and dipropylene glycol phenyl ether. In some examples, the second solvent is selected from the group comprising 2-pyrrolidinone, tripropylene glycol methyl ether and tripropylene glycol n-butyl ether.

[000137] In some examples, the inkjet ink composition comprises at least about 0.1 wt% of the second solvent by total weight of the composition, for example at least about 0.5 wt%, at least about 1 wt%, at least about 1.5 wt%, or about 2 wt% by total weight of the composition.

[000138] In some examples, the inkjet ink composition comprises up to about 8 wt% of the second solvent by total weight of the composition, for example up to about 5 wt%, up to about 3 wt%, or about 2 wt% by total weight of the composition.

[000139] In some examples, the inkjet ink composition comprises the second solvent in an amount of from 0 wt% to about 8 wt% by total weight of the composition, for example about 0.1 wt% to about 8 wt% by total weight of the composition, from about 0.5 wt% to about 8 wt%, from about 0.5 wt% to about 5 wt%, or from about 0.5 wt% to about 4 wt% by total weight of the composition.

Other additives

[000140] The ink vehicle may also comprise a variety of additional components, suitable for inkjet ink compositions, selected from surfactants (for example suitable surfactants may be selected form alkyl polyethylene oxides, alkyl phenyl polyethylene oxides, polyethylene oxide block copolymers, acetylenic polyethylene oxides, polyethylene oxide (di)esters, polyethylene oxide amines, protonated polyethylene oxide amides, dimethicone copolyols, fluoroalkyl polyethylene oxides, substituted amine oxides, and the like, surfactants when present may be present in an amount from 0.01 wt% to 10 wt%), buffers, biocides (such as Nuosept™ (Nudex™ Inc.), Ucarcide™ (Union carbide Corp™.), Vancide™ (R.T. Vanderbilt™ Co.), Proxel™ (Lonza™), and combinations thereof), viscosity modifiers, sequestering agents (such as EDTA (ethylene diamine tetraacetic acid)), stabilizing agents, wetting agents, and humectants. In some examples, these other additives may be present in a total amount of from 0 wt% to 20 wt%.

[000141] In some examples the aqueous inkjet ink composition comprises:

from about 2 wt% to about 15 wt% of a latex polymer comprising (meth)acrylate monomers or (meth)acrylamide monomers, optionally comprising cycloaliphatic (meth)acrylate monomers or cycloaliphatic (meth)acrylamide monomers;

from about 0.5 wt% to about 10 wt% of a pigment by total weight of the composition; and

an ink vehicle.

[000142] In some examples the aqueous inkjet ink composition comprises:

from about 2 wt% to about 15 wt% of a latex polymer comprising (meth)acrylate monomers or (meth)acrylamide monomers, optionally comprising cycloaliphatic (meth)acrylate monomers or cycloaliphatic (meth)acrylamide monomers;

from about 0.5 wt% to about 10 wt% of a pigment by total weight of the composition; and

an ink vehicle comprising water and about 1 to 50 wt% of a co-solvent by total weight of the composition, wherein the co-solvent comprises an organic solvent having a boiling point in the range of about 170 °C to about 215 °C.

[000143] In some examples the aqueous inkjet ink composition comprises:

from about 2 wt% to about 15 wt% of a latex polymer comprising (meth)acrylate monomers or (meth)acrylamide monomers, optionally comprising cycloaliphatic (meth)acrylate monomers or cycloaliphatic (meth)acrylamide monomers;

from about 0.5 wt% to about 10 wt% of a pigment by total weight of the composition; and

an ink vehicle comprising water and about 1 to 50 wt% of a co-solvent by total weight of the composition, wherein the co-solvent comprises a solvent having a boiling point in the range of about 170 °C to about 215 °C; and a solvent having a boiling point of about 220 °C or more.

Aqueous Inkjet Overcoat Composition

[000144] The aqueous inkjet overcoat composition comprises a latex polymer, a wax and an overcoat vehicle.

Latex Polymer of the Overcoat Composition

[000145] In some example, the aqueous inkjet overcoat composition comprises a latex polymer comprising a (meth)acrylate or (meth)acrylamide polymer or copolymer. In some example, the aqueous inkjet overcoat composition comprises a latex polymer comprising a (meth)acrylate polymer or copolymer.

[000146] In some examples, the latex polymer comprises a (meth)acrylate/(meth)acrylamide polymer or copolymer. In some examples, the latex polymer comprises a (meth)acrylate/(meth)acrylamide copolymer. For example, the latex polymer may comprise a copolymer of a (meth)acrylate/(meth)acrylamide monomer and another vinyl monomer, for example another vinyl monomer selected from styrenes, C1 to C8 alkyl methacrylates, C1 to C8 alkyl acrylates, ethylene glycol methacrylates and dimethacrylates, methacrylic acids, acrylic acids, and combinations thereof.

[000147] In some examples, the latex polymer of the overcoat composition comprises linear (meth)acrylate monomers or linear (meth)acrylamide monomers. The term "linear" is used to refer to monomers comprising a (meth)acrylate/(meth)acrylamide moiety linked to a non-cyclic moiety. In some examples, the linear (meth)acrylate monomers or linear (meth)acrylamide monomers may be linear aliphatic (meth)acrylate/(meth)acrylamide monomers.

