

Description

This invention relates to ink compositions employed in ink-jet printing, and, more particularly, to a method of improving the water fastness of the ink by means of a chemical reaction to form a polymeric lattice for binding the dye of the ink thereto.

Safe inks employed in ink-jet printers generally contain water-soluble dyes which are not very smear resistant after drying on paper.

Printing of colored ink on paper using ink-jet printing is known. See, for example, Savit, US-A-4382262. In that patent, drops of clear material are fired onto a specially treated paper, which combines with material in the paper to form colored dots. Several jets are employed; each jet is connected to a reservoir containing a different colorless material, which upon contact with the specially treated substrate chemically reacts to provide a different color.

US-A-4360548 provides a hidden image, made detectable by rubbing, by applying to a substrate a first ink-like material in image configuration, followed by a second ink-like material to cover the image and the area surrounding the image. Each of the two materials contain one of a color-forming pair of reactants which are substantially colorless, but which together react to form a colored product.

Neither of these references discloses nor suggests forming smear-resistant inks on a substrate. Thus, a need remains for a simple method for improving the water fastness of the ink on a substrate.

US-A-3694241 discloses a method of printing, such as onto high-speed newspaper web, which includes selectively depositing onto an activator-containing substrate a curable ink composition having as essential ingredients (a) a pigment, (b) a polyene having at least two reactive unsaturated carbon-to-carbon double bonds per molecule, and (c) a polythiol containing two or more thiol groups per molecule. The activator present in the substrate effects curing of the curable ink composition deposited thereon.

IBM Technical Disclosure Bulletin Vol. 22 (8A), pages 3301-3302 (January 1980) discloses a method of decreasing the drying time of ink by treating the paper with small quantities of a material which acts at the interface of the cellulosic and aqueous phases to overcome the surface energy of the applied droplet. This speeds up the mechanism of absorption into the paper surface and thus provides a faster drying time.

US-A-4196437 discloses a method and apparatus for providing a compound liquid jet of fine droplets for use in ink-jet printers. A primary stream is formed by ejecting under pressure a primary liquid from a nozzle and then causing the

primary stream to traverse a thin layer of a secondary liquid to form a compound liquid stream which breaks up to form a compound jet of fine droplets, each containing both the primary liquid and the secondary liquid. The two liquids may react with each other in the compound jet either as they travel towards the recording medium or when they have impinged on it. The film formed may consist of a polymerized chemical compound formed by such reaction.

The present invention provides a method of ink-jet printing on a substrate comprising (a) providing said substrate; (b) providing an ink-jet print head having at least a first set of nozzles connected to a first reservoir; (c) providing an ink composition comprising a coloring agent and a vehicle and at least one reactive species capable of reacting with a second species to form a polymer on said substrate, said polymer binding said coloring agent thereto, said second species comprising either a component in said substrate or a component maintained in a second reservoir, separate from said first reservoir and associated with a second set of nozzles indexed with said first set of nozzles; and (d) applying either said ink or said ink and said second component separately to said substrate to form said polymer thereon, whereby formation of said polymer improves the water fastness of said ink on said substrate.

The reaction of the at least one reactive species with the substrate (one component system) or with the ink (two component system) forms a polymer which binds the dye and thus improves water fastness of the ink.

The discussion which follows is presented in terms of an ink having as the vehicle a glycol-water or alcohol-water base. However, it will be appreciated that the teachings of the invention may be applied to other vehicles in inks employed in ink-jet printing.

In the use of the method, an ink-jet print head is provided, with at least one orifice provided with the head and a liquid reservoir connected with the orifice. As used herein, the print head may have associated therewith the two orifices and corresponding liquid orifices or nozzles. Alternatively, the print head may comprise two separate head systems, each with its own orifice and reservoir, but indexed so as to fire a drop of liquid in such a fashion as to achieve substantial overlay of one drop from one orifice by one drop from the other orifice.

It will be appreciated that in the typical ink-jet apparatus, a print head comprises a plurality of nozzles, each fed by a common reservoir. The ink is deposited on the substrate either by a piezoelectric element or, in the case of thermal ink-jet printing, by a resistor associated with a nozzle which is

activated at the appropriate time for depositing the ink. In the thermal ink-jet printer, a drop of ink from the reservoir is heated by the resistor to form a bubble and propelled or "fired" toward the substrate. In any event, firing of a series of bubbles of ink in a particular desired pattern results in formation of a desired character on the substrate.

