

Paper is the Fifth Color

The Impact of Paper on Color Management

By Ray Cheydleur, X-Rite's Global OEM Technical Manager and Color Integration Specialist

When we think about color management and what needs to be controlled to get the best result from the technology, we normally think of things like proper press maintenance, process control aims and tolerances, RIP settings, color management software, and the instruments used to take the measurements. Often forgotten --except perhaps as a small portion of the preparatory steps mentioned above—is the paper to be printed on!

Paper Choice

The choice of paper is critical for many designers and is often a fundamental part of the design. From both a design and production perspective, it is important to remember that paper is the fifth color. While many people believe that traditional color management is about managing the CMYK inks and their separations, paper has as much of an influence on the color of the final printed piece, as it does on the mechanical and chemical action of the inks or toners.

The initial choices made on paper selection may have little consideration of the impact later in the production chain, and sometimes have unintended consequences. Choices are often made based on price, brightness, color, finish, recycled content or other attributes. But when a paper is not directly specified in the design, it often then falls to the printer to specify a paper that fits in with the overall production goals, to meet the customer's general specifications, price considerations and production efficiencies.

A lot has changed in the world of paper. One of the biggest changes in recent years has been the increased use of optical brightening agents (OBAs) in many papers to give the appearance of a very bright, white paper. Printers have been known to accuse paper companies of using cheaper goods and “cheating” by using optical brighteners. In reality, the rise in the use of brighteners can be attributed to a host of reasons, including production efficiency for maintaining a consistent look to a paper with changing content, and a desire from customers for a brighter sheet at lower cost.

Another subtler problem can be the *intended* colorcast of the sheet. While in some ways we might consider OBAs an unintended colorcast, designers will sometimes purposefully choose a paper that has a colorcast. Then the question from a color management perspective is: do we need to do something about color balance because of the paper color without even worrying about OBAs?

Communication

Clear communication of goals and requirements up front is fundamental. Designers, paper manufacturers, standards bodies and printers all have different languages and standards of measure. Therefore it is important that expectations are properly defined from the outset on what is being requested and supplied. If a customer requires the printer to meet a certain printing specification, but specifies a paper that inherently does not meet that specification, this becomes a communication issue that needs to be solved prior to production. Similarly, it is important to understand what a paper supplier is giving you. Paper manufacturers have traditionally measured and reported colorimetric values and brightness using tools and specifications that are not commonly found in the graphic arts. A few paper companies now supply colorimetric characterizations specified at D50/2 degrees, which is the graphic arts standard. In any case, as with any incoming material, it is good to verify that what you think you are buying is indeed what you are receiving.

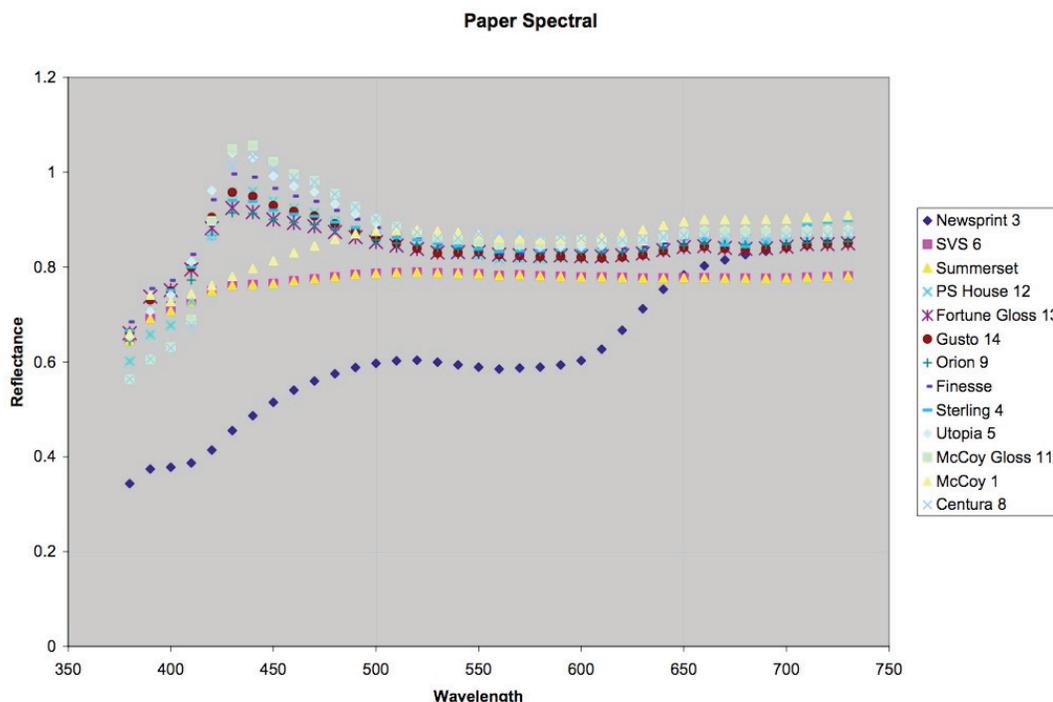
Printing Specifications

In the world of offset printing specifications, we often hear the terms “number 1 sheet” or “number 5 sheet”. In more specific terms these refer to the content, finish and brightness of paper based on ISO standards or printing specifications like SWOP and GRACoL. Unfortunately today this is, at best, polite fiction. It is virtually impossible to find a standard printing sheet that meets the original specifications, particularly in terms of colorimetric aims. There are specific proofing papers that meet these aims and we will discuss the impact of this later in this article. When we move to the world of digital print, we are even less likely to have standard papers that meet ISO and printing specification aims. What is a printer to do?