[000148] In some examples, linear (meth)acrylate/(meth)acrylamide monomers comprise alkyl ((meth)acrylate/(meth)acrylamide monomers (for example C1 to C8 alkyl (meth)acrylate/(meth)acrylamide monomers).

[000149] In some examples, the latex polymer comprises linear (meth)acrylate monomers comprising alkyl methacrylate monomers (e.g. C1 to C8 alkyl methacrylate monomers). In some examples, the latex polymer comprises alkyl methacrylate monomers (e.g. C1 to C8 alkyl methacrylate monomers) and alkyl acrylate monomers (C1 to C8 alkyl

acrylate monomers). In some examples, the latex polymer comprises alkyl methacrylate monomers (e.g. C1 to C8 alkyl methacrylate monomers). In some examples, the polymer latex comprises alkyl methacrylate monomers (e.g. C1 to C8 alkyl methacrylate monomers) and alkyl acrylate monomers (C1 to C8 alkyl acrylate monomers).

[000150] In some examples, the latex polymer comprises linear (meth)acrylamide monomers comprising alkyl methacrylamide monomers (e.g. C1 to C8 alkyl methacrylamide monomers). In some examples, the latex polymer comprises alkyl methacrylamide monomers (e.g. C1 to C8 alkyl methacrylamide monomers) and alkyl acrylamide monomers (C1 to C8 alkyl acrylamide monomers). In some examples, the latex polymer comprises alkyl methacrylamide monomers (e.g. C1 to C8 alkyl methacrylamide monomers). In some examples, the polymer latex comprises alkyl methacrylamide monomers (e.g. C1 to C8 alkyl methacrylamide monomers) and alkyl acrylamide monomers (C1 to C8 alkyl acrylamide monomers).

[000151] In some examples, the latex polymer comprises a copolymer comprising alkyl (meth)acrylate (e.g. C1 to C8 alkyl (meth)acrylate monomers) and styrene monomers. In some examples, the latex polymer comprises a copolymer comprising alkyl (meth)acrylate (e.g. C1 to C8 alkyl (meth)acrylate monomers), styrene monomers and (meth)acrylic acid monomers.

[000152] In some examples, the latex polymer comprises a copolymer comprising alkyl (meth)acrylamide (e.g. C1 to C8 alkyl (meth)acrylamide monomers) and styrene monomers. In some examples, the latex polymer comprises a copolymer comprising alkyl (meth)acrylamide (e.g. C1 to C8 alkyl (meth)acrylamide monomers), styrene monomers and (meth)acrylic acid monomers.

[000153] In some examples, the latex polymer comprises methyl (meth)acrylate monomers, for example a copolymer comprising methyl (meth)acrylate monomers.

[000154] In some examples, the latex polymer comprises methyl (meth)acrylamide monomers, for example a copolymer comprising methyl (meth)acrylamide monomers.

[000155] In some examples, the inkjet overcoat composition comprises up to about 30 wt% latex polymer by total weight of the inkjet overcoat composition. In some examples, the inkjet overcoat composition comprises up to about 25 wt% latex polymer by total weight of the inkjet overcoat composition. In some examples, the inkjet overcoat composition comprises up to about 20 wt% latex polymer by total weight of the inkjet overcoat

composition. In some examples, the inkjet overcoat composition comprises up to about 15 wt% latex polymer by total weight of the inkjet overcoat composition.

[000156] In some examples, the inkjet overcoat composition comprises at least about 1 wt% latex polymer by total weight of inkjet overcoat composition. In some examples, the latex inkjet ink composition comprises at least about 2 wt% latex polymer by total weight of the inkjet overcoat composition. In some examples, the inkjet overcoat composition comprises at least about 5 wt% latex polymer by total weight of the inkjet overcoat composition. In some examples, inkjet overcoat composition comprises at least about 8 wt% latex polymer by total weight of the inkjet overcoat composition.

[000157] In some examples, the inkjet overcoat composition comprise from about 1 wt% to about 35 wt% latex polymer by total weight of inkjet overcoat composition. In some examples, the inkjet overcoat composition comprise from about 2 wt% to about 30 wt% latex polymer by total weight of the inkjet overcoat composition. In some examples, the inkjet overcoat composition comprise from about 5 wt% to about 25 wt% latex polymer by total weight of the inkjet overcoat composition. In some examples, the inkjet overcoat composition comprise from about 5 wt% to about 20 wt% latex polymer by total weight of the inkjet overcoat composition. In some examples, the inkjet overcoat composition comprise from about 5 wt% to about 15 wt% latex polymer by total weight of the inkjet overcoat composition. In some examples, the inkjet overcoat composition comprise from about 5 wt% to about 12 wt% latex polymer by total weight of the inkjet overcoat composition. In some examples, the inkjet overcoat composition comprise from about 5 wt% to about 8 wt% latex polymer by total weight of the inkjet overcoat composition.

[000158] In some examples, the latex polymer has a glass transition temperature of up to about 90 °C, for example up to about 75 °C. The glass transition temperature of the latex polymer may be determined by DSC (differential scanning calorimetry) according to ASTM D3418.