The substrate employed in the practice of the invention commonly comprises ordinary cellulosic paper. However, other substrates may also be employed, such as fibrous and resinous sheet or film material and non-porous transparent polyester films and similar materials which are difficult to mark. Suitable examples also include cellulose acetate and mylar.

The ink compositions employed in the practice of the invention commonly comprise a vehicle consisting essentially of a glycol (glycol ether or polyhydric alcohol and monomethyl derivatives thereof) or low molecular weight alcohol (one to five carbon atoms) and, optionally, water plus a dye. Unless otherwise indicated, compositions given are in terms of weight percent (wt.%).

A surfactant, typically about 0.01%, may be added to improve wettability of the ink on paper. Examples include Atlas G-263, available from Atlas Refinery, Inc. (Newark, NJ) and Fluorad, available from 3M Company (St. Paul, MN).

A polymer may also be added to help control bubble formation. The polymer, typically present in an amount ranging from about 0.001 to 1%, may comprise polyvinyl pyrrolidone, GAFquat 734, available from the GAF Corporation, Chemical Products (New York, NY) and a mixture of polyvinyl pyrrolidone and polyvinyl alcohol.

The vehicle of the ink typically comprises at least one glycol. Glycols suitably employed in the practice of the invention include ethylene glycol, diethylene glycol, propylene glycol and polyethylene glycol. Additional examples of glycols include the glycol ethers of ethylene glycol dimethyl ether (glyme) and diethylene glycol dimethyl ether (diglyme).

The glycols may be used alone or in aqueous solution. In aqueous solutions, the glycol (or glycol mixture) is usually present in an amount ranging from about 10 to 60%, the balance being water.

Alternately, the vehicle may comprise at least one low molecular weight alcohol, such as an alcohol having from one to five carbon atoms. Examples include methanol, ethanol, iso-propanol and tert-butanol. The alcohol is usually present in an amount ranging from about 0 to 50%, the balance being at least one of water and one or more glycols.

The dye is present in tinctural strength, namely, about 1 to 10% of the ink composition. The dye may be an anionic or a cationic dye, black or

colored. Examples of anionic dyes include sulfonic acid dyes and acid forms of azo dyes, such as Food Black 2. Examples of cationic dyes include triaryl methanes, such as Acid Blue 9, and salts of amino groups on dyes, such as Direct Black 17 and copper phthalocyanine.

In accordance with the invention, the water fastness of the ink is improved by including a reactive species that is reactive either with a component of the ink or with the substrate to form a polymer which binds the dye thereto. The reactive species is included with the ink if the reaction is with the substrate (one component system) or is maintained in a separate reservoir and fired through a separate orifice if the reaction is with a component of the ink (two component system). In the latter case, the orifices are indexed so that both the ink and reactive species are deposited on the same location on the substrate.

As an example of a one component system, an ink comprises a colloidal suspension of carbon black in diglyme solvent. The carbon black is present in an amount of 6% by weight. The reactive species is an aliphatic diacid dihalide, such as sebacyl chloride, present in a concentration of about 7%.

Upon deposition on a cellulose-containing substrate, such as paper, the sebacyl chloride reacts with the cellulose to form a cellulosic polymer, which in one form is commonly known as rayon. The carbon particles are held in the polymer lattice. As a consequence, the ink is very waterfast.

An example of a two component system comprises an ink in which the vehicle comprises 15% diethylene glycol and the balance water and the dye is Food Black 2. The reactive species comprise carboxymethyl cellulose (CMC), present in essentially the same vehicle as the ink, the concentration ranging from about 0.1 to 1%, and an aluminum salt. The reaction yields an insoluble salt of the CMC polymer. The aluminum salt is conveniently present as a 2% solution in water. Various salts of aluminum or other cations are used to adjust the pH and precipitation rate of the polymer. Examples of suitable aluminum salts include aluminum chloride, $AlCl_3$, and aluminum hydroxy acetates, $Al(C_2H_3O_2)_x(OH)_{3-x}$, where x is an integer from 1 to 3.

The carboxymethyl cellulose is maintained in one reservoir, the aluminum salt in another. The dye may be in either reservoir.

Again, the result is a chemical reaction which forms a polymer and binds the dye of the ink in the polymer lattice, thereby forming a water-fast ink.

Analogous to the reaction of a carboxy-cellulose and aluminum salt is the reaction of an amino-cellulose and a carbonate salt. For example, chitosan, which is a cellulose polymer containing

amino groups, reacts with an alkali or alkaline metal carbonate (Na_2CO_3 , K_2CO_3) to form an insoluble product. As above, the amino-cellulose may be contained in one reservoir and the carbonate in another.

