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Title: COATING COMPOSITION FOR INKJET PRINTING

Abstract: An inkjet-receptive coating composition for efficacious inkjet printing which is a synergistic composition of swellable, water-insoluble polyvinylpyrrolidone particles and microporous (fumed) silica particles.
COATING COMPOSITION FOR INKJET PRINTING

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to an inkjet-receptive coating composition for efficacious inkjet printing, and, more particularly, to a synergistic composition of swellable, water-insoluble polyvinylpyrrolidone particles and microporous (fumed) silica particles.

2. Description of the Prior Art

The image quality of inkjet printing has begun to approach that of silver halide photography and these advances have carried inkjet printing to the point where a further advance now depends on the quality of inkjet papers. An inkjet printed image on plain paper is generally inferior to a silver halide image on photographic paper, but it becomes difficult to distinguish between the two when the inkjet printing is performed on high-grade photo paper.

Currently, three types of glossy inkjet paper are used: cast-coated, swelling and microporous. Cast-coated paper is of limited image quality as its base paper absorbs ink. Swelling and microporous papers avoid this because they use a polyethylene (PE) coated base paper that makes the base impermeable to ink. The PE coated bases, however, do not absorb ink; hence the image quality of swelling and microporous papers depends chiefly on the mechanisms of the image receiving layers. Swelling papers consist mainly of water-soluble polymers, offering high optical density, but slow drying, low gloss, disadvantageous curl and low water resistance.
Accordingly, it is an object of this invention to provide new and improved inkjet-receptive coating compositions for inkjet-substrates such as paper for efficacious inkjet printing.

SUMMARY OF THE INVENTION

What is described herein is an inkjet-receptive coating composition for efficacious, water-resistant inkjet printing which is:

(a) (i) swellable, water-insoluble polyvinylpyrrolidone (PVPP) particles and (ii) microporous silica particles, and (b) a binder for the particles.

In a preferred embodiment, (a) is 2-5% by weight, and (b) is 5-15% by weight, of the composition.

The (b) binders are polymeric materials such as polyvinyl alcohol.

A preferred microporous composition includes water at a suitable solids content, e.g. 18%.

DETAILED DESCRIPTION OF THE INVENTION

In accordance with the invention, there is provided herein an inkjet-receptive coating composition for efficacious inkjet printing. The composition is:

(a) (i) swellable, water-insoluble polyvinylpyrrolidone (PVPP) particles and (ii) microporous silica particles, and (b) a binder for the particles.

In a preferred embodiment, (a) is 2-5% by weight and (b) is 5-15% by weight of the composition.

Suitable (b) binders are polymeric materials such as polyvinyl alcohol.

A preferred microporous composition includes water at a suitable solids content, e.g. 18%.
The water-insoluble, crosslinked PVPP powder in the composition herein acts as a microporous inkjet layer and at the same time imparts water resistance to the print. Typically, the PVPP powder has an average particle size of about 27 micron and a BET surface area of about 1.9 m²/g.

The microporous or fumed silica component of the composition of the invention is a very fine particle size material. A typical fumed silica has a BET surface area of 380 m²/g, a high bulk density and a particle size in the range of 4-30 microns. Fumed silica particles stick together to form agglomerate particle chains.

The combination of PVPP and fumed silica is microporous in nature and its structure presents a honeycomb of pores to receive the ink. Such an admixture thus achieves high ink absorbing speed and image permanence without swelling the paper.

Suitably, the (c) binder in the coating composition of the invention may be any polymeric material conventionally used in commercial inkjet-receptive coating compositions, for example, polyvinyl alcohol, polyvinylpyrrolidone (PVP), gelatin, and the like. Polyvinyl alcohol and PVP are preferred.

Suitable weight ratios of PVPP and fumed silica are about 10-70% PVPP to 30-90% fumed silica, preferably 30-50:50:70.

The invention will now be described in more detail with reference to the following experimental results.
Coating Formulations

Formulations incorporating PVPP and fumed silica in ratios of 30:70 and 50:50 by weight were prepared with a polyvinyl alcohol (PVOH) material as binder therein. The weight ratio of PVOH to silica/PVPP was 1:2. With water, the formulations had an 18% solids content.

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Formulation A</th>
<th>Formulation B</th>
<th>Formulation C</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVPP (15% solids solution) **</td>
<td></td>
<td>141</td>
<td>235</td>
</tr>
<tr>
<td>Fumed Silica (15% solids solution) *</td>
<td>470</td>
<td>329</td>
<td>235</td>
</tr>
<tr>
<td>PVOH (35% solids solution)</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Water</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

* Sigma-Aldrich Chemicals (99.8% fumed silica, surface area 380 m²/g)  
** ISP Corp.

