APPEARANCE OF OPTICALLY BRIGHTENED MATERIALS UNDER DIFFERENT TYPES OF ARTIFICIAL LIGHTING

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Abstract: The evaluation of whiteness of materials, including textiles, is something of an evergreen in the field of colorimetry. However, with the advent of LED lighting technology, textile manufacturers have a new challenge to increase the perceived whiteness of their products. The optical brightening technologies used to date require some modification to achieve the optimum result. It is known that LED light sources can be based on different technologies. For this reason, trying to find a relationship between the modified parameters of the equations for whiteness calculations and the corelated color temperature is proving to be problematic.

Keywords: *whiteness, FWA, colorimetry, color appearance model.*

Introduction: Optically brightening agents work on the principle of fluorescence, where invisible UV radiation is converted by the OBA molecule into visible light typically in the range of 420 to 460 nm [1]. If UV light is not present, then OBAs are inactive and in some cases may even cause a slight yellowish tint to the physically bleached fabric. This is why many white LED light sources appear to be ineffective in terms of the final appearance of the fabric. Currently, the most widely used white LED light source technology is based on a blue chip and a yellow-orange phosphor. The emission maximum of blue chips is typically between 440 and 460 nm, and below 420 nm these lights emit practically no energy. This means that OBA is not activated by such LEDs. However, this most unique technology is gradually being improved, and phosphors composed of two or three interconnected systems are being used alongside single phosphors. The principle of these phosphors is such a cascade, where a light source (blue or more recently violet chip) builds up the first phosphor and it emits light of a certain wavelength [2]. This light then contributes, alongside the excitation light of the chip, to the resulting white light, but in addition acts itself as an excitation light source for the next phosphor whose absorption maximum is shifted to higher wavelengths. This second or third phosphor then contributes to the overall quality of the resulting white light, which has a higher color rendering index as a result. Since the violet chips emit at wavelengths between 400 and 440 nm, their radiation can also be used to excite OBA to enhance the whiteness of materials, including textiles. The effectiveness of these new LED lights was therefore the subject of our research.

Materials and Methods: The subjects of the research were 4 high color rendering index LED lights based on Yuji's violet chip and RGB phosphor technology with nominal CCT: 2700, 4000, 5000 and 6500 K. An experimental light box and a set of samples with different OBA concentrations were used for evaluation. The final appearance of the samples was measured using a SpectraScan PR740 spectroradiometer from PhotoResearch.

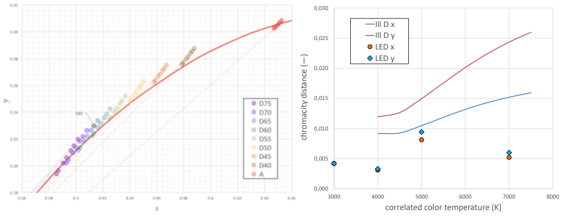

Figure 1 Theoretical positions of FWA samples using CIE Illuminant D with different color temperatures (left), comparison of chromatic distance of FWA samples between CIE Illuminant D and tested LED lights (right)

Results: The left graph in Figure 1 shows the theoretical positions of the test samples on the chromatic surface of the CIE xy diagram if ideal daylight were used, in this case the mathematical model - CIE standard light D. It is clear that as the CCT decreases, compression occurs, i.e. the samples get closer and closer to each other and at the moment when no excitation radiation would be present, then they would merge into a single point. The graph on the right shows the idealized progression of the chromatic distance of the tested samples in the x and y coordinates of the CIE xy diagram as a function of CCT. Furthermore, the chromatic distances of the tested set of samples are adequately shown in the case of using 4 tested LEDs with high color rendering index. It is clear that the corresponding distances are shorter and do not fully follow the theoretical curves. This is due to the fact that although the tested LEDs had typical CCTs, the proportion of effective excitation radiation for OBA activation was different and was not consistent with the CCTs.

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