ROOM: Retouch Once, Output Many with a New Color Reference File

Juergen Seitz[1] and Birgit Plautz[2]

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This article offers a little review of the past few decades of prepress and color communication technology, and suggests a proposal for a new reference image file from which to derive all files, no matter the output. In doing so, it is suggested that an RGB workflow might be the best way to deliver consistent color reproduction.

A reference in color communication is typically based on a creative idea that comes from content originators—typically those who design, colorize, paint—or perhaps even create a fabric. Often it is the print buyer who, with art directors, is controlling and driving color references.

But, to make it short, an idea from the designer is communicated down the chain to art directors digitally to prepress and then to its final form—which can be output in many digital and/or print forms.

What have we used for color references to make sure that the designer's expectations are met? How can we make sure that the dress that is seen in print or on a monitor is the true color?

One reference is physical. It has not been uncommon to bring physical samples to a press run—anything from textile samples, wood—you name it. These real, physical items are still carried to serve as color references for color critical reproduction. They are delivered as samples for retouching, or as reference pieces along with proofs.

If it is very critical, there are colorimetrical reference values that are considered.

If we look back a few years, there was one piece that effectively served as the color, contrast, modulation, sharpness...THE visual reference. It's the photo slide. Art directors would even bring the original photo slide into the pressroom with a color

[1]Senior Technical Advisor, [2]Manager, Technical Services
GMG GmbH & Co. KG

accurate light table to see if there were any issues with the reproduction.

Since pretty much all image sources are now digital, we have lost such a reference. We have successfully advertised our digital world as an advantage, even to those print buyers who have lost their physical references.

After many years debating about who is the better artist—the retoucher or the printer—we have graduated to standards for reproduction, taking into consideration, print, ink, paper, and all the related measurements to achieve accurately some ISO standardized printing processes. As a result, powerful tools already exist, and related methodologies to reliably deliver the expected result in print.

Because output processes are now well organized, standardized and controlled we have seen how, at the end, the output has set the rules for all color communication. The creative process has become more and more forced to respect all rules emanating from the final output medium, from the standardization in color measurement, and the viewing and print (primarily offset). In essence, the color control process was completely reversed, starting from the output process and ending with the content creator—even if the final output condition is not yet known.

The impact of the standardization of printing processes and printing conditions has been very powerful. Many organizations, working groups and consultants developed exceptional tools that have helped to communicate color in a way that we had not seen before. There are FOGRA data sets, CGATS21 data sets, and Japanese data sets describing different flavors of standardized printing, among others. There are even more ICC profiles and profiling tools that have been derived from these characterized processes.

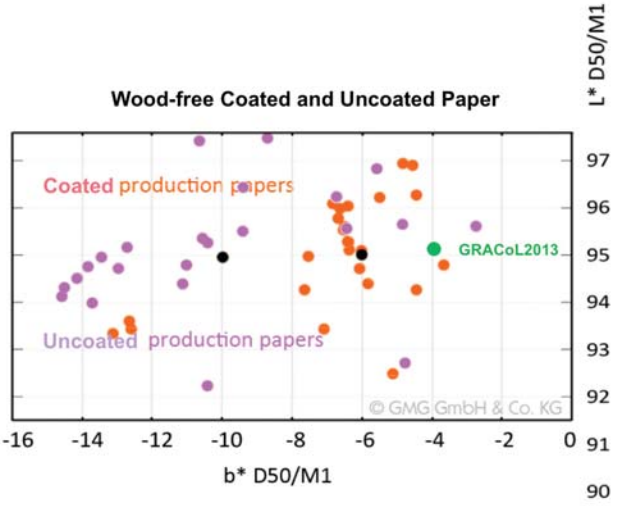

image 1

In the end, an actual print is still one snapshot of a final output of one of the analog output processes using a specific paper stock with a certain ink set based on a snapshot of standardized quality criteria, with local interpretations, using common measurement technologies and viewing cabinets, and of those analog printing conditions with all their restrictions. All of those standards and tools were created to support customer expectations with the lack of a real physical color reference. Where could we find such a reference? Is it my screen? Is it my GRACoL proof?

