CHAPTER 3

EXPERIMENTS

3.1 Materials

3.1.1 Standard grey scales

3.1.1.1 Grey scale for assessing change in colour

The grey scale used for assessing change in colour as specified in ISO 105-A02 consists of nine pairs of non-glossy colour chips, which illustrate the perceived colour differences corresponding to fastness rating 5, 4-5, 4, 3-4, 3, 2-3, 2, 1-2 and 1. The first member of each pair is neutral grey in colour and the second member of the pair illustrating fastness rating 5 is identical with the first member. The second members of the remaining pairs are increasingly lighter in colour so that each pair illustrates increasing contrasts or perceived colour differences. The second member of each pair shall be such that the colour difference between it and the adjacent first member is as shown in Table 2-1.

3.1.1.2 Grey scale for assessing staining

The grey scale used for assessing staining as specified in ISO 105-A03 consists of nine pairs arranged in geometrical progression. The first member of each pair is white in colour and the second member of the pair illustrating fastness rating 5 is identical with the first member. The second members of the remaining pairs are increasingly darker in colour so that each pair illustrates increasing contrasts or perceived colour differences which are defined colorimetrically. The second member of each pair shall be such that the colour difference between it and the adjacent first member is as shown in Table 2-4.

3.1.2 Specimens

3.1.2.1 Specimens for assessing change in colour

One hundred and twenty specimens were prepared using cotton fabric dyed with direct dyes. The finess of cotton fabric was 20x16 tex. The treated specimen for each pair was faded in a wash fastness test. The typical trend for changing colour was that the treated colour become paler than its untreated counterpart, but with little change in hue. Thirty untreated specimens were dyed initially. These were well distributed in colour space, with five Munsell hues: 5Y, 5G, 5B, 5P and 5R. Each untreated specimen was washed to obtained the fading colour with four steps i.e. about 4.5-5, 4, 3-4, 2-3 grade at $N_c^{\#}$ value. Therefore, we could get 30 colours with 4 steps fading each. Dyes used in this experiment are as shown in Table 3-1 (15).

Table 3-1 Dyes used in this experiment

C.I. No.	Commercial name	Hue
Direct Yellow 87	Kayarus Yellow PG	Y
Direct Green 63	Kayarus Supra Green GG 200	G
Direct Black 22	Direct Fast Black B 160	B
Direct Blue 236	Kayarus Supra Blue BCL	PB
Direct Violet 66	Kayarus Supra Violet 5 BL conc.	P
Direct Red 83.1	Kayarus Supra Rubin BL	RP
Direct Red 89	Kayarus Supra Scarlet BNL 200	R
Direct Orange 39	Kayarus Supra Orange 2 GL 125	YR
Direct Brown 210	Kayarus Supra Brown GTL	YR

Specimens covered a wide range of colour space, and Figures 3.1 and 3.2 show the specimen distribution on CIELAB a* b* and L* C* planes respectively. There was a clear trend in change of colour, the treated specimen was paler than the untreated one, i. e., the treated specimen was closer to the undyed fabric than to the untreated specimen.

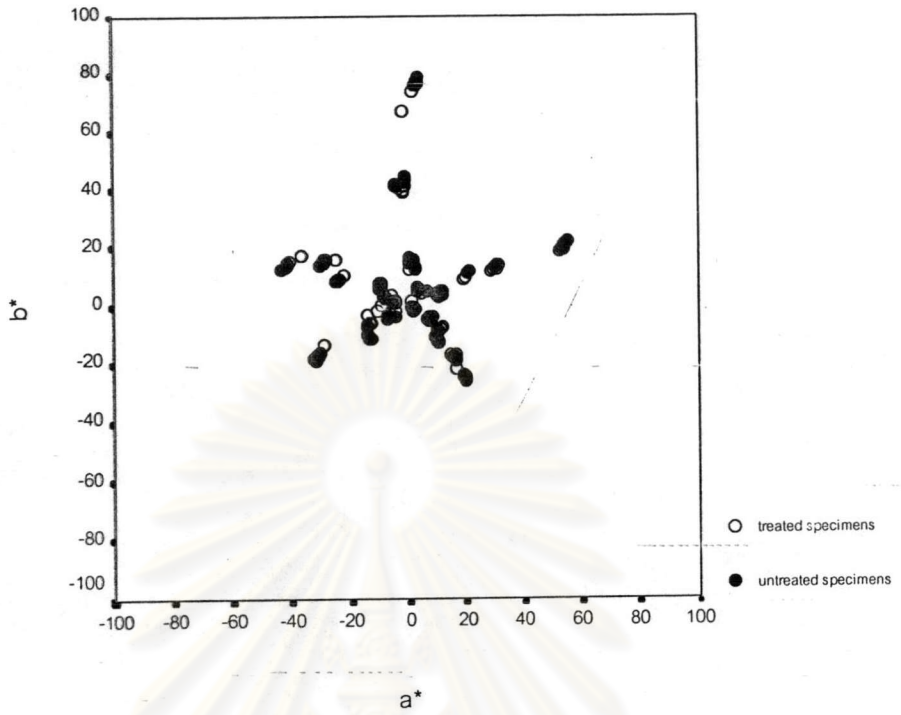

Figure 3-1 Colorimetric data of the specimens for change in colour assessment plotted on CIELAB a* b* diagram

