

PWSOI-3

STUDY ON APPEARANCE OF MATERIAL ILLUMINATED BY LED LIGHTING

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INTRODUCTION

The LED applications have recently grown significantly due to LED's long life span, high energy efficiency etc. Also, a wide variety of LEDs with different peak wavelengths are now available.

Recently, there are various kinds of lighting fixtures using LED, such as the down light, pendants, and spotlights, which are found in shops. The purpose of this study is to identify the characteristics of LED lighting which show textures of materials .

METHODS

Experimental set-up

In order to compare four different lamps including LED lighting, four evaluation boxes shown in Figure 1 are prepared. An outline of the experiment device is shown in Table 1 . A compact fluorescent lamp (incandescent color), an incandescent lamp and two kinds of warm white LEDs are used. They are the warm white LED with high color rendering and the warm white LED with low color rendering, Figure 2 shows the wavelength of LEDs. CCT of all the lamps are about 2800K-3200K. Before the experiment, illuminance distribution of the floors of the boxes are measured to confirm that there is no difference in illuminance distribution between the boxes.

Six texture samples are selected. They are satin, green satin, lame, leather, fur, hemp, green hemp and wool. These are shown in Figure 3.

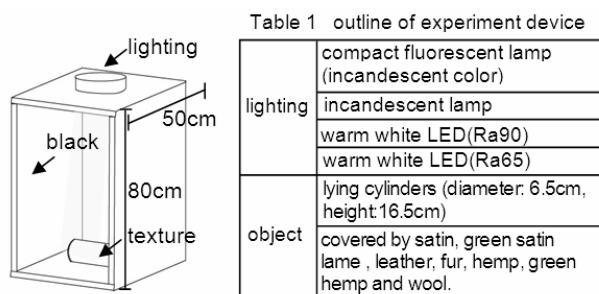


Figure 1 evaluation box

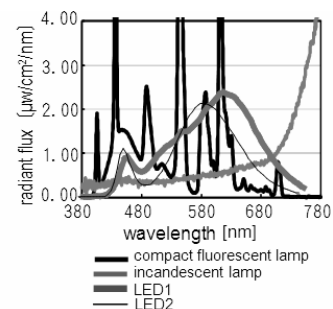


Figure 2 wavelength of light source

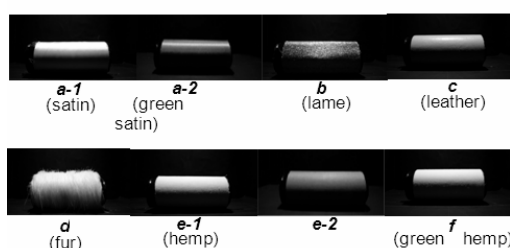


Figure 3 texture samples

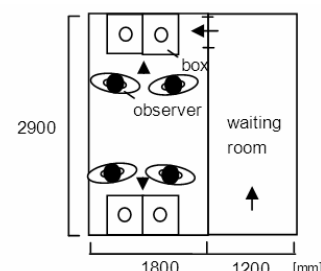


Figure 4 evaluation room

Subjective experiment

The evaluation room is shown in Figure 4. There are 4 student observers. There are four experimental boxes named A(compact fluorescent lamp), B(incandescent lamp), C(warm white LED(Ra90)) and D(warm white LED(Ra65)). Scheffe's Paired Comparison (Ura's version) is used for the evaluation. Questions are shown in Figure 5. For textures **a** to **d** Questions 1 to 8, except 6 are used, while for textures **e** and **f**, Questions 1 to 6 are used. Ten seconds are allowed to see each box.