If it is my GRACoL proof, how accurate is this in an absolute comparison, if I look at the distribution of production paper tints (see graph)? With the actual M1 measurement condition all those paper tint measurements do spread even more than with the old M0 measurement.
If we look at this graph, it is obvious that, for example, GRACoL2013, might not be the best candidate. It is on the right, on the yellow side, compared to almost all the production papers in its class. Just imagine adjusting the paper tints from GRACoL to each of these papers!

References and Expectations Management

A reference may be absolute, like a spot color, where the printer has to create a very accurate match to a reference value, with defined and measurable tolerances. But to keep this example: already with spot colors on different substrates, an absolute reference may fail easily. (Think of a PANTONE® Reflex Blue on canvas or newspaper.)

A reference may be relative (like the photo slide in the past), where the task is to produce an expected match to a defined reference, where the task is to produce color according to the expectations.

So, how do we manage these color expectations? How do we communicate variations? For example, how do we handle print production that is going to be produced at several sites, with several technologies, on several substrates? If we look at those graphs of paper tints, we have to keep in mind that these are only offset papers. How are we going to handle even more variations in color-critical productions? What references can we really rely on now?

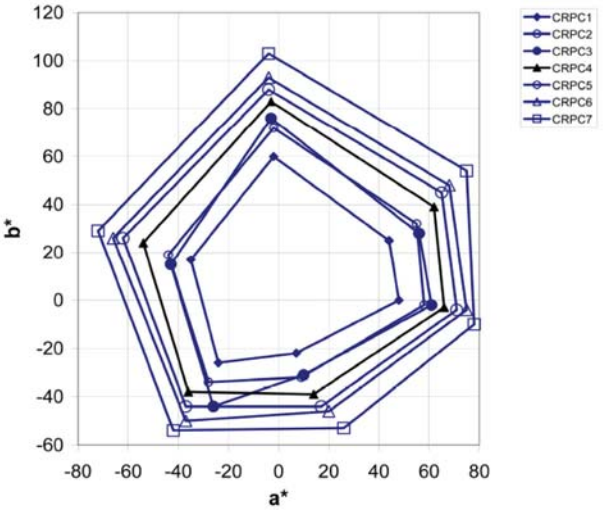

image 2

Is this graph a solution? In the CGATS TR 21, we can find seven color spaces that are well designed with a (G7) calibrated press on several papers with different white values. Unfortunately, the substrate will 'blow up' every one of these candidates to a multitude of avatars—which will confuse all prepress and design color communications to the max, if we want to work with absolute references.

We might now use a XYZ formula that can be trusted on a new paper stock. In the end, we need to communicate the new color set characterization in the chain so that we do not reduce the profile, but just multiply it by 'X'.

If we recap the past few years of prepress and print evolution we can consider:

- Current tools allow a visual accuracy that did not exist in the past. "What you see is what you get" works. We are now relying on measurements about what we will see later on.
- With high-end reproduction and the higher sensitivity of measurement and viewing conditions, the consideration of substrates is much more important than in the past.
- There are many forms other than analog printing processes that have to be considered (digital print, TV, internet, etc.) in many of the typical productions today. The number of output conditions will increase even further. When you have that many, how do you do accurately reproduce color? Paper selection is down the supply chain, far beyond retouching.
- This trend is not ending soon. The number of output media for high-end production will continuously increase. Color communication based on absolute references would require fingerprints from each medium to match.

Who defines the reference?

When it comes to color communication, we need to allow the one creative idea to go through, as much as possible, an automated process that considers all of the output variables to deliver one common result. This goes back to our initial understanding of where a color should come from: How can we empower the creative people and their image decisions? We need to deliver better strategies than just following fuzzy color references from print. Certainly today's tools and mathematics can deliver better processes.

