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(54) Image enhancing compositions

(57) Disclosed is an image enhancing composition for imaging and printing processes, said composition containing a solvent, a polymeric binder, a dye mordant, a substantially water soluble anticurl compound, a substantially water soluble desizing compound, a lightfastness compound, a defoamer, an optional biocide, and an optional filler.

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Description

[0001] U.S. Patent 5,709,737, the disclosure of which is totally incorporated herein by reference, discloses an ink composition which comprises water, a colorant, an organic compound miscible with water, and an anticurl compound selected from the group consisting of (1) acetylenic alcohols, (2) amido alcohols, (3) tris compounds, (4) derivatives of 1,2-diols and 1,3-diols, (5) thio diols, (6) aromatic and heterocyclic alcohols, (7) imino alcohols, (8) salts of hydroxyl compounds, (9) saccharides; and mixtures thereof, and an optional microwaveable compound.

[0002] Illustrated in copending application U.S. Serial No. (not yet assigned - D/97663), the disclosure of which is totally incorporated herein by reference is a transparency comprised of a supporting substrate, and thereover and thereunder two coatings, a first heat dissipating antistatic coating layer in contact with the substrate, and wherein the first coating contains a heat dissipating binder with a melting point of for example, in the range of from about 100 to about 260°C, and an antistatic compound and a second ink receiving coating layer thereover containing a blend of a binder polymer, an alkylated oxazoline compound with a melting point of for example, between about 40°C to about 80°C, a lightfastness compound, and a biocide.

[0003] The appropriate components of this copending application, such as for example, the anticurl compounds can be selected for the invention of the present application in embodiments thereof.

BACKGROUND OF THE INVENTION

[0004] This invention relates generally to compositions, and more specifically, to image enhancing chemical compositions that can preferably be applied on-line to non-imaged substrates, such as papers like plain copy paper, recycled paper, coated papers, plastics, such as MYLAR®, TESLIN®, and the like, and especially papers selected for xerographic imaging, ink jet printing processes, inclusive of acoustic ink jet processes, gravure printing systems, and thermal transfer printing processes, preferably prior to printing with different marking technologies, and which compositions reduce, minimize, or avoid substrate curling.

PRIOR ART

[0005] Paper is often sized with sizing compounds for the purpose of retarding or preventing penetration of liquids into the paper. This is commonly done by introducing the sizing compound into the pulp during the paper manufacturing operation, and wherein acid sizing components, such as Mon size available from Monsanto Chemical Company, or alkaline sizing chemicals, such as Hercon-76 available from Hercules Company, are precipitated onto the paper fibers primarily for the purpose of controlling penetration of liquids into the final dry paper. This process is known as internal sizing. Surface sizing involves the application of dispersions of film-forming substances, such as converted starches, gums and modified polymers to previously formed paper, and which sizing imparts strength to the paper. The sizing values of common plain papers, including the commercial papers that can be selected for the present invention in embodiments thereof, vary between, for example, about 0.4 second to about 4,685 seconds as measured on the Hercules sizing tester (Hercules Incorporated) as described in TAPPI STANDARD T-530 pm-83 issued by the Technical Association of the Pulp and Paper Industry. The TAPPI method employs a mildly acidic aqueous dye solution as the penetrating compound to permit optical detection of the liquid front as it moves through the paper sheet. This apparatus determines the time required for the reflectance of the sheet surface not in contact with the penetrant to drop to a predetermined (80 percent) percentage of its original reflectance. Papers in the sizing range of about 50 seconds to about 300 seconds are preferred, primarily to decrease costs, and decrease the porosity values of the substrates, which porosity can be measured with a Parker Print-Surf, porosimeter which records the volume of air/minute flowing through a sheet of paper. These values vary from about 100 to about 1,260 mil/minute and preferably from about 100 to about 600 mil/minute to permit, for example, the use of these papers in various printing technologies such as thermal transfer, liquid toner development, xerography, ink jet processes, and the like. These internally and surface sized papers, when used in creating images or prints using nonphotographic imaging, such as ink jet printing, generate unwanted paper curl, and the images on these papers are neither resistant to water nor light. The degree of paper curl, and image resistance to water and light depends for example, on the type of printing processes and the chemical composition of inks being used.

[0006] Ink jet printing systems generally are of two types: continuous stream and a more common drop-on-demand. In drop-on-demand systems, a droplet is expelled from an orifice directly to a position on a recording medium in accordance with digital data signals. A droplet is not formed or expelled unless it is to be placed on the recording medium. Since drop-on-demand systems require no ink recovery, charging, or deflection, they are much simpler than the continuous stream type. There are three types of drop-on-demand ink jet systems.

[0007] One type of drop-on-demand system has as its major compounds an ink filled channel or passageway having a nozzle on one end and a piezoelectric transducer near the other end to produce pressure pulses. The relatively large

size of the transducer prevents close spacing of the nozzles, and physical limitations of the transducer result in low ink drop velocity. Low drop velocity diminishes tolerances for drop velocity variation and directionality, thus impacting the system's ability to produce high quality copies. Drop-on-demand systems, which use piezoelectric devices to expel the droplets also suffer the disadvantage of a slow printing speed.

[0008] The second type of drop-on-demand system is known as thermal ink jet, or bubble jet, and produces high velocity droplets and allows very close spacing of nozzles. The major compounds of this type of drop-on-demand system are an ink-filled channel having a nozzle on one end and a heat generating resistor near the nozzle. Printing signals representing digital information originate an electric current pulse in a resistive layer within each ink passageway near the orifice or nozzle causing the ink in the immediate vicinity to evaporate almost instantaneously and create a bubble. The ink at the orifice is forced out as a propelled droplet as the bubble expands. When the hydrodynamic motion of the ink stops, the process is ready to begin again. With the introduction of a droplet ejection system based upon thermally generated bubbles, commonly referred to as the "bubble jet" system, the drop-on-demand ink jet printers provide simpler, lower cost devices than their continuous stream counterparts, and yet have substantially the same high speed printing capability. Thermal ink jet processes are well known and are described, for example, in U.S. Patent 4,601,777, U.S. Patent 4,251,824, U.S. Patent 4,410,899, U.S. Patent 4,412,224, and U.S. Patent 4,532,530, the disclosures of each of which are totally incorporated herein by reference.

[0009] The third type of drop-on-demand system is known as acoustic ink printing. In acoustic ink jet printing, reference for example copending applications U.S. Serial No. 935,929, U.S. Serial No. 935,889, U.S. Serial No. 935,639, U.S. Serial No. 936,084, and U.S. Serial No. 831,451, the disclosures of which are totally incorporated herein by reference, an acoustic beam exerts a radiation pressure against features upon which it impinges. Thus, when an acoustic beam impinges on a free surface of the ink of a pool of liquid from beneath, the radiation pressure which it exerts against the surface of the pool may reach a sufficiently high level to release individual droplets of liquid from the pool, despite the restraining force of surface tension. Focusing the beam on or near the surface of the pool intensifies the radiation pressure it exerts for a given amount of input power, reference, for example, *IBM Technical Disclosure Bulletin,* Vol. 16, No. 4, September 1973, pages 1168 to 1170, the disclosure of which is totally incorporated herein by reference. Acoustic ink printers typically comprise one or more acoustic radiators for illuminating the free surface of a pool of liquid ink with respective acoustic beams. Each of these beams usually is brought to focus at or near the surface of the reservoir (i.e., the liquid/air interface). Furthermore, printing conventionally is accomplished by independently modulating the excitation of the acoustic radiators in accordance with the input data samples for the image that is to be printed. This modulation enables the radiation pressure, which each of the beams exerts against the free ink surface, to make brief, controlled excursions to a sufficiently high pressure level for overcoming the restraining force of surface tension. That, in turn, causes individual droplets of ink to be ejected from the free ink surface on demand at an adequate velocity to cause them to deposit in an image configuration on a nearby recording medium. The acoustic beam may be intensity modulated or focused/defocused to control the ejection timing or an external source may be used to extract droplets from the acoustically excited liquid on the surface of the pool on demand. Regardless of the timing mechanism employed, the size of the ejected droplets is determined by the waist diameter of the focused acoustic beam. Acoustic ink printing is attractive primarily because it does not require the nozzles or the small ejection orifices which have caused many of the reliability and pixel placement accuracy problems that conventional drop on demand and continuous stream ink jet printers have suffered. The compositions and processes of the present invention can be selected for acoustic ink jet methods as illustrated hereinbefore and in the appropriate copending applications recited herein.

[0010] Pixel placement accuracy problem is believed to exist with conventional drop on demand and continuous stream ink jet printers. The size of the ejection orifice is an important critical ink jet design parameter because it determines the size of the droplets of ink that the jet ejects. As a result, the size of the ejection orifice cannot be readily increased without sacrificing resolution. Acoustic printing has increased intrinsic reliability since usually there are no nozzles to clog. Furthermore, small ejection orifices are avoided, so acoustic printing can be performed with a greater variety of inks than conventional ink jet printing, including inks with high viscosities and inks containing pigments and other particulate compounds. Acoustic ink printers embodying print heads comprising acoustically illuminated spherical focusing lenses can print precisely positioned pixels (picture elements) at resolutions which are sufficient for high quality printing of relatively complex images. It has also been determined that the size of the individual pixels printed by such a printer can be varied over a significant range during operation, thereby accommodating, for example, the printing of variably shaded images. Furthermore, the known droplet ejector technology can be adapted to a variety of print head configurations, including (1) single ejector embodiments for raster scan printing, (2) matrix configured ejector arrays for matrix printing, and (3) several different types of page width ejector arrays, ranging from (i) single row, sparse arrays for hybrid forms of parallel/serial printing to (ii) multiple row staggered arrays with individual ejectors for each of the pixel positions or addresses within a page width image field (i.e., single ejector/pixel/line) for ordinary line printing.

[0011] Inks suitable for acoustic ink jet printing typically are liquid at ambient temperatures (i.e., about 25°C), however, this ink may also be in a solid state at ambient temperatures and where a provision is made for liquefying the ink by heating or any other suitable method prior to introduction of the ink into the print head. With these inks images of two

or more colors can be generated by several methods, including by processes wherein a single print head launches acoustic waves into pools of different colored inks. Further information regarding acoustic ink jet printing apparatus and processes, and which acoustic systems may be selected for the compositions and processes of the present invention, is disclosed in, for example, U.S. Patent 4,308,547, U.S. Patent 4,697,195, U.S. Patent 5,028,937, U.S. Patent 5,041,849, U.S. Patent 4,751,529, U.S. Patent 4,751,530, U.S. Patent 4,751,534, U.S. Patent 4,801,953, and U.S. Patent 4,797,693, the disclosures of each of which are totally incorporated herein by reference. The use of focused acoustic beams to eject droplets of controlled diameter and velocity from a free-liquid surface is also described in *J. Appl. Phys.,* vol. 65, no. 9 (1 May 1989) and references therein, the disclosure of which is totally incorporated herein by reference. In this process, the print head produces approximately 2.2 picoliter droplets by an acoustic energy process.

[0012] The aqueous inks used in the acoustic ink jet printing can be similar to those used in piezoelectric devices where the inks have a surface tension of, for example, greater than about 50 dynes/centimeter, and the inks used in thermal ink jet printing processes have low surface tensions, that is for example, in the range of 30 to 40 dynes/centimeter. Due to the varying chemical and physical differences in the ink compositions employed in continuous ink jet printing, thermal ink jet printing and acoustic ink jet printing, the substrate, such as paper and transparency, requirements for high quality printing also vary. Thus, if one desires to have a single paper substrate for all ink jet printing, one needs to develop a special in-machine substrate treatment prior to their entering the marking engine. This treatment can be chemical in nature, followed by substrate drying and optionally calandering the substrate prior to its printing. The chemical treatment can be applied on to one printing side of the substrate or to both sides of the substrate followed by substrate drying and optionally calandering the substrate prior to its printing. The chemical treatment to the substrate can be applied via a spray device or it can be jetted on to paper via an additional jet. When an additional jet is employed in acoustic ink jet printing, the additional jet may be a jetting head from a thermal ink jet printer, which is capable of jetting larger drops of the chemical treatment thereby accelerating the paper treatment process. In the event one needs to treat paper in specific areas only, such as pretreating paper in areas where cyan and magenta colors are to be printed, there may be selected an additional acoustic printing head.

[0013] In U.S. Patent 5,612,777, the disclosure of which is totally incorporated herein by reference, there is illustrated an apparatus, such as color xerographic copier or printer and method for creating lightfast color images which images on paper are coated with a composition including a lightfast compound and a hydrophobic polymeric binder which protects the images from rough handling and degradation from exposure to UV radiation.

[0014] European Patent Application 767060 discloses liquid discharging head for thermal ink-jet printer having two groups of grooves forming liquid flow paths respectively corresponding to energy generating elements in combination with respective element boards for discharging ink and processing liquid. The liquid discharging head comprises first and second element boards with several energy generating elements for generating energy for liquid discharge. A grooved member is positioned between the opposed first and second element boards. A first group of grooves forms liquid flow paths respectively corresponding to the energy generating elements in combination with the first element board. A second group of grooves forms liquid flow paths respectively corresponding to the energy generating elements in combination with the second element board. The discharge ports communicate with the liquid flow paths such that the discharge ports corresponding to the first element board are adapted to discharge ink, and the discharge ports corresponding to the second element board are adapted to discharge processing liquid. The grooved member has a recess portion constituting a common liquid chamber for supplying liquid to the liquid flow paths, corresponding to each element board.