An example of another two component system comprises hexamethylenediamine in one reservoir and an aliphatic diacid, such as adipic acid (or adipic anhydride), or the dihalide form thereof in a second reservoir. The dye may be in either or both reservoirs. However, the best dot regularity in placement on the substrate is generally obtained with the ink nozzle connected to the reservoir containing the dye fired second.

The foregoing reaction results in the formation of nylon 66. While the foregoing reaction requires a temperature of about 280°C , other nylon-forming reactions are exothermic and occur at room temperature.

EXAMPLES

Example 1.

In a one-pen configuration, the ink comprised a colloidal suspension of 5% carbon black in diglyme. The reactive species was sebacyl chloride, present in a concentration of 7%. The ink was deposited onto a cellulose-containing substrate to form a cellulosic polymer. Qualitatively, the print quality was good compared to existing thermal ink-jet printing and the water fastness was far superior to any ink observed to date in ink-jet printing. The paper dissolved before the ink did.

Example 2.

In a two-pen configuration, one reservoir contained a 2% aqueous solution of AlCl_3 . The second reservoir contained a 5% dye (Food Black 2), 0.1 to 1% carboxymethyl cellulose, 15% diethylene glycol and the balance water. The reaction of the two components on a paper substrate produced an insoluble salt of the carboxymethyl cellulose polymer. This polymer encapsulated the dye and gave a protective coating to the paper. The result was a very water-fast print with excellent quality. Very quick fixing to the paper was observed.

Thus, there has been disclosed a method of improving the water fastness of an ink on a substrate employing ink-jet printing. Various changes and modifications will make themselves available to those of ordinary skill in the art, and all such changes and modifications are intended to fall within the scope of the invention as defined by the appended claims.

Claims

1. A method of ink-jet printing on a substrate comprising:
 - (a) providing said substrate;
 - (b) providing an ink-jet print head having at least a first set of nozzles connected to a first reservoir;
 - (c) providing an ink composition comprising a coloring agent and a vehicle and at least one reactive species capable of reacting with a second species to form a polymer on said substrate, said polymer binding said coloring agent thereto, said second species comprising either a component in said substrate or a component maintained in a second reservoir, separate from said first reservoir and associated with a second set of nozzles indexed with said first set of nozzles; and
 - (d) applying either said ink or said ink and said second component separately to said substrate to form said polymer thereon, whereby formation of said polymer improves the water fastness of said ink on said substrate.
2. The method of claim 1 wherein said vehicle includes at least one member selected from the group consisting of glycols and alcohols.
3. The method of claim 2 wherein said glycol consists essentially of at least one member selected from the group consisting of ethylene glycol, diethylene glycol, propylene glycol, polyethylene glycol, ethylene glycol dimethyl ether and diethylene glycol dimethyl ether.
4. The method of claim 3 wherein said vehicle consists essentially of diethylene glycol and water, said glycol present in an amount ranging from about 10 to 60% by weight, the balance water.
5. The method of claim 2 wherein said alcohol consists essentially of a low molecular weight alcohol comprising from one to five carbon atoms, present in an amount up to about 50% by weight, the balance water.
6. The method of claim 5 wherein said alcohol consists essentially of at least one member selected from the group consisting of methanol, ethanol, iso-propanol and tert-butanol.
7. The method of any of claims 1, 2, 3, 4, 5 and 6 wherein said at least one reactive species reacts with a component in said substrate to



amino groups, reacts with an alkali or alkaline metal carbonate (Na_2CO_3 , K_2CO_3) to form an insoluble product. As above, the amino-cellulose may be contained in one reservoir and the carbonate in another.

An example of another two component system comprises hexamethylenediamine in one reservoir and an aliphatic diacid, such as adipic acid (or adipic anhydride), or the dihalide form thereof in a second reservoir. The dye may be in either or both reservoirs. However, the best dot regularity in placement on the substrate is generally obtained with the ink nozzle connected to the reservoir containing the dye fired second.

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Example 2.

In a two-pen configuration, one reservoir contained a 2% aqueous solution of AlCl_3 . The second reservoir contained a 5% dye (Food Black 2), 0.1 to 1% carboxymethyl cellulose, 15% diethylene glycol and the balance water. The reaction of the two components on a paper substrate produced an insoluble salt of the carboxymethyl cellulose polymer. This polymer encapsulated the dye and gave a protective coating to the paper. The result was a very water-fast print with excellent quality. Very quick fixing to the paper was observed.