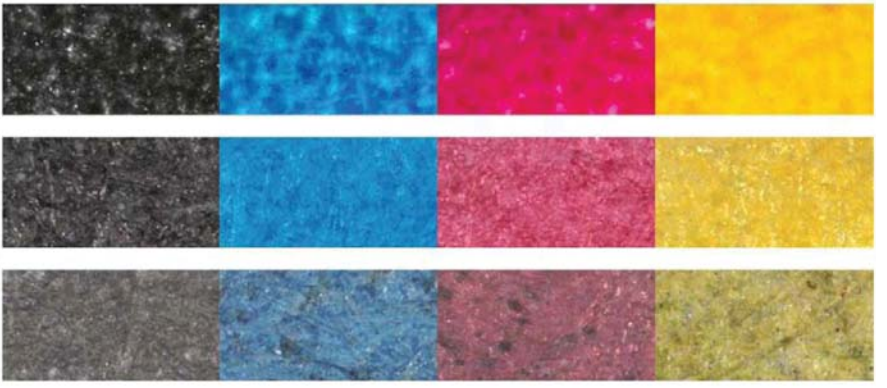

Abbildung A-135: Mikroskopaufnahmen von Primärfarben-Volltöne, die standardisiert auf Bilderdruckpapier (1), Naturpapier (2) und Zeitungspapier (3) gedruckt wurden.

Source: ProzessStandard Offsetdruck des bvdm, www.prozess-standard.de

image 3

It should be as easy as this example of, from top to bottom, coated paper, uncoated paper, and newsprint. For the most part, we would accept these CMYK printed samples to be aligned, even though we may see a heavy ΔE. Color is relative. Absolute color is the exception in most use cases in our traditional publishing world.

The most important tool in color communication is a reference, in the best case a physical reference. We can use proofing systems to deliver a master proof, a kind of "paper-photo slide"—a reliable, accurate color output that represents what we want. And this "paper slide", as we call it, can be perfectly aligned to fulfill the many aspects of a typical customer's expectations. In the new model, we replace the photo slide with a master proof—a soft or hard copy proof to offer a common appearance for the entire chain.

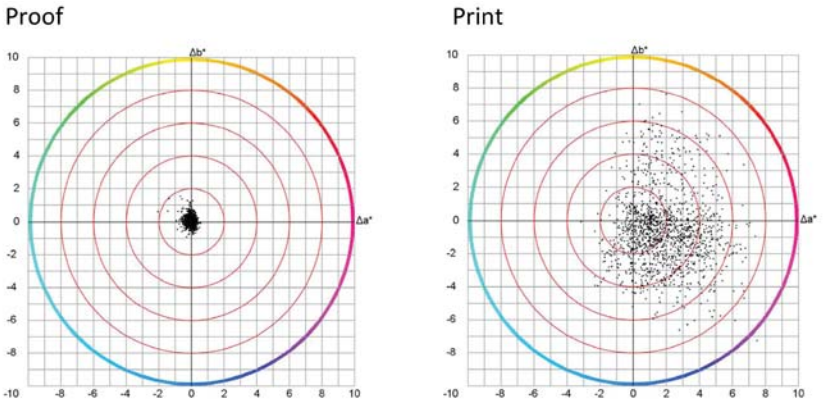

image 4

In the entire chain of color communication, the hardcopy proof provides the easiest and most accurate color reproduction. From the original to the final 'converted' or printed product the proof is more accurate than any printed sheet from, e.g., an offset press.

Candidates for color communication references

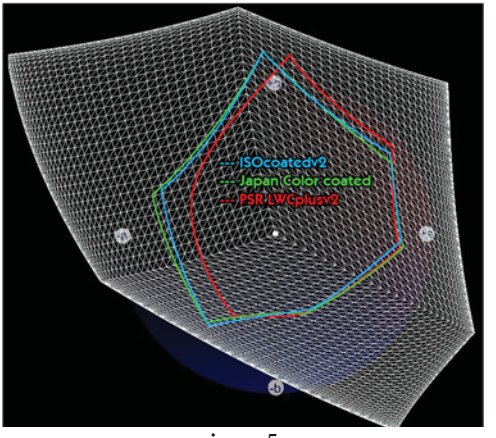

image 5

Let's look at RGB as a reference.