[0015] U.S. Patent 5,211,747, the disclosure of which is totally incorporated herein by reference, discloses an ink composition having a pH of about 5 to about 10, and which ink contains a colorant, a liquid carrier and less than about 5 weight percent of a desizing compound. The desizing compound may be (1) poly(oxyalkylene) modified compounds of sorbitan esters, fatty amines, alkanol amides, castor oil, fatty acids and fatty alcohols; (2) hydrophilic poly(dialkylsiloxanes); (3) fatty imidazolines; (4) fatty ester modified compounds of phosphate, sorbitan, glycerol, poly(ethylene glycol), sulfosuccinic acid, sulfonic acid and alkyl amine; (5) quaternary alkosulfate compounds; (6) poly(propylene oxide)-co-poly(ethylene oxide) copolymers; (7) poly(alkylene glycol); or (8) mixtures thereof.

[0016] U.S. Patent 5,302,249, the disclosure of which is totally incorporated herein by reference, illustrates desizing compounds, or agents of (1) hydrophilic poly(dialkyl siloxanes), such as poly(dimethylsiloxane)-b-poly (propyleneoxide)-b-poly(ethyleneoxide) copolymers (Alkasil NEP 73-70, Alkaril Chemicals); (2) poly(alkylene glycol), such as poly(propylene glycol) (Alkapol PPG-4000, Alkaril Chemicals, and which compounds can be selected for the invention compositions.

[0017] U.S. Patent 5,223,338, the disclosure of which is totally incorporated herein by reference, discloses a recording sheet capable of imparting water resistance to ink jet images, which comprises a substrate and a coating consisting essentially of (1) quaternary ammonium polymers; (2) an optional binder polymer; and (3) an optional filler.

[0018] U.S. Patent 5,314,747, the disclosure of which is totally incorporated herein by reference, discloses a recording sheet capable of imparting water resistance to ink jet images, which sheet comprises (a) a base sheet, (b) a cationic sulfur compound selected from the group consisting of sulfonium compounds, thiazolium compounds, benzothiazolium

compounds, and mixtures thereof, (c) an optional binder, and (d) an optional pigment.

[0019] U.S. Patent 5,320,902, the disclosure of which is totally incorporated herein by reference, discloses a recording sheet capable of imparting water resistance to ink jet images, which sheet consists essentially of a substrate and, in contact with the substrate, a monoammonium compound, an optional binder compound and an optional filler compound.

[0020] U.S. Patent 5,441,795, the disclosure of which is totally incorporated herein by reference, illustrates a recording sheet capable of imparting water resistance to ink jet images, which sheet is comprised of a base sheet and a material selected from the group consisting of pyridinium compounds, piperazinium compounds, and mixtures thereof.

[0021] U.S. Patent 5,457,486, the disclosure of which is totally incorporated herein by reference, discloses a recording sheet capable of imparting water resistance to ink jet images, which sheet is comprised of (a) a base sheet; (b) a material selected from the group consisting of tetrazolium compounds, indolinium compounds, imidazolinium compounds, and mixtures thereof (c) an optional pigment, and (d) an optional binder.

[0022] Although incorporation of paper desizing compounds and paper anticurl agents in ink jet inks, or incorporation of quaternary compounds, desizing compounds and decurling compounds in paper illustrated in the above mentioned patents, may be adequate for special inks and special papers, there remains a need for more efficient image enhancing chemical compositions that enable for example, high quality images when printed with various printing processes. There also remains a need for unique chemical compositions containing a polymeric binder, a dye mordant, desizing/anticurl compounds, waterfast and lightfast compounds that can be applied to a number of different papers to for example, reduce and eliminate paper curl and produce lightfast, waterfast, high optical density images. In addition, there remains a need for treated imaged papers wherein the fibers thereof are coated with compositions thereover enabling, for example, papers with images developed thereon possessing acceptable curl, high optical density values, and minimum showthrough. Also, there remains a need for treated imaged papers that permit images with excellent ink adhesion, such as more than about 95 percent, longer shelf life, and scratch resistant images of high optical density. Additionally, there is a need for image enhancing fluid treatments which are compatible with the imaged plain copy papers, recycled papers, imaged filled papers, sized papers, and coated papers, which treatments will enable the aforementioned materials to, for example, generate low curl, high optical density images with a number of ink jet printing processes.

SUMMARY OF THE INVENTION

[0023] It is a feature of the present invention to provide chemical compositions for imaged papers with many of the advantages illustrated herein.

[0024] Another feature of the present invention resides in the provision of chemical compositions containing polymeric binder, desizing and anticurl/decurling compounds that reduce, minimize, or eliminate paper curl caused primarily by the swelling of paper fibers.

[0025] Also, in another feature of the present invention there are provided treated papers wherein the fibers thereof are coated with compositions thereover enabling, for example, papers with images developed thereon having acceptable curl, high optical density values, and minimum showthrough.

[0026] Another feature of the present invention resides in treated imaged papers that permit images with excellent ink adhesion, such as more than 95 percent, longer shelf life, and scratch resistant images of high optical density.

[0027] Furthermore, in another feature of the present invention there are provided treated ink jet papers that minimize, or avoid, bleeding of colors.

[0028] Another feature of the present invention relates to the application of certain chemical compositions to ink jet papers to permit papers with, for example, acceptable curl, and excellent waterfastness and lightfastness of the ink jet images.

[0029] In yet another feature of the present invention there are provided compositions that are compatible with the plain imaged copy papers, recycled papers, imaged filled papers, sized papers, and coated papers, which compositions will enable low curl, and high optical density images with various ink jet printing processes.

[0030] In yet another feature of the present invention there are provided anticurl chemical compositions which are compatible with imaged plain copy papers, recycled papers, coated papers, filled papers and sized papers, and which compositions permit low or no paper curl, high optical density images with ink jet ink printing processes, and wherein papers with the resulting chemical compositions can be selected for acoustic ink jet methods, and wherein the papers can be precoated in for example an acoustic ink jet apparatus.

[0031] The present invention relates to ink compositions comprised of a hydrophilic solvent, a polymeric binder, a dye mordant, a water soluble, wherein soluble refers, for example, to a preferable solubility in the range of about 0.10 grams to about 30 grams per 100 milliliters of water, a paper anticurl compound, a water soluble paper desizing compound, a lightfast compound, a defoamer, a biocide, and a filler; and a chemical composition, which composition enhances image quality with a polymeric binder present in an amount of from about 0.1 part by weight to about 4 parts by weight,

and preferably from about 1 part by weight to about 2 parts by weight, although the amounts can be outside of this range, a dye mordant present in an amount of from about 0.1 part by weight to about 50 parts by weight, and preferably from about 5 parts by weight to about 50 parts by weight, although the amounts can be outside of this range, a water soluble paper anticurl compound present in an amount of from about 0.1 part by weight to about 20 parts by weight, and preferably from about 5 parts by weight to about 15 parts by weight, although the amounts can be outside of this range, a water soluble paper desizing compound present in an amount of from about 0.1 part by weight to about 5 parts by weight and preferably from about 1 part by weight to about 3 parts by weight, although the amounts can be outside of this range, a lightfastness compound present in an amount of from about 0.1 part by weight to about 7 parts by weight, and preferably from about 2 parts by weight to about 5 parts by weight, although the amounts can be outside of this range, a defoamer present in an amount of from about 0.1 part by weight to about 3 parts by weight, and preferably from about 1 part by weight to about 3 parts by weight, although the amounts can be outside of this range, a biocide present in an amount of from about 0.1 part by weight to about 3 parts by weight, and preferably from about 1 part by weight to about 3 parts by weight, although the amounts can be outside of this range, a filler present in an amount of from about 0.1 part by weight to about 7 parts by weight, and preferably from about 1 part by weight to about 3 parts by weight, although the amounts can be outside of this range, and a hydrophilic solvent of for example water, an aliphatic alcohol, such as methanol, ethanol, propanol, butanol, and the like, present in an amount of from about 99.2 parts by weight to about 1 part by weight, and preferably from about 83 parts by weight to about 16 parts by weight, although the amounts can be outside of this range. The total amount of all components in the composition is about 100 parts, or 100 percent. The image enhancing composition can be applied to an nonimaged paper in a thickness of, for example, from about 0.5 micron to about 20 microns.

[0032] The chemical compositions selected for substrate coatings also can be comprised, for example, of water present in an amount of from about 99.2 parts by weight to about 1 part by weight, a polymeric binder present in an amount of from about 0.1 part by weight to about 4 parts by weight, a dye mordant present in an amount of from about 0.1 part by weight to about 50 parts by weight, a water soluble paper anticurl/decurling compound present in an amount of from about 0.1 part by weight to about 20 parts by weight, a water soluble paper desizing compound present in an amount of from about 0.1 part by weight to about 5 parts by weight, a lightfast compound present in an amount of from about 0.1 part by weight to about 7 parts by weight, a defoamer present in an amount of from about 0.1 part by weight to about 3 parts by weight, an optional biocide present in an amount of from about 0.1 part by weight to about 3 parts by weight, and an optional filler present in an amount of from about 0.1 part by weight to about 7 parts by weight.

[0033] The composition amounts can be determined by known methods, and more specifically, for example, as follows. Various blends of the binder, cationic dye mordant, the anticurl compound, the desizing compound, lightfast compounds, defoamers, fillers, and biocides were prepared in a hydrophilic solvent, such as water, ethanol, and the like, and coated on to various substrates, such as paper. After drying the paper at 100°C, they were tested for coating adhesion to paper and printed with a Xerox Corporation ink jet test fixture to, for example, check print quality, drying times of the images, lightfast, waterfast values and intercolor bleed. The data was analyzed statistically for the optimum range of amounts.

[0034] In embodiments, in the image enhancing chemical composition the hydrophilic solvent is present in an amount of from about 83 to 16 parts by weight, the polymeric binder is present in an amount of from about 1 to 3 parts by weight, the dye mordant is present in an amount of from about 5 to about 50 parts by weight, the substantially water soluble paper anticurl compound is present in an amount of from about 5 to 15 parts by weight, the substantially water soluble paper desizing compound is present in an amount of from about 1 to 3 parts by weight, the lightfast compound is present in an amount of from about 2 to about 5 parts by weight, the defoamer is present in an amount of from about 1 to 3 parts by weight, the biocide is present in an amount of from about 1 to 2 parts by weight, and the filler is present in an amount of from about 1 to about 3 parts by weight. The image enhancing chemical composition comprised of (1) a polymeric binder, (2) dye mordant, waterfast compound, (3) a paper decurling compound, (4) a paper desizing compound, (5) lightfast compound, (6) defoamer, (7) filler, (8) biocide, (9) and hydrophilic solvent, such as water, has the following preferred composition range:

[1+5+5+1+2+ 1+1+1+83=100] to :[3+50+15+3+5+ 3+3+2+16=100].

[0035] More specifically, the present invention is directed to the application and coating of image enhancing chemical compositions to nonimaged substrates, such as plain papers, recycled papers, and the like, preferably prior to their printing with different marking technologies, such as ink jet, inclusive of acoustic ink jet and xerography. The present invention relates to chemical compositions comprised of a hydrophilic solvent such as water, polymeric binder, a dye mordant also known as a waterfast compound, a water soluble paper anticurl, or decurling compound, a water soluble paper desizing compound, a lightfast compound, a filler, a defoamer, a biocide and a heat shrinkable polymeric binder, and which composition can be applied to at least one substrate surface, and more specifically, to two substrate surfaces, that is the image and nonimage sides of a nonimaged ink jet paper and heat dried prior to its entering the ink jet

marking head. In aspects thereof, the chemical compositions are comprised of a mixture of (1) a low viscosity polymeric binder with a viscosity of, for example, from about 2 to about 20 cps and preferably with a viscosity of from about 5 to about 10 cps, such as a hydrocarbon wax or polyester latex, and the like; (2) a waterfast dye mordant, such as quaternary acrylic copolymer latexes like HX-42-1, HX-42-3 available from Interpolymer Corporation; (3) a paper anticurl/decurling compound including hydrophilic pantothenol (Aldrich #29,578-7), trimethylolpropane, (Aldrich #23,974-7), trimethylol propane ethoxylate, (Aldrich #41,617-7), trimethylol propane triacrylate, (Aldrich #24,680-8), trimethylolpropane tris(2-methyl-1-aziridine propionate), or (Aldrich #40,544-2), neopentyl glycol ethoxylate, (Aldrich #41,027-6); (4) a paper desizing compound including hydrophilic poly(dimethyl siloxanes), poly(alkylene glycol), the derivatives thereof, such as poly(propylene glycol dimethacrylate), poly(ethylene glycol diacrylate), or poly(propyleneoxide)-poly(ethyleneoxide) copolymers; or quaternary alkosulfate compounds; fatty imidazolines, and the like; (5) a lightfast compound, such as UV absorbing compounds, including glycerol 4-amino benzoate, Escalol 106 from Van Dyk Corporation; hexadecyl-3,5-di-tert-butyl-4-hydroxy-benzoate, Cyasorb UV-2908, #41,320-8, from Aldrich Chemical Company; (6) a defoamer alcohol compound such as behenyl alcohol, Aldol-60, stearyl alcohol, Aldol-61, and the like obtainable from Sherex Chemical Company; (7) a biocide such as 2-hydroxy propylmethane thiosulfonate (BUSAN 1005 available from Buckman Laboratories Inc.); or methylene bis(thiocyanate) (Metasol T-10 available from Calgon Corporation); (8) a filler such as hydrated alumina (Hydrad TMC-HBF, Hydrad TM-HBC, available from J.M. Huber Corporation), or barium sulfate (K.C. Blanc Fix HD80 available from Kali Chemie Corporation); and (9) a hydrophilic solvent such as water, methanol and ethanol.