Thus, there has been disclosed a method of improving the water fastness of an ink on a substrate employing ink-jet printing. Various changes and modifications will make themselves available to those of ordinary skill in the art, and all such changes and modifications are intended to fall within the scope of the invention as defined by the appended claims.

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1. A method of ink-jet printing on a substrate comprising:
 - (a) providing said substrate;
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 - (c) providing an ink composition comprising a coloring agent and a vehicle and at least one reactive species capable of reacting with a second species to form a polymer on said substrate, said polymer binding said coloring agent thereto, said second species comprising either a component in said substrate or a component maintained in a second reservoir, separate from said first reservoir and associated with a second set of nozzles indexed with said first set of nozzles; and
 - (d) applying either said ink or said ink and said second component separately to said substrate to form said polymer thereon, whereby formation of said polymer improves the water fastness of said ink on said substrate.
2. The method of claim 1 wherein said vehicle includes at least one member selected from the group consisting of glycols and alcohols.
3. The method of claim 2 wherein said glycol consists essentially of at least one member selected from the group consisting of ethylene glycol, diethylene glycol, propylene glycol, polyethylene glycol, ethylene glycol dimethyl ether and diethylene glycol dimethyl ether.
4. The method of claim 3 wherein said vehicle consists essentially of diethylene glycol and water, said glycol present in an amount ranging from about 10 to 60% by weight, the balance water.
5. The method of claim 2 wherein said alcohol consists essentially of a low molecular weight alcohol comprising from one to five carbon atoms, present in an amount up to about 50% by weight, the balance water.
6. The method of claim 5 wherein said alcohol consists essentially of at least one member selected from the group consisting of methanol, ethanol, iso-propanol and tert-butanol.
7. The method of any of claims 1, 2, 3, 4, 5 and 6 wherein said at least one reactive species reacts with a component in said substrate to



form said polymer.

8. The method of claim 7 wherein said ink comprises a colloidal suspension of carbon black in diglyme solvent, the concentration of said carbon black being about 6%, said reactive species comprises an aliphatic diacid dihalide and said component comprises cellulose, thereby forming a cellulosic polymer. 5
9. The method of claim 8 wherein said aliphatic diacid dihalide consists essentially of sebacyl chloride, present in an amount of about 7%. 10
10. The method of any of claims 1, 2, 3, 4, 5 and 6 wherein said at least one reactive species reacts to form said polymer on said substrate with a component applied separately to said substrate, said component being maintained in a reservoir separate from said first reservoir, and associated with a second set of nozzles indexed with said first set of nozzles. 15 20
11. The method of claim 10 wherein said ink comprises a vehicle comprising about 15% diethylene glycol and the balance water and a dye consisting essentially of Food Black 2, said reactive species comprises a solution of carboxymethyl cellulose in substantially the same vehicle in a concentration ranging from about 0.1 to 1%, maintained in a first reservoir, and said component consists essentially of a soluble aluminium salt in water in a concentration of about 2%, maintained in a second reservoir, said polymer formed on said substrate comprising a carboxymethyl cellulose insoluble salt. 25 30 35
12. The method of claim 10 wherein said reactive species comprises hexamethylenediamine and said component comprises a member selected from the group consisting of aliphatic diacids, the anhydride form thereof and the dihalide form thereof, said polymer formed on said substrate comprising a nylon. 40 45
13. The method of claim 12 wherein said aliphatic diacid consists essentially of adipic acid.

Patentansprüche

1. Verfahren zum Tintenstrahldrucken auf ein Substrat, welches umfaßt:
- (a) Bereitstellen des Substrats,
- (b) Bereitstellen eines Tintenstrahldruckkopfes mit mindestens einer ersten Gruppe von Düsen, die mit einem ersten Vorratsbehälter verbunden sind, 55

(c) Bereitstellen einer Tintenmischung, welche ein Färbemittel, ein Bindemittel und mindestens eine reaktive Spezies enthält, die mit einer zweiten Spezies reagieren kann, so daß ein Polymer auf dem Substrat gebildet wird, wobei das Polymer das Färbemittel daran bindet und die zweite Spezies entweder eine Komponente in dem Substrat oder eine Komponente enthält, die in einem zweiten Vorratsbehälter gespeichert wird, welcher von dem ersten Vorratsbehälter getrennt und einer zweiten Gruppe von Düsen, die mit der ersten Gruppe von Düsen ausgerichtet sind, zugeordnet ist, und

(d) Aufbringen entweder der Tinte oder der Tinte und der zweiten Komponente getrennt auf das Substrat, um darauf das Polymer zu bilden, wobei die Bildung des Polymers die Wasserfestigkeit der Tinte auf dem Substrat verbessert.