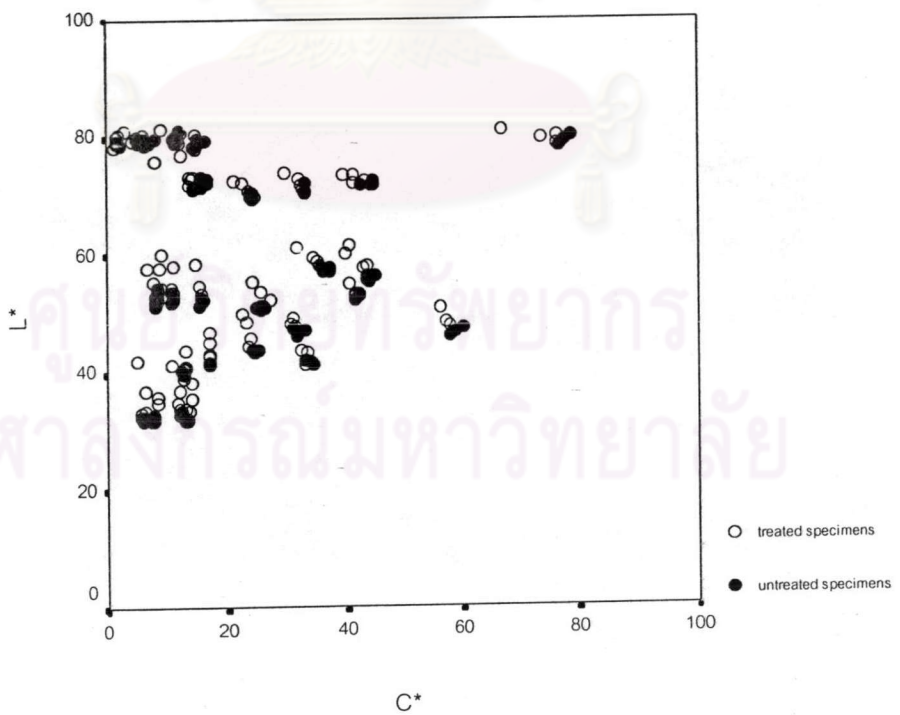

Figure 3-2 Colorimetric data of the specimens for change in colour assessment plotted on CIELAB L* C* diagram

3.1.2.2 Specimens for assessing staining

Eighty sample pairs used in this study were paired with coloured and untreated cotton fabrics. The untreated fabrics are white fabric, and the coloured fabrics are dyed by reactive dyestuffs. The hues of treated fabrics are 10 Munsell hues; Red, Yellow Red, Yellow, Green Yellow, Green, Blue Green, Blue, Purple Blue, Purple and Red Purple. The sample pairs were changed step-by-step to 8 steps excluding white. The sample pairs were approximately 4-5, 4, 3-4, 3, 2-3, 2, 1-2 and 1 grades at the N_S value.

Figures 3-3 and 3-4 show the sample distribution on the CIELAB a*,b* and L*,C* planes, respectively. These figures show that the treated samples covered various parts of colour space. In general, the treated samples appear deeper than the untreated fabrics.

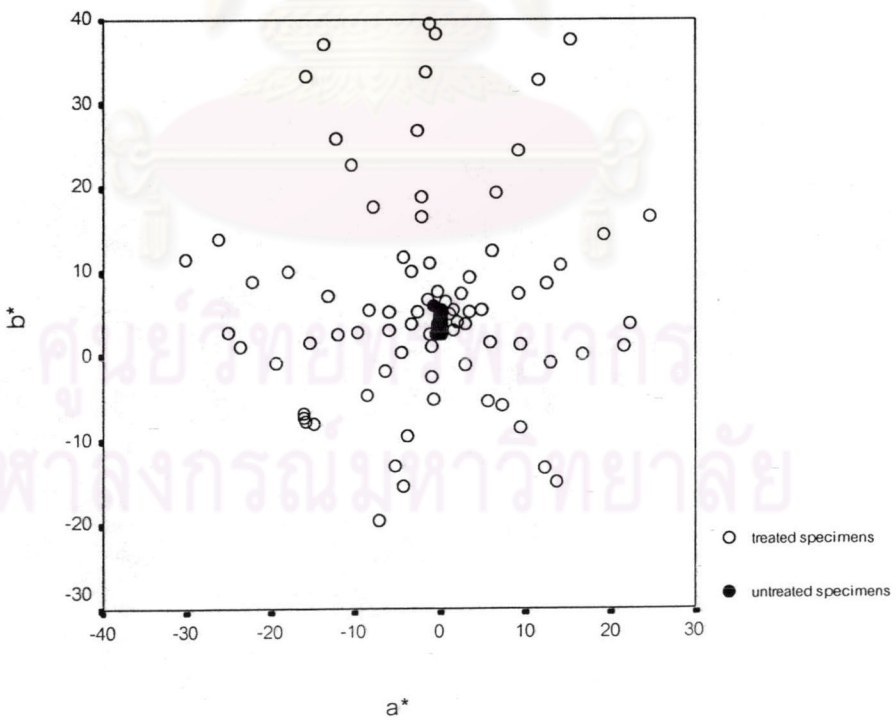

Figure 3-3 Colorimetric data of the specimens for staining assessment plotted on CIELAB a* b* diagram