[0036] The present invention is directed to creating high gloss, lightfast, waterfast color ink jet images which exhibit a high degree of scuff or abrasion resistance, and wherein a fifth developer housing containing the image enhancing chemical compositions indicated herein are provided in a color image creation apparatus, such as an acoustic ink jet, piezo-electric ink jet or thermal ink jet apparatus, normally comprising only four developer housings. The additional fifth housing contains the compositions illustrated herein, such as mixture of a hydrophilic solvent such as water, methanol, ethanol, a defoamer, such as tetramethyl decynediol and amorphous silica, Surfynol-104S, available from Air Products Company, a biocide such as cationic poly(oxyethylene (dimethylamino)-ethylene (dimethylamino) ethylene dichloride) (BUSAN 77 available from Buckman Laboratories Inc., a clear polymeric material, such as a hydrocarbon wax, a waterfast dye mordant, such as quaternary acrylic copolymer latex, a paper anticurl/decurling compound such as hydrophilic pantothenol, a paper desizing compound such as hydrophilic poly(dimethyl siloxanes), and a material which absorbs ultraviolet light (UV), such as hexadecyl-3,5-di-tert-butyl-4-hydroxy-benzoate, for minimizing color image degradation due to ultraviolet light and a filler such as hydrated alumina. The fifth or additional developer housing containing the chemical composition preferably occupies the first position in the development zone. It will be appreciated that the additional developer housing containing the chemical composition may occupy other positions, such as the last position in the development zone.

[0037] In aspects thereof, the present invention relates to a composition comprised of a solvent, preferably a hydrophilic solvent, a polymeric binder, a dye mordant, a water soluble or substantially water soluble, for example about 75 to about 95 percent solubility, paper anticurl compound, a water soluble or substantially water soluble, for example about 75 to about 95 percent solubility, paper desizing compound, a lightfastness compound, a defoamer, an optional biocide, and an optional filler; a composition wherein the polymeric binder is present in an amount of from about 1 parts by weight to about 3 parts by weight, and is selected, for example, from the group consisting of (1) a polyamide latex, (2) polyalkylene waxes, (3) a neoprene rubber latex, (4) a polyester latex, (5) a vinyl acrylic terpolymer latex, (6) an acrylic emulsion latex, (7) a styrene-butadiene latex, (8) a hydroxyethyl cellulose, (9) a vinylmethylether/maleic acid copolymer, and (10) a cationic hydroxyethyl cellulose, or other known suitable polymeric binders; the dye mordant is present in an amount of from about 5 parts by weight to about 50 parts by weight, and is selected from the group consisting of (1) monoammonium quaternary salts, (2) phosphonium quaternary salts, (3) sulfonium quaternary salts, (4) thiazolium quaternary salts, (5) pyridinium quaternary salts, (6) benzothiazolium quaternary salts and (7) polymeric acrylic quaternary latexes; said water soluble paper anticurl compound is present, for example throughout with regard to the amounts, in an amount of from about 5 parts by weight to about 15 parts by weight, and is selected from the group consisting of (1) pantothenol, (2) trimethylolpropane ethoxylate, (3) neopentyl glycol ethoxylate, (4) glycerol propoxylate-b-glycerol ethoxylate triol, (5) glycerol ethoxylate-b-glycerol propoxylate triol, (6) triethanol amine ethoxylate, (7) N-methyl diethanolamine, (8) 1,4-bis(2-hydroxyethoxy)-2-butyne), (9) 3-piperidino-1,2-propanediol, and (10) 1-4-bis(2-hydroxy ethyl) piperazine; the paper desizing compound is present in an amount of from about 1 part by weight to about 3 parts by weight, and is selected from the group consisting of (1) hydrophilic poly(dialkylsiloxanes); (2) poly(alkylene glycol); (3) poly(propylene oxide)-poly(ethylene oxide) copolymers; (4) fatty ester modified compounds of phosphate, sorbitan, glycerol, poly(ethylene glycol), sulfosuccinic acid, sulfonic acid, and alkyl amine; (5) poly(oxyalkylene) modified compounds of sorbitan esters, fatty amines, alkanol amides, castor oil, fatty acid, and fatty alcohol; (6) quaternary alkosulfate compounds; and (7) fatty imidazolines; the lightfast compound is present in an amount of from about 2 parts by weight to about 5 parts by weight, and is selected from the group consisting of (1) glycerol 4-amino benzoate; (2) 4-allyloxy-2-hydroxybenzophenone; (3) 2-(2'-hydroxy-5'-methylphenyl) benzotriazole; (4) [2,2,6,6-tetramethyl-4-piperidi-

nyl)-1,2,3,4-butane-tetra carboxylate; (5) 2-dodecyl-N-(2,2,6,6-tetramethyl-4-piperidinyl) succinimide; (6) poly[N,N-bis(2,2,6,6-tetramethyl-4-piperidinyl)-1,6-hexane diamine-co-2,4-dichloro-6-morpholino-1,3,5-triazine; (7) didodecyl-3,3'-thiodipropionate; (8) 1,6-hexamethylene-bis(3,5-di-tert-butyl-4-hydroxyhydro cinnamate; (9) 2,2,4-trimethyl-1,2-hydroquinoline; (10) bis-(1,2,3,6-tetrahydrobenzaldehyde) pentaerythritol acetal; (11) paraffin wax; and mixtures thereof; the defoamer is present in an amount of from about 1 part by weight to about 3 parts by weight and is selected from the group consisting of (1) silica filled polydimethyl siloxane; (2) erucyl erucamide; (3) polyethyleneglycol-4-dilaurate; (4) polyethylene oxide/polypropyleneoxide block copolymers; (5) tetramethyl decynediol; (6) polyethylene glycol-2-oleammonium chloride; (7) octadecyl diethanol methyl ammonium chloride; (8) tributyl phosphate; (9) sulfonated oleic acid sodium salt; and (10) alcohol-ethoxylate-phosphate-ester acid; and the biocide is present in an amount of from about 1 part by weight to about 2 parts by weight, and is selected from the group consisting of (1) 2-hydroxy propyl methane thiosulfonate; (2) 2-(thiocyano methylthio) benzothiazole; (3) methylene bis(thiocyanate); (4) 2-bromo-4'-hydroxyacetophenone; (5) 3,5-dimethyl tetrahydro-2H-1,3,5-thiadiazine-2-thione; (6) potassium N-hydroxymethyl-N-methyl-dithio carbamate; (7) an anionic blend of methylene bis-thiocyanate (33 parts by weight), sodium dimethyl-dithiocarbamate (33 parts by weight), and sodium ethylene bisdithio carbamate (33 parts by weight); (8) cationic poly(oxyethylene(dimethylamino)-ethylene (dimethylamino) ethylene dichloride); (9) a cationic blend of methylene bisthiocyanate and dodecyl guanidine hydrochloride); and (10) a cationic blend of a sulfone, bis(trichloromethyl) sulfone and a quaternary ammonium chloride; a process comprising applying to a substrate a composition comprised of a hydrophilic solvent, a polymeric binder, a dye mordant, a water soluble paper anticurl compound, a water soluble paper desizing compound, a lightfast compound, a defoamer, an optional biocide, and an optional filler; a process wherein said applying is from a channel containing a nozzle and followed by jetting in a predetermined pattern on the image receiving side of said substrate an aqueous ink from an ink jet head; a process wherein the substrate is coated, and which coated substrate is selected for ink jet printing, and wherein the channel with said nozzle has an acoustic beam about opposite the nozzle openings, and which beam generates pressure pulses for jetting said composition in an amount of from about 0.1 to about 2 milliliters on the image receiving substrate side; a process wherein the channel with the nozzle has a heat generating resistor opposite the ink jet head nozzle openings to generate pressure pulses for jetting the chemical composition in an amount of from about 0.5 to about 3 milliliters on the image receiving side of the substrate, and wherein the resulting developed images possess a high optical density of about 1.65 for black, about 1.55 for cyan, about 1.35 for magenta, and about 1.25 for yellow, flat curl values of within ±1.0 millimeter of 5 millimeters, and waterfast values of about 95 percent for black, about 94 percent for cyan, about 85 percent for magenta, and about 82 percent for yellow; and lightfast values of about 100 percent for black, about 98 percent for cyan, about 96 percent for magenta, and about 90 percent for yellow; a process wherein the channel with the nozzle has a piezoelectric transducer about opposite the ink jet head nozzle openings to generate pressure pulses for jetting the composition in an amount of from about 0.5 to about 5 milliliters on the image receiving side; a process wherein the channel with the nozzle contains a water pump attached to the nozzle, and which pump is in position opposite the nozzle ink jet head openings to generate pressure pulses for jetting the composition in an amount of from about 0.5 to about 50 milliliters on each side of the substrate, and thereafter drying the substrate at about 80 to about 100°C between a pair of pressure rolls at pressures of about 75 to about 125 psi; a process wherein the composition is an image enhancing composition, and wherein the polymeric binder is present in an amount of from about 1 part by weight to about 3 parts by weight, the dye mordant is present in an amount of from about 5 parts by weight to about 50 parts by weight, the water soluble paper anticurl compound is present in an amount of from about 5 parts by weight to about 15 parts by weight, the water soluble paper desizing compound is present in an amount of from about 1 part by weight to about 3 parts by weight, the lightfast compound is present in an amount of from about 2 parts by weight to about 5 parts by weight, the defoamer is present in an amount of from about 1 part by weight to about 3 parts by weight, the biocide is present in an amount of from about 1 part by weight to about 2 parts by weight, the filler is present in an amount of from about 1 part by weight to about 3 parts by weight, and the hydrophilic solvent is water present in an amount of from about 83 parts by weight to about 16 parts by weight, and wherein the total of all of the components of the composition is about 100 pads; a process wherein the polymeric binder is optionally present in an amount of from about 1 part by weight to about 3 parts by weight, and is selected from the group consisting of (1) polyamide latex, (2) polyalkylene wax, (3) neoprene rubber latex, (4) polyester latex, (5) vinyl acrylic terpolymer latex, (6) acrylic emulsion latex, (7) styrene-butadiene latex, (8) hydroxyethyl cellulose, (9) vinylmethylether/maleic acid copolymer, and (10) cationic hydroxyethyl cellulose; a process wherein the polymeric binder is a neoprene rubber latex, or a polyester latex; a process wherein the dye mordant is optionally present in an amount of from about 5 parts by weight to about 50 parts by weight, and is selected from the group consisting of (1) monoammonium quaternary salts, (2) phosphonium quaternary salts, (3) sulfonium quaternary salts, (4) thiazolium quaternary salts, (5) pyridinium quaternary salts, (6) benzothiazolium quaternary salts and (7) polymeric acrylic quaternary latexes; a process wherein the dye mordant is an acrylic copolymer latex, or the quaternary monoammonium salt myristyl trimethyl ammonium bromide; a process wherein the anticurl paper compound is optionally present in an amount of from about 5 parts by weight to about 15 parts by weight, and is selected from the group consisting of (1) pantothenol, (2) trimethylolpropane ethoxylate, (3) neopentyl glycol ethoxylate, (4) glycerol propoxy-