[000159] In some examples, the latex polymer has a glass transition temperature of about 20 °C or greater, for example about 30 °C or greater, about 40 °C or greater, about 45 °C or greater, or about 50 °C or greater.

[000160] In some examples, the latex polymer has a glass transition temperature of up to about 100 °C, for example up to about 95 °C, up to about 90 °C, up to about 80 °C, or up to about 70 °C.

[000161] In some examples, the latex polymer has a glass transition temperature in the range of about 20 °C to about 100 °C, for example about 30 °C to about 90 °C, about 50 °C to about 90 °C, or about 55 °C to about 70 °C.

The glass transition temperature (Tg) of the latex polymer may be estimated using the Fox equation (T. G. Fox, Bull. Am. Physics Soc., Volume 1, Issue No. 3, page 123 (1956)) using the Tg of the homopolymers of each of the monomers forming the copolymer of the latex polymer. The maximum Tg of each of the homopolymers of each of the monomers making up to copolymer of the latex polymer may be taken from literature values (for example as listed in "Polymer Handbook", edited by J. Brandrup, E.H. Immergut, and E.A. Grulke, Wiley Publishers, 4th edition). The glass transition temperature of the latex polymer may also be determined using DSC (differential scanning calorimetry) according to ASTM D3418.

Wax

[000162] The aqueous inkjet overcoat composition comprises a wax.

[000163] In some examples, the wax can have a melting point ranging from 60° C. to 110° C. Generally, the wax can have a particle size ranging from 50 nm to 600 nm. In some examples, the wax can have a particle size ranging from 200 nm to 300 nm. In some examples the wax is present in the overcoat composition in an amount ranging from 0.25 wt% to 5 wt% by total weight of the overcoat composition. In some examples, the wax is present in an amount from 0.5 wt% to 4 wt%, in some examples form about 1 wt% to about 3 wt%.

[000164] The wax may be provided as a wax emulsions. Wax emulsions are commercially available from a number of vendors, for example Keim-Additec, Lubrizol, Michelman, and BYK Chemie. Wax emulsions that are useful in this invention include but are not limited to: Lubrizol: Liquilube™ 411, Liquilube™ 405, Liquilube™ 488, Liquilube™ 443, Liquilube™ 454; Michelman: ME80825, ME48040, ME98040M1, ME61335, ME90842, ME91240, ML160; Keim-Additec: Ultralube® E-521/20, Ultralube® E-7093, Ultralube® 7095/1, Ultralube® E-8046, Ultralube® E-502V, Ultralube® E-842N: Byk: Aquacer® 2650, Aquacer® 507, Aquacer® 533, Aquacer® 515, Aquacer® 537, Aquaslip™ 671, Aquaslip™ 942.

Overcoat Vehicle

[000165] The overcoat vehicle may comprise water and a co-solvent. The co-solvent of the overcoat vehicle may be as described for the co-solvent of the inkjet ink composition.

Printing Method

[000166] Described herein is a method of printing comprising:

providing a non-porous substrate;

applying an aqueous pre-treatment fluid comprising a cationic polymer and a pre-treatment vehicle to the non-porous substrate to form a pre-treatment layer;

inkjet printing an aqueous ink composition comprising a latex polymer comprising a (meth)acrylate polymer or copolymer, a pigment and an ink vehicle to the non-porous substrate to form an ink layer; and

inkjet printing an aqueous overcoat composition comprising a latex polymer comprising a (meth)acrylate polymer or copolymer, a wax and an overcoat vehicle to the non-porous substrate to form an overcoat layer.

[000167] In some examples, the method comprises heating the pre-treatment layer, ink layer and overcoat layer disposed on the substrate to cure the latex polymers to form a latex polymer film disposed on the substrate.

[000168] In some examples, the method comprises

applying the aqueous pre-treatment fluid to the non-porous substrate to form a pre-treatment layer disposed on the non-porous substrate;

inkjet printing the aqueous ink composition to the non-porous substrate to form an ink layer disposed on the pre-treatment layer; and

inkjet printing the aqueous ink composition the non-porous substrate to form an overcoat layer disposed on the ink layer.

[000169] In some examples, the method may comprise applying the aqueous pre-treatment fluid, aqueous ink composition and aqueous ink composition to the non-porous substrate in any order. In some examples, the aqueous pre-treatment fluid, aqueous ink composition and aqueous ink composition may be applied in-line to the non-porous substrate.

[000170] In some examples, the aqueous pre-treatment fluid is inkjet-printed to the non-porous print substrate.

[000171] The 'printed composition' referred to below comprises the pre-treatment layer, ink layer and overcoat layer (for example, formed in any order) on the print substrate.

[000172] In some examples, the method of printing comprises curing the latex polymer, for example curing the latex polymer (e.g. the latex polymer of the ink composition and the

latex polymer of the overcoat composition) on the print substrate (e.g. non-porous print substrate). Curing of the latex polymer forms a film of latex on the surface of the print substrate. Curing the latex polymer to form a film of latex on the print substrate improves the durability of an image printed using the inkjet-printed system described herein.

