Colour rendering properties of LED sources

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Seen under different light sources object colours can change due to differences in light source spectral power distributions and thus differences in their colour rendering properties. Standard methods of colour rendering have been developed with traditional broad band sources in mind, therefore it seemed interesting to check also visually the colour rendering properties of LED clusters intended to produce white light, and to compare these with the colour rendering of more conventional light sources.

Light emitting diodes (LEDs) produce light by recombination taking place between energy bands of the material, or between one of the energy bands and a more or less localized state in the forbidden band of the material. In both cases the emission band is relatively narrow and mono-peaked compared to traditional sources, where either a broadband spectrum is emitted or the emission contains many spectral lines or a number of narrow bands.

Our aim was to test the colour rendering characteristics of LED clusters at two distinctly different chromaticities, therefore an incandescent like (low colour temperature) and a daylight like source chromaticity was used. This has been realized partly by using LED clusters, and partly by using incandescent and fluorescent lamps. We have built a two-chamber test box, where samples could be illuminated by different light sources, so that the colour rendering capabilities of the sources could be tested. The selected colour samples were chosen from the Macbeth ColorChecker chart.

Subjects had to compare the two identical groups of the ColorChecker samples under the different illuminants. They got an oral description and in virtue of this they had to scale how large the colour difference they perceived between the corresponding coloured patches of the two boxes, compared to the colour difference between two reference samples was. Subjects used 5-step or 10-step rating scales. The reference colour samples were selected from the Munsell Book of Colour and they were placed under one of the illuminants.

Both visual scaling and traditional colour rendering calculation has been performed.

In case of LED clusters results depended very strongly on the wavelengths of the emission maxima of the LED clusters used. Experiments have shown that an update of the present CIE Test Method is needed to be able to characterize the colour rendering properties of modern light sources correctly.