late-b-glycerol ethoxylate triol, (5) glycerol ethoxylate-b-glycerol propoxylate triol, (6) triethanol amine ethoxylate, (7) N-methyl diethanolamine, (8) 1,4-bis(2-hydroxyethoxy)-2-butyne, (9) 3-piperidino-1,2-propanediol, and (10) 1-4-bis(2-hydroxy ethyl) piperazine; a process wherein the anticurl paper compound is pantothenol or 1,4-bis(2-hydroxyethoxy)-2-butyne; a process wherein the paper desizing compound is present in an amount of from about 1 part by weight to about 3 parts by weight, and is selected from the group consisting of (1) hydrophilic poly(dialkylsiloxanes); (2) poly(alkylene glycol); (3) poly(propylene oxide)-poly(ethylene oxide) copolymers; (4) fatty ester modified compounds of phosphate, sorbitan, glycerol, poly(ethylene glycol), sulfosuccinic acid, sulfonic acid, and alkyl amine; (5) poly(oxyalkylene) modified compounds of sorbitan esters, fatty amines, alkanol amides, castor oil, fatty acid, and fatty alcohol; (6) quaternary alkosulfate compounds; and (7) fatty imidazolines; a process wherein the paper desizing compound is poly(propylene glycol), or a poly(dimethylsiloxane)-b-poly(propyleneoxide)-b-poly(ethyleneoxide)copolymer; a process wherein the lightfast compound is optionally present in an amount of from about 2 parts by weight to about 5 parts by weight, and is selected from the group consisting of (1) glycerol 4-amino benzoate; (2) 4-allyloxy-2-hydroxybenzophenone; (3) 2-(2'-hydroxy-5'-methylphenyl)benzotriazole; (4) [2,2,6,6-tetramethyl-4-piperidinyl)-1,2,3,4-butane-tetra carboxylate; (5) 2-dodecyl-N-(2,2,6,6-tetramethyl-4-piperidinyl) succinimide; (6) poly[N,N-bis(2,2,6,6-tetramethyl-4-piperidinyl)-1,6-hexanediamine-co-2,4-dichloro-6-morpholino-1,3,5-triazine; (7) didodecyl-3,3'-thiodipropionate; (8) 1,6-hexamethylene-bis(3,5-di-tert-butyl-4-hydroxyhydro cinnamate; (9) 2,2,4-trimethyl-1,2-hydroquinoline; (10) bis-(1,2,3,6-tetrahydrobenzaldehyde) pentaerythritol acetal; and (11) paraffin wax; a process wherein the lightfast compound is poly[N,N-bis(2,2,6,6-tetramethyl-4-piperidinyl)-1,6-hexane diamine-co-2,4-dichloro-6-morpholino-1,3,5-triazine), or 2-dodecyl-N-(2,2,6,6-tetramethyl-4-piperidinyl) succinimide; a process wherein the defoamer is optionally present in an amount of from about 1 part by weight to about 3 parts by weight and is selected from the group consisting of (1) silica filled polydimethyl siloxane; (2) erucyl erucamide; (3) polyethyleneglycol.-4-dilaurate; (4) polyethylene oxide/polypropyleneoxide block copolymers; (5) tetramethyl decynediol; (6) polyethylene glycol-2-oleammonium chloride; (7) octadecyl diethanol methyl ammonium chloride; (8) tributyl phosphate; (9) sulfonated oleic acid sodium salt; and (10) alcohol-ethoxylate-phosphate-ester acid; a process wherein the defoamer is tetramethyl decynediol, or polyethylene glycol-2-oleammonium chloride; a process wherein the biocide is optionally present in an amount of from about 1 part by weight to about 2 parts by weight and is selected from the group consisting of (1) 2-hydroxy propyl methane thio sulfonate; (2) 2-(thiocyanomethylthio) benzothiazole; (3) methylene bis(thiocyanate); (4) 2-bromo-4'-hydroxyacetophenone; (5) 3,5-dimethyl tetrahydro-2H-1,3,5-thiadiazine-2-thione; (6) potassium N-hydroxy methyl-N-methyldithiocarbamate; (7) an anionic blend of methylene bis-thiocyanate (33 parts by weight), sodium dimethyl-dithiocarbamate (33 parts by weight), and sodium ethylene bisdithio carbamate (33 parts by weight); (8) cationic poly(oxyethylene(dimethylamino)-ethylene(dimethylamino)ethylene
dichloride); (9) a cationic blend of methylene bisthiocyanate and dodecyl guanidine hydrochloride; (10) a cationic blend of a sulfone, bis(trichloromethyl) sulfone and a quaternary ammonium chloride; a process wherein the biocide is a cationic blend of methylene bisthiocyanate and dodecyl guanidine hydrochloride, or a cationic blend of a sulfone of bis(trichloromethyl) sulfone and a quaternary ammonium chloride; a process wherein the filler is optionally present in an amount of from about 1 to about 3 parts by weight, and is selected from the group consisting of (1) colloidal silica, (2) titanium dioxide, (3) calcium carbonate, (4) a blend of calcium fluoride and silica, (5) zinc oxide, and (6) a blend of zinc sulfide with barium sulfate; a process wherein the filler is calcium carbonate or colloidal silica; a process wherein the hydrophilic solvent is water, methanol or ethanol, and which solvent is present in an amount of from about 16 parts by weight to about 83 parts by weight; a process wherein there is selected an image enhancing chemical composition comprised of a blend of about 25 parts by weight of the hydrophilic solvent water, 3 parts by weight of a heat shrinkable binder rubber latex neoprene, or a polyester latex; about 49 parts by weight of a dye mordant quaternary acrylic copolymer latex, or quaternary monoammonium salt myristyl trimethyl ammonium bromide; about 15 parts by weight of the water soluble paper anticurl compound pantothenol, or 1,4-bis(2-hydroxyethoxy)-2-butyne; about 3 parts by weight of the water soluble/dispersible paper desizing compound poly(propylene glycol) or a poly(dimethyl siloxane)-b-poly(propyleneoxide)-b-poly(ethyleneoxide) copolymer; about 3 parts by weight of a lightfast compound poly[N,N-bis(2,2,6,6-tetramethyl-4-piperidinyl)-1,6-hexane diamine-co-2,4-dichloro-6-morpholino-1,3,5-triazine), or 2-dodecyl-N-(2,2,6,6-tetramethyl-4-piperidinyl) succinimide; about 1 part by weight of defoamer tetramethyl decynediol or polyethylene glycol-2-oleammonium chloride; about 1 part by weight of a biocide comprised of a cationic blend of methylene bisthiocyanate and dodecyl guanidine hydrochloride, or a cationic blend of a sulfone of bis(trichloromethyl) sulfone and a quaternary ammonium chloride; about 3 parts by weight of a filler calcium carbonate or colloidal silica, wherein the total of all of the components is about 100 parts; and wherein the images generated with the composition possess an optical density of 1.65 (black),1.55 (cyan),1.35 (magenta),1.25 (yellow); flat curl values of within ±1.0 millimeter of 5 millimeters; waterfast values of 95 percent (black), 94 percent (cyan), 85 percent (magenta), and 82 percent (yellow); and lightfast values of 100 percent (black), 98 percent (cyan), 96 percent (magenta), and 90 percent (yellow); a process wherein the substrate is selected from the group consisting of (1) polyethylene terephthalate, (2) polyethylene naphthalates, (3) polycarbonates, (4) polysulfones, (5) polyether sulfones, (6) poly(arylene sulfones), (7) cellulose triacetate, (8) polyvinyl chloride, (9) cellophane, (10) polyvinyl fluoride, (11) polypropylene, (12) polyimides, and (13) paper; a process wherein

the substrate is polyethylene terephthalate, polypropylene, or paper; an ink jet process wherein images formed on a substrate are developed with an ink jet composition, and there is applied to the substrate prior to development a composition comprised of a hydrophilic solvent, a polymeric binder, a dye mordant, a water soluble paper anticurl compound, a water soluble paper desizing compound, a lightfast compound, a defoamer, a biocide, and a filler; a process wherein the image enhancing composition forms a coating on the substrate; a process wherein the substrate is paper; and a process wherein the coating is of a thickness of from about 0.0001 to about 5 microns; a substrate with a coating thereover comprised of a hydrophilic solvent, a polymeric binder, a dye mordant, a water soluble paper anticurl compound, a water soluble paper desizing compound, a lightfast compound, a defoamer, an optional biocide, and an optional.

[0038] The type of paper, for example, whether the paper is coated, recycled, plain paper, highly calendered paper, and the like, used in ink jet imaging process is very important in obtaining the desired quality of images. A typical plain paper is generally comprised of blends of hard wood, such as hardwood kraft, and softwood, such as softwood kraft fibers which blends contain, for example, from about 10 percent to 90 parts by weight of softwood, and from about 90 to about 10 parts by weight of hardwood. Examples of hardwood include Seagull W dry bleached hardwood kraft preferably present, for example, in some cases in an amount of 70 parts by weight. Examples of softwood include La Tuque dry bleached softwood kraft present, for example, in some cases in an amount of 30 parts by weight. In forming paper, the wood fibers are dispersed in dilute aqueous slurry, which is wet laid as a mat or web onto the screen of a conventional Fourdrinier-type machine. After the web has been dewatered, it is dried to a predetermined moisture level upstream of the size press. These plain papers may also contain fillers and pigments in effective amounts of, for example, from about 1 to about 60 parts by weight, such as clay (available from Georgia Kaolin Company, Astro-fil 90 clay, Engelhard Ansilex clay), titanium dioxide (available from Tioxide Company as Anatase grade AHR), calcium silicate CH-427-97-8, XP-974 (J.M. Huber Corporation), and the like. Also, the plain paper may contain various effective amounts of sizing chemicals (for example from about 0.25 percent to about 25 parts by weight of pulp), such as Mon size (available from Monsanto Company), Hercon-76 (available from Hercules Company), Alum (available from Allied Chemicals as Iron free alum), and retention aids, like those available from Allied Colloids as Percol 292.

[0039] With the present invention, there are provided treated papers, that is for example substrates, such as papers, and wherein the image quality is enhanced by the chemical compositions illustrated herein, and that can be applied to at least one surface of a paper prior to printing. The polymeric binder of the chemical composition can be heat shrinkable and this assists in reducing curl during the heating and calandering step as determined, for example, by holding the paper with the thumb and forefinger in the middle of one of the long edges of the sheet (for example, in the middle of one of the 11 inch edges in an 8.5 by 11 inch sheet), and the arc formed by the sheet is matched against a predrawn standard template curve, for example template curves showing from about 5 millimeters to about 200 millimeters of curl. The anticurl compounds of the chemical composition, which, for example, coat the paper fibers during remoisturization of paper almost instantaneously, render them substantially insensitive to moisture imbalance from the back and front side. The desizing compound, or agent of the chemical composition, such as alkylene oxide-b-dimethyl siloxane copolymer, quaternary alkosulfate compounds, and the like penetrate into the paper, lift the internal sizing from the fibers and rearrange the sizing material in the bulk of the paper thereby counterbalancing the changes in the mechanical properties of paper, such as paper stiffness caused by the remoisturization process. The dye mordant interacts with the dye and immobilizes the dye on the surface of paper; the lightfast compound protects images from degradation due to light, oxygen and ozone; the defoamer prevents the formation of foam in the chemical composition while its being applied on to paper; the biocide prevents the formation of fungus or slime while it is being stored in the reservoir, thermal ink jet head or acoustic ink jet head; and the filler fills the pores of the paper keeping inks from penetrating deep into paper.

[0040] The chemical compositions can be applied to at least one surface of a paper from a reservoir using a spray nozzle and passing the paper through two heated pressure rolls. In embodiments, the chemical composition can be applied to at least one surface of an ink jet paper using an additional ink jet head assemble comprised of piezoelectric ink jet heads, thermal ink jet heads and acoustic ink jet heads prior to the paper entering the printing engine. The chemical compositions applied can be comprised of a mixture or blend of (1) a polymeric binder, such as a wax, polyester latex, or other similar compound, such as gelatin; (2) a dye mordant, such as quaternary acrylic copolymer latexes such as HX-42-1, HX-42-3, available from Interpolymer Corporation; ammonium quaternary salts as disclosed in U.S. Patent 5,320,902, the disclosure of which is totally incorporated herein by reference; (3) a paper anticurl/decurling compound including hydrophilic pantothenol (Aldrich #29,578-7), trimethylolpropane (Aldrich #23,974-7), trimethylolpropane ethoxylate (Aldrich #40,977-4; Aldrich #40,978-2; Aldrich #41,616-9; Aldrich #41,617-7), trimethylolpropane triacrylate (Aldrich #24,680-8), trimethylolpropane trimethacrylate (Aldrich #24,684-0), trimethylolpropane ethoxylate triacrylate (Aldrich #41,217-1; #41,219-8), trimethylolpropane propoxylate triacrylate (Aldrich #40,756-9; #40,757-7), trimethylolpropane ethoxylate methylether diacrylate (Aldrich #40,587-1), trimethylolpropane tris(2-methyl-1-aziridine propionate) (Aldrich #40,544-2), or neopentyl glycol ethoxylate (Aldrich #41,027-6), (4) paper desizing compounds, including hydrophilic poly(dimethyl siloxanes); poly(alkylene glycol), the derivatives thereof, poly(propylene oxide), poly(ethylene oxide) copolymers; fatty ester modified compounds of phosphate, sorbitan, glycerol, poly(ethylene glycol), sulfosuccinic

acid, sulfonic acid, alkyl amine; poly(oxyalkylene) modified compounds of sorbitan esters, fatty amines, castor oil, fatty acid, fatty alcohol; quaternary alkosulfate compounds; or fatty imidazolines, (5) a lightfast or lightfastness compound, such as UV absorbing compounds including glycerol 4-amino benzoate, Escalol 106 from Van Dyk Corporation; resorcinol monobenzoate, RBM from Eastman Chemicals; octyl dimethyl amino benzoate, Escalol 507 from Van Dyk Corporation; or hexadecyl-3,5-di-tert-butyl-4-hydroxybenzoate, Cyasorb UV-2908, #41,320-8, from Aldrich Chemical Company; (6) a defoamer such as alcohol compounds, such as behenyl alcohol, Aldol-60, stearyl alcohol, Aldol-61, isostearyl alcohol, Aldol-66, oleyl alcohol, Aldol-85, cetearyl alcohol, Aldol-640, from Sherex Chemical Company, dimethyl octynediol, Surfynol-82, dimethyl octynediol on silica, Surfynol-82S, tetramethyl decynediol, Surfynol-104, tetramethyl decynediol and 2-ethylhexanol, Surfynol-104A, tetramethyl decynediol and 2-butoxy ethanol, Surfynol-104BC, tetramethyl decynediol and 2-ethylene glycol, Surfynol-104E, tetramethyl decynediol and amorphous silica, Surfynol-104S, tetramethyl decynediol ethoxylated, Surfynol-440, acetylenic glycol, Surfynol-PC, acetylenic diol, or Surfynol-SE, all being available from Air Products Company; (7) a biocide such as 2-hydroxy propyl methane thiosulfonate (BUSAN 1005 available from Buckman Laboratories Inc.); 2-(thio cyanomethyl thio) benzothiazole (BUSAN 30WB, 72WB, available from Buckman Laboratories Inc.); or methylene bis(thiocyanate) (Metasol T-10 available from Calgon Corporation; (8) a filler such as hydrated alumina (Hydrad TMC-HBF, Hydrad TM-HBC, available from J. M. Huber Corporation), barium sulfate (KC. Blanc Fix HD80 available from Kali Chemie Corporation), calcium carbonate (Microwhite Sylacauga Calcium Products), high brightness clays (such as Engelhard Paper Clays), calcium silicate (available from J.M. Huber Corporation; and (9) a hydrophilic solvent such as water, methanol and ethanol.