[000173] In some examples, the pre-treatment, ink and overcoat vehicles comprise water and co-solvents (e.g. a blend of co-solvents). In order for the latex polymer (the latex polymer of the ink composition and the latex polymer of the overcoat composition) to be cured, firstly water should be evaporated from the printed composition, then the co-solvent (for example, first solvent and second solvent (where present)) should be at least partially evaporated from the printed composition such that particles of latex polymer come into close contact. Once the particles of the latex polymer come into close contact (due to the at least partial evaporation of water and co-solvents) the particles of the latex polymer may coalesce by the intermingling of polymer chains between adjacent latex polymer particles to cure the latex polymer to from a latex polymer film. In order for the latex polymer to be cured the temperature must be above the minimum film formation temperature (MFFT) of the latex polymer. Pigment particles, where present, remain in the printed composition and are embedded within the latex polymer film on curing of the latex polymer.

[000174] Water is evaporated from the printed composition before the co-solvents are removed from the printed inkjet ink composition as water has a higher volatility (e.g. lower boiling point) than the co-solvents.

[000175] In some examples, the co-solvents comprise a first solvent and a second solvent as described herein. In such examples, the first solvent is evaporated, or at least partially evaporated, before the second solvent, again due to the higher volatility of the first solvent compared to the second solvent. The second solvent remains in the printed composition after the water has been evaporated and the first solvent at least partially evaporated.

[000176] The present inventors have found that the presence of a co-solvent having a boiling point of less than about 215°C (e.g. a first solvent) in the printed composition allows for fast drying of the printed composition to enable high throughput through a printing system. The present inventors have found that the presence of the second solvent in the printed composition which remain in the printed composition after evaporation of the water and at least partial evaporation of the first solvent ensures that the MFFT of the latex polymer remains lowered during the curing of the latex polymer.

[000177] In some examples, curing the latex polymer comprises evaporating water from the printed composition. In some examples, curing the latex polymer comprises evaporating water and at least a portion of the co-solvent from the printed composition. Evaporation of water and at least a portion of the co-solvents allows latex polymer particles within the printed composition to coalesce into a film ("cure"). Evaporation may be facilitated in a printing system by providing heat and/or airflow. Heating may be either conductive, radiative, or convective. Airflow may comprise parallel or impinging airflow. In some examples, heating the ink layer to evaporate water, for example water and at least a portion of co-solvents comprises heating the printed composition such that the temperature of the print substrate is maintained below a temperature at which deformation (e.g. warping) of the print substrate occurs. For example, heating the ink layer such that the print substrate reaches a temperature of less than about 70 °C, for example about 65 °C or less.

[000178] In some examples, curing the latex polymer comprises evaporating substantially all of the water from the printed composition, for example evaporating at least about 95 wt%, for example at least about 99 wt%, or at least about 99.5 wt% of the water comprised in the inkjet ink composition printed as the printed composition. In some examples, curing the latex polymer comprises evaporating all of the water from the ink layer so that no water remains in the printed composition

[000179] In some examples, curing the latex polymer comprises evaporating at least a portion of the co-solvent comprises evaporating a major amount of the co-solvents of the pre-treatment composition, inkjet ink composition and overcoat composition printed as the printed composition from the printed composition, for example evaporating at least about 80 wt%, at least about 90 wt%, at least about 95 wt%, or at least about 99 wt% of the co-solvent comprised in the pre-treatment composition, inkjet ink composition and overcoat composition printed as the printed composition.

[000180] In some examples, curing the latex polymer comprises heating the latex polymer such that latex polymer particles coalesce to form a latex polymer film. Forming a latex polymer film occurs after evaporation of water from the printed composition and at least partial evaporation of the co-solvents. Forming a latex polymer film may comprise heating the printed composition to a temperature greater that the MFFT of the latex polymer in the printed composition. In some examples, forming a latex polymer film comprises heating the printed composition to a temperature greater that the MFFT of the latex polymer in the printed composition and a temperature less than a temperature which may cause deformation of the print substrate.

[000181] In some examples, the method of printing comprises selecting an inkjet ink composition such that the MFFT of the latex polymer is below a temperature which may cause deformation of the print substrate. Figure 1 is a schematic diagram of a printing system 100 comprising an inkjet printer 115 in a printing zone 110 of the printing system 100 and a drier 125 positioned in a curing zone 120 of the printing system 100. A print substrate may be transported through the printing system 100 along the path shown by arrow A such that the print substrate is first fed to the printing zone 110 where a pre-treatment composition, inkjet ink composition and overcoat composition are inkjet-printed onto the print substrate by the inkjet printer 115 (for example from an inkjet carriage comprising inkjet cartridges comprising the pre-treatment composition, inkjet ink composition and overcoat composition described above) to form a printed composition on the print substrate. The printed composition disposed on the print substrate may then be heated in the printing zone 110 (for example the air temperature in the printing zone may range between 10°C and 90°C) such that water may be evaporated from the printed composition. The print substrate may then be transported to the curing zone 120 where the printed composition is heated (for example, the air temperature in the printing zone may range between 10°C and 140°C) and air is blown onto the print substrate (as shown by arrows C) such that the co-solvents are at least partially evaporated from the printed composition and the latex polymer is heated to a temperature above the MFFT of the latex polymers in the printed composition. In some examples, the printing system 100 comprises a fan 130 for blowing air over the print substrate passing through the printing zone 110 to evaporate water from the printed composition.

