Metamerism 101: When brown is green and red is blue

By Jeff Lewis – May 2005

Have you ever gotten up in the morning and, in the warm glow of your tungsten-lit bedroom, put on a pair of brown socks – then when you reach the cold, fluorescent light of the office, you realize that you are actually wearing one brown and one green sock?

You have just become the victim of metamerism. While it is an embarrassing situation (if you are a colorist by profession, it is worth a trip back home to change), in certain commercial applications, it can be costly as well.

Metamerism (also called paramerism, but for practical purposes, we will stick to the more common and accepted *meta* prefix), can be defined as occurring when a pair of objects appear to match under one set of conditions and fail to match under alternate conditions. There are three types of metamerism: illuminant, observer and geometric. Observer and geometric metamerism are rarely encountered in industry, so we will focus on illuminant metamerism in this article.

It must be understood that color is a perception (sensation), not an intrinsic quality of an object. Without going into a full color course, the color we perceive is the result of light interacting with and being modified by an object. This modified light is then reflected or transmitted to an observer who then interprets the results. This interpretation is what we call color.

The object's contribution to the color is restricted to its absorption of specific wavelengths of light. The color we perceive is what remains—the reflected light. Since what's left is the combination of the light and the object, we are only subjected to the combined stimuli.

Metamerism occurs when two objects, which have different spectral absorption distributions, are made to match in a specific illuminant, such as daylight. These objects, when viewed under tungsten light, could appear very different in apparent color. The reason for this is that tungsten has a much stronger red component than daylight. Discrepancies in the absorption in this area of the spectrum will be enhanced. The result is a visual mismatch.

The simplest method of eliminating metamerism is to strive for a curve match—where both the visual color and the spectral curve of the objects match. Depending on circumstances, this is not always possible. For example, if the standard panel is an ink swatch or a thermoplastic chip, the colorants used to make that standard may not be appropriate for the intended application.

Factors, such as light or temperature resistance or toxicity restrictions, may dictate selection of a pigment that is not used in the standard.

In these cases, it is necessary to choose a primary illuminant to do the match, and then to measure and be aware of the color differences that will be encountered in alternate illumination conditions. The colorant supplier and customer must work closely to avoid confusion and disappointment in the color matching process.