[0041] The image enhancing chemical compositions can be applied onto the substrates, such as pape,r in a manner similar to that described in U.S. Patent 5,434,029, the disclosure of which is totally incorporated herein by reference.

[0042] A pair of rollers similar to a fuser, operating at significantly lower load and temperature are utilized for curl prevention during the fluid application and drying process. The roll that contacts the back side of the paper has a chemical composition applicator sump [pool of chemical composition] used in a manner similar to a donor roll RAM (Release Agent Management) system in roll fusers such as that shown in U.S. Patent 4,254,732, the disclosure of which is totally incorporated herein by reference. A metering blade controls the amount of chemical composition applied to the backside of the copy. The amount of this chemical composition present in equiamounts on each side of paper varies, for example, from about 50 to about 100 milligrams and preferably from about 20 to about 50 milligrams and more preferably from about 5 to about 20 milligrams. In addition to application of chemical composition to the back side of the copy substrate, the fluid applying roll cooperates with the other roller to constrain the substrate while it is absorbing the chemical composition. Thus, the chemical composition can be applied to the substrate by the pressure of the pair of rollers and dried at the same time. The chemical composition can also be applied to the substrate through a channel having a nozzle that has a water pump near the other end to produce pressure pulses for jetting the chemical composition, in an amount of from about 0.5 to about 50 milliliters on each side of the substrate and drying the substrate at 80°C to about 100°C through a pair of pressure rolls at pressures of between 75 to 125 psi. The image enhancing chemical compositions can also be applied onto the substrate such as paper via additional jets such as from one to ten additional jets, where the mechanism of fluid jetting is controlled by either a piezoelectric transducer, a thermal ink jet or an acoustic ink jet mechanism. This stream of droplets is desirably directed onto the surface of a paper of the present invention, which stream is controlled to permit application of coatings in all or only in the desired areas. One example of this partial paper treatment for image enhancement via additional jets is in coating specific areas where cyan and magenta inks are to be printed.

[0043] Examples of substrates to be coated include papers, polyesters, including MYLAR®, polyethylene terephthalate available from E.I. Du Pont de Nemours & Company, MELINEX®, polyethylene terephthalate available from Imperial Chemicals, Inc., CELANAR®, polyethylene terephthalate available from Celanese Corporation, polyethylene naphthalates, such as Kaladex PEN films, available from Imperial Chemical Industries, polycarbonates, such as LEXAN®, available from General Electric Company, polysulfones, such as those available from Union Carbide Corporation, polyether sulfones, UDEL®, available from Union Carbide Corporation, polyether sulfones, VICTREX®, available from ICI Americas Incorporated, poly(arylene sulfones), cellulose triacetate, polyvinylchloride, cellophane, polyvinyl fluoride, polyimides, and the like, with polyester, such as MYLAR®, being preferred in view of its availability and relatively low cost. The substrate can also be opaque, including opaque MYLARS®, which are barium sulfate and titanium dioxide filled polyethylene terephthalate, such as TESLIN®, which is filled polypropylene with micro voids available from PPG Industries. Filled plastics can also be employed as the substrate, particularly when it is desired to prepare a nevertear paper recording sheet.

[0044] Illustrative examples of commercially available, internally and externally (surface) sized papers that may be treated with the image enhancing chemical composition, and with a thickness of, for example, from about 50 microns to about 200 microns and preferably of a thickness of from about 100 microns to about 125 microns include Diazo papers, offset papers such as Great Lakes offset, recycled papers such as Conservatree, office papers such as Automimeo, Eddy liquid toner paper and copy papers from companies such as Nekoosa, Champion, Wiggins Teape, Kymmene, Modo, Domtar, and Veitsiluoto.

[0045] Specific examples of binder polymers present in an amount of, for example, from about 0.1 part by weight to about 4 parts by weight, and preferably from about 1 to about 3 parts by weight of the image enhancing chemical compositions within which a decurling compound can be dispersed or admixed, include latex polymers, (polymers capable of forming a latex is a polymer that forms in water or in an organic solvent a stable colloidal system in which the disperse phase is polymeric), and water soluble polymers such as those described in U.S. Patent 5,624,743, the disclosure of which is totally incorporated herein by reference.

[0046] Preferred binders polymers present in an amount of, for example, from about 0.1 part by weight to about 4 parts by weight, and preferably from about 1 to about 3 parts by weight of the image enhancing chemical compositions include (1) polyamide latex such as PIOMIDE, available from Pioneer Plastics; (2) polyalkylene waxes, such as paraffin wax emulsions Paracol 404C, 404G, 804A, available from Hercules Incorporated; (3) rubber latex, such as neoprene available from Serva Biochemicals; (4) polyester latex, such as Eastman AQ 29D available from Eastman Chemical Company; (5) vinyl acrylic terpolymer latex, such as 76 RES 3103 from Union Oil Chemical Division; (6) acrylic emulsion latex, such as Rhoplex B-15J, Rhoplex P-376; (7) styrene-butadiene latexes such as 76 RES 4100 and 76 RES 8100 available from Union Oil Chemicals Division; (8) hydroxyethyl cellulose (Natrosol 250LR, Hercules Chemical Company); (9) vinylmethylether/maleic acid copolymer (Gantrez S-95, GAF Corporation); and (10) cationic hydroxyethyl cellulose (Polymer JR-125, polyquaternium-10, Amerchol; cationic Cellosize, Union Carbide).

[0047] Suitable cationic dye mordant compounds are diamino alkanes; quaternary salts; quaternary acrylic copolymer latexes, such as HX-42-1, HX-42-3, available from Interpolymer Corporation; ammonium quaternary salts as disclosed in U.S. Patent 5,320,902, the dislosure of which is totally incorporated herein by reference; phosphonium quaternary salts; and sulfonium, thiazolium and benzothiazolium quaternary salts as disclosed in U.S. Patent 5,314,747, the disclosure of which is totally incorporated herein by reference. The three preferred quaternary dye compounds include (1) quaternary acrylic copolymer HX-42-3, available from Interpolymer Corporation; (2) monoammonium salt myristyl trimethyl ammonium bromide (Aldrich #86,042-5); and (3) monoammonium salt didecyldimethylammonium bromide (Aldrich #38,231-0).

[0048] Specific examples of anticurl/decurling compounds that can be selected for the image enhancing chemical composition treatment or coating on a single side, or both sides thereof of papers are described in copending application US. Serial No. 603,516, the disclosure of which is totally incorporated herein by reference. Examples of decurling compounds are pantothenol (Aldrich #29,578-7); (2) trimethylolpropane ethoxylate, (Aldrich #40,977-4; Aldrich #40,978-2; Aldrich #41,616-9; Aldrich #41,617-7), trimethylol propanetriacrylate, (Aldrich #24,680-8), trimethylolpropane-trimethacrylate (Aldrich #24,684-0), trimethylol propane ethoxylate triacrylate (Aldrich #41,217-1; #41,219-8) trimethylol propane propoxylate triacrylate (Aldrich #40,756-9; #40,757-7), trimethylolpropane ethoxylate methylether diacrylate (Aldrich #40,587-1), trimethylolpropane tris(2-methyl-1-aziridinepropionate) (Aldrich #40,544-2), neopentyl glycol ethoxylate (Aldrich #41,027-6), neopentyl glycol propoxylate (Aldrich #40,987-1; Aldrich #41,214-7), glycerol propoxylate (Aldrich #37,389-3; Aldrich #37,390-7; Aldrich #37,391-5; Aldrich #37,392-3; Aldrich #37,396-6; Aldrich #41,028-4), block copolymers of glycerol propoxylate with glycerol ethoxylate represented by glycerol propoxylate-b-glycerol ethoxylate, such as glycerol propoxylate-b-glycerol ethoxylate triol (Aldrich #37,386-9; Aldrich #37,387-7; Aldrich #37,388-5), glycerol ethoxylate-b-glycerol propoxylate triol (Aldrich #40,918-9), pentaerythritol ethoxylate (Aldrich #41,615-0; #41,873-0), pentaerythritol propoxylate (Aldrich #41,874-9; #41,875-7), pentaerythritol propoxylate/ethoxylate (Aldrich #42,502-8), triethanol amine ethoxylate (Aldrich #41,658-4), N-methyl diethanolamine (Aldrich #M4,220-3), N-ethyl diethanolamine (Aldrich #11,206-2), N-butyl diethanolamine (Aldrich #12,425-7), N-phenyl diethanolamine (Aldrich #P2,240-0), triethanol amine (Aldrich #T5,830-0), trioctylamine (Aldrich #T8,100-0), 4-xylylene diamine (Aldrich #27,963-3), 1,4-bis(2-hydroxyethoxy)-2-butyne (Aldrich #B4,470-8), 1-phenyl-1,2-ethanediol (Aldrich #30,215-5; #P2,405-5), 3-methoxy-1,2-propanediol (Aldrich #26,040-1), 3-allyloxy-1,2-propanediol (Aldrich #25,173-9), 3-ethoxy-1,2-propanediol (Aldrich #26,042-8), 3-phenoxy-1,2-propanediol (Aldrich #25,781-8), 3-octadecyloxy-1,2-propanediol (Aldrich #B40-2), 3-(4-methoxy phenoxy)-1,2-propanediol (Aldrich #21,024-2), mephensin[3-(2-methyl phenoxy)-1,2-propanediol] (Aldrich #28,656-7), 3-(diethylamino)-1,2-propanediol (Aldrich #21,849-9), 2-phenyl-1,2-propanediol (Aldrich #21,376-4), 3-amino-1,2-propanediol (Aldrich #A7,600-1), 3-(diisopropylamino)-1,2-propanediol (Aldrich #25,766-4), 3-(N-benzyl-N-methylamino)-1,2-propanediol (Aldrich #21,850-2), 3-pyrrolidino-1,2-propanediol (Aldrich #21,851-0), 3-piperidino-1,2-propanediol (Aldrich #21,849-9), 3-morpholino-1,2-propanediol (Aldrich #21,848-0), 2,2-dimethyl-1-phenyl-1,3-propanediol (Aldrich #40,873-5), 2-benzyloxy-1,3-propanediol (Aldrich #36,744-3), 4-8-bis(hydroxymethyl) tricyclo [5.2.1.02.6]decane (Aldrich #B4,590-9), 1-[N,N-bis(2-hydroxyethyl)isopropanol amine (Aldrich #23,375-7), N,N-bis(2-hydroxypropyl)ethanolamine (Karl Industries), 1-[2-(2-hydroxyethoxy)ethyl]-piperazine (Aldrich #33,126-0), 1-4-bis(2-hydroxy ethyl)piperazine (Aldrich #B4,540-2), homovanillyl alcohol (Aldrich #14,883-0), phenethyl alcohol (Aldrich #P1,360-6), 3,6-dimethyl-4-octyne-3,6-diol (Aldrich #27,840-8), 2-(hydroxymethyl)-1,3-propanediol (Aldrich #39,365-7), 2-butyl-2-ethyl-1,3-propanediol (Aldrich #14,247-6), 2-piperidine methanol (Aldrich #15,522-5), 2,2,4-trimethyl-1,3-pentanediol (Aldrich #32,722-0), Vitamin E (Aldrich #25,802-4), Vitamin E acetate (Aldrich #24,817-7), Vitamin K (Aldrich #28,740-7), tri(ethylene glycol)dimethylacrylate (Aldrich #26,154-8), triethyl citrate (Aldrich #10,929-0) 2,4,7,9-tetramethyl-5-decyne-4,7-diol (Aldrich #27,838-8); and mixtures thereof.

