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Study on the fading rate and exhibiting mode of museum silk textiles

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Abstract. Experimental study of the fading rate and mutation point of induction periods for three natural dyes are carried out. Besides, illuminace distributions and visual effects in two exhibiting modes, vertical hanging mode and inclining exhibiting mode under the same illuminace are investigated. The results of both experiments are analyzed and their implications for the safe exhibiting and lighting mode for museum silk textiles are discussed.

Introduction

I. padfield and S. Landi[1] studied the light fastness of natural dyes, which elaborated that there would be different changes when different colors of textiles displayed for 50 years. They found that the yellow dye faded fastest, madder and cochineal dyed fabric would lose its original luster, and degradation would occur in indigo dyed cotton fabric while blue wool fabric remains unchanged.

Harrison(1953) proposed the damage function of the light wavelength between 300nm and 600nm. The damage factor was obtained from the experiments of inferior paper induced by light. J. Krochman et. al. made further research based on Harrison's study. The study proposes a hypothesis, which was that the photoaging criteria should be color change. The study used CIE1976L * a * b * color difference equation as the standard, and the color change ΔE *= 1 as the critical point of change, the reaction reaches the critical point was obtained by the method of aging accelerated under high radiation. D. G. Duff et. al. used Munsell color system and the CIE system studied the wool stained with some natural dye, such as Rubia cordifolia, Caesalpinia Sappan, cochineal, indigo and other dyes, which exposured under the 500W mercury lamp from 20cm for a total of 240 hours, and ultimately they got the green dye color which had the maximum color change before and after aging.

Christopher Cuttle[2] balanced light satisfaction and radiation though the experiment of three spectral bands (red, green and blue) combination, to achieve the objective that it would reduce the work of art's irradiance and degradation without reducing the lighting and the visual satisfaction while on display.

So far, there are not many studies on the fading rate of natural dyes for silk texitles, as well as on the safe exhibition life for silk texitles. This paper will focus on the experimental study of fading rate and mutation points of induction periods for three natural dyes, and, illuminace distributions and visual effects under the same illuminace in vertical hanging mode and inclining exhibiting mode.

Experimental

Fading Rate Experiment. Silk fabric, habutai, was dyed with three natural dyes, cortex phellodendri, brazilwood and indigo. The dyeing recipes and procedures were taken from ref. [3~6]. The dyes were such selected that their lightfastness properties ranged from fugitive to stable.

The specimens were put in a self-made chamber as shown in Fig. 1.

(a) elevation view (b) top view

Fig. 1. Illustration of device for fading rate experiment

The specimens were exposed to tungsten halogen lamp at an average illuminance of 1250 lx (25°C). The colors of the specimens were measured at intervals by a fully automatic color difference meter SC-80 (Beijing Kangguang optical instrument Co. Ltd.). Color difference was then calculated by the CIE1976 L*a*b* color difference equation:

$$\Delta E = \left[\left(\Delta L^* \right)^2 + \left(\Delta a^* \right)^2 + \left(\Delta b^* \right)^2 \right]^{\frac{1}{2}} \quad (1)$$

where ΔL^* is lightness-dark difference, Δa^* redness-greenness difference and Δb^* yellowness-blueness difference.

For cortex phellodendri, the area of berberine peak was tested by a high performance liquid chromatograph (Shema Seiki, Japan) under illuminance 5000 lx.

Exhibiting Mode Experiment. The dyed habutai fabrics were made into robes as shown in Fig. 2.

