Application Note:
Inkjet Media Print Quality Analysis

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Introduction

The nature of inkjet printing places many demands on inkjet media related to print quality. This creates some serious challenges that must be met by media developers and monitored by media manufacturers.

One of the keys to developing and manufacturing media that is competitive in the marketplace is precise quantification of the print quality. Having objective measurements of print quality is key to setting and meeting development goals and maintaining a consistent manufacturing process.

This application note discusses some print quality measurements useful for evaluating inkjet media.

Wicking, Feathering, and Ink Holdout

What is the difference between a paper towel and a piece of inkjet media? Paper towels are designed to pull liquids into the body of the paper, but inkjet media need to hold ink at the media surface and not allow the ink to wick into the body of the media or along its surface.

Ink wicking can be characterized by measuring the width and raggedness of printed lines using a device such as the Personal IAS or IAS-1000, as shown in Figure 1.

Sample	A	B	Delta
Line Width	914µm	962µm	48µm
Line Raggedness	3.2µm	6.4µm	3.2µm

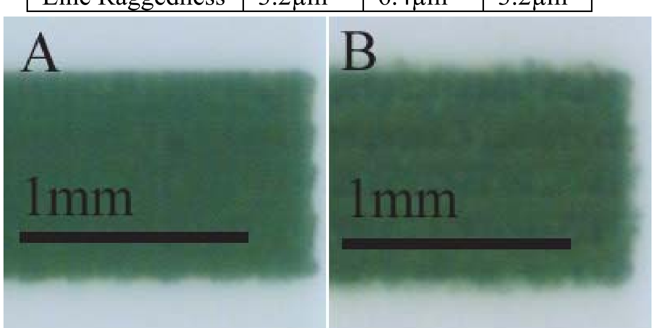

Figure 1: Example of wicking on two different media samples.

Media B is showing a significant amount of wicking compared to Media A. The line printed on Media B is 48µm wider than it is on Media A. This indicates that ink is moving laterally along the surface of Media B. A second indication is the increased raggedness (feathering) of the line edge for Media B. Line width and raggedness are defined in the ISO-13660 print quality standard.

Note that even though these differences are small, they are quite significant. Being able to measure small differences is essential to assessing print quality and objective instrument based measurement is the best way to do that.

Excess wicking can make text look either too fuzzy or bold. It can also cause small white text to almost disappear. Halftone areas darken as wicking increases. For many media developers, the wicking behavior must be made to match the behavior of the OEM media.

When assessing media wicking, lines in both horizontal and vertical orientation and a range of colors (CMYKRGB) should be examined.

Coalescence

Coalescence is the tendency of wet ink on the media surface to separate into areas of high and low concentration of colorant. The printed media appears "mottled" or non-uniform in print density.

Sample	C	D	Delta
Mottle (reflect.)	0.17	0.32	0.15

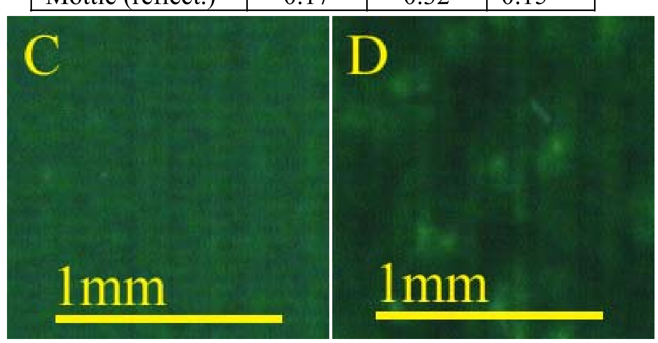

Figure 2: Example of coalescence (contrast enhanced)

Coalescence can be quantified using a mottle measurement method described in ISO-13660. The method divides the measurement area into a number of small square cells and computes the variation in reflectance or density in those cells. Smaller numbers indicate less variation.

An example of a coalescence problem can be seen in Figure 2 along with the mottle measurements. Note the non-uniformity in density for Media D compared to Media

C. The mottle value of Media D is significantly higher than Media C. Obviously, this mottled appearance is very undesirable in photographic prints or business graphics.

Coalescence problems occur most commonly in areas of high ink coverage, often in secondary colors (red, green, blue), and high tints (80% to 100%). When assessing media performance for coalescence, a number of patches of different colors in high tints should be measured. The different color patches will have different acceptance limits. Benchmarking should be developed for media types of interest. A quantitative objective method of measuring mottle is necessary facilitate this process.