[0049] The preferred water soluble paper anticurl compounds are (1) pantothenol (Aldrich #29,578-7); (2) trimethylolpropane ethoxylate, (Aldrich #40,977-4; Aldrich #40,978-2; Aldrich #41,616-9; Aldrich #41,617-7); (3) neopentyl glycol ethoxylate (Aldrich #41,027-6); (4) glycerol propoxylate-b-glycerol ethoxylate triol (Aldrich #37,386-9; Aldrich #37,387-7; Aldrich #37,388-5); (5) glycerol ethoxylate-b-glycerol propoxylate triol (Aldrich #40,918-9); (6) triethanol amine ethoxylate (Aldrich #41,658-4); (7) N-methyl diethanolamine (Aldrich #M4,220-3); (8) 1,4-bis(2-hydroxyethoxy)-2-butyne (Aldrich #B4,470-8); (9) 3-piperidino-1,2-propanediol (Aldrich #21,849-9); (10) 1-4-bis(2-hydroxy ethyl)piperazine (Aldrich #B4,540-2); and mixtures thereof.

[0050] Specific examples of water soluble desizing compounds that can be selected for the composition treatment or coating on a single side, or both sides thereof of papers include paper desizing compounds, such as those described in U.S. Patent 5,211,747 and U.S. Patent 5,302,249, the disclosures of which are totally incorporated herein by reference. The preferred desizing compounds include (1) poly(dimethyl siloxane) carbinol terminated (PS555, PS556, PS558, Petrarch Systems Inc.); (2) poly(dimethyl siloxane)-b-poly(methyl siloxane alkylene oxide) copolymers (PS073, PS072, PS071, Petrarch Systems Inc.), Alkasil HEP 182-280, Alkasil HEP 148-330, Alkaril Chemicals, nonhydrolyzable copolymers containing S1-C linkages; (3) poly(dimethyl siloxane)-b-poly(propylene oxide)-b-poly(ethylene oxide) copolymers (Alkasil NEP 73-70, Alkaril Chemicals), hydrolyzable copolymer containing S1-O-C linkages; (4) polyquaternary poly(dimethyl siloxane) copolymers (which can be obtained by the addition reaction of α,ω-hydrogen polysiloxane with epoxides containing olefinic bonds and then reacting the product with a diamine); (5) poly(propylene glycol) (Alkapol PPG-425, Alkapol PPG-4000, Alkaril Chemicals); (6) fatty ester modifications of phosphates (Alkaphos B6-56A, Alkaril Chemicals; (7) sorbitan esters (Alkamuls PSML-4 [poly(oxyethylene) sorbitan monolaurate], Alkamuls PSMO-20 [poly(oxyethylene) sorbitan monooleate], Alkamuls PSTO-20 [poly(oxyethylene)sorbitan trioleate], Alkaril Chemicals); (8) [nonyl phenol ethoxylates], Alkasurf NP-1, NP-11; (9) nonpolymeric quaternary ammonium ethosulfate (Finquat CT, Cordex AT-172, Finetex Corporation); (10) fatty imidazolines and their derivatives, such as Alkazine-O [oleic derivative]; and the like.

[0051] A number of the paper anticurl/decurling compounds and paper desizing compounds can also act as antifoaming agents for the image enhancing chemical compositions.

[0052] In addition, the image enhancing chemical composition contains lightfastness compounds present, for example, in an amount of from about 0.1 part by weight to about 7 parts by weight, and preferably from about 2 parts by weight to about 5 parts by weight, such as those described in U.S. Patent 5,612,777 and U.S. Patent 5,624,743, the disclosures of which are totally incorporated herein by reference.

[0053] The preferred lightfastness compounds are (1) glycerol 4-amino benzoate, Escalol 106, from Van Dyk Corporation; (2) 4-allyloxy-2-hydroxy benzophenone, Uvinul 600, #41,583-9, Aldrich Chemicals; (3) 2-(2'-hydroxy-5'-methylphenyl) benzotriazole, Tinuvin 900 from Ciba Geigy Corporation; (3) [2,2,6,6-tetramethyl-4-piperidinyl)-1,2,3,4-butanetetracarboxylate, Mixxim HALS 57 Fairmount Corporation; (4) 2-dodecyl-N-(2,2,6,6-tetramethyl-4-piperidinyl) succinimide, Cyasorb UV-3581, #41,317-8, Aldrich Chemical Company; (5) poly[N,N-bis(2,2,6,6-tetramethyl-4-piperidinyl)-1,6-hexane diamine-co-2,4-dichloro-6-morpholino-1,3,5-triazine), Cyasorb UV-3346, #41,324-0, Aldrich Chemical Company; (6) didodecyl 3,3'-thiodipropionate, Cyanox, LTDP, #D12,840-6, from Aldrich Chemical Company; (7) 1,6-hexamethylene-bis(3,5-di-tert-butyl-4-hydroxyhydrocinnamate), Irganox 259, Ciba-Geigy Corporation; (8) 2,2,4-trimethyl-1,2-hydroquinoline, Vulkanox-HS, Mobay Corporation, (9) bis-(1,2,3,6-tetrahydrobenzaldehyde) pentaerythritol acetal, Vulkazon AFS/LG, from Mobay Corporation; (10) Paraffin Wax, Petrolite C-700, Petrolite C-1035, from Petrolite Corporation; and mixtures thereof.

[0054] Specific examples of defoamers, or antifoaming agents present in an amount of from about 0.1 to about 3 parts by weight and preferrably from about 1 to about 3 parts by weight that can be selected for the image enhancing chemical composition treatment or coating on a single side, or both sides thereof of papers include (A) nonionic compounds, such as (a) silicone containing compounds such as polydimethyl siloxane, Akrochem SWS-201 Akrochem Chemicals; silica filled polydimethyl siloxane, Sag Silicone Antifoam-100 from Union Carbide Chemical Company; silicone/polyalkylene glycol, Sag Silicone Antifoam-100 from Union Carbide Chemical Company; silicone glycol, Masil-2132, -2133, -2134, from PPG-Mazer; (b) amide containing compounds, such as erucylerucamide, Kenamide-E-221, erucylstearamide, Kenamide-S-221; ethylenedioleamide, Kenamide-W-20; ethylenedistearamide, Kenamide-W-39; all available from Witco/Humko; acetylated-polyamide, Nalco-70, Nalco Chemical Company (c) ester compounds, such as methyl oleate, Emerest 2301, Henkel and Emery Chemicals; Lipo diglycol laurate, diethylene glycol mono stearate, Lipo DGS-SE Lipo Chemicals; diethylene glycol mono laurate, Alkamuls DEG-ML, polyethylene glycol-4-oleate, Ethylan-A2, polyethylene glycol-12-laurate, Alkamuls-600-ML, Alkaril Chemicals; polyethyleneglycol-4-dilaurate, Alkamuls 200-DL, Alkaril Chemicals; polyethylene glycol-12-stearate, Alkamuls 600-MS, Alkaril Chemicals (d) ether compounds such as polyethyleneoxide/ polypropyleneoxide block copolymers, Dow Corning 63N10, linear alcohol ethoxylates such as nonoxynol-1, nonoxynol-4, nonoxynol-13, from DeSoto, alcohol compounds, such as behenyl alcohol, Aldol-60, stearyl alcohol, Aldol-61, Sherex Chemical Company, tetramethyl decynediol, Surfynol-104S, tetramethyl decynediol ethoxylated, Surfynol-440, available from Air Products Company (B) cationic compounds, such as polyethylene glycol-2-oleammonium chloride, Ethoquad O/12, octadecyl diethanol methyl ammonium chloride, M-Quat-32, Akzo Chemical

Company (C) anionic compounds, such as tributyl phosphate, TBP, from FMC Corporation, Pliabrac-TBP, Merrand, sulfonated oleic acid sodium salt, Sulfonate OA-5, Tennesse, linear alkyl aryl sodium sulfonate, Sulframin 40, Witco Chemicals, alcohol-ethoxylate-phosphate-ester acid form, Emphos P-415M, phenol ethoxylate phosphate ester acid form, Emphos TS-230, Witco Chemicals, iminopropionate partial sodium salt, Amphoteric 400, Exxon; and mixtures thereof.

[0055] Preferred antifoaming compounds preferably present in an amount of from about 1 to about 3 parts by weight include (1) silica filled polydimethyl siloxane, Sag Silicone Antifoam-100 from Union Carbide Chemical Company; (2) erucylerucamide, Kenamide-E-221; (3) polyethyleneglycol-4-dilaurate, Alkamuls 200-DL, Alkaril Chemicals; (4) polyethyleneoxide/polypropyleneoxide block copolymers, Dow Corning 63N10; (5) tetramethyl decynediol and amorphous silica, Surfynol-104S, available from Air Products Company; (6) polyethylene glycol-2-oleammonium chloride, Ethoquad O/12; (7) octadecyl diethanol methyl ammonium chloride, M-Quat-32, Akzo Chemical Company; (8) tributyl phosphate, TBP, FMC Corporation, Pliabrac-TBP, Merrand; (9) sulfonated oleic acid sodium salt, Sulfonate OA-5, Tennesse; and (10) alcohol-ethoxylate-phosphate-ester acid form, Emphos P-415M.

[0056] In addition, the image enhancing chemical composition can contain one or more biocides as described for example, in U.S. Patent 5,663,004, the disclosure of which is totally incorporated herein by reference. Examples of suitable preferred biocides include (A) nonionic biocides, such as (1) 2-hydroxypropylmethane thiosulfonate (BUSAN 1005 available from Buckman Laboratories Inc.); (2) 2-(thiocyanomethyl thio) benzothiazole (BUSAN 30WB, 72WB, available from Buckman Laboratories Inc.); (3) methylene bis(thiocyanate) (Metasol T-10 available from Calgon Corporation; (4) 2-bromo-4'-hydroxyacetophenone (BUSAN 90 available from Buckman Laboratories); (5) 3,5-dimethyl tetrahydro-2H-1, 3,5-thiadiazine-2-thione (SLIME-TROL RX-28 available from Betz Paper Chem); (B) anionic biocides, such as (1) anionic potassium N-hydroxymethyl-N-methyl-dithiocarbamate (BUSAN 40 from Buckman Laboratories Inc.); (2) an anionic blend of methylene bis-thiocyanate (33 parts by weight), sodium dimethyl-dithiocarbamate (33 parts by weight), and sodium ethylene bisdithiocarbamate (33 parts by weight) (AMERSTAT 282 from Drew Industrial Division; AMA-131 from Vinings Chemical Company); (3) sodium dichlorophene (G-4-40, available from Givaudan Corporation); and the like, as well as mixtures thereof; (C) cationic biocides, such as (1) cationic poly(oxyethylene(dimethylamino)-ethylene(dimethylamino)ethylene dichloride) (BUSAN 77 available from Buckman Laboratories Inc.); (2) a cationic blend of methylene bisthiocyanate and dodecyl guanidine hydrochloride (SLIME TROL RX-31, RX-32, RX-32P, RX-33 from Betz Paper Chem Inc.); (3) a cationic blend of a sulfone, such as bis(trichloromethyl) sulfone and a quaternary ammonium chloride (SLIME TROL RX-36 DPB-865 from Betz Paper Chem Inc.); (4) a cationic blend of methylene bis-thiocyanate and chlorinated phenols (SLIME-TROL RX-40 from Betz Paper Chem Inc.); and the like, and mixtures thereof. The biocide can be present in any suitable amount, however; typically the biocide is present in an amount of from about 0.001 percent to about 5 parts by weight of the coating composition, although the amount can be outside this range.

[0057] In addition, the image enhancing chemical composition, can contain fillers such as colloidal silica, pigments such as blends of zinc sulfide with barium sulfate, colorants such as dyes of project Magenta 1T (Zeneca, Inc.), Project Cyan, (Zeneca, Inc.); mixtures of dyes and pigments, to impart a light color, for example, a color with an optical density on paper of between about 0.1 about 0.5, to paper prior to its printing. Specific examples of fillers include (1) colloidal silica, such as Syloid 74, available from Grace Company (preferably present, in one embodiment, in an amount of from about 0.5 to about 5 parts by weight percent); (2) titanium dioxide (Rutile or Anatase from NL Chem Canada, Inc.); and (3) calcium carbonate (Microwhite Sylacauga). Specific examples of pigments include (1) blend of calcium fluoride and silica, such as Opalex-C available from Kemira OY; (2) zinc oxide, such as Zoco Fax 183, available from Zo Chem; (3) blends of zinc sulfide with barium sulfate, such as Lithopane, available from Schteben Company; (4) brightener pigments such as those derived from coumarin, stillbine and oxazole derivatives and the like, and mixtures thereof. Brightener pigments can enhance color mixing and assist in improving print-through in imaging substrates of the present invention. These additives can be present in any effective amount, however, typically are present in amounts of from about 0.1 to about 7 parts by weight of the coating composition.

[0058] The Hercules size values recited herein were measured on the Hercules sizing tester (Hercules Incorporated) as described in TAPPI STANDARD T-530 pm-83 issued by the Technical Association of the Pulp and Paper Industry. This method is closely related to the widely used ink flotation test. The TAPPI method has the advantage over the ink flotation test of detecting the end point photometrically. The TAPPI method employs a mildly acidic aqueous dye solution as the penetrating compound to permit optical detection of the liquid front as it moves through the paper sheet. The apparatus determines the time required for the reflectance of the sheet surface not in contact with the penetrant to drop to a predetermined (80 percent) percentage of its original reflectance.

[0059] The porosity values recited herein were measured with a Parker Print-Surf, porosimeter that records the volume of air/minute flowing through a sheet of paper.