Coating Technique:

Each formulation was applied to 80 gsm ASA sized paper using the K coater, Meyer bar 0, speed 3. The coatings weighed 20-21 gsm, after drying at 100°C for 2 minutes.

Evaluation of Coated Paper Printing:

Both thermal and piezoelectric print heads were utilized:

HP DeskJet 930C – mode-plain paper draft print quality 300 x 600 dpi was used. Typically an Epson Stylus Photo 890 was used alternatively, plain paper, automatic, microwave on, high speed on – 360 dpi. Color blocks of black, cyan, magenta and yellow were produced on the printer for each formulation and for the uncoated base paper which was used as a reference.
for optical density measurements. Lines, DPI varying color blocks and interbleed color blocks were printed for microscopy.

**Printing Assessments:**

**Drying Times**

Each print was allowed to dry for 1 minute after printing, and then each color block was transfer tested (blotted) onto ASA 80 gsm. The amount of ink transfer was visually interpreted and scored 0 (total transfer) – 10 (no transfer).

**Optical Density and Water Fastness – Change in Optical Density After Water Immersion**

Water immersion 23°C/10 mins.

Instrumentation – GretagMacbeth D196, where the unprinted paper coating was used as the white base standard and the filmic coatings were overlaid onto ASA paper and the unprinted area used as the white base standard. The optical density was read over 4 areas on each color block to assess the variation (mottle).

**Preparation of Coated Papers**

The Flow Chart below was used to prepare papers coated with the compositions of the invention.
PREPARATION OF COATED PAPERS

PREPARE AQUEOUS DISPERSIONS OF RAW MATERIALS
PVOH 35% as supplied
Add the fumed silica slowly to the water, under high speed stirring;
then homogenize PVPP – warm water to ~40°C;
then add PVPP under high speed stirring

FORMULATE
Add PVOH to the PVPP stirring slowly
Add ~ ¼ weight of silica stirring slowly
Add water stirring slowly then remaining silica

COATING SLURRY

COATING
Coat onto A4, ASA sized 80 gsm paper using the K coater,
Meyer bar 0, 3 coats

DRYING
100°C for 2 minutes between coats

SMOOTH OUT THE WRINKLES
Place coated papers under pressure ~ 10 g/cm² for 24 hours

COATED PAPER FOR EVALUATION
RESULTS

1. DRYING TIMES

The dry time transfer test was a visual interpretation of the amount of ink transferred onto a standard base paper 1 minute after printing. All formulations scored 10 with no ink transfer.

2. INITIAL OPTICAL DENSITY

A slight decrease in optical density as the PVPP content increased in the composition was noted because the highly microporous structure of the fumed silica gave excellent print definition and ink resolution which could not be fully matched by PVPP. This trend, however, was very much less marked with the HP inks; typically, black HP pigmented ink showed no change in optical density with compositions containing PVPP.

The degree of variation in optical density (mottle) however, decreased as the silica was replaced by the PVPP, perhaps because PVPP provided a more even coating.

3. WATER RESISTANCE TESTS

As the silica was replaced by PVPP in the composition, the water resistance of the print increased significantly for both Epson and HP inks. Specifically, the Epson inks gave up to 68% loss of optical density after water immersion with 0% PVPP, only up to 13% loss with 30% PVPP and only a maximum of 7% loss with 50% PVPP in the composition. These advantageous results were only somewhat less pronounced with HP inks.

While the invention has been described with particular reference to certain embodiments thereof, it will be understood that changes and modifications may be made which are within the skill of the art. Accordingly, it is intended to be bound only by the following claims, in which:
WHAT IS CLAIMED IS:

1. An inkjet-receptive coating composition for efficacious, water-resistant inkjet printing comprising:
   (a) (i) swellable, water-insoluble polyvinylpyrrolidone (PVPP) particles and (ii) microporous silica, and (b) a binder for said particles.

2. A composition according to claim 1 wherein, by weight, (a) is 2-5% and (b) is 5-15%, of the composition.

3. A composition according to claim 1 wherein (b) is a polymer.

4. A composition according to claim 3 wherein (b) is polyvinyl alcohol or polyvinylpyrrolidone.

5. A composition according to claim 1 which is a microporous composition.

6. A composition according to claim 1 wherein (ii) is fumed silica.

7. A composition according to claim 1 including (c) water.

8. A composition according to claim 7 at a solids content of 18%.

9. A composition according to claim 1 wherein the weight ratio of (i) to (ii) is 10-70:30-90.

10. A composition according to claim 9 wherein said weight ratio is 30-50:50-70.