If we compare an RGB color space with some offset printing color spaces, we can see that characteristics like shape and dimension are significantly different. If we are working in RGB, everyone can easily understand that there is a challenge to compress this color space to something printable. The shapes of these gamuts are also much different. In some areas we have almost the same size, in other areas the RGB color space far exceeds the capabilities of CMYK. If you retouch for one color space, you reduce the benefits of the other space. This is not a good gamut mapping strategy.

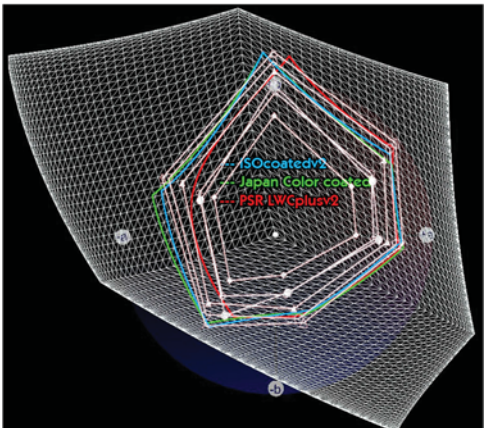

image 6

We can see that the basic characteristics of many different traditional CMYK color spaces seem to be comparable. Even though their sizes differ, the shape—and with it the color—compare well with each other. There only needs to be a minimal amount of transformation to match all of these printed spaces.

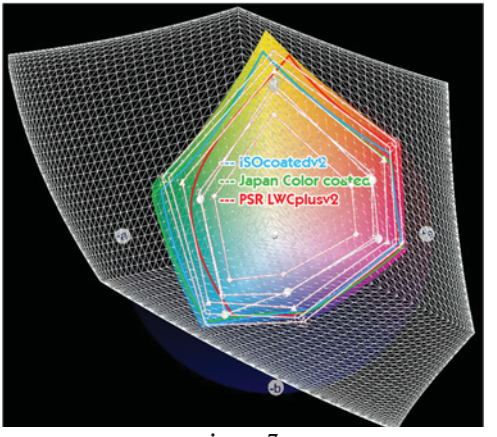

image 7

When GMG worked several years ago on tools to create an easier way to handle an RGB workflow, we decided to use these core characteristics in a comparison between RGB and CMYK as a key. The most important step to conquer must be a common characteristic in the interpretation from an RGB-shape to a CMYK-shape. Size should not matter as much (remember the 3 CMYK coated, uncoated and newsprint prints). Our ColorMaster was born as a virtual CMYK communication color space.

(sub) Automation in color communication

Here‘s a list of ingredients for an RGB color handling-approach:

- Controlled expectation: Probably most important is the up-front clarification of what a relative color experience looks like
- Excellent gamut mapping: But then, really great dynamic gamut mapping is needed that avoids any choice from relative to perceptual, handling RGB and Master-CMYK to a common appearance final output result. We have developed mapping so that the center of the color space reveals as little gray and skin tone changes as possible
- Reduce absolute color references to where it has to be
- Establish and educate users on the use of a physical reference— a “paper slide”

Here is a short description of an empirical method to improve and control the expectations we have developed during the past several years.

(sub) Choice of reference images:
We started by collecting all images that are critical in color comparison, with multiple samples. Over the years we had already collected image and technical material for visual evaluations of color comparisons. In 2008/ 2009 we additionally supported diploma work on this topic.

Some of the criteria that we evaluated and took into consideration include:

How well do my images cover the gamut? We used a tool that allows us to represent every pixel of an image by a dot. We try to use images that cover the entire gamut so we are not missing certain spots during our evaluations.