[0060] The imaged substrates of the present invention in aspects thereof, exhibit reduced hanging curl such as within about ±1.0 millimeters of 5 millimeters, and their hanging curve values were excellent and within about ±5.0 millimeters of 40 millimeters. Generally, the term "hanging curl" refers to the distance between the base line of the arc formed by the imaged substrates when viewed in cross-section across its width (or shorter dimension, for example 8.5 inches in an 8.5 by 11 inch sheet, as opposed to length, or longer dimension, for example 11 inches in an 8.5 by 11 inch sheet)

and the midpoint of the arc. To measure curl, a sheet can be held with the thumb and forefinger in the middle of one of the long edges of the sheet (for example, in the middle of one of the 11 inch edges in an 8.5 by 11 inch sheet) and the arc formed by the sheet can be matched against a pre-drawn standard template curve. Generally, the term "flat curl" refers to the average height of the four corners of a printed paper laying flat on its nonimaged side.

[0061] The optical density measurements recited herein were obtained on a Pacific Spectrograph Color System. The system consists of two major compounds, an optical sensor and a data terminal. The optical sensor employs a 6 inch integrating sphere to provide diffuse illumination and 2 degrees viewing. This sensor can be used to measure both transmission and reflectance samples. When reflectance samples are measured, a specular compound may be included. A high resolution, full dispersion, grating monochromator was used to scan the spectrum from 380 to 720 nanometers. The data terminal features a 12 inch CRT display, numerical keyboard for selection of operating parameters, and the entry of tristimulus values, and an alphanumeric keyboard for entry of product standard information. The print through value as characterized by the printing industry is Log base 10 (reflectance of a single sheet of unprinted paper against a black background/reflectance of the back side of a black printed area against a black background) measured at a wavelength of 560 nanometers.

[0062] The intercolor bleed values in microns were measured on the checkerboard ink jet pattern between black and the yellow color using a calibrated microscope.

[0063] Specific embodiments of the invention will now be described in detail. These examples are intended to be illustrative, and the invention is not limited to the materials, conditions, or process parameters set forth in these embodiments. All parts and percentages are by weight unless otherwise indicated. Comparative Examples and data are also provided.

COMPARATIVE EXAMPLE I

[0064] Checkerboard patterns were printed on a nontreated, noncoated Courtland paper (Champion Paper Company, Hercules sizing value of 250 seconds and porosity value of 840 mil/minute) using an acoustic ink jet test printer comprised of one or more acoustic radiators for illuminating the free surface of a pool of liquid ink with respective acoustic beams. Each of these beams usually is brought to focus at or near the surface of the reservoir (i.e., the liquid/air interface). Furthermore, printing conventionally is accomplished by independently modulating the excitation of the acoustic radiators in accordance with the input data samples for the image that is to be printed. This modulation enables the radiation pressure, which each of the beams exerts against the free ink surface, to cause brief, controlled excursions to a sufficiently high pressure level for overcoming the restraining force of surface tension. That, in turn, causes individual droplets of ink to be ejected from the free ink surface on demand at an adequate velocity. The inks of the following composition were used in the above acoustic ink jet test printer.

Black:

[0065] 18.0 Grams of ethylene glycol (Caledon Laboratories Ltd.), 0.25 gram of butyl carbitol (Aldrich Chemical Company), 0.05 gram of proxel GXL biocide (Zeneca, Inc.) 50.2 grams of water, 10.5 grams of Basacid X-34 process black dye (BASF Wyandotte Corporation) and 21 grams of ProJet Fast Black 2 (Zeneca, Inc.) were mixed and stirred for two hours. The ink was then filtered through a 0.45 μm pore size surfactant free cellulose acetate filter.

Cyan:

[0066] 20.0 Grams of ethylene glycol (Caledon Laboratories Ltd.), 0.25 grams of butyl carbitol (Aldrich Chemical Company) 0.05 gram of proxel GXL biocide (Zeneca, Inc.), 58.25 grams of water, 19.5 grams of ProJet Cyan, Zeneca, Inc.) and 1.95 grams of Duasyn acid blue AE SF (Hoechst Celanese Corporation) were mixed and stirred for two hours. The ink was then filtered through a 0.45 μm pore size surfactant free cellulose acetate filter.

Magenta:

[0067] 22.0 Grams of ethylene glycol (Caledon Laboratories Ltd.), 0.15 gram of butyl carbitol (Aldrich Chemical Company), 0.05 gram of proxel GXL biocide (Zeneca, Inc.), 62.8 grams of water, 7.5 grams of ProJet Magenta 1T (Zeneca, Inc.) and 7.5 grams of Acid Red 52 (Tricon) were mixed and stirred for two hours. The ink was then filtered through a 0.45 μm pore size surfactant free cellulose acetate filter.

Yellow:

[0068] 15.6 Grams of ethylene glycol (Caledon Laboratories Ltd.), 5.5 grams of diethylene glycol (Aldrich # H2,645-

6), 0.37 gram of butyl carbitol (Aldrich Chemical Company), 0.05 gram of proxel GXL biocide (Zeneca, Inc.), 45.68 grams of water, and 32.8 grams of ProJet Yellow OAM (Zeneca, Inc.) were mixed and stirred for two hours. The ink was then filtered through a 0.45 μm pore size surfactant free cellulose acetate filter.

[0069] Subsequent to being printed and subjected to drying, these images were placed in a constant temperature room set at 23°C and 50 percent humidity for 7 days. Thereafter, these imaged papers were tested for hanging curl using Xerox Standard Template Curves, and the papers were also tested for flat curl. The flat curl values of the tested papers were poor and within ±5.0 millimeters of 40 millimeters, and their hanging curve values were poor and within ±5.0 millimeters of 150 millimeters. All measurements were made after a constant time of 7 days. The optical density of the developed images was measured at 1.39 (black), 1.22 (cyan), 1.07 (magenta), 1.12 (yellow). The intercolor bleed between black and yellow was measured at 59 microns. The waterfast values of these images were measured at 85 percent (black), 27 percent (cyan), 28 percent (magenta), and16 percent (yellow). The lightfast values of these images were measured at 100 percent (black), 95 percent (cyan), 94 percent (magenta), and 96 percent (yellow).

EXAMPLE II

[0070] An image enhancing chemical composition comprised of a blend of 50 parts by weight of the hydrophilic solvent water, 1 part by weight of a heat shrinkable binder polyester latex, Eastman AQ 29D, Eastman Chemical Company, 27 parts by weight of a dye mordant quaternary monoammonium salt myristyl trimethyl ammonium bromide (Aldrich #86,042-5), 12 parts by weight of an anticurl compound pantothenol (Aldrich #29,578-7), 2 parts by weight of the water soluble paper desizing compound poly(dimethylsiloxane)-b-poly(propyleneoxide)-b-poly(ethyleneoxide) copolymer (Alkasil NEP 73-70, Alkaril Chemicals), 1 part by weight of the defoamer tetramethyl Surfynol-104, Air Products Company, 1 part by weight of the biocide of a cationic blend of methylene bisthiocyanate and dodecyl guanidine hydrochloride (SLIME TROL RX-31 from Betz Paper Chem Inc.); 3 parts by weight of the lightfast compound poly[N,N-bis(2,2,6,6-tetramethyl-4-piperidinyl)-1,6-hexane diamine-co-2,4-dichloro-6-morpholino-1,3,5-triazine), Cyasorb UV-3346, #41,324-0, Aldrich Chemical Company, and 3 parts by weight of a filler colloidal silica (Grace Chemical Company) was applied on paper through a channel having a nozzle that had a water pump near the other end to produce pressure pulses for jetting the chemical composition in an amount of 20 milliliters on each side of the substrate and drying the substrate at 80°C to about 100°C through a pair of pressure rolls at pressures of between 75 to 125 psi.

[0071] Checkerboard patterns were printed on this treated Courtland paper (Champion Paper Company, Hercules sizing value of 250 seconds) using an acoustic ink jet printer containing the inks of Example I. Subsequent to being printed and subjected to drying, these images were placed in a constant temperature room set at 23°C and 50 percent humidity for 7 days. Thereafter, these imaged papers were tested for hanging curl using Xerox Standard Template Curves, and the papers were also tested for flat curl. The flat curl values of the tested papers were excellent and within ±1.0 millimeter of 5 millimeters, and their hanging curve values were excellent and within ±5.0 millimeters of 40 millimeters. All measurements were made after a constant time of 7 days. The optical density of images formed and developed on the above prepared coated papers was measured at 1.46 (black), 1.43 (cyan), 1.21 (magenta), and 1.20 (yellow). The intercolor bleed between black and yellow was measured at 29 microns. The waterfast values of these images were measured at 93 percent (black), 92 percent (cyan), 81 percent (magenta), and 78 percent (yellow). The lightfast values of these images were measured as 100 percent (black), 95 percent (cyan), 86 percent (magenta), and 84 percent (yellow). A comparison of the results in Example I with those obtained after treatment in Example II show an increase in the optical density of the images, an increase in the waterfast values of the images, and a decrease in the intercolor bleed values without substantially affecting the lightfast values of the images.

EXAMPLE III

[0072] An image enhancing chemical composition comprised of a blend of 25 parts by weight of water, 3 parts by weight of a heat shrinkable binder rubber latex neoprene available from Serva Biochemicals, 3 parts by weight of the water soluble paper desizing compound poly(propylene glycol) (Alkapol PPG-4000, Alkaril Chemicals), 15 parts by weight of the water soluble paper anticurl compound pantothenol, (Aldrich #29,578-7), 1 part by weight of defoamer tetramethyl decynediol and amorphous silica, Surfynol-104S, available from Air Products Company, 1 part by weight of the biocide derived from a cationic blend of methylene bisthiocyanate and dodecyl guanidine hydrochloride (SLIME TROL RX-31 from Betz Paper Chem Inc.), 49 parts by weight of a dye mordant quaternary acrylic copolymer latex, HX-42-3 available from Interpolymer Corporation, 3 parts by weight of the lightfast compound poly[N,N-bis(2,2,6,6-tetramethyl-4-piperidinyl)-1,6-hexanediamine-co-2,4-dichloro-6-morpholino-1,3,5-triazine), Cyasorb UV-3346, #41,324-0, from Aldrich Chemical Company, and 3 parts by weight of the filler calcium carbonate (Microwhite Sylacauga Calcium Products), [20 milligrams of blend per side of the page] was metered on to paper in a manner similar to that described in U.S. Patent 5,434,029 from a sump of the fluid and dried at 100°C at a pressure 125 psi.

[0073] Checkerboard patterns were printed on the above prepared treated Courtland paper (Champion Paper Com-

pany, Hercules sizing value of 250 seconds) using an acoustic ink jet printer containing the inks of the Example I. Subsequent to being printed and subjected to drying, these images were placed in a constant temperature room set at 23°C and 50 percent humidity for 7 days. Thereafter, these imaged papers were tested for hanging curl using Xerox Standard Template Curves, and the papers were also tested for flat curl. The flat curl values of the tested papers were excellent and within ±1.0 millimeter of 5 millimeters, and their hanging curve values were excellent and within ±5.0 millimeters of 30 millimeters. The optical density of the developed images was measured at 1.65 (black), 1.55 (cyan), 1.35 (magenta), and 1.25 (yellow). The intercolor bleed between black and yellow was measured at 10 microns. The waterfast values of these images were measured as 95 percent (black), 94 percent (cyan), 85 percent (magenta), and 82 percent (yellow). The lightfast values of these images were measured at 100 percent (black), 98 percent (cyan), 96 percent (magenta), and 90 percent (yellow). A comparison of the results in Example I and Example II with Example III show a further increase in the optical density of the images, an increase in the waterfast values of the images, and a decrease in the intercolor bleed values with an increase in the lightfast values of the images.

EXAMPLE IV

[0074] A composition comprised of a blend of 50 parts by weight of water, 1 part by weight of a heat shrinkable binder polyester latex, Eastman AQ 29D available from Eastman Chemical Company, 2 parts by weight of the water soluble paper desizing compound poly(dimethylsiloxane)-b-poly(propyleneoxide)-b-poly(ethyleneoxide) copolymers (Alkasil NEP 73-70, Alkaril Chemicals), 12 parts by weight of the water soluble paper anticurl compound 1,4-bis(2-hydroxyethoxy)-2-butyne (Aldrich #B4,470-8), 1 part by weight of defoamer tetramethyl decynediol and amorphous silica, Surfynol-104S, Air Products Company, 1 part by weight of the biocide of a cationic blend of methylene bisthiocyanate and dodecyl guanidine hydrochloride (SLIME TROL RX-31 from Betz Paper Chem Inc.), 27 parts by weight of the dye mordant quaternary monoammonium salt myristyl trimethyl ammonium bromide (Aldrich #86,042-5), 3 parts by weight of the lightfast compound poly[N,N-bis(2,2,6,6-tetramethyl-4-piperidinyl)-1,6-hexane diamine-co-2,4-dichloro-6-morpholino-1,3,5-triazine), Cyasorb UV-3346, #41,324-0, Aldrich Chemical Company, 3 parts by weight of the filler colloidal silica (Grace Chemical Company) was applied on the image receiving side of paper with a thermal ink jet head in an amount of 2 milligrams. Checkerboard patterns were printed on this treated Courtland paper (Champion Paper Company, sizing value of 250 seconds) using an acoustic ink jet printer containing inks of the Example I.