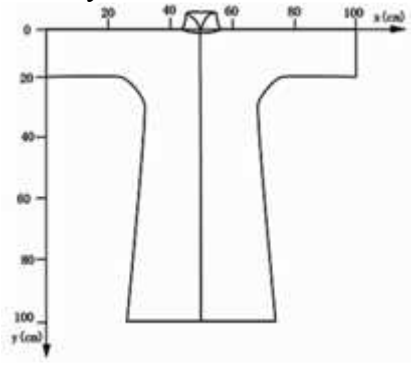
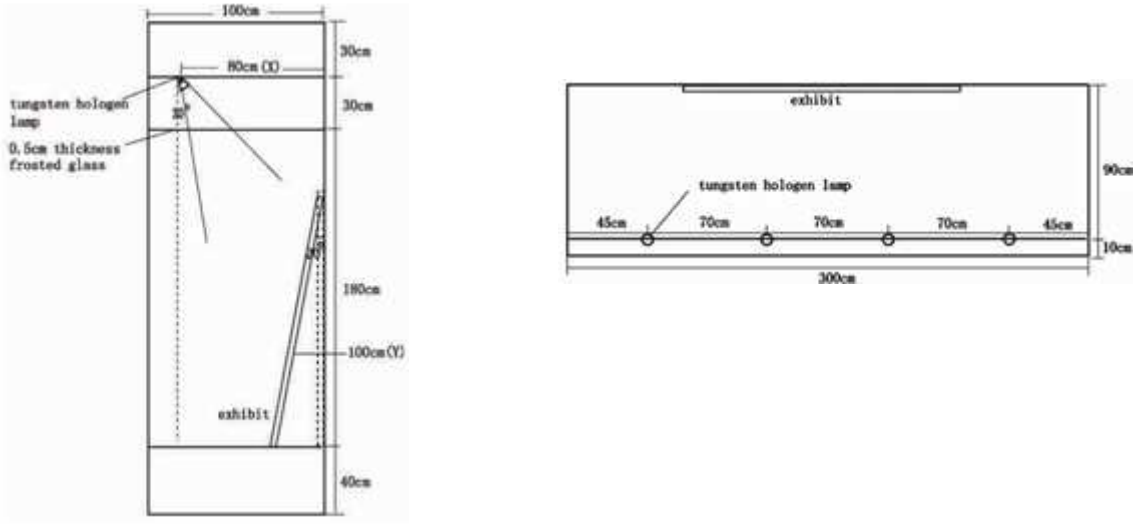


Fig. 2. Size of specimen for lighting mode experiment

The specimens were then put in a self-made chamber as shown in Fig. 3 and exposed to tungsten halogen lamp at an average illuminance of 50 lx (25°C), which is similar to the lighting conditions in museum.



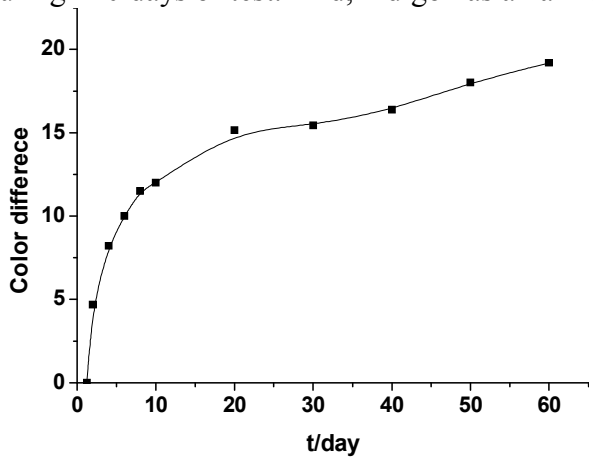
(a) elevation view (b) top view

Fig. 3. Illustration of device for lighting mode experiment

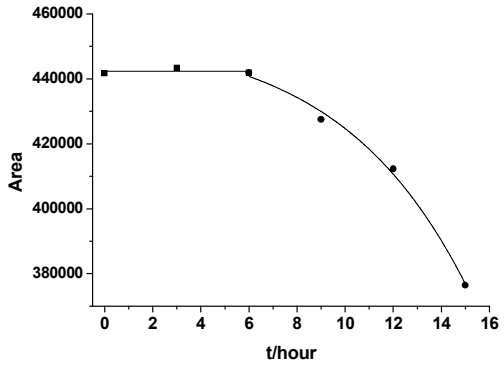
The illuminance distributions on the specimens under two exhibiting modes, namely upright hanging mode and inclining exhibiting mode, were measured by a LX-1330B digital luxmeter (Shenzheng Jindatong Instrument and meter Co. Ltd).

Results and Discussion

Fading Rate. The fading rate curves for cortex phellodendri, brazilwood and indigo are shown in Fig. 4. The three curves present different change trend. Cortex phellodendri has a rapid fading rate in the first 10 days and a much lower one thereafter. The fading rate of Brazilwood decrease gradually during 120 days of test. And, indigo has an almost linear fading rate in 100 days.