Examples

[000183] The following illustrate examples of the compositions, systems and related aspects described herein. Thus, these examples should not be considered to restrict the present disclosure, but are merely in place to teach how to make examples of compositions of the present disclosure.

[000184] Latex A referred to in the Examples below is a latex polymer comprising a copolymer consisting primarily of poly(cyclohexylmethacrylate) prepared as follows. Water (258g) was heated to 80°C with mechanical agitation. At 80°C, latex seed (5.4g; 67nm particle size) was added to the reactor. At 80°C, potassium persulfate (0.87g) dissolved in water (4% solution) is added. To this mixture was added over 300 minutes: an aqueous emulsion comprised of water (39g), copolymerizable surfactant (Hitenol® BC-10) (7.6g), cyclohexyl methacrylate (172g), phenoxyethyl methacrylate (25.2g) and methacrylic acid (8.7g). Residual monomer was reduced using high temperature (80°C) followed by (17.5g) 5% solution of ascorbic acid and 5% solution of (12.6g) tert-butyl hydroperoxide at 70°C. After cooling to near ambient temperature, pH was adjusted to 8 with dilute potassium hydroxide; inkjet suitable aqueous biocides were added. The resulting acrylic latex was 35% solids by total weight of latex emulsion; particle size 0.22 µm (particle size determined using Microtrac™ Nanotrac Wave II); viscosity (at 25 °C) less than 50 cp.

[000185] Latex B referred to in the Examples below is a latex polymer comprising a copolymer consisting primarily of poly(methyl methacrylate) prepared as follows. Water (116g) was heated to 77°C with mechanical agitation. At 77°C, potassium persulfate (0.30g) dissolved in water (4% solution) was added. At 77°C, latex seed (4.4g; 67nm particle size) was added to the reactor. To this mixture was added over 300 minutes an aqueous emulsion comprised of water (28.2g), copolymerizable surfactant selected from Hitenol® BC-10, BC-30, KH-05 or KH-10 (1.5g), methyl methacrylate (91.1g), styrene (24.1g), butyl acrylate (4.8g), and methacrylic acid (0.6g). Residual monomer was reduced as described in relation to Latex A. After cooling to near ambient temperature, pH is adjusted to 8 with dilute potassium hydroxide; inkjet suitable aqueous biocides are added. The resulting acrylic latex is 31% solids by total weight of latex emulsion; particle size 0.22 µm; viscosity less than 50 cp.

[000186] The pre-treatment composition referred to in the Examples below comprises 2.45 wt% of a cationic polymer (Floquat™ FL2350), 20 wt% 1,2-butanediol, 2.31 wt% surfactant with the balance being water.

[000187] The ink vehicle used in the Examples shown in tables 1 and 2 below contained 15 wt% 1,2-butanediol, 3 wt% 2-pyrrolidinone, 2 wt% Dowanol™ TPM (tripropylene glycol methyl ether), 0.7 wt% Dowanol™ TPnB (tripropylene glycol n-butyl ether) and water, wherein the amount of each of the solvents is provided by total weight of the composition with the balance of each of the compositions (comprising the components specified) being water.

[000188] The overcoat vehicle used in the Examples shown in tables 1 and 2 below contained 18 wt% 1,2-butanediol, 5 wt% 2-pyrrolidinone, 2 wt% Dowanol™ TPM (tripropylene glycol methyl ether), 1.3 wt% Dowanol™ TPnB (tripropylene glycol n-butyl ether) and water, wherein the amount of each of the solvents is provided by total weight of the composition with the balance of each of the compositions (comprising the components specified) is water.

[000189] "Fluted PP" in the examples below refers to IntePro® 3 mm fluted polypropylene media.

[000190] Inkjet printing systems were produced as specified in table 1 below. Each inkjet printing system was used to print an image on a print substrate by applying the pre-treatment fluid to the print substrate (rigid polypropylene) to form a pre-treatment layer disposed on the print substrate. The inkjet ink composition was then inkjet-printed to the pre-treatment later disposed on the print substrate to form an ink later disposed on the pre-treatment layer. The overcoat composition was then inkjet-printed to the ink layer to form an overcoat layer disposed on the ink layer. During printing of the inkjet ink composition and the overcoat vehicle the print substrate along with the layers disposed thereon was heated to evaporate water from the printed layers. The layered composition was then dried further in a curing zone to evaporate the water and the solvents and cure the latex polymers. Adhesion of the inkjet printing system to the print substrate, rub resistance of the printed image on the print substrate and dry laminate adhesion onto the printed image on the printed substrate (no overcoat was printed for this test) along with printhead reliability (decap performance) and fluid levels of the total printing systems printed to the print substrate relative to the Example in which no overcoat was used is provided in Table 1 below.

