THE LUMINANCE SENSATION OF COLOURED LED LIGHTING

Written by Peter Kort, Luc van der Poel

Coloured LED lighting is becoming increasingly important in lighting concepts. It is used not only in the theatre and for city beautification, but also in shops, reception areas and even in office environments. The luminance effects of spotlighting using white light are well known and are described in terms of the accent factor; coloured lighting is not yet described in this way. The attraction value of coloured light is expected to be higher than that of white light due to the colour contrast. The following experiments shed some light on the behaviour of coloured lighting in relation to white lighting.

THE EXPERIMENT

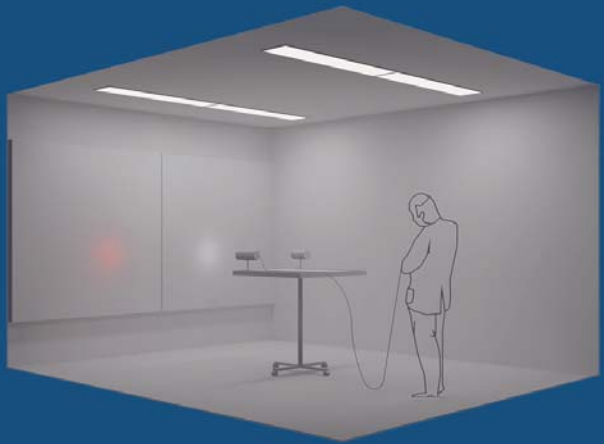
The experiment defines the relative luminance sensation generated by the primary colours of a LED spot. The method uses a pattern created by two LED spots on a highly reflective wall. The wall is divided into two equal parts. On one half you see a spot in one of the primary colours, on the other a white LED spot with a preset intensity. The test patterns are red-white, green-white, and blue-white. The observer changes the intensity of the coloured spot until they feel the luminance sensation generated by the two spots is equal. This test is performed for each combination, once in complete darkness and once with 350 lux on the wall.

RESULT

The results reflect the luminosity function: green light contributes the most to the intensity perceived by the human eye, and blue light contributes the least. When the white light was set at 100, we found the ratio for red to be 33, for green 50, and for blue 17.

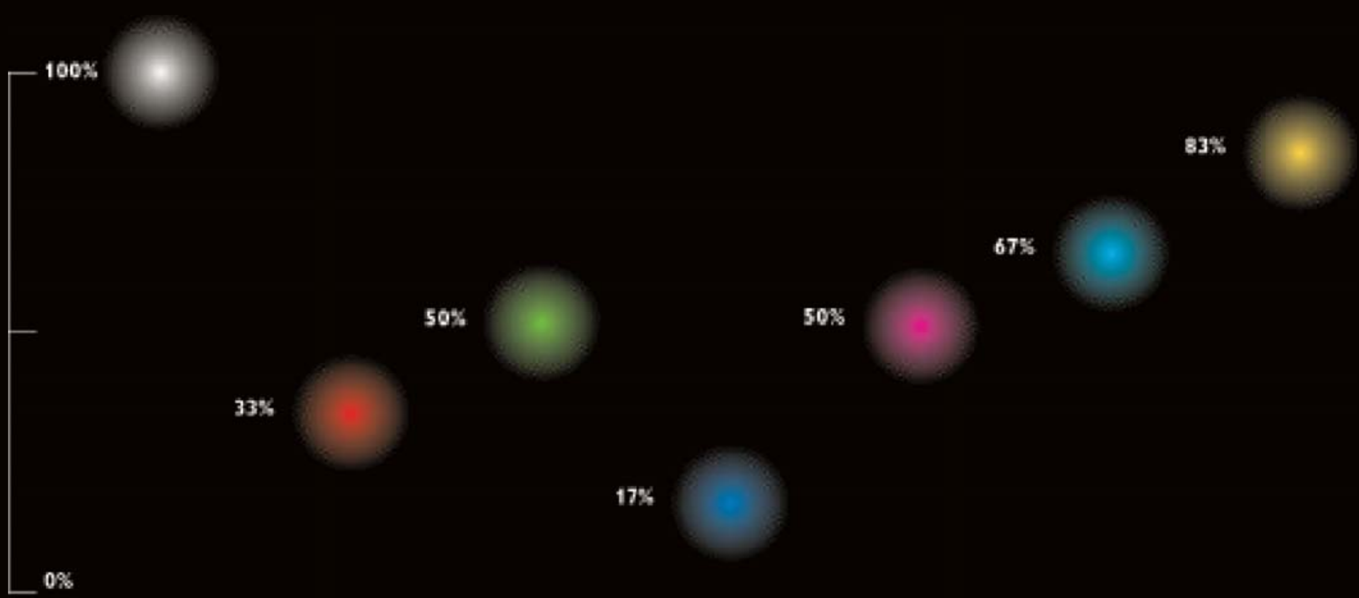
Another, secondary outcome of the test shows that the sum of the red/green/blue ratios found (additive colour mixing of RGB gives white light) is equal to the intensity of the white spot.