ISO, CGATS (Committee for Graphic Arts Technologies Standards) and organizations like IDEAlliance are working hard to address this problem from a specification point of view. Recognizing the issue, there are two fundamental approaches to solving the problem: changing the specification of the white point of

paper – an ever-changing somewhat elusive goal; or alternatively, provide for a method to dynamically adapt the specified white point within a range to meet the overall specification aim. This work is not yet complete but research has been done to show the applicability of these concepts.

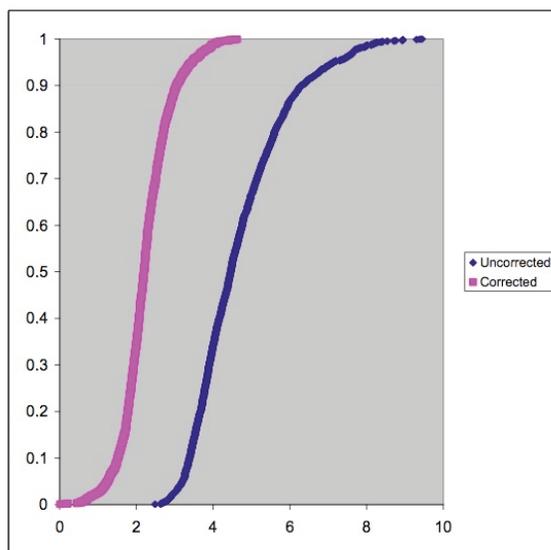
In the graph below you can see the amount of brighteners in papers commonly used today – the “hump” in the spectral curve between 400 and 440nm show the effect of the brightening agents. So a paper like Summerset has essentially no brightening agent but is fairly flat and neutral white, whereas Newsprint and McCoy Gloss are the more extreme examples in this chart.



The graph below represents the correction of one data set to another on papers with different optical brightener content.

McCoy 1 from Fortune Gloss

	L*	a*	b*	DE
McCoy 1	94.64	-1.32	3.38	
Fortune Gloss	93.12	0.83	-4.33	
Change	-1.52	2.15	-7.71	8.1446



Viewing Conditions and Paper

Maintaining proper viewing conditions for print evaluations is a key part of color management. The standards for viewing booths have changed over the last couple of years with the most recent release of ISO 3664 *Graphic technology and photography — Viewing conditions*. It may be difficult to see in this magazine but in the photograph below are two identical viewing booths: one is fitted with lamps that fit the latest standard, and the other is fitted with lamps from the previous standard. This, in combination with additional updated measurement standards, promises to tighten the agreement between measured results and what your eye actually can see.



Paper and Color Management

What additional tools can color management bring to the table to help tame the paper problem? Traditionally the way to “solve” the OBA problem was to ignore them. The primary way we ignored them was by using a filter that cut the UV light to stop it from hitting the paper and thus prevented the brightening effect of the OBAs. This is still a very effective approach to process control, but it is no longer the norm in color management. The other way we ignored it was by doing just that, not acknowledging the problem.

Today, we are much more likely to solve the OBA problem by quantifying the amount of OBA by including the UV in the measurement, and then adjusting the ICC profile to compensate for its presence. Some recent color solutions provide Optical Brightener Correction (OBC) technology, which allows you to fine tune the profile results by evaluating specific test charts against a series of Munsell color standards in the target viewing condition. This combination of physical standards and measured results allows for a uniquely precise correction for optical brighteners.

An additional parameter that can be handled in color management is the final viewing environment. Traditionally, a graphic arts workflow targets a daylight illuminant (usually noted as D50/2 – describing the illumination and viewing angle). One additional way to fine-tune the result is to define the viewing condition of the final destination or illumination at the intended point of use if it is not D50. This can be done by either using CIE defined illuminants or by actually measuring the lighting in the final environment.

Earlier in this article we asked the question: do we need to do something about *intended* colorcasts in paper? The answer is not fixed in stone. Modern color management solutions do allow you to bias your results to either a strictly neutral result with no consideration of paper color, or to a neutrality based on the paper color. This can be very important, as the human eye will quickly key in on the “white” of the paper and judge other colors on the paper based on that shade.

Best Practices

Be aware of the many different ways that paper impacts the final color of printed work. For proofing, carefully manage the amount of OBA content from proof sheet to printed sheet, and stay tuned for updated print specifications from ISO. When measuring paper, understand the impact of filters on the measuring device. Take advantage of all the options now available in a modern color management solution to make paper, the fifth color, an asset to the final product.

About the author

Ray has worked with X-Rite for more than a decade. Currently Ray works to integrate the technical resources within X-Rite with OEM partners to create new solutions. Prior to X-Rite, Ray ran a test digital imaging facility for Eastman Kodak, a successful photo studio in Chicago, and has managed both large and small photographic production facilities. Ray is chairman of ANSI/CGATS SC3 on metrology and participates in the US delegation to ISO on graphic arts and photographic standards.