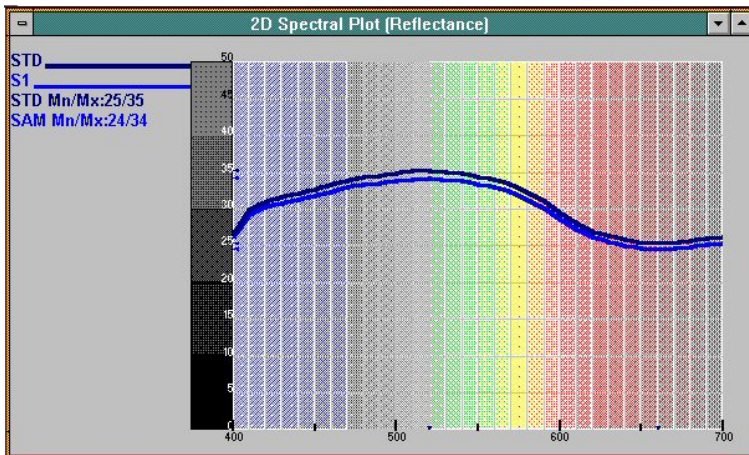# Metamerism

The light in which an object is viewed can definitely affect its appearance. Does the fluorescent lighting in a department store dressing room really show you how an outfit looks on you, or do you have to wait until you get outside to judge the color? Does a car look the same under bright sunlight as it does under a dim streetlight at night? The lighting under which color is judged is very important.

Metamerism is the phenomenon by which a pair of spectrally different specimens match under one illuminant, but not under other illuminants. Textile dyers, for example, measure metamerism to ensure that the fabric used for shirt sleeves matches that used for shirt bodies under indoor fluorescent and incandescent lighting, as well as outdoor natural daylight. Metameric fabrics would not achieve this match under all lighting conditions. Because metamerism involves the spectral reflectances of samples, a spectrophotometer (rather than a colorimeter) is required to evaluate it.

The spectral curves of two closely matching, non-metameric samples are nearly identical, as shown below. The difference in non-metameric samples is usually related to dye strength or concentration. The samples could theoretically be made to match perfectly.

Under D65/10°:

Standard L = 57.44, a = -5.96, b = 0.23
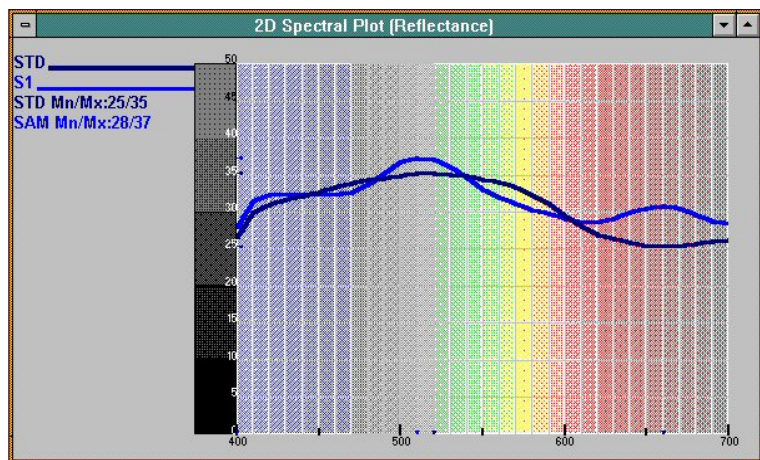Sample L = 56.55, a = -5.77, b = 0.03

Under Fcw/10°:

Standard L = 57.24, a = -4.62, b = 0.13
Sample L = 56.34, a = -4.47, b = -0.04

Metamerism Index = 0.05

Items measured using ColorQuest II Sphere and Universal Software.

The spectral curves of two metameric samples cross in several spots, but do not match completely, as shown below. Metameric samples usually contain different pigments or dyes. They will never match perfectly, but can be used like a match if the metamerism index is low.

The world's true measure of color

HunterLab

Under D65/10°:

Standard L = 57.44, a = -5.96, b = 0.23
Sample L = 57.35, a = -5.76, b = 0.16

Under Fcw/10°:

Standard L = 57.24, a = -4.62, b = 0.13
Sample L = 56.66, a = -4.29, b = -0.56

Metamerism Index = 0.79

Items measured using ColorQuest II Sphere and Universal Software.

Metamerism Index is used to measure the degree of metamerism. It is calculated with respect to two different illuminants. With HunterLab software, you can choose the illuminants for which metamerism will be calculated. Metamerism Index is based on Hunter L, a, b values as shown below:

$$MI = \sqrt{\left(\Delta L_{n1} - \Delta L_{n2}\right)^2 + \left(\Delta a_{n1} - \Delta a_{n2}\right)^2 + \left(\Delta b_{n1} - \Delta b_{n2}\right)^2}$$

where n1 is the first illuminant, n2 is the second illuminant, and $\Delta = \text{Value}_{sample} - \text{Value}_{standard}$.

In general when performing color matching, if the metamerism index is less than 0.5, you have made an acceptable match. An MI of greater than 0.5 but less than 1 is doubtful; you may wish to reformulate. An MI of greater than 1 requires reformulation.

Note: Fluorescent illuminants are always the most difficult for matching. You may wish to allow some leeway in your specification when dealing with a fluorescent illuminant.

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