2. Verfahren nach Anspruch 1, bei dem das Bindemittel mindestens einen Bestandteil enthält, der aus der aus Glykolen und Alkoholen bestehenden Gruppe gewählt ist.
3. Verfahren nach Anspruch 2, bei dem das Glykol im wesentlichen aus mindestens einem Bestandteil besteht, der aus der Gruppe gewählt ist, die aus Ethylenglykol, Diethylenglykol, Propylenglykol, Polyethylenglykol, Ethylenglykoldimethylether und Diethylenglykoldimethylether besteht.
4. Verfahren nach Anspruch 3, bei dem das Bindemittel im wesentlichen aus Diethylenglykol und Wasser besteht, wobei das Glykol in einer Menge von ungefähr 10 bis 60 Gew.-% vorliegt und der Rest aus Wasser besteht.
5. Verfahren nach Anspruch 2, bei dem der Alkohol im wesentlichen aus einem Alkohol mit geringem Molekulargewicht besteht, der zwischen 1 und 5 Kohlenstoffatome enthält und in einer Menge von bis zu ungefähr 50 Gew.-% vorliegt, wobei der Rest aus Wasser besteht.
6. Verfahren nach Anspruch 5, bei dem der Alkohol im wesentlichen aus mindestens einem Bestandteil besteht, der aus der Gruppe gewählt ist, die aus Methanol, Ethanol, Isopropylalkohol und tertiärem Butylalkohol besteht.
7. Verfahren nach einem der Ansprüche 1 bis 6, bei dem mindestens eine reaktive Spezies mit einer Komponente in dem Substrat reagiert, um das Polymer zu bilden.



8. Verfahren nach Anspruch 7, bei dem die Tinte eine kolloidale Suspension von Ruß in Diglyme als Lösungsmittel umfaßt, wobei die Konzentration des Rußes bei ungefähr 6 % liegt, die reaktive Spezies ein Dihalogenid einer aliphatischen Disäure umfaßt und die besagte Komponente Cellulose enthält, wodurch ein Cellulose-Polymer gebildet wird.

9. Verfahren nach Anspruch 8, bei dem das Dihalogenid der aliphatischen Disäure im wesentlichen aus Sebacylchlorid besteht, das in einer Menge von ungefähr 7 % vorhanden ist.

10. Verfahren nach einem der Ansprüche 1 bis 6, bei dem die zumindest eine reaktive Spezies zum Bilden des Polymers auf dem Substrat mit einer getrennt auf das Substrat aufgetragenen Komponente reagiert, wobei diese Komponente in einem von dem ersten Vorratsbehälter getrennten Vorratsbehälter gespeichert wird, der einer zweiten Gruppe von Düsen, die mit der ersten Düsengruppe ausgerichtet sind, zugeordnet ist.

11. Verfahren nach Anspruch 10, bei dem die Tinte ein Bindemittel, das ungefähr 15 % Diethylenglykol und als Rest Wasser enthält, und eine Farbe, die im wesentlichen aus "Food Black 2" besteht, enthält, die reaktive Spezies eine Lösung von Carboxymethylcellulose in im wesentlichen demselben Bindemittel in einer Konzentration von ungefähr 0,1 bis 1 % enthält, die in einem ersten Vorratsbehälter gespeichert wird, und bei dem die besagte Komponente im wesentlichen aus einem löslichen Aluminiumsalz in Wasser in einer Konzentration von ungefähr 2 % besteht, das in einem zweiten Vorratsbehälter gespeichert wird, wobei das auf dem Substrat gebildete Polymer ein in Carboxymethylcellulose unlösliches Salz umfaßt.

12. Verfahren nach Anspruch 10, bei dem die reaktive Spezies Hexamethyldiamin und die besagte Komponente einen Bestandteil enthält, der aus der Gruppe gewählt ist, die aus aliphatischen Disäuren, deren Anhydridform und deren Dihalogenidform besteht, wobei das auf dem Substrat gebildete Polymer ein Nylon umfaßt.