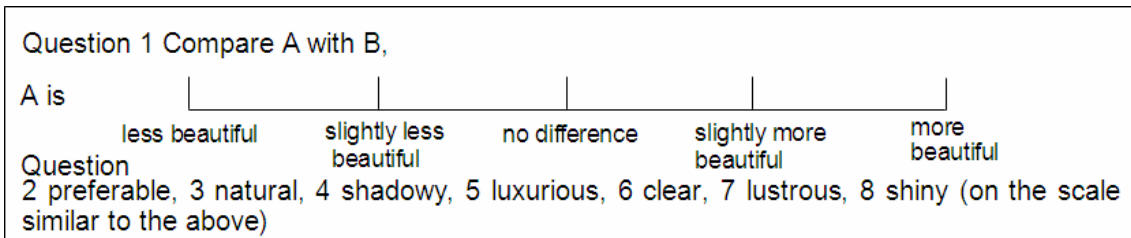


Figure 5 Questions

RESULTS

Luminance distribution

It is shown that different light sources cause different luminance distribution on the same texture. Figure 6 shows satin's histogram of luminance. Figure 7 shows the change in the luminance along the vertical line at the center of the cylinder covered by satin and hemp. The difference in luminance distribution between the texture is large.

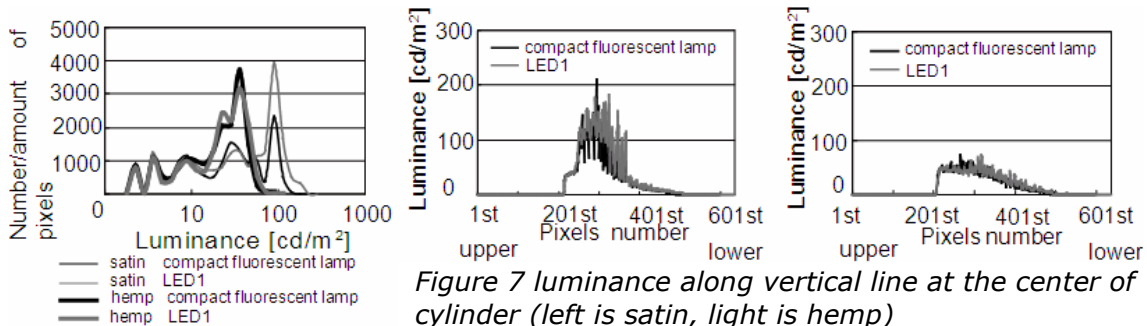


Figure 6 histogram

Figure 7 luminance along vertical line at the center of cylinder (left is satin, light is hemp)

The judgement of observer

The results of the judge's evaluation were analyzed using the Scheffe's Paired Comparison (Ura's version).

A significant effect (5% significance level) was shown only in Question 8 "shiny" for green satin as shown in Table 2. Figure 7 shows the assumed position of the light source on the evaluation scale regarding Question 8

Table 2 Scheffe's Paired Comparison regarding Question 8

texture	source	sum of squares	rate of varianc	significant difference
green satain	total	49.00		
	main effect	7.19	2.40	*
	main effect ×personal	13.81	1.53	
	combination effect	1.94	0.65	
	order effect	1.02	1.02	
	order effect×personal	2.40	0.80	
	error	22.65	0.78	

(** significant difference 0.01,* significant difference 0.05)

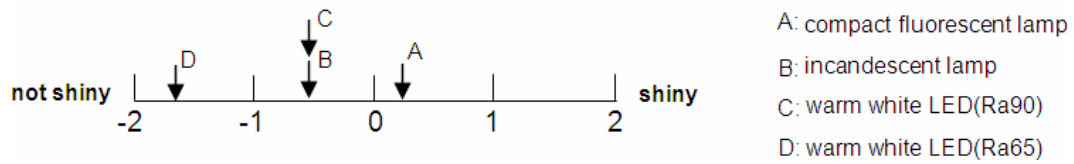


Figure 8 evaluation scale

CONCLUSIONS

Subjective experiments show the evaluation of texture appearance illuminated by a compact fluorescent lamp, an incandescent lamp, an LED1(Ra90) and an LED2(Ra65).