PRINCIPLES OF COLOR TECHNOLOGY

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F. Other Quality Metrics

- **Matamerism**
  - Stimuli with different spectral properties can match visually
  - Blessing
    - Enabling color reproduction using a few colorants
  - Cursing
    - Matches are conditional

- **Metamerism Indices**
  - Matric to help select the best recipe
– Illuminant matamerism

Pairs of colors with different spectral reflectance curves can match under one set of viewing and illuminating conditions, but fail to match under another.
– Observer metamerism

Mismatch due to a change in observer.
Reference condition

- Metameric pair match

Test condition

- Degree of metamerism is evaluated

Metameric index, MI

- Special index of metamerism

\[
MI = \left[ \left( \frac{\Delta L^*}{k_L S_L} \right)^2 + \left( \frac{\Delta C^*_a b}{k_C S_C} \right)^2 + \left( \frac{\Delta H^*_a b}{k_H S_H} \right)^2 \right]^{1/2}
\]

where \( \Delta L^* = L^*_\text{batch} - L^*_\text{standard} \)

- Weighted metameric index

\[
MI_{\text{weighted}} = \frac{w_2 \Delta E^*_{a b, A} + w_3 \Delta E^*_{a b, F_2} + \cdots}{w_2 + w_3 + \cdots}
\]
- **Metamer**
  - Spectrally different objects or color stimuli that have the same tristimulus values

- **Paramer**
  - Specimens having different spectrophotometric curves produce approximately the same color sensation under the same illuminating and viewing conditions

The pair of specimens is highly metameric.
Color inconstancy index

- Color constancy
  - Tendency for samples to retain their color appearance despite changes in the color and level of illumination

- Color inconstancy
  - Because of poor color memory
  - Considering much of our colored world as color constant when most specimens lack color constancy
Under different illuminations
- Color inconstancy index, CII

\[
CII = \left[ \left( \frac{\Delta L^{*}}{2S_L} \right)^2 + \left( \frac{\Delta C_{ab}^{*}}{2S_C} \right)^2 + \left( \frac{\Delta H_{ab}^{*}}{S_H} \right)^2 \right]^{1/2}
\]

\[
CII = 7.3.
\]
G. Summary

◆ Color tolerance
  – To evaluate historical and visual data and optimize the tolerance limit using an appropriate color-difference equation
CH 5. Colorants

◆ Perceived color of an object
  – Combination
    • Spectral power distribution of the light source
    • Spectral transmittance or reflectance of the object
    • Spectral sensitivities of the eye
    • Brain’s interpretation

◆ Colorant
  – Substances modify the perceived color or impart color to colorless objects
    – Dyes and pigments
A. Some Matters of Terminology

- Color and colorant

PIGMENTS
B. Dyes Versus Pigments

◆ Dye
  – Water-soluble substance from an aqueous solution

◆ Pigment
  – Insoluble, particulate material dispersed in the medium it colored
- **Solubility**
  - Dyes are soluble, and pigments insoluble

- **Chemical nature**
  - Dyes are organic, and pigments inorganic

- **Transparency**
  - Dyes are used to color a transparent resin without spoiling its transparency
  - Pigments are used if opacity is desired
– Transparency

Same colorant, different transparency depending on its particle size and degree of dispersion.
– Transparency

Reflective index different from that of the material to scatter light efficiently.
◆ Presence of a binder
  – Dye: Becoming a part of the colored material without the need for an intermediate binder
  – Pigment: Requirement of a binder

◆ Summary
  – Dye: Soluble, organic, transparent, no need for a binder
  – Pigment: Insoluble, inorganic, opacity, binder
The End