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Evaluation of Instrumental Methods for Assessing Colour Fastness

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Abstract

Instrumental methods for assessing colour fastness of textile products have been standardized by organizations such as the International Organization for Standardization (ISO) and Japanese Industrial Standards (JIS). In addition to these, a few methods have been proposed. Despite the existence of these methods, fastness assessments are still being carried out in many places through visual inspection. In a laboratory, experienced inspectors share a common understanding about degree of fastness; however, there are variations between laboratories across different countries and between experienced workers and trainees. Therefore, in order to encourage the use of the instrumental method, four methods were re-evaluated. In the experiment, a set of fabric samples were instrumentally evaluated using four different methods and the samples were also visually assessed by professional inspectors in a textile testing centre in Japan. Then, the results of the instrumental methods were evaluated by comparing with the visual results. A method proposed by Gui and Luo et al was considered to be the best model in terms of the agreement with the visual results and also this method was less influenced by the difference of colour measurement methods.

Keywords: Textile; Fastness; Colour; Inspection

1 Introduction

Colour fastness of textile products is an important quality feature. As an actual fact, poor colour fastness often tops the list of consumer complaints. Colour fastness is described as "the resistance of the colour of textiles to the different agents to which these materials may be exposed during manufacture and their subsequent use" [1]. It is usually assessed separately with respect to change in colour and staining [1]. For colour fastness assessments, as shown in Fig. 1, two sets of standard grey scales are usually used as references; one for change in colour and the other for staining. The grey scales consist of nine pairs of grey coloured chips aligned alongside each other. Each pair has a grade which is arranged according to the contrast between each pair. The range of the grade is 5 to 1 with four additional intermediate half grades (1–2, 2–3, etc). The pair graded

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5 has two identical chips but the pair graded 1 has the greatest contrast among the nine pairs. The pairs graded 1–2 to 4–5 have intermediate contrasts. Regarding the change in colour, the fastness grading of a specimen after a test is assigned according to visual contrast between the tested specimen and the original material. The grading of 5 is given to the test specimen, if there is no difference between them; otherwise a grading of the grey scale which corresponds to the contrast between the test specimen and the original material is given. In case of the staining, the contrast is visually assessed between a piece of undyed fabric and the same material of fabric but that has been in contact with a test specimen during the staining test. As well as the change in colour, the fastness grading is given accordingly to the grey scale.

(a) (b)

Fig. 1: Standard grey scales (a) for change in colour and (b) for staining

Instrumental assessment methods also have been standardized by organizations such as the International Organization for Standardization (ISO) [2, 3] and Japanese Industrial Standards (JIS) [4]. Despite the existence of these methods, fastness assessments are still being carried out in many places through visual inspection. In a laboratory, experienced inspectors share a common understanding about the fastness grades. However, there are variations between laboratories across different countries and between experienced workers and trainees. Therefore, the instrumental assessments are recommended to use as a reference in training inspectors.

The procedures of the visual assessment methods recommended by the ISO [5, 6] and the JIS [7, 8] are more or less the same; however the concepts of formulae incorporated into the instrumental assessments are not the same. The ISO formula is based on a CIELAB colour space [9]. On the other hand, the JIS formula is based on a dyer's colour system which has three attributes of hue, colour depth and dyer's brightness derived from Munsell coordinates. Besides these, new formulae have been proposed by Gui and Luo et al. [10, 11] and Sato and Nakamura et al. [12]. In spite of the introduction of these formulae, they have not been practiced. One of the reasons is due to the lack of study about these formulae to guarantee the performance.

Therefore, the adequacy of the instrumental methods were re-examined in this study focusing on the change in colour. The four fastness formulae were implemented: the ISO and the JIS formulae as well as those introduced by Gui and Luo et al. and Sato and Nakamura et al., and their performance were compared against visual assessment carried out at a laboratory in Japan. These four formulae derive a fastness grade using colorimetric values of fabric samples. A contact-type of a spectrophotometer is usually used to measure fabric samples, and thus it was used to measure samples in this study. Additionally, a spectroradiometer (non-contact type) is also used. Then, the performance of these colour measurement instruments were compared in terms of colorimetric values and fastness values.

In the following sections, fabric samples used in both visual and instrumental assessments are introduced first. Secondly, visual assessments on fastness carried out using fabric samples are described. Thirdly, instrumental assessment methods including colour measurements methods and fastness formulae compared in this study are introduced. Then, the performance of colour measurement instruments in terms of colorimetric values and fastness values are discussed. Finally, results of visual assessments and fastness values obtained through instrumental assessments are compared.