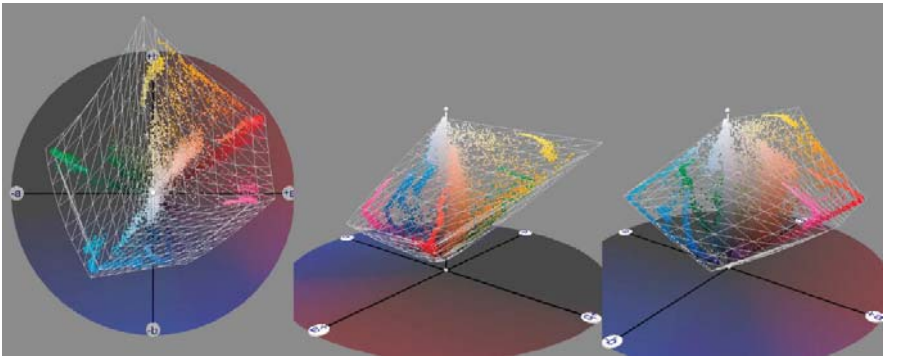

image 8

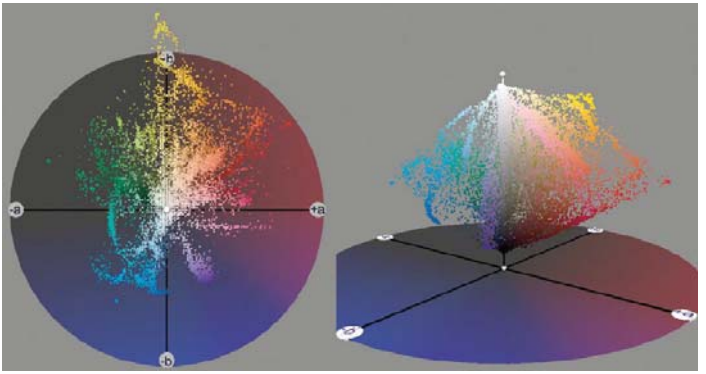

image 9

This brings us to the selection of required images:

image 10

Using eye tracking, we determined which image was the most interesting. We also selected different important areas for color quality.

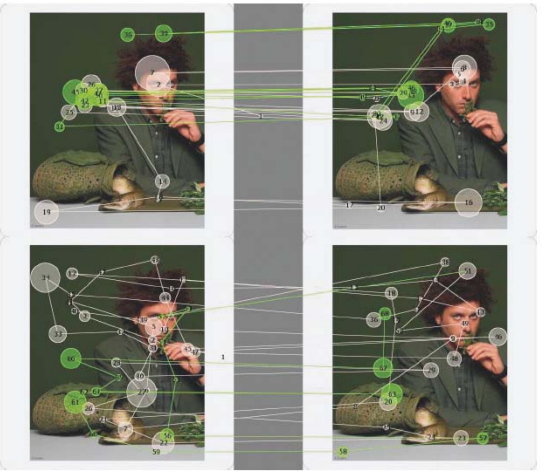

image 11

This was followed by identifying the most important areas of each different image.

image 12

Then, a group of experienced color management people reviewed each and every image, output in many various ways, while determining gamut mapping results—from several RGB color spaces to many CMYK-spaces, from newsprint to multi-ink-inkjet.

image 13

We added step wedges to improve the usability of the images in a visual comparison.

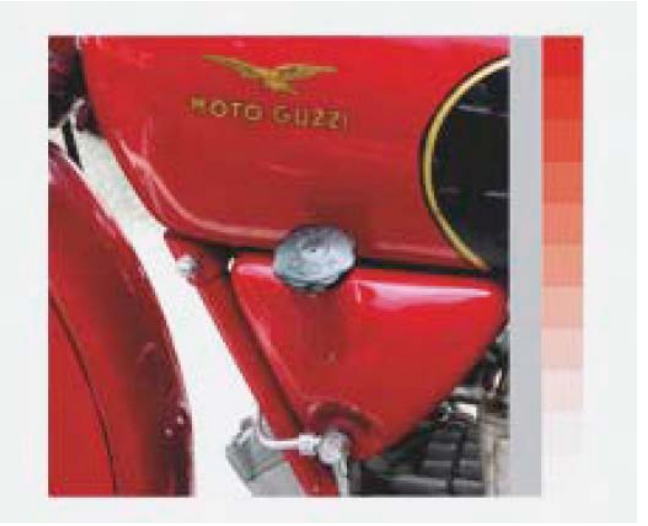

image 14

Then we evaluated the impact of sharpness and detail contrast within the visual assessment...

image 15

image 16

image 17

Besides those image-related criteria, several technical images were chosen to check conversion smoothness and the quality of gamut compression on a more technical level.