[000191] Adhesion was measured with using the cross hatch tape adhesion test which was carried out as defined in ASTM D3359-09, except that Intertape Polymer Group™ 515965 tape was used in place of Permacel™ P99 test tape. The numbers 1-5 provided

in Table 2 refer to the amount of latex ink removed from each of the samples following this test according to the following scale:

Test Scale: 0 = 0% removed
1 = < 5% removal
2 = 5 – 15% removal
3 = 15 – 35% removal
4 = 35 – 65% removal
5 = > 65% removal

[000192] Windex Blue® window cleaner and 70% isopropyl alcohol rub resistance were measured using a Taber® linear abraser model 5750 equipped with an acrylic crockmeter tip covered with polyester cloth. The cloth was dipped in the rubbing fluid, and the printed image was rubbed 5X with 600g pressure. Plot damage and wiper cleanliness are graded with the following scale:

Taber® Score	Plot Damage	Wiper Appearance	Criteria for Scoring
0	none	clean	no damage, no color transfer, clean wiper
0.5	none	hint of color	no damage (including gloss), no color loss, faint transfer to wiper
1	gloss loss	light ink transfer	no color loss - only gloss loss, light transfer to wiper
2	significant	significant transfer	0-20% color loss
3	severe	significant transfer	20-50% color loss
4	severe	significant transfer	50-80% color loss
5	severe	significant transfer	>80% color loss

[000193] Decap was measured by printing the compositions from an inkjet printhead and then waiting for 7 seconds, and then counting the number of spits (printhead firings)

required to bring the nozzle back to full health, as measured by looking at printed line health (density and trajectory).

[000194] Table 1

System	Pretreatment	Ink	Overcoat (OC)	Fluted PP adhesion	Fluted PP rub resistance	Decap performance	Fluid levels
Comparative Example 1	Yes	3 wt% pigment, 7 wt% Latex A, 0.8 wt% wax	None	4	4	Good	Default
Example 2	Yes	4 wt% pigment, 10 wt% Latex A	9 wt% Latex A, 3 wt% wax	1	2	Good	+20%
Comparative Example 3	Yes	4 wt% pigment, 0 wt% Latex A	14 wt% Latex A, 3 wt% wax	3	3	Ink Good; OC poor	+40%

[000195] The results provided in table 1 show that the inkjet printing system comprising a pre-treatment fluid, inkjet ink composition and inkjet overcoat composition as described herein provides improved substrate adhesion, rub resistance, printhead reliability. The system described herein also provides improved fluidic efficiencies compared to the system of comparative examples 3 which provides a similar solid content in the printed image to the system of Example 2. The system of Example 2 also only requires an additional 20% fluid to increase the solid content by 50 wt% compared to the system of comparative example 1.

[000196] The present inventors have found that by providing a system in which a wax slip aid is provided in the overcoat composition rather than the ink composition allows a lower amount of wax to be used to provide desired durability and such a system also exhibits improved adhesion to the print substrate.

[000197] Inkjet printing systems of Examples 4 and 5 were provided as specified in table 2 below and printed on a print substrate as described above for the systems of Examples 1-3. The systems of Examples 4 and 5 were printed to rigid polypropylene and tested for adhesion and rub resistance as described above. The systems of Examples 4 and 5 were also printed to a flexible vinyl substrate and the image printed thereon rubbed with 70% isopropyl alcohol (IPA).

[000198] Table 2

System	Pre-treatment	Ink	Overcoat (OC)	PP adhesion	PP rub resistance	Flexible vinyl IPA rub resistance
Example 4	Yes	4 wt% pigment, 10 wt% Latex A	9wt% Latex A, 3wt% wax	1	2	4-5
Example 5	Yes	4 wt% pigment, 10 wt% Latex A	9wt% Latex B, 3wt% wax	1	2	2

[000199] The results provided in table 2 show that the chemical resistance of the printing system can be improved by using different latex polymers in the ink composition compared to the overcoat composition. For example, the present inventors have found that using a latex polymer derived from a composition comprising cycloaliphatic (meth)acrylate monomers (such as cyclohexyl methacryate) in the ink composition and a latex polymer derived from a composition comprising alkyl (meth)acrylate monomers (such as methyl methacryate) in the overcoat composition provides improved adhesion to non-porous substrates such as polypropylene and also provides improved chemical resistance compared to inks containing either alkyl (meth)acrylate or cycloaliphatic methacrylate latexes in the ink alone, or blends of the two latex types in a single ink fluid .

[000200] Table 3 below shows an Example of an inkjet printing system comprising black, cyan, magenta, yellow, light magenta and light cyan ink compositions which has been found to provide improved adhesion, durability, chemical resistance, on a wide range of print substrates. 'OC' is used to refer to overcoat composition and 'PT' is used to refer to the composition of the pre-treatment fluid.

