Environmental Effects on Image Bleed with Various Ink Jet Imaging Substrates

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Summary

A series of paper substrates, with and without ink-receptive coatings, were evaluated for image bleed under high humidity conditions on different ink jet printing systems. Both image bleed at time of imaging and upon storage after imaging were evaluated. Pigments and binders that act as ink insolubizers were found to be key factors in minimizing image bleed. Increasing coating weight was found to reduce image bleed in several cases.

Introduction

As new ink jet printing systems with higher resolutions and multiple color printing are introduced, the requirements for resistance to image bleed are increasing. This image bleed on ink jetpapers is defined in this paper as lateral spread of the ink image on the surface into an adjacent imaged or unimaged area. Anothertype of image bleed which involves penetration of the image into the paper, including degrees of image strike through to the back side of the paper, is not the subject of this paper. Image bleed in this study is evaluated as the ability to maintain resolution by minimizing bleed across non-imaged areas of one dot size in width and to maintain color quality by minimizing migration of one color unto another color that is one dot size in width.

The evaluation of image bleed was first done at the time of imaging. Since some ink jet papers exhibit increased image bleed after exposure to certain environmental storage conditions, a second evaluation was done after a period of exposure to a specified enviroriment. In initial screening experiments of different environmental conditions, it was found that the warm, humid condition of 30°C and 80% RH, among the operating and storage conditions recommended for the ink jet printing systerns, provided the most severe test for the image bleed This 30°C / 80% RH condition at the time of imagnag and after one-week's storage time was used in evaluating image bleed properties.

Although the ink jet composition and prmter vary considerably in these evaluations, we were interested in identifying any factors for minimizing image bleed which might be common among the different ink jet papers.

Experimental

All testing was done in an environmental room maintained at 30°C and 80% RH. The following commercial ink jet printers were placed in the environmental room for the imaging evaluations: Hewlett Packard Paint Jet XL, Hewlett Packard Desk Jet 500C, Hewlett Packard Design Jet 600,

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Table I. Image Bleed on Monochrome Ink Jet Printer.

Test No.	Basic Type of Paper	Special Coating Treatment	% Image Bleed (At time of Imaging at 30°C and 80% RH)	% Image Bleed (After storage at 30°C and 80% RH)
1.	Opaque Bond	Sizing A	100	100
2.	Opaque Bond	Sizing B	45	100
3.	Translucent	Sizing C	0	15
4.	Vellum	Sizing B at 6 g/m^2	15	85
5.	Vellum	Sizing B at 9 g/m^3	0	25
6.	Polyethylene Coated Paper	Coating A	20	100
7.	Polyethylene Coated Paper	Coating B	0	10

Table II. Image Bleed on Color Ink Jet Printer

Test No.	Basic Type of Paper	Special Coating Treatment	% Image Bleed (At time of Imaging at 30°C and 80% RH)	% Image Bleed (After storage at 30°C and 80% RH)
1.	Opaque Bond	Coating C at 6 g/m^2	100	100
2.	Opaque Bond	Coating C at 9 g/m^2	75	100
3.	Translucent	Coating C at 12 g/m^2	60	100
4.	Vellum	Coating D at 6 g/m^2	45	90
5.	Vellum	Coating D at 9 g/m^2	35	85
6.	Opaque Bond	Coating D at 12 g/m^2	25	70
7.	Polyethylene Coated Paper	Coating E	85	100
8.	Polyethylene Coated Paper	Coating F	0	5

Canon BJC-800, and Canon CJ-10. Printers and paper samples were equihlibrated for 16 hours prior to testing. After imaging, the paper samples were stored as individual sheets in the environmental room with the imaged side fully exposed to the environment for a period of seven days.

The papers evaluated were uncoated opaque bond translucent, and vellum papers, coated papers, and coated polyethylene extruded papers from experimental production.

Image bleed evaluation was done using test patterns where two black or cyan imaged bars, approximately I millimeter in width and parallel to each other, are separated by an unimaged or yellow-imaged if a color printer, area which has a width of one dot size of the printer in its highest resolution mode. Six samples were imaged for each test. Ten random readings per sample were made using a microscope to observe the percentage of the narrow gap contaminated with image from the wider bars. The average of these readings was calculated as the percentage of image bleed.

Results and Discussions

A series of papers were evaluated on a 600 DPI (dots per inch) monochrome ink jet printer, the Hewlett Packard Design Jet 600. These experimental papers varied in basic types and in materials used in sizing or coating or in coat weight as shown in Table I. On the opaque bond paper, the two sizings were applied at the same weight, but Sizing B had a resin additive with increased affinity for the anionic black dye in the ink. On the translucent paper, Sizing C was similar to Sizing B, but with a higher percentage of special resin and applied at a 50% higher weight. On the polyethylene coated paper, Coatings A and B were similar in coat weight and composition except that Coating B had a silica pigment with greater affinity to the black dye than the silica pigment in Coating A.

A second series of papers were evaluated on four-color ink jet printers: Hewlett Packard Paint Jet XL, Hewlett Packard Desk Jet 500C, Canon BJC-800, and Canon CJ-10.

Table II shows the results from the tests on the Canon BJC-800 printer with various experimental papers . Results on the other three printers followed these same general trends. On the opaque bond papers, Coatings C and D were similar in composition except that approximately half of the polyvinyl alcohol (PVA) resin in C was replaced by a combination of a cationic resin and a second resin with more affinity for insolubilizing anionic dyes. On the polyethylene coated papers, Coating E and F were similar in coat weight and composition except that Coating F had a modified PVA resin with better affinity to anionic dyes than the unmodified PVA resin in Coating E.

The presence of pigment or resin binder in sufficient quantity to act as an ink insolubilizng reduce image bleed was found to be a key factor in a series of controlled experiments. Blends of pigments and resins with these insolubilizing properties are an option to further improvements in resistance to image bleed.