[0075] Subsequent to being printed and subjected to drying, these images were placed in a constant temperature room set at 23°C and 50 percent humidity for 7 days. Thereafter, these imaged papers were tested for hanging curl using Xerox Standard Template Curves, and the papers were also tested for flat curl. The flat curl values of the tested papers were excellent and within ±1.0 millimeter of 5 millimeters, and their hanging curve values were excellent and within ±5.0 millimeters of 30 millimeters. The optical density of images was measured at 1.55 (black), 1.50 (cyan), 1.28 (magenta), and 1.25 (yellow). The intercolor bleed between black and yellow was measured at 15 microns. The waterfast values of these images were measured at 95 percent (black), 90 percent (cyan), 80 percent (magenta), and 80 percent (yellow). The lightfast values of these images were measured at 100 percent (black), 96 percent (cyan), 96 percent (magenta), and 90 percent (yellow). These results show that the image enhancing chemical composition of the present invention can also be jetted on to paper via additional ink jet heads with improved image quality.

EXAMPLE V

[0076] The composition of Example IV was applied on the image receiving side of paper with an acoustic ink jet head in an amount of 1 milligram. Checkerboard patterns were printed on this treated Courtland paper (Champion Paper Company, Hercules sizing value of 250 seconds) using an acoustic ink jet printer containing the inks of Example I. Subsequent to being printed and subjected to drying, these images were placed in a constant temperature room set at 23°C and 50 percent humidity for 7 days. Thereafter, these imaged papers were tested for hanging curl using Xerox Standard Template Curves, and the papers were also tested for flat curl. The flat curl values of the tested papers were excellent and within ±1.0 millimeter of 10 millimeters, and their hanging curve values were excellent and within ±5.0 millimeters of 45 millimeters. The optical density of images was measured at 1.50 (black), 1.45 (cyan), 1.28 (magenta), and 1.25 (yellow). The intercolor bleed between black and yellow was measured at 20 microns. The waterfast values of these images were measured at 95 percent (black), 90 percent (cyan), 80 percent (magenta), and 80 percent (yellow). The lightfast values of these images were measured at 100 percent (black), 96 percent (cyan), 93 percent (magenta), and 85 percent (yellow). These results indicate that the image enhancing chemical composition of the present invention can be jetted on to paper via additional acoustic ink jet heads with improved image quality.

[0077] Other embodiments and modifications of the present invention may occur to those of ordinary skill in the art subsequent to a review of the information presented herein; these embodiments and modifications, and equivalents thereof, are also included within the scope of this invention.

Claims

1. A composition comprised of a solvent, a polymeric binder, a dye mordant, a substantially water soluble anticurl compound, a substantially water soluble desizing compound, a lightfastness compound, a defoamer, an optional biocide, and an optional filler.

2. The composition in accordance with claim 1 wherein said solvent is hydrophilic and said polymeric binder is present in an amount of from about 1 parts by weight to about 3 parts by weight, and is selected from the group consisting of (1) a polyamide latex, (2) polyalkylene waxes, (3) a neoprene rubber latex, (4) a polyester latex, (5) a vinyl acrylic terpolymer latex, (6) an acrylic emulsion latex, (7) a styrene-butadiene latex, (8) a hydroxyethyl cellulose, (9) a vinylmethylether/maleic acid copolymer, and (10) a cationic hydroxyethyl cellulose; said dye mordant is present in an amount of from about 5 parts by weight to about 50 parts by weight, and is selected from the group consisting of (1) monoammonium quaternary salts, (2) phosphonium quaternary salts, (3) sulfonium quaternary salts, (4) thiazolium quaternary salts, (5) pyridinium quaternary salts, (6) benzothiazolium quaternary salts and (7) polymeric acrylic quaternary latexes; said water soluble paper anticurl compound is present in an amount of from about 5 parts by weight to about 15 parts by weight, and is selected from the group consisting of (1) pantothenol, (2) trimethylolpropane ethoxylate, (3) neopentyl glycol ethoxylate, (4) glycerol propoxylate-b-glycerol ethoxylate triol, (5) glycerol ethoxylate-b-glycerol propoxylate triol, (6) triethanol amine ethoxylate, (7) N-methyl diethanolamine, (8) 1,4-bis(2-hydroxyethoxy)-2-butyne), (9) 3-piperidino-1,2-propanediol, and (10) 1-4-bis(2-hydroxy ethyl) piperazine; said paper desizing compound is present in an amount of from about 1 part by weight to about 3 parts by weight, and is selected from the group consisting of (1) hydrophilic poly(dialkylsiloxanes); (2) poly(alkylene glycol); (3) poly(propylene oxide)-poly(ethylene oxide) copolymers; (4) fatty ester modified compounds of phosphate, sorbitan, glycerol, poly(ethylene glycol), sulfosuccinic acid, sulfonic acid, and alkyl amine; (5) poly(oxyalkylene) modified compounds of sorbitan esters, fatty amines, alkanol amides, castor oil, fatty acid, and fatty alcohol; (6) quaternary alkosulfate compounds; and (7) fatty imidazolines; said lightfast compound is present in an amount of from about 2 parts by weight to about 5 parts by weight, and is selected from the group consisting of (1) glycerol 4-amino benzoate; (2) 4-allyloxy-2-hydroxybenzophenone; (3) 2-(2'-hydroxy-5'-methylphenyl) benzotriazole; (4) [2,2,6,6-tetramethyl-4-piperidinyl)-1,2,3,4-butane-tetra carboxylate; (5) 2-dodecyl-N-(2,2,6,6-tetramethyl-4-piperidinyl) succinimide; (6) poly[N,N-bis(2,2,6,6-tetramethyl-4-piperidinyl)-1,6-hexane diamine-co-2,4-dichloro-6-morpholino-1,3,5-triazine; (7) didodecyl-3,3'-thiodipropionate; (8) 1,6-hexamethylene-bis(3,5-di-tert-butyl-4-hydroxyhydro cinnamate; (9) 2,2,4-trimethyl-1,2-hydroquinoline; (10) bis-(1,2,3,6-tetrahydrobenzaldehyde) pentaerythritol acetal; (11) paraffin wax; and mixtures thereof; said defoamer is present in an amount of from about 1 part by weight to about 3 parts by weight, and is selected from the group consisting of (1) silica filled polydimethyl siloxane; (2) erucyl erucamide; (3) polyethyleneglycol-4-dilaurate; (4) polyethylene oxide/polypropyleneoxide block copolymers; (5) tetramethyl decynediol; (6) polyethylene glycol-2-oleammonium chloride; (7) octadecyl diethanol methyl ammonium chloride; (8) tributyl phosphate; (9) sulfonated oleic acid sodium salt; and (10) alcohol-ethoxylate-phosphate-ester acid; and said biocide is present in an amount of from about 1 part by weight to about 2 parts by weigh, and is selected from the group consisting of (1) 2-hydroxy propyl methane thiosulfonate; (2) 2-(thiocyanomethylthio) benzothiazole; (3) methylene bis(thiocyanate); (4) 2-bromo-4'-hydroxyacetophenone; (5) 3,5-dimethyl tetrahydro-2H-1,3,5-thiadiazine-2-thione; (6) potassium N-hydroxymethyl-N-methyl-dithio carbamate; (7) an anionic blend of methylene bis-thiocyanate (33 parts by weight), sodium dimethyl-dithiocarbamate (33 parts by weight), and sodium ethylene bisdithio carbamate (33 parts by weight); (8) cationic poly(oxyethylene(dimethylamino)-ethylene (dimethylamino) ethylene dichloride); (9) a cationic blend of methylene bisthiocyanate and dodecyl guanidine hydrochloride); and (10) a cationic blend of a sulfone, bis(trichloromethyl) sulfone and a quaternary ammonium chloride.

3. A process comprising applying to a substrate a composition comprised of a solvent, a polymeric binder, a dye mordant, a substantially water soluble anticurl compound, a substantially water soluble desizing compound, a lightfast compound, a defoamer, an optional biocide, and an optional filler.

4. The process in accordance with claim 3 wherein said composition is an image enhancing composition, and wherein the polymeric binder is present in an amount of from about 1 part by weight to about 3 parts by weight, the dye mordant is present in an amount of from about 5 parts by weight to about 50 parts by weight, the water soluble paper anticurl compound is present in an amount of from about 5 parts by weight to about 15 parts by weight, the water soluble paper desizing compound is present in an amount of from about 1 part by weight to about 3 parts by weight, the lightfast compound is present in an amount of from about 2 parts by weight to about 5 parts by weight, the defoamer is present in an amount of from about 1 part by weight to about 3 parts by weight, the biocide is present in an amount of from about 1 part by weight to about 2 parts by weight, the filler is present in an amount of from about 1 part by weight to about 3 parts by weight, and the hydrophilic solvent is water present in an amount of from

about 83 parts by weight to about 16 parts by weight, and wherein the total of all of said components of said composition is about 100 parts.

5. The process in accordance with claim 3 wherein said substrate is polyethylene terephthalate, polypropylene, or paper, said polymeric binder is a neoprene rubber latex, or a polyester latex, said dye mordant is an acrylic copolymer latex, or the quaternary monoammonium salt myristyl trimethyl ammonium bromide, said anticurl compound is pantothenol or 1,4-bis(2-hydroxyethoxy)-2-butyne, said desizing compound is poly(propylene glycol), or a poly(dimethylsiloxane)-b-poly(propyleneoxide)-b-poly(ethyleneoxide)copolymer, said lightfast compound is poly[N,N-bis(2,2,6,6-tetramethyl-4-piperidinyl)-1,6-hexanediamine-co-2,4-dichloro-6-morpholino-1,3,5-triazine), or 2-dodecyl-N-(2,2,6,6-tetramethyl-4-piperidinyl) succinimide, said defoamer is tetramethyl decynediol, or polyethylene glycol-2-oleammonium chloride, said biocide is a cationic blend of methylene bisthiocyanate and dodecyl guanidine hydrochloride, or a cationic blend of a sulfone of bis(trichloromethyl) sulfone and a quaternary ammonium chloride, and/or said filler is calcium carbonate or colloidal silica.

6. The process in accordance with claim 3 wherein said solvent is a hydrophilic solvent of water, or an alcohol, and which solvent is present in an amount of from about 16 parts by weight to about 83 parts by weight.

7. The process in accordance with claim 3 wherein said composition is an image enhancing chemical composition comprised of a blend of about 25 parts by weight of the hydrophilic solvent water, 3 parts by weight of a heat shrinkable binder rubber latex neoprene, or a polyester latex; about 49 parts by weight of a dye mordant quaternary acrylic copolymer latex, or quaternary monoammonium salt myristyl trimethyl ammonium bromide; about 15 parts by weight of the water soluble paper anticurl compound pantothenol, or 1,4-bis(2-hydroxyethoxy)-2-butyne; about 3 parts by weight of the water soluble/dispersible paper desizing compound poly(propylene glycol) or a poly(dimethylsiloxane)-b-poly(propyleneoxide)-b-poly(ethyleneoxide) copolymer; about 3 parts by weight of a lightfast compound poly[N,N-bis(2,2,6,6-tetramethyl-4-piperidinyl)-1,6-hexanediamine-co-2,4-dichloro-6-morpholino-1,3,5-triazine), or 2-dodecyl-N-(2,2,6,6-tetramethyl-4-piperidinyl) succinimide; about 1 part by weight of defoamer tetramethyl decynediol or polyethylene glycol-2-oleammonium chloride; about 1 part by weight of a biocide comprised of a cationic blend of methylene bisthiocyanate and dodecyl guanidine hydrochloride, or a cationic blend of a sulfone of bis(trichloromethyl) sulfone and a quaternary ammonium chloride; about 3 parts by weight of a filler calcium carbonate or colloidal silica, wherein the total of all of said components is about 100 parts; and wherein the images generated with said composition possess an optical density of 1.65 (black),1.55 (cyan),1.35 (magenta),1.25 (yellow); flat curl values of within ±1.0 millimeter of 5 millimeters; waterfast values of 95 percent (black), 94 percent (cyan), 85 percent (magenta), and 82 percent (yellow); and lightfast values of 100 percent (black), 98 percent (cyan), 96 percent (magenta), and 90 percent (yellow).

8. An ink jet process wherein images formed on a substrate are developed with an ink jet composition, and there is applied to the substrate a composition comprised of a hydrophilic solvent, a polymeric binder, a dye mordant, a substantially water soluble anticurl compound, a substantially water soluble desizing compound, a lightfast compound, a defoamer, a biocide, and a filler.

9. A substrate with a coating thereover comprised of a hydrophilic solvent, a polymeric binder, a dye mordant, a substantially water soluble anticurl compound, a substantially water soluble desizing compound, a lightfast compound, a defoamer, an optional biocide, and an optional filler.

10. The ink jet process in accordance with claim 8 or the substrate in accordance with claim 9 wherein said substrate is paper.

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 99 11 3734

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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TECHNICAL FIELDS SEARCHED (Int.Cl.7)

B41M
G03C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	24 September 1999	Martins Lopes, L

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 99 11 3734

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