[000201] Table 3

Ingredients	Composition (wt% by total weight of composition)							
	Black ink	Cyan ink	Magenta ink	Yellow ink	Light magenta ink	Light cyan ink	OC	PT
Pigment	2.6	1.7	3.5	3.8	0.9	0.6		

Dispersants and wetting agents	1.8	1.5	1.0	1.4	1.1	1.0	1.0	1.4
Latex A	10.0	10.0	10.0	10.0	10.0	10.0		
Latex B							9.0	
Wax dispersion							3.0	
1,2-butanediol	15.0	15.0	15.0	15.0	15.0	15.0	18.0	20.0
2-pyrrolidinone	3.0	3.0	3.0	3.0	3.0	3.0	5.0	
Dowanol™ TPM	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
Dowanol™ TPnB	0.7	0.7	0.7	0.7	0.7	0.7	1.3	
Cationic Polymer								2.5
Water	64.9	66.1	64.9	64.1	67.3	67.8	60.7	76.2
pH	8.5	8.5	8.5	8.5	8.5	8.5	8.5	2.8

[000202] While the printing systems, compositions, methods and related aspects have been described with reference to certain examples, it will be appreciated that various modifications, changes, omissions, and substitutions can be made without departing from the spirit of the disclosure. It is intended, therefore, that the ink compositions, methods and related aspects be limited only by the scope of the following claims. Unless otherwise stated, the features of any dependent claim can be combined with the features of any of the other dependent claims, and any other independent claim.

CLAIMS

1. An inkjet printing system comprising:

an aqueous pre-treatment fluid comprising a cationic polymer and a pre-treatment vehicle;

an aqueous inkjet ink composition comprising a latex polymer comprising a (meth)acrylate or (meth)acrylamide polymer or copolymer, a pigment and an ink vehicle; and

an aqueous inkjet overcoat composition comprising a latex polymer comprising a (meth)acrylate or (meth)acrylamide polymer or copolymer, a wax and an overcoat vehicle.

2. An inkjet printing system according to claim 1, wherein the latex polymer of the ink composition is different to the latex polymer of the overcoat composition.

3. An inkjet printing system according to claim 1, wherein the latex polymer of the ink composition is derived from a composition comprising cycloaliphatic (meth)acrylate monomers.

4. An inkjet printing system according to claim 1, wherein the latex polymer of the overcoat composition is derived from a composition comprising alkyl (meth)acrylate monomers.

5. An inkjet printing system according to claim 1, wherein the latex polymer of the ink composition is derived from a composition comprising cyclohexyl (meth)acrylate monomers and the latex polymer of the overcoat composition is derived from a composition comprising methyl (meth)acrylate monomers.

6. An inkjet printing system according to claim 1, wherein aqueous pre-treatment fluid comprises:

about 0.1 wt% to about 25 wt% of a cationic polymer by total weight of the pre-treatment fluid; and

a pre-treatment vehicle comprising water and about 1 to about 50 wt% by total weight of the pre-treatment fluid of a co-solvent having a boiling point in the range of about 170 °C to about 215 °C.

7. An inkjet printing system according to claim 1, wherein the aqueous inkjet ink composition comprises:

from about 2 wt% to about 30 wt% of a latex polymer comprising (meth)acrylate monomers;

from about 0.5 wt% to about 25 wt% of a pigment by total weight of the composition; and

an ink vehicle.

8. An inkjet printing system according to claim 7, wherein the aqueous inkjet ink composition comprises:

from about 2 wt% to about 25 wt% of a latex polymer comprising cycloaliphatic (meth)acrylate monomers;

from about 0.5 wt% to about 30 wt% of a pigment by total weight of the composition; and

an ink vehicle comprising water and about 1 to 50 wt% of a co-solvent by total weight of the composition, wherein the co-solvent comprises an organic solvent having a boiling point in the range of about 170 °C to about 215 °C.

9. An inkjet printing system according to claim 1, wherein the overcoat composition comprises from about 2 wt% to about 15 wt% of a latex polymer comprising alkyl (meth)acrylate monomers.

10. An inkjet printing system according to claim 9, wherein the overcoat composition comprises:

from about 2 wt% to about 15 wt% of a latex polymer;

from about 0.25 wt% to about 5 wt% of wax; and

an overcoat vehicle.

11. An inkjet printing system according to claim 1, wherein

the aqueous pre-treatment fluid comprises:

about 0.1 wt% to about 25 wt% of a cationic polymer by total weight of the pre-treatment fluid; and

a pre-treatment vehicle comprising water and about 1 to about 50 wt% by total weight of the pre-treatment fluid of a co-solvent having a boiling point in the range of about 170 °C to about 215 °C;

the inkjet ink composition comprises:

from about 2 wt% to about 30 wt% of a latex polymer comprising (meth)acrylate monomers;

from about 0.5 wt% to about 25 wt% of a pigment by total weight of the composition; and

an ink vehicle; and

the inkjet overcoat composition comprises:

from about 2 wt% to about 15 wt% of a latex polymer;

from about 0.25 wt% to about 5 wt% of wax; and

an overcoat vehicle.

12. A method of printing comprising:

providing a non-porous substrate;

applying an aqueous pre-treatment fluid comprising a cationic polymer and a pre-treatment vehicle to the non-porous substrate to form a pre-treatment layer disposed on the non-porous substrate;

inkjet printing an aqueous ink composition comprising a latex polymer comprising a (meth)acrylate polymer or copolymer, a pigment and an ink vehicle to the non-porous substrate to form an ink layer disposed on the pre-treatment layer; and

inkjet printing an aqueous overcoat composition comprising a latex polymer comprising a (meth)acrylate polymer or copolymer, a wax and an overcoat vehicle to the non-porous substrate to form an overcoat layer disposed on the ink layer.