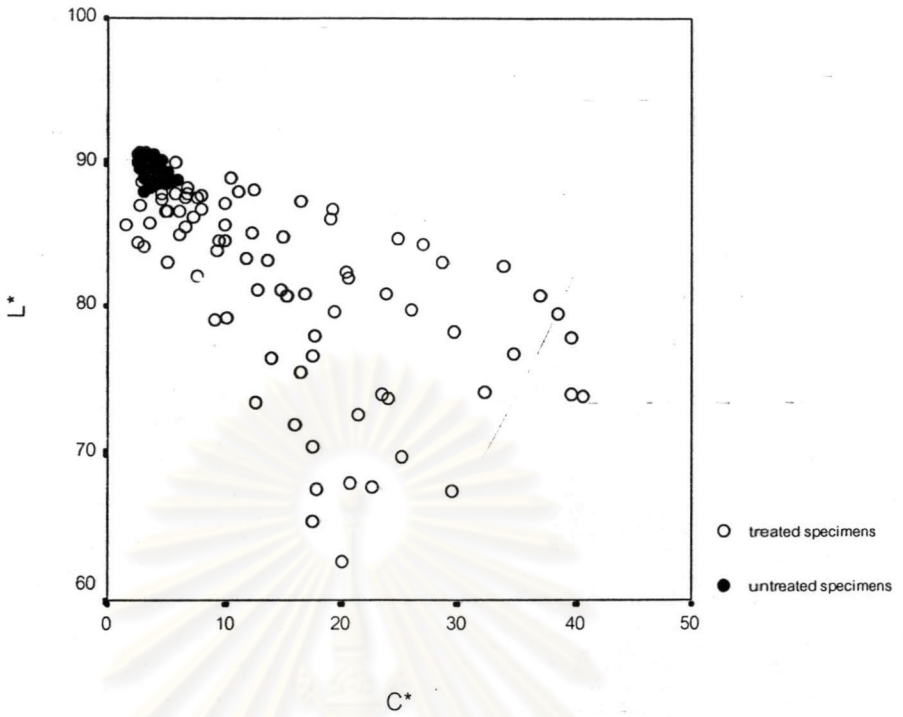

Figure 3-4 Colorimetric data of the specimens for staining assessment plotted on CIELAB L* C* diagram

3.2 Apparatuses

- Gretag SPM 50 spectrophotometer
- Standard light cabinet with the illuminant D_{65}, 600 lx. The light is incident upon the surfaces at an angle of approximately 45 degrees.

3.3 Observers

The observers with normal sight were classified into two groups as follows:

- The students group, who are university students between 17-25 years old. The number of students is 50 persons, which consist of 21 male and 29 female students.

- The colour specialists group, who are chief printers. The number of the specialists is 10 persons.

3.4 Procedure

3.4.1 Visual assessment

The experimental procedure and viewing conditions conformed to ISO 105-A02 and ISO 105-A03. The grey scale was place nearby the specimen under illuminant D_{65} in a light cabinet. The observers assessed the magnitude of the visual contrast between a treated specimen and its untreated specimen. This contrast was compared visually with the contrast represented by nine pairs of standard grey scale, ranging from 5, which illustrates no contrast, to 1, which illustrates the largest contrast. The fastness rating of the specimen is that number of the grey scale which corresponds to the contrast between the untreated and the treated specimens

3.4.2 Instrumental assessment

3.4.2.1 Measurement of the colorimetric values from sample pairs

The colorimetric values L*, a*, b*, C* and h of the treated and its corresponding untreated specimen were measured by the Gretag SPM 50 spectrophotometer under the illuminant D_{65} and 10 degree standard observer condition as specified in ISO 105-A02 and ISO 105-A03. The colorimetric values of the specimens for change in colour and staining assessment are shown in Appendices A and B respectively.

3.4.2.2 Calculation of change in colour and staining

The obtained colorimetric values were calculated using colour fastness formulae, and converted to the colour fastness grade by interpolation between the colour difference values and grades from the standard grey scale.

3.4.3 Analysis of the relevant colour fastness grade between visual and instrumental assessments

The criterion to find out the accuracy of each formula is to plot the relationship between visual results and the ones that calculated from those formulae. For perfect agreement between visual and instrumental results, all points should lie on the 45-degree line. The correlation coefficient (r) and standard error of estimation were also calculated to indicate the degree of agreement between the formulae's predictions and the visual results. If the values of r and standard error near 1 and 0 respectively, the correlation between the results of visual assessment and instrumental assessment are high. In this research, the acceptable level of correlation coefficient was set to be not less than 0.9.