POLARIS

White Star

Software for Whiteness

Introduction

Whiteness is the perception invoked by objects appearing to show the color white; there is a large difference between objects appearing to be white and of those being white. These are two different concepts that, while related, should not be confused and can be defined as follows:

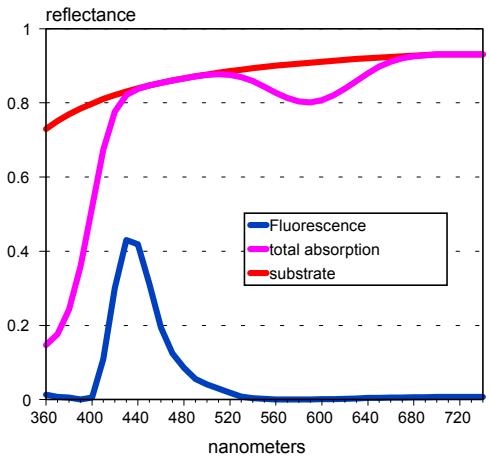
- The color white has no saturation and a very high lightness value. As such all colors located along the "achromatic axis" are perceived, depending on their value of lightness as white. Actually only those having lightness values over 80% are seen as white, unsaturated colors with lightness values below 80% are seen to different extents as gray.
- Whiteness is the color impression of those objects appearing as white to the observer. In general they have a finite value of saturation that lies in the blue region of the color space, a high level of lightness is prerequisite for whiteness perception.

To achieve high values of whiteness different methods of color mixing are applied; these make extensive use of shading dyes and Fluorescent Whitening Agents, thus resulting in a combination of additive and subtractive color mixing techniques. The use of fluorescence introduces a strong dependence of the observed color on the illumination environment, remarkably on the levels of ultraviolet (UV) light, a portion of the spectrum that is invisible to human eyes. The dependence of whiteness perception on illumination introduces a strong metameric effect that demands a careful treatment and a systematic approach. One mandatory requirement is the separation of additive and subtractive color mixing elements contributing to the perceived whiteness in order to determine their extents and impact on the metameric effect shown by the object.

Measurement principles

Due to the dependence of fluorescence on the amount of UV light during the measurement, its amount must be carefully regulated and maintained in order to assure stability and reliability of the results; this is normally achieved by introducing a movable UV-cut-off filter.

Polaris takes full advantage of Minolta's Numerical UV Control, which is further modified for fluorescence quantification; with this approach the sample is illuminated with different amounts of UV light to excite fluorescence, the detected light is processed by the software to separate fluorescent and non-fluorescent parts, as depicted in the figure.



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Polaris is the most modern development in the field of whiteness measurements. It operates in conjunction with a modified instrument of the Minolta 3600 series and takes full advantage of the Numerical UV Control (NUVC). Polaris introduces a new philosophy in measuring and understanding whiteness appearance, which allows the exact control of high levels of whiteness and achieves stability during manufacturing.

Furthermore Polaris extracts the effect of shading agents in order to determine the base white of the substrate. This allows separating contributions to whiteness as originating from substrate alone, substrate with shading agent and total whiteness, giving thus a full picture of the parameters involved and resulting metameric effects.

Features

Colorimetric data calculated include:

Illuminants: D_{65}, A and TL-84
Observers: CIE and ASTM 2° and 10°
Color: (X,Y,Z), (x,y), (L*,a*,b*)
Color differences: CIE, CMC, DIN-99, CIELAB2000
Whiteness: CIE, Ganz, Berger, ASTM; CIE whiteness is calculated for different illuminants; CIE and Ganz whiteness numbers are decomposed into their components
Paper brightness: ISO and ISO fluorescence D_{65}
Opacity: Tappi and ISO
Yellowness index: ASTM

Supported fluorescence standards: STFI, TITV, Hohensteiner Institute

Languages supported: English, Spanish and German

Hardware requirements

- PC with operating system Windows 98/2000/NT 4.0
- Pentium processor (recommended at least Pentium III); hardware configuration should match requirements of the operating system
- Monitor SVGA with at least 1024x768 resolution
- 20 MB free space on hard disk for program and database
- Free serial interface RS-232 for communication with the instrument

Package content

- Spectrometer Minolta of the 3600 series modified for whiteness measurements. Models 3600/3610 have d/8° (SCE/SCI) and model 3630 has d/0° (SCE) geometries.
- Polaris software (basic version) on CD
- Valid fluorescent calibration scale (TITV) for setting fluorescence values with calibration data on CD
- Fluorescent plastic tile for calibration maintenance

Future versions

Version 1.2: communication module for full technical support through the Internet
Version 1.3: calculation module of scattering and absorption, and module for recipes of substrates and fillers
Version 1.4: module for recipes of shading agents
Version 1.5: module for recipes of Fluorescent Whitening Agents

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