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ORIGINAL ARTICLE

Effect of UV radiation on the dyeing of cotton fabric with reactive blue 13

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UV radiation

Abstract For the present study, the cotton fabric and dye solution were irradiated to UV radiation for different times. Dyeing was performed using un-irradiated and irradiated cotton with un-irradiated and irradiated reactive blue dye. Different dyeing parameters such as temperature, pH and time were optimized using irradiated dye and irradiated cotton. The data of colour report were obtained from un-irradiated and irradiated cotton dyed with reactive blue dye using spectra flash (SF650). Colourfastness properties show that UV radiation of both cotton and dye powder has improved the grading of fastness from fair to good. It is found that UV irradiation has not only enhanced the strength of dye on irradiated fabric but also improved the dyeing properties.

1. Introduction

Dyes are the kind of organic compounds which can a bring bright and firm colour to other substances (Gong et al., 2005). Reactive dyes are widely used in the textile industries because of their simple dyeing procedure and good stability during washing process (Muruganandham and Swaminathan, 2004).There are many kinds of dyes being used in the textile industry. Reactive dye is a class of highly coloured organic substances primarily utilized for tinting industries that attach themselves to their substrate by a chemical reaction that forms a covalent bond between the molecule of the dye and that of the fibre (Matyjas and Rybicki, 2003). These dyes have been increasingly used in the textile, leather, paper, rubber, plastics, cosmetics and pharmaceutical and food industries. These are also the most popular dyes used for the dyeing of cotton fabric because of their brightness of shade wide colour strength and over all good colour fastness properties of the resultant dye. The dye stuff has become a part of the fibre and is much likely to be removed by washing it so that the dye stuff adheres by adsorption (Lewis and Vo, 2007).

Interest in eco-friendly textile wet processing techniques has been increasing in recent years due to the increased awareness of environmental issues throughout the world. The main challenge that now the textile industry faces is to modify production at a competitive price by using safe dyes and chemicals as well as by reducing treatment cost (Prabu and Sundrarajan,

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2002). Reactive dyes also have a great environmental impact because they cause water bodies to become coloured, absorb and reflect sunlight which in turn interferes with the aquatic ecosystem and cause great toxicity to the water bodies having dye effluents (Okada et al., 1997).

Previous studies showed that most of the researchers are involved in the work regarding the removal of waste water using UV radiation but there is no such work carried out on the effect of UV radiation on the dyeing behaviour of reactive dyes. It is found that UV radiation can improve the colour fastness properties, reaction also occurs at low temperature, has improved wet fastness due to covalent bond formation, and the dye can be reused (Iqbal et al., 2008).

An attempt has been made to improve the colour strength as well as colour fastness properties using irradiated dye and irradiated cotton fabric. For this purpose a reactive blue dye has been selected. The aim of the study is to improve the colour strength of cotton fabric dyed with reactive blue 13 and also enhance colour fastness properties under the influence of UV radiation.

2. Materials and methods

2.1. Preparation of samples

Plain weaved, bleached and mercerized cotton fabric was provided by Bismillah (PVT) Faisalabad and reactive blue 13 dye was provided by Haris Dyes and Chemicals, Faisalabad, Pakistan.

2.2. Radiation processes

Cotton fabric and reactive blue dye were exposed to UV radiation (245 nm, 180 W) for 20, 30, 40, 50 and 60 min in the Department of Chemistry, University of Agriculture Faisalabad, Pakistan (Wojnarovits and Takacs, 2008; Iqbal et al., 2008).

2.3. Optimization of dyeing conditions

In order to see the effect of UV radiation, different dyeing parameters such as temperature, pH and time were optimized. In order to observe the effect of temperature, dyeing was carried out at 40, 50, 60, 70 and 80 °C and in another experiment to observe the effect of pH, dyeing was carried out at 6, 7, 8, 9 and 10 pH. To study the effect of time, dyeing was carried out at 20, 25, 30, 35 and 40 min (Klimiuk et al., 2003; Kannan et al., 2006).

2.4. Evaluation of colour strength and lab values

Dyed fabrics were subjected to CIE Lab values system for evaluation of L^*, a^* and b^* values and colour strength (%) with the help of Spectra flash spectrophotometer (SF650) with illuminant D 6510° observer.

2.5. Rating of colour fastness properties

The optimized dyed fabrics were tested through the ISO standard method, to evaluate the effect of UV radiation on colour fastness properties such as colour fastness to light, washing and rubbing. Standard methods such as ISO105-CO3 for colour fastness to washing, ISO 105 X-12 for colour fastness to rubbing and ISO 105-BO5 for colour fastness to light were applied to investigate the effect of radiation on the colour fastness properties of fabric dyed with irradiated and un-irradiated reactive blue 13 (Mousa et al., 2006).

3. Results and discussions

The influence of UV-radiation on the colour strength using irradiated and un-irradiated fabric dye has been studied. It is observed from Fig. 1(a) and (b) that irradiated fabric has the maximum affinity for the irradiated dye to attach as compared to un-irradiated cotton fabric samples. Lab values given in Table 2 indicate that samples dyed with 1% dye solution are darker and bluer as compared to samples dyed with 0.5% dye solution as shown in Table 1. The results indicated in Fig. 1 demonstrate that irradiation treatment for 30 min gives maximum darkness in strength. The irradiation for too low time (20 min) did not give significant results because the fabric does not activate to sorb more dye onto it and aggregates of dyed fabric absorb at once rush onto its surface and cause

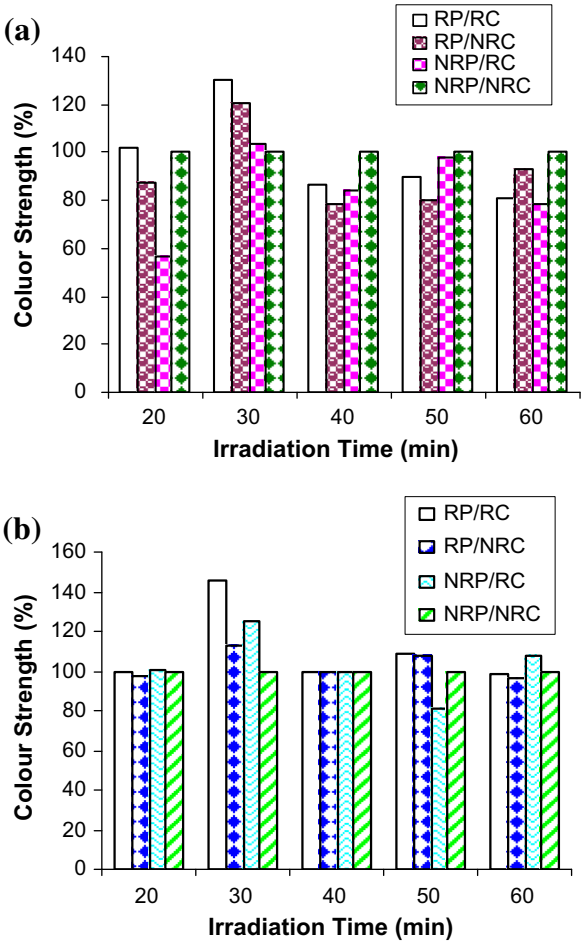

Figure 1 Effect of radiation time on dyeing of irradiated and un-irradiated cotton fabric using irradiated and un-irradiated dye solution 0.5% (a) and 1% (b).