13. Verfahren nach Anspruch 12, bei dem die aliphatische Disäure im wesentlichen aus Adipinsäure besteht.

Revendications

1. Procédé d'impression à jet d'encre sur un substrat consistant à

(a) prévoir ledit substrat ;

(b) prévoir une tête d'impression à jet d'encre ayant au moins un premier jeu de buses reliées à un premier réservoir ;

(c) prévoir une composition d'encre qui comprend un agent colorant et un véhicule, et au moins une espèce réactive capable de réagir avec une seconde espèce pour former un polymère sur ledit substrat, ledit polymère liant ledit agent colorant à ce substrat, ladite seconde espèce comprenant, soit un composant contenu dans ledit substrat, soit un composant contenu dans un second réservoir, séparé du premier réservoir et associé à un second jeu de buses qui sont avancées pas-à-pas avec le premier jeu de buses ; et

(d) appliquer, soit ladite encre, soit ladite encre et ledit second composant séparément sur ledit substrat, pour former ledit polymère sur celui-ci, la formation dudit polymère améliorant la solidité à l'eau de ladite encre sur ledit substrat.

2. Procédé selon la revendication 1, dans lequel ledit véhicule comprend au moins un élément choisi dans le groupe composé des glycols et des alcools.

3. Procédé selon la revendication 2, dans lequel ledit glycol est essentiellement composé d'au moins un élément choisi dans le groupe composé de l'éthylène glycol, du diéthylène glycol, du propylène glycol, du polyéthylène glycol, de l'éthylène glycol diméthyl éther et du diéthylène glycol diméthyl éther.

4. Procédé selon la revendication 3, dans lequel ledit véhicule est essentiellement composé de diéthylène glycol et l'eau, ledit glycol étant présent en une proportion allant d'environ 10 à 60 % en poids, le reste étant de l'eau.

5. Procédé selon la revendication 2, dans lequel ledit alcool est essentiellement composé d'un alcool à bas poids moléculaire contenant un à cinq atomes de carbone, dans une proportion d'environ 50 % en poids, le reste étant de l'eau.

6. Procédé selon la revendication 5, dans lequel ledit alcool est essentiellement composé d'au moins un élément choisi dans le groupe composé du méthanol, de l'éthanol, de l'iso-propa-



nol et du tert-butanol.

7. Procédé selon une des revendications 1, 2, 3, 4, 5 et 6, dans lequel ladite au moins une espèce réactive réagit avec un constituant contenu dans ledit substrat pour former ledit polymère.

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8. Procédé selon la revendication 7, dans lequel ladite encre comprend une solution colloïdale de noir de carbone dans un solvant diglyme, la concentration dudit noir de carbone étant d'environ 6 %, ladite espèce réactive comprenant un dihalogénure de diacide aliphatique et ledit constituant comprend de la cellulose, pour former ainsi un polymère cellulosique.

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9. Procédé selon la revendication 8, dans lequel ledit dihalogénure de diacide aliphatique est essentiellement composé de chlorure de sébacyle, présent dans une proportion d'environ 7 %.

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10. Procédé selon une quelconque des revendications 1, 2, 3, 4, 5 et 6, dans lequel ladite au moins une espèce réactive réagit pour former ledit polymère sur ledit substrat, avec un composant appliqué séparément audit substrat, ledit composant étant contenu dans un réservoir séparé dudit premier réservoir, et associé à un second jeu de buses qui sont entraînées pas-à-pas avec le premier jeu de buses.

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11. Procédé selon la revendication 10, dans lequel ladite encre comprend un véhicule comprenant au moins 15 % de diéthylène glycol, le reste étant de l'eau, et un colorant essentiellement composé de Food Black 2, ladite espèce réactive comprend une solution de carboxyméthyl cellulose contenue dans sensiblement le même véhicule dans une concentration allant d'environ 0,1 à 1 %, contenue dans un premier réservoir, et ledit composant est essentiellement composé d'un sel d'aluminium soluble dans l'eau, dans une concentration d'environ 2 %, contenu dans un second réservoir, ledit polymère formé sur ledit substrat étant constitué par un sel insoluble de carboxyméthyl cellulose.

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12. Procédé selon la revendication 10, dans lequel ladite espèce réactive comprend de l'hexaméthylènediamine et ledit composant comprend un élément choisi dans le groupe composé des diacides aliphatiques, de leurs formes anhydrides et de leurs formes dihalogénures, ledit polymère formé sur ledit substrat constituant un nylon.

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13. Procédé selon la revendication 12, dans lequel ledit diacide aliphatique est essentiellement composé d'acide adipique.