For the diversity of input RGB-color spaces, we always start with AdobeRGB1998, sRGB and ECI-RGBv2.

After we evaluated and chose our images and described their use, we analyzed the diversity of the many global print references in order to understand representative output conditions. Differences of the ink systems, the printing processes,

and the primary printing color hue angles were considered. At the end, four output conditions were chosen to represent a good 'standard' of all the critical criteria in a traditional printing prepress setup: offset coated, offset uncoated, gravure LWC, and coldset newsprint.

All smooth check elements and images were controlled with all combinations from the three RGB-spaces to the four output CMYK color spaces. The visual appraisal was either done on a calibrated screen or on a calibrated proof. After the evaluation of the smoothness within all of the different color sectors, the colorimetrical evaluation was done and captured in Excel tables. A minimum of three experts conducted each appraisal. In the case of contradictory results, the team reviewed the issue.

As a result we went through five years and three major releases of gamut mapping formulas that are designed to fulfill the best average and expected results—and are very well received by our customers. The target of our research and quality of the gamut mapping was to deliver an automated color conversion quality that convinces print buyers to skip traditional (and uneconomical) CMYK-retouching.

We will skip the RGB-preview—the RGB-image on an RGB screen. A bright, modulated color promise will never be fulfilled in any CMYK-based output conditions.

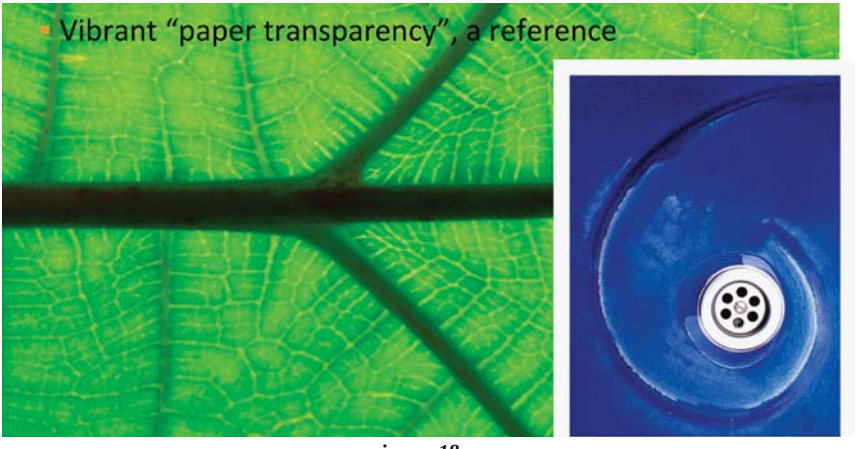

image 18

Our preview is our ColorMaster. This is also the shell of CRPC7. This represents a vibrant, but not over-promising, color appearance. The image is RGB, but the preview is using GMG GamutMapping to preview this result. This is what the customer gets.

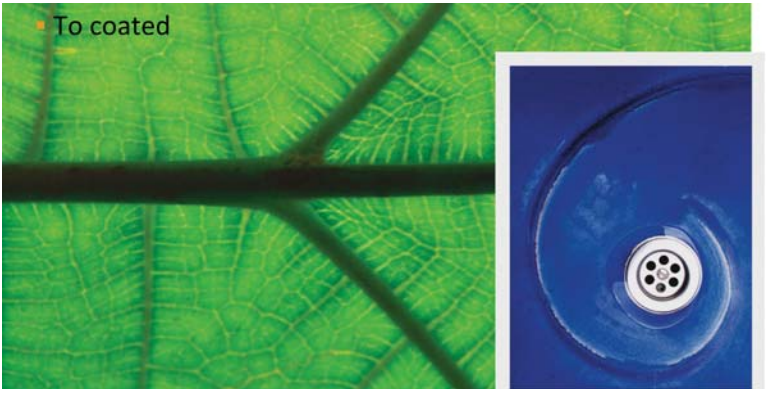

image 19

This is the printed result if the end product is going to be printed on swop#3...

