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(54) Permanent ink jet imaging of cellulosic material

(57) A pretreatment solution for a cellulosic fabric to be printed, allows the printed fabric to maintain color brightness and image permanence. The pretreatment solution comprises a mixture of water, a salt, and a hydroxyalkyl imine derivative. The hydroxyalkyl imine derivative is selected from the group consisting of branched polyethyleneimine polymer, diphenylguanidine, hydroxyethyl and hydroxypropyl. In a preferred embodiment of the present invention, the branched polyethyleneimine polymer comprises ethoxylated polyethyleneimine.

EP 0 828 024 A2

Description

Technical Field

The present invention relates to cellulosic fabrics that are to be printed or dyed and, more particularly, to a pretreatment solution for the cellulosic fabric.

Background Art

Currently, textile printing by conventional manual methods can take many months from the initial submission of a design to production. The major bottleneck in this lengthy process is the production of the multicolor design at the sample print stage, because a different screen has to be produced on the textile substrate for each color in the design.

Various textile printing processes are known in the art, such as the method for textile printing disclosed in U.S. Patent No. 4,702,742; the process for ink jet printing on textiles disclosed in U.S. Patent No. 4,725,849; and the ink jet printing process disclosed in U.S. Patent No. 5,358,558, all of which are totally incorporated herein by reference.

Full color graphics printing with such continuous ink jet systems is being developed and practiced by Scitex Digital Printing, Inc., in Dayton, Ohio. Imaging in the digital color press is done with four separate and independent printheads. Each head images a different one of the primary colors, cyan, magenta, yellow or black. The printheads are of the binary, continuous ink jet type, and employ planar charging technology known in the art. One challenge with developing a digital color press is to formulate inks which will run in the digital color press. An ink formulation capable of producing high quality acceptable print, which will run in a digital color press system, is disclosed in U.S. Patent No. 5,601,639, entitled SYSTEM AND METHOD FOR ACHIEVING RUNNABILITY AND JET STRAIGHTNESS FOR A DIGITAL COLOR PRESS, totally incorporated herein by reference.

Other patents describe ink jet inks containing a reactive dye, such as U.S. Patent Nos. 4,849,770 and 5,250,121, totally incorporated herein by reference. In order to print cellulosic material with reactive dyes, the textile must be pretreated with a mixture of chemicals, such as inorganic salts, to improve substantivity of the dye to the fabric, alkalies to help dye fixation, starches and urea. The material is then dried, printed with dyes or pigments, dried, steamed to fix the dyes, washed to remove unfixed dyes and chemicals, and dried.

It is seen then that it would be desirable to be able to dramatically reduce the complexity of textile printing processes, and simplify the production of multicolor design.

Summary of the Invention

The present invention provides for a dramatic reduction in the complexity of textile printing processes. To achieve this, the present invention proposes to pretreat the cellulosic fabric by immersing the fabric that is to be printed in a dilute solution of ethoxylated polyethylenimine, drying, jetting with inks, and drying again. Air drying is feasible with the present invention, eliminating a costly and complex steam fixation operation. The present invention further proposes using the cyan, magenta, yellow and black (C, M, Y, K) system of a digital color press to generate multiple colors and shades.

In accordance with a preferred embodiment of the present invention, a pretreatment solution comprises water, a salt and a hydroxyalkyl imine derivative selected from the group consisting of branched polyethyleneimine polymer and diphenylguanidine.

It is an object of the present invention to dramatically reduce the complexity of textile printing processes. It is an advantage of the present invention that it provides a pretreatment solution that does not adversely affect brightness and print quality. It is yet another advantage that a fabric, when treated with the pretreatment solution of the present invention, can be printed not only with reactive dyes, but also with any direct dye, and still produce permanent images. It is a further advantage of the present invention that the waste effluent from the invention process will be much less contaminated and easier to handle than the waste from the conventional printing process.

Other objects and advantages of the invention will be apparent from the following description and the appended claims.

Detailed Description of the Invention

In accordance with the present invention, fabric that is to be printed or dyed is treated with a dilute solution of an N-hydroxyalkyl imine, such as ethoxylated polyethylenimine or diphenylguanidine, prior to being jetted with inks. The present invention proposes using the cyan, magenta, yellow and black (C, M, Y, K) system of a digital color press to generate varying ink shades for printing on the fabric. A fabric treated with the pretreatment solution of the present invention can produce permanent images when printed with reactive or direct dyes.

The cellulosic fabric pretreatment solution of the present invention comprises a salt to help the fabric take up the dye, an N-hydroxyalkyl imine to encourage color integrity and permanence in the printed fabric, and water. The N-hydroxyalkyl imine is preferably selected from the group comprising branched polyethyleneimine polymer, such as ethoxylated polyethyleneimine substituted at about 80% of the available nitrogens, and diphenylguanidine. In a preferred embodiment of the present invention, the EPI has molecular weight in the range of

40,000 to 60,000.

The following examples illustrate various formulations for the pretreatment solution of the present invention, and the resultant effectiveness of each embodiment. Although the pretreatment solutions described below comprise ammonium sulfate, it will be obvious to those skilled in the art that other salts can be used to achieve similar results.

