Kodak Graphic Communications
Canada Company
3700 Gilmore Way
Burnaby, B.C., Canada
V5G 4M1
Tel: 1.604.451.2700
Fax: 1.604.437.9891

http://graphics.kodak.com/
Request support:
https://ecentral.kodak.com/

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White Paper

Contact Name
William Li
Tel: +1 604 451 2700
william.li@kodak.com

Reducing Ink Consumption on Press: Using GCR or UCR Separations and Re-separations for Offset Printing

The Kodak® ColorFlow™ software manages various color control elements—curves, ICC device profiles, and ICC DeviceLink profiles—in one software application. ColorFlow handles the following tasks:

- Calibrates and coordinates the color behavior of presses, proofing devices, scanners, and monitors
- Establishes and maintains tight integration between the prepress workflow system and the various devices
- Controls color in a blended production environment—such a shop that uses offset and digital presses

The ColorFlow software stores and manages curves and profiles and applies its knowledge of color relationships to align curves and profiles for consistency. Color relationship management provides stability and consistency to color and reduces production costs and training needs.

The ColorFlow software is available with an optional Ink Optimizing Solution, which helps to reduce ink consumption and ink costs for web and sheetfed printers and to improve print quality through greater press stability. The Ink Optimizing Solution produces ICC DeviceLink profiles that can be used to re-separate images using Gray Component Replacement (GCR).

This white paper explores the concepts behind ink optimization and, in particular, the issues and opportunities related to printability with RGB to CMYK and CMYK to CMYK re-separations.

Converting RGB images for CMYK printing

Before going to press, RGB color images must be converted to CMYK process colors. Typically, image gamuts are compressed and colors may be modified as an image is transformed from the RGB gamut to the gamut of CMYK printing. This transformation can affect the on-press printability of the image in terms of color stability and ink usage.

Black ink reduces ink usage and stabilizes color

RGB contains three color channels. Four-color process printing requires the addition of a black channel to the three primary colors—cyan, magenta, and yellow. There are several reasons for the addition of black ink. When the color black is made from cyan, magenta, and yellow, it often appears “muddy” or less crisp than pure black ink. Also, making dark colors from the three chromatic process colors can lead to a higher than desirable volume of ink on a printed page. When compared to neutral colors made primarily from a single black ink, the consistency of neutral colors made from three process colors is more difficult to maintain on press.

The net effect of introducing black ink is reduced ink costs and increased color stability, especially in gray tones. The black component must be introduced to the color blend in such a way that it does not negatively affect the visual appearance of the image.

Two approaches to replacing chromatic colors with black

Two common techniques of introducing the black component are Under Color Removal (UCR) and Gray Component Replacement (GCR).

UCR separation

GCR separation

When large percentages of three process inks blend to form a color, there is a substantial neutral or gray component. Past a certain point, adding more of one process color simply darkens the result. The UCR technique uses black ink to replace some of the process colors in shadow areas and in neutral colors. For example, in a screen tint build of 50% cyan, 40% magenta, and 45% yellow, the addition of magenta starts the graying process, and its 40% value indicates the largest amount of black that can be added in place of other colors. The black component of a UCR separation resembles a “skeleton” image.

The GCR technique is a specialized form of under-color removal that involves a more general replacement of chromatic inks. In areas where the three chromatic colors are present—even in lighter tones—black is substituted for a partial amount of each of the three colors. The black component of a GCR separation resembles a complete grayscale image.

Benefits of GCR in the pressroom

Ink usage

To achieve the same final visual appearance on press, the difference in ink usage of GCR separations compared to UCR separations can be substantial. For example, in the images on page 2, the GCR separation uses only 68% of the volume of ink required by the UCR separation. This saving occurs primarily with the chromatic colors.

Color stability

Because a GCR separation uses a non-chromatic color—black—throughout the tonal range, it reduces the amount of C, M, and Y inks used in the midtones and quartertones. The color in GCR-separated images is more stable, even though solid ink densities normally vary through a press run. Added stability means that a press operator has less leeway to adjust color if required. However, the increased demand for a “by the numbers” print manufacturing process means that printers are moving away from making color on press. Rather than being a hindrance, the reduced leeway provided by GCR separations can be been seen as a benefit that supports this trend in the industry.

Other advantages

In addition to reduced ink usage and increased color stability, other benefits of GCR separations include:

- Reduced makeready times and faster startups
- Reduced fanout or web growth
- Dramatic improvement of image appearance in the event of slight press misregistration
- Reduced drying times
- Higher printing speeds
- Improved repeatability of print jobs

Potential issues with GCR in the pressroom

GCR separations make extensive use of black ink throughout the tonal range. This places a greater emphasis on the integrity of the black ink and press unit, particularly in a black first-down ink sequence. If there are issues of poor transfer, trapping, dot gain instability, or ink/water issues with the black printer, the impact on presswork is magnified. Also, because black is used throughout the tonal range, rosettes or moiré are slightly more visible in large, flat, screen tint builds. In cold-set newspaper applications where yellow is often first down, less yellow ink is laid down and, therefore, there is a slight reduction in the sealing effect of the paper before the other process inks are overprinted.

CMYK to CMYK—reseparating documents for press

The Ink Optimizing Solution for ColorFlow re-separates images, making it possible to optimize CMYK data that was targeted for one device condition to work with another CMYK device condition. It also enables you to change the maximum Total Ink Area Coverage and to apply the GCR separation technique to maximize ink savings and on-press color stability.

Reseparating images renders all separations in multi-page projects (such as magazines and newspapers) to a common color-separated format, which enhances the printability of the job.

The re-separation is accomplished by a sophisticated ICC DeviceLink profile embedded in the Kodak Prinergy® software. ICC DeviceLink profiles define the direct conversion from a specific source ink space to a destination ink space. The basis for creating a DeviceLink profile is an ordinary ICC profile or an industry-standard device condition such as SWOP C5 or FOGRA39. Using a DeviceLink profile maintains the integrity of the color separations so that pure C, M, Y, K screen tints remain pure and solid (100%) CMYK values.

Foundation for on-press success

In order to save ink with re-separated images and GCR separations and to achieve successful performance on press, several factors must be addressed. The validity of the DeviceLink profile is dependent on the data acquired from the device condition. Therefore, it is critical to start with a stable, reliable, consistent device condition. If the device condition is not stable, the data will be suspect, and it may not be possible for the press to return to its proper color response. In addition, inadequacies in the press or the inks will be magnified, which will reduce the effectiveness of the GCR separation technique.

sSummary

The ColorFlow software with the Ink Optimizing Solution provides the following benefits:

- Helps to reduce ink consumption and ink costs for web and sheetfed printers
- Helps to improve print quality through greater press stability
- Produces ICC DeviceLink profiles that can re-separate images using the GCR separation technique
- Uses ICC DeviceLink profiles to define the conversion from a source ink space to a destination ink space
- Uses ICC DeviceLink profiles to control the maximum Total Ink Area Coverage and provide ink savings and on-press color stability
- Allows CMYK data to be repurposed to work with various CMYK device conditions

About Kodak Graphic Communications Group (GCG)

The leading provider of graphic communications solutions worldwide, Kodak's Graphic Communications Group (GCG) offers image capture systems; professional color, copydot, and high-speed document scanning systems; inkjet printing and proofing systems; workflow and color management software; thermal imaging devices for film, plates, and proofs; high-quality proofing media, printing plates, and recording film; on-demand color and black-and-white printing systems; data storage products; and professional services. With corporate headquarters located in Rochester, N.Y., Kodak (NYSE: EK) has the largest global sales force and is committed to a digitally oriented growth strategy.

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