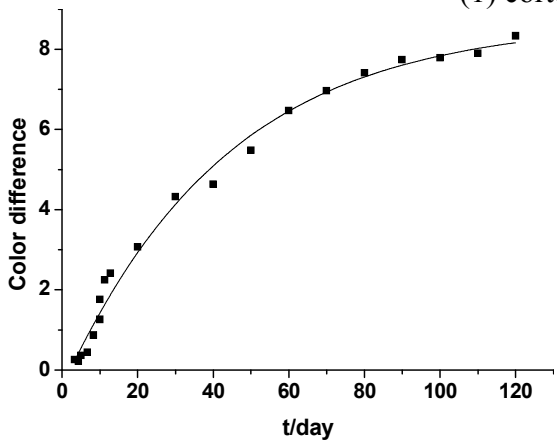


a. Fading rate

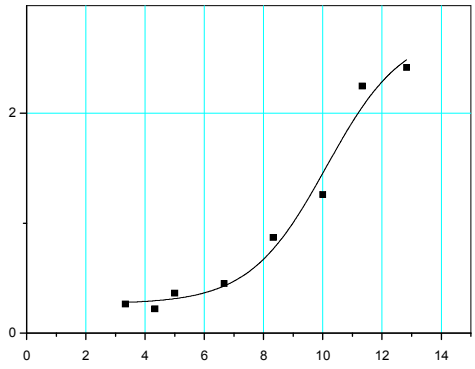


b. Area of berberine peak

(1) cortex phellodendri

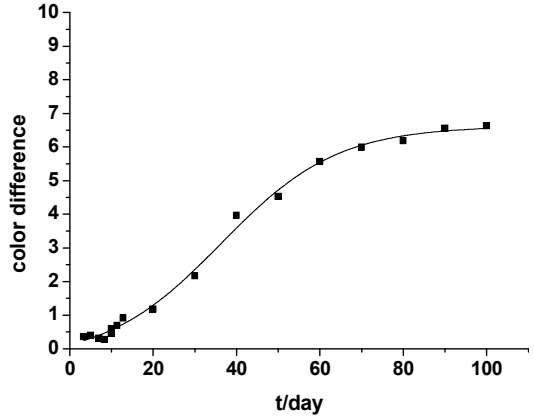


a. Fading rate

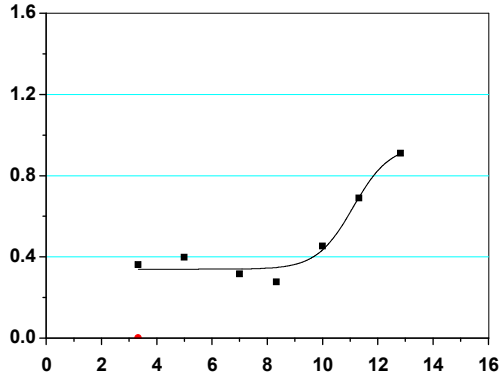


b. magnified figure

(2) brazilwood



a. Fading rate



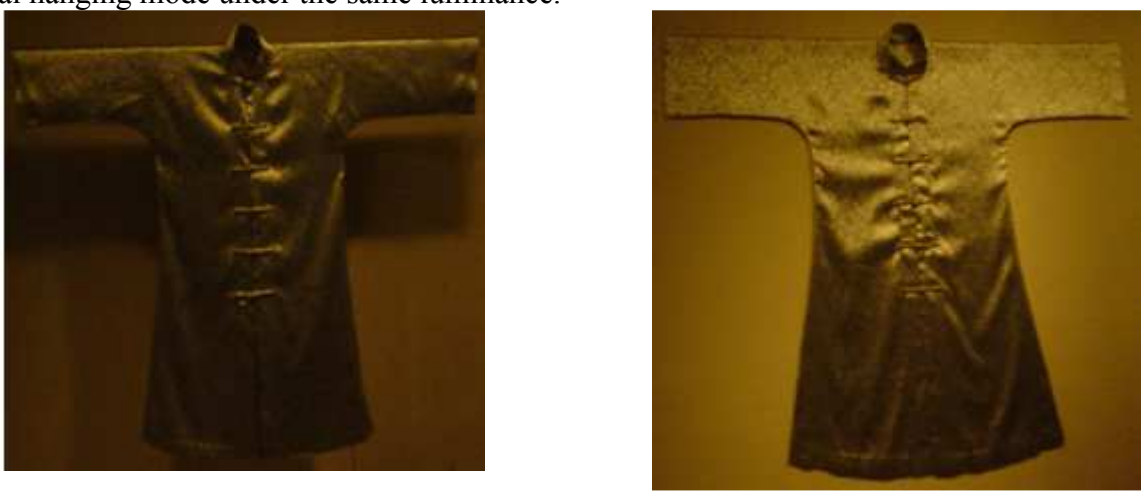
b. magnified figure

(3) indigo

Fig. 4. Fading rate curves for natural dyes

Considering museum exhibition, the start point of accelerating fading rate or the mutation point of induction period is of great interest especially regarding to cultural relic protection. The mutation point of cortex phellodendri obtained by gas chromatography is obtained from peak area of berberine (Fig.4 (1)a) while that of brazilwood and indigo are obtained from the initial part of fading rate curves the magnified figures are shown in Fig. 4 (2)a and (3)a. By converting to illuminance 50 lux which is normal in museum exhibition, the mutation points of induction period points of the three dyes are around 50 days, 175 days and 250 days respectively. This result is useful in the determination of exhibition time for museum silk textiles.