Intercolor Bleed

Another print quality problem that has some similarity to wicking is known as intercolor bleed. Intercolor bleed is the tendency of wet ink of one color to bleed into wet ink of another color.

One way to measure intercolor bleed is measure the width of two lines that form a color pair. A color pair would be, for example, a cyan line on a magenta field and a magenta line on a cyan field, as shown in Figure 3.

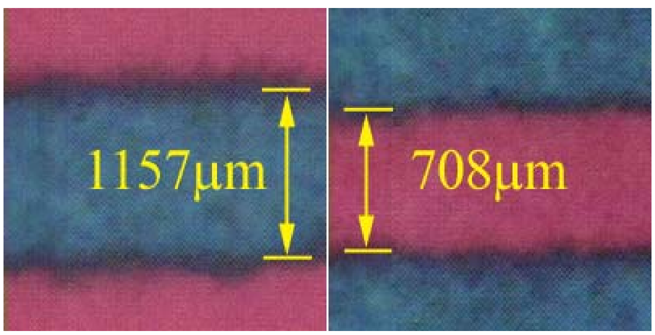

Figure 3: Measurement of intercolor bleed

Ideally, the two lines would have exactly the same width indicating zero bleed. But there is always some bleed. Bleed is computed by subtracting two line widths and dividing by four, e.g. (1157-708)/4=112µm. This indicates the distance each edge has moved from their intended positions.

Media can have a significant effect on intercolor bleed as shown in Figure 4. When evaluating media for intercolor bleed, all primary and secondary color combinations should be measured because it is difficult to predict which colors will bleed. Once experience has been gained, it may be possible to examine just a few troublesome colors.

Intercolor bleed can have an adverse effect on the quality of small colored text printed on a color background. In some cases, it can render the text illegible. In effect, intercolor bleed reduces the resolution of the printer.

Sample	E	F	Delta
Bleed (cyan/magenta)	65µm	112µm	47µm

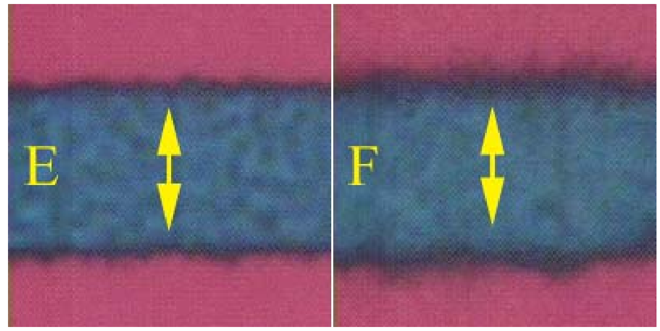

Figure 4: Intercolor bleed of Media E and F

Tone Reproduction

Inkjet media coatings affect the way ink drops absorb into the media surface and this, in turn, affects the density of halftone patches. This effect can occasionally be seen in a tone reproduction curves. A tone reproduction curve is a plot of reflectance (or density) vs tint value from 0% to 100%, Figure 5. Many printer manufacturers try to make this curve linear, while others seem to prefer a slight curve. When developing media for a specific printer, it is best to try to match the tone curve of the OEM media.

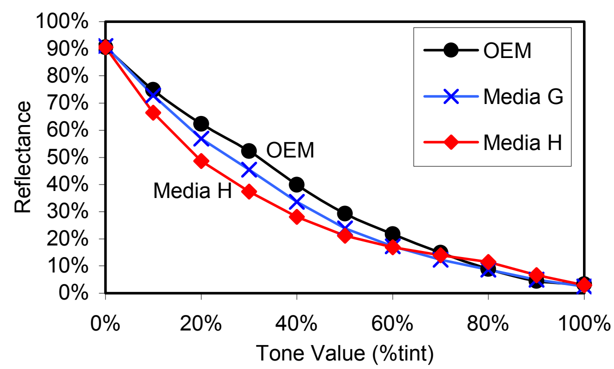

Figure 5: Tone Reproduction Curves

Often, excessive ink wicking can result in midtones being darker than is desired as shown in Figure 5. Experimental Medias G and H are darker in the midtones than the OEM media they are intended to match. This darkening of midtones will make photographic images look darker.

Another common problem is reach full maximum density black at 90% (for example) rather than at 100%. This can result in loss of details in the shadow area of images.

In Summary

Measuring wicking, coalescence, intercolor bleed and tone reproduction curves can quantitatively assess inkjet print quality. Color gamut and dry time measurements can be added to make the testing more comprehensive.