Finally, two primary colours were combined to create yellow, magenta and cyan. The outcome showed that the relative luminance of secondary colours could be found by adding together the relative luminance of two primary colours. In this way we can predict for every colour the relative luminance compared to white light.

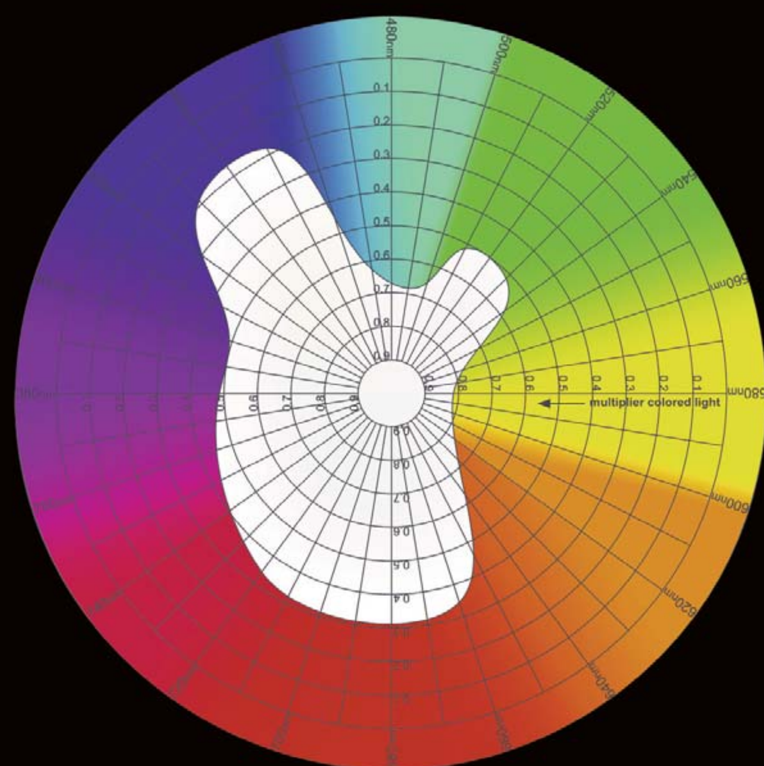


Test scene
The observer changes the intensity of the coloured spot until they feel the luminance sensation generated by the two spots is equal. This test is performed for each of the three combinations, red-white, green-white, blue-white, once in complete darkness and with 350 lux on the wall.

RELATIVE LUMINANCE



Additive colour mixing:
Light is perceived as white if all the three types of receptors in our eye are stimulated simultaneously. The colours red, green and blue (RGB) all activate one type of receptor



Relative luminance:
The graph shows the different relative luminance for all colours with the same luminance sensation as white light. One can see, for example, that green light (525 nm) generates the same visual attraction with only 50 per cent of the luminance of white light. The relative luminance for cyan (490 nm) is 70 per cent.