Example 1

Deionized water	99.0%
Ammonium Sulfate	1.0%

Example 2

Deionized water	94.0%
polyethyleneimine	5.0%
Ammonium Sulfate	1.0%

Example 3

Deionized water	94.0%
EPI	5.0%
Ammonium Sulfate	1.0%

To determine the effectiveness of the solutions in each Example above, prewashed samples of cellulosic material were immersed in the solutions of Examples 1, 2 and 3. Each wet sample was air dried. The dried sample was imaged with continuous ink jet inks, such as commercially available Scitex 3600 Black Ink 1, 1007 Black, condor N Red and Condor N Blue. The imaged samples were again dried, by suitable means such as heat drying. The samples were then tested for permanence by soaking the samples in hot water, having a temperature, for example, of 70 to 80 degrees Celsius, for a period of five minutes.

Samples obtained in Example 1, comprising water and salt, showed severe deterioration of color after soaking in hot water. Samples obtained in Example 2, where polyethyleneimine has been added to the mixture of Example 1, showed considerable advantage in permanence over Example 1, but still showed slight bleeding and fading. Samples obtained in Example 3, where the polyethyleneimine is ethoxylated, showed excellent permanence and preservation of color integrity. No bleeding was observed using the pretreatment solution of Example 3. In addition, brightness and print quality were not affected.

The hydroxy groups in EPI appear to have more affinity toward the cellulosic material through hydrogen bonding and also contributed to the excellent properties observed in the samples of Example 3. Of course, it should be noted that other hydroxyalkyl imine derivatives can be used in accordance with this invention, without departing from the scope and coverage of the invention. For example, other hydroxyalkyl imine derivatives comprise those derived from diphenylguanidine. The hydroxyalkyl derivatives could also comprise hydroxyethyl and/or hydroxypropyl of the corresponding polyamine. The pretreatment solution of the present invention may also comprise other polymers, in addition to the EPI, without departing from the scope of the invention, which are capable of forming hydrogen bonds with cellulose such as polyamides, polyvinyl alcohols, acrylic polymers, polyurethanes, hydroxyethyl cellulose, carboxymethyl cellulose, mixed cellulose esters and epoxide resins.

Industrial Applicability and Advantages

The present invention is useful in the field of textile printing, and has the advantage of formulating a solution for cellulosic fabric prior to applying ink or dye to the fabric, to allow the fabric to retain color brightness and image permanence.

The invention has been described in detail with particular reference to certain preferred embodiments thereof, but it will be understood that modifications and variations can be effected within the spirit and scope of the invention.

Claims

1. A pretreatment solution for a cellulosic fabric to be printed, the pretreatment solution comprising water, a salt, and a hydroxyalkyl imine derivative.

2. A pretreatment solution as claimed in claim 1 wherein the hydroxyalkyl imine derivative is selected from the group consisting of branched polyethyleneimine polymer and diphenylguanidine.

3. A pretreatment solution as claimed in claim 2 wherein the branched polyethyleneimine polymer comprises ethoxylated polyethyleneimine.

4. A pretreatment solution as claimed in claim 3 wherein the ethoxylated polyethyleneimine is substituted at about 80% of the available nitrogens.

5. A pretreatment solution as claimed in claim 3 wherein the ethoxylated polyethyleneimine has a molecular weight of 40,000 to 60,000.

6. A pretreatment solution as claimed in claim 3 further comprising a polymer capable of forming hydrogen bonds with cellulose.

7. A pretreatment solution as claimed in claim 6 wherein the polymer is selected from the group consisting of polyamides, polyvinyl alcohols, acrylic polymers, polyurethanes, hydroxyethyl cellulose, carboxymethyl cellulose, mixed cellulose esters and epoxide resins.

8. A pretreatment solution as claimed in claim 2 wherein the hydroxyalkyl imine derivative is selected from the group consisting of branched polyethyleneimine polymer, diphenylguanidine, hydroxyethyl and hydroxypropyl.

9. A pretreatment solution as claimed in claim 1 wherein the hydroxyalkyl imine derivative comprises ethoxylated polyethyleneimine.

10. A pretreatment solution as claimed in claim 1 wherein the hydroxyalkyl imine derivative is present in an amount of from about 1 to 20 percent by weight.

11. A pretreatment solution as claimed in claim 1 wherein the salt comprises ammonium sulfate.

12. A pretreatment solution as claimed in claim 1 wherein the salt is present in an amount of from about 0.1 to 5 percent by weight.

13. A process for generating images on a cellulosic fabric which comprises the steps of using an ink jet printing apparatus to print on a fabric pretreated with the pretreatment solution of claim 1 and forming permanent images on the pretreated fabric by causing the ink to be expelled in droplets onto the fabric, thereby generating an image on the fabric.

14. A process as claimed in claim 13 wherein a first drying step is applied to the pretreated fabric prior to jetting the pretreated fabric with inks.

15. A process as claimed in claim 14 wherein the first drying step comprises air drying.

16. A process as claimed in claim 13 wherein a second drying step is applied to the pretreated fabric after jetting the pretreated fabric with inks.

17. A process as claimed in claim 16 wherein the second drying step comprises air drying.