Color Rendering: A Tale of Two Metrics

It was the best measure of color rendering; it was the worst measure of color rendering.

Color rendering index (CRI) is the most common metric used by the lighting industry to represent the color rendering properties of electric light sources. CRI was intended to characterize how "true" or "natural" objects appear when illuminated by a light source. However, it was never intended to represent how well object colors can be differentiated under a light source.

LRC researchers examined CRI and other metrics of color rendering to determine how useful they are at predicting subjective judgments of how "natural" objects appear, how "vivid" objects appear, and how well one can discriminate between subtle differences in colors.

Experiments

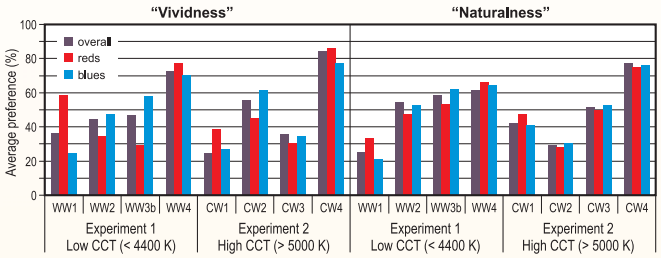
Researchers performed three experiments to examine the color rendering properties of different phosphor-based light sources.

- Experiment 1 used only low (<4400) CCT
- Experiment 2 used only high (>5000) CCT
- Experiment 3 used both low and high CCT

Each experiment used two types of tasks. A color discrimination task required subjects to perform the Farnsworth-Munsell 100-hue test under four different light sources and under two light levels. A paired-comparison task presented subjects with a collage of photos showing two species of birds (blue jays and cardinals). Subjects compared the "naturalness" and "vividness of the blues and the reds under the different lighting conditions. They also assessed the overall "naturalness" and "vividness" of the collage itself.

Farnsworth-Munsell 100-hue test

Paired-comparison task



The graph above shows the subjective judgments of "vividness" and "naturalness" at 50 footcandles for light sources with various CCTs. Note that WW4 and CW4 have high CRI and GAI for both experiments.

Results

When used in conjunction with another measure of color rendering (gamut area index [GAI]), CRI is useful at predicting subjective judgments of how "natural" and "vivid" objects appear, and how well one can discriminate between subtle differences in colors. Neither measure by itself meets all of the expectations of a light source for providing good color rendering under all viewing conditions. Alone, GAI is better than CRI as a predictor of color discrimination. Light level is also important for color discrimination.

More research is needed to determine if just two metrics are sufficient to ensure good color rendering from a light source and whether CRI and GAI are the best metrics to use. However, it is clear that using these two-metrics together will be a useful improvement over relying solely on CRI as the measure of color rendering.

The scientific paper, "Color Rendering: A tale of two metrics," will appear in the journal *Color Research and Application*.

Sponsor

U.S. Environmental Protection Agency

Rensselaer

View LRC Project Sheets at
www.lrc.rpi.edu/resources/newsroom/projectsheets.asp

Lighting Research Center

Lighting Research Center, Rensselaer Polytechnic Institute • 21 Union Street • Troy, NY 12180 • (518) 687-7100 • www.lrc.rpi.edu