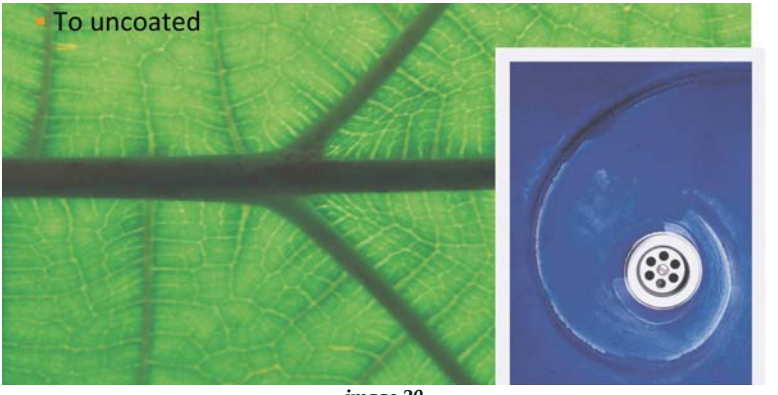

image 20

...or on uncoated paper...

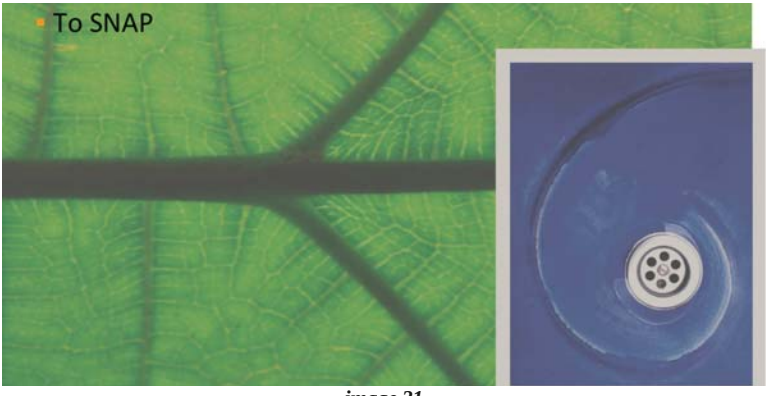

image 21

... or on newsprint in coldset.

The expectation can still be handled to the satisfaction of the customer. Blue has a tendency to turn magenta or purple. Green can turn blue or yellow—but not with the consistent results from the developed gamut mapping, shown with these samples.

(sub) Success in the real world

This ColorMaster reference file went through its 'proof of concept' under one of the most demanding tests: a task from an international customer, printing throughout the world.

With their catalogs, one creative idea goes through many printing processes and local standards—printed at many print facilities throughout the world. Whether offset or gravure, and on many substrates, there is one expected result.

Using a ColorMaster reference for all color communication, this customer saves 80% of retouching costs compared to their past working practices, where every image was finalized as a CMYK file.

Their feedback is that they have never been as good and as well aligned with their many global production sites:

- The number of print starts where their quality control team is attending has been dramatically reduced.
- None of the images that are printed in any of their catalogues or brochures has been treated in CMYK.
- For several years now, the art directors who sign off on the 'color OK' have stopped looking at any of the final proofs. All color judgments are done with "paper slides".
- Final separations to one of the 38 color workflows in this year's production work was fully automated. Hardcopy proofs were printed directly from the final data and sent to the printer—without production staff even seeing it.
- All of this is successfully done under the many print standards, even more substrates, and working with 30-40 printers every year.

A new reference file

Using ColorMaster as reference in color communication returns the power of color management to the art director, where it belongs, However, in the process, it provides a reference that is realistically reproduced no matter the final output: all forms of print or digital reproduction.

Most important, this reference file still works within all global standards and processes. At the end, the content originator is happy because what is created is what is produced—while anyone in repro can easily match the reference. In this case, everyone wins.