Exhibiting Mode. The visual effects of specimens in two exhibiting modes are shown in Figure 5. From the figure, it is seen that inclining exhibiting mode has a better visually perceivable effect than vertical hanging mode under the same luminance.



(1) vertical hanging (2) inclining exhibiting

Fig. 5. Two exhibiting modes

The illuminace distribution measured in both exhibiting modes are listed in Table 1 and Table 2 respectively.

Table 1. Illuminance distribution measured in upright hanging mode

x / *y*	0	10	20	30	40	50	60	70	80	90	100
	0	10	20	30	40	50	60	70	80	90	100
0	20	24	27	33	35	50	54	59	51	41	20
10	20	23	26	29	36	38	55	58	56	46	34
20	20	22	26	34	41	50	62	66	46	37	28
30	\	\	\	37	43	61	68	71	\	\	\
40	\	\	\	42	51	57	73	74	\	\	\
50	\	\	\	45	49	63	73	70	\	\	\
60	\	\	\	53	55	67	74	67	\	\	\
70	\	\	\	30	42	47	52	46	\	\	\
80	\	\	\	30	54	51	43	36	\	\	\
90	\	\	\	32	30	38	44	42	\	\	\
100	\	\	\	30	39	41	30	23	\	\	\

Table 2. Illuminance distribution measured in inclining exhibiting mode

x / y	0	10	20	30	40	50	60	70	80	90	100
0	18	21	25	29	31	35	38	39	36	32	30
10	20	23	27	33	40	40	47	46	59	34	31
20	21	25	30	36	45	50	57	56	46	38	32
30	\	\	\	43	51	58	64	60	\	\	\
40	\	\	\	49	58	66	65	63	\	\	\
50	\	\	\	50	59	67	68	62	\	\	\
60	\	\	\	52	61	69	68	58	\	\	\
70	\	\	\	53	60	62	62	51	\	\	\
80	\	\	\	54	58	59	55	43	\	\	\
90	\	\	\	47	55	51	45	36	\	\	\
100	\	\	\	40	53	40	36	38	\	\	\

From the above data, it can be seen that the illuminance distrutes more even and in a more bigger area in the mode of inclining exhibiting, which agree well with the visual effect. Hence, the inclining mode is more suitable for musem textile exhibition.

In the future studies, the fadign rate and exhibiting mode will be considered comprehensively so as to propose a safe exhibiting and lighting mode for museum silk textiles.

Conclusions

In this paper, the fading rate of three natural dyes, cortex phellodendri, brazilwood and indigo, are studied experimentally. The results show that indigo is the best lightfatness dye and phellodendri the worst.

The start point of accelerating fading rate or the mutation point of induction period is important for museum silk textiles. The experimental data shows that the mutation point of induction period for phellodendri, brazilwood and indigo are around 50 days, 175 days and 250 days respectively under museum lighting conditions, namely under illuminance 50 lux, which outline the safe exhibition time for silk textiles with different colors.

The visual effects and illuminance distributions under vertical hanging mode and inclining exhibiting mode are studied. The results show that the latter have advantages over the former in both aspects. This result suggests that inclining exhibiting mode is more suitable for muse silk textiles.

Both fading rate and exhibiting mode will be considered comprehensively in the future work for the exploration of a safe exhibiting and lighting mode for museum silk textiles.

Acknowledgements

References

[1] D.G. Duff et al.: Studies in Conservation, 22(1977), p. 161-169.

[2] C. Cuttle: Lighting Res. Technol. 28(1996), p.1-9.

[3] Z.X. Wang: Textile Dyeing and Finishing Journal Vol. 24 (2002), p. 15-18.

[4] Y.Li, J. Yang: Journal of Shandong Forestry Science and Technology (2008), p. 3-5.

[5] Z.C. Yu, Y.D. TAO, Q.B. Zhou: Silk Monthly, (2010), p. 10-11.

[6] Y.S. Sun: Silk Monthly, (2000), p. 24-29.

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