13. A method of printing according to claim 12, wherein the method comprises heating the pre-treatment layer, ink layer and overcoat layer disposed on the substrate to cure the latex polymers to form a latex polymer film disposed on the substrate.

14. A method of printing according to claim 12, wherein:

the aqueous pre-treatment fluid is applied to the non-porous substrate to form a pre-treatment layer disposed on the non-porous substrate;

the aqueous ink composition is inkjet-printed to the non-porous substrate to form an ink layer disposed on the pre-treatment layer; and

the aqueous overcoat composition is inkjet-printed to the non-porous substrate to form an overcoat layer disposed on the ink layer.

15. A method of printing according to claim 12, wherein the aqueous pre-treatment fluid is inkjet-printed to the non-porous print substrate.

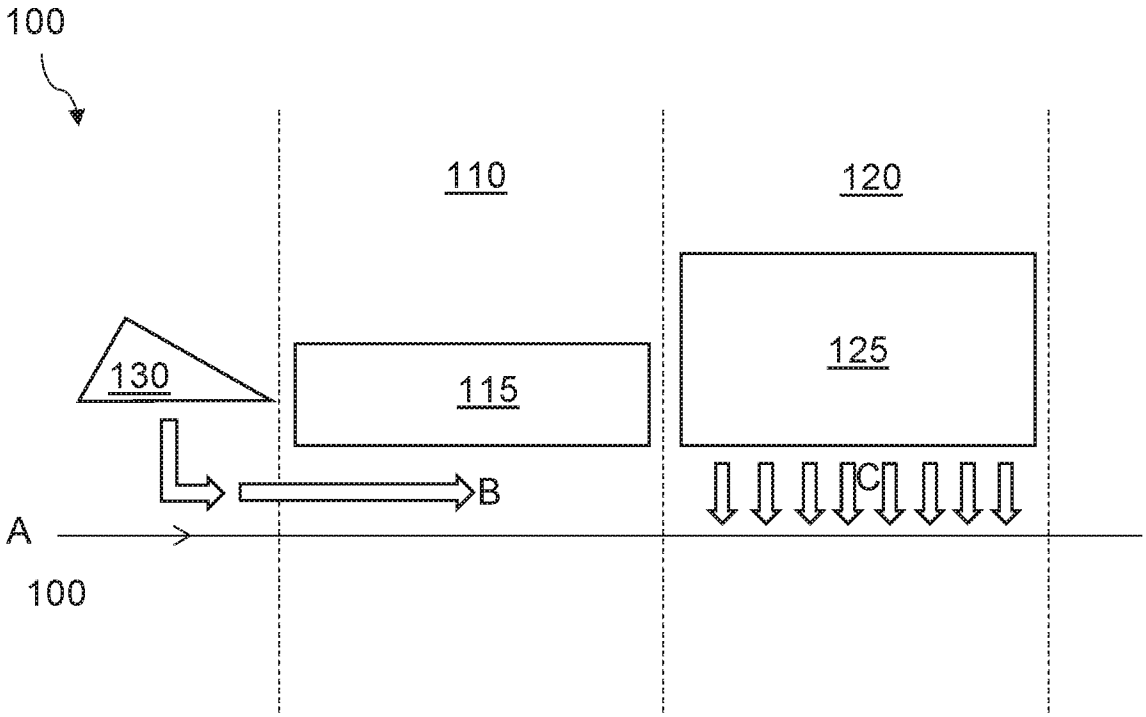


Fig.1

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 2017/015903

A. CLASSIFICATION OF SUBJECT MATTER

C09D11/023 *(2014.01)*
C09D11/104 *(2014.01)*
C09D11/107 *(2014.01)*
B41J2/01 *(2006.01)*

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)

C09D 11/00-11/16, 11/30, 11/322, 11/38, B41M 1/00, 1/26-1/38, 5/00, 5/50, 5/52, 7/00, B41J 2/01

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)

PAJ, Esp@cenet, PatSearch, USPTO, DWPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 7246896 B2 (HEWLETT-PACKARD DEVELOPMENT COMPANY L.P.) 24.07.2007, abstract, column 3 lines 3-11, column 4 line 23 - column 5 line 6, column 5 line 43 - column 9 line 47	1-15
Y	US 2016319147 A1 (HEWLETT-PACKARD DEVELOPMENT COMPANY, L.P.) 03.11.2016, abstract, paragraphs [0007], [0041]-[0047], [0049], [0069]-[0070], [0072], [0075], [0101]	1-15
Y	WO 2016/175738 A1 (HEWLETT-PACKARD DEVELOPMENT COMPANY, L.P.) 03.11.2016, abstract, paragraphs [0011]-[0016], [0038], [0041], [0049],[0050]	1-15

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

☐ See patent family annex.

* Special categories of cited documents:

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"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	Date of mailing of the international search report
06 September 2017 (06.09.2017)	12 October 2017 (12.10.2017)

Name and mailing address of the ISA/RU:	Authorized officer
Federal Institute of Industrial Property, Berezhkovskaya nab., 30-1, Moscow, G-59, GSP-3, Russia, 125993 Facsimile No: (8-495) 531-63-18, (8-499) 243-33-37	A.Galetina Telephone No. (8-495) 531-65-15