Journal of Fiber Bioengineering and Informatics 7:3 (2014) 363–375
doi:10.3993/jfbi09201406

A Comparative Study of the Salt-free Reactive Dyeing Property of Treated Cotton Fabric with a Chicken-feather Protein Derivative Agent and a Linking Cationic Agent

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Received 8 Janurary 2014; accepted (in revised version) 10 July 2014; available online 23 September 2014

Abstract

Cotton fabric is treated with a chicken-feather protein derivative auxiliary (named WLS-10) and with a self-made linking cationic agent (named WLS), respectively. WLS-10 was prepared with chicken-feather protein and WLS. The salt-free reactive dyeing properties of the treated cotton fabric were assessed and compared with the untreated cotton fabric dyed with salt. The results show that both the cotton fabrics treated with WLS-10 and WLS dyed without added salt obtained a higher dye uptake (E), color strength value (K/S), fixation of adsorbed dye (F) and the total fixation of the original applied dye (T) than untreated cotton fabric dyed with added salt. The treated cotton fabric did not decrease levelness and color fastness. However the dyeing properties of the WLS-10 treated cotton fabric were better than the WLS treated fabric.

Keywords: Chicken-feather Protein Derivative Agent; Cationic Modified Treatment; Cotton Fabric; Salt-free and Low Alkaline Dyeing; Reactive Dyes

1 Introduction

Cotton is a typical cellulose, which is vastly applied in our daily life due to its advantages such as soft hand, moisture absorption and comfortable properties. Hence, people have made great effort investigating different features of cotton fibre in textile research [1-3]. Cotton is a hydrophilic fibre since its polar surface contains large amounts of hydroxyl groups, which implies that the fibre will be negatively charged in solution.

Since most of dyes are also charged in solution, the Coulomb interaction between the fibre and the dyes is largely affected by the charges on both sides, which has great relevance to the dyeing ability of the fibre. In particular reactive dye which is negatively charged in solution is most

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commonly used for dyeing cotton fibre. Normally, a large amount of salt is added in the dye-bath to decrease the negative charges on the cotton surface in order to enhance the adsorption speed of dyes from the dye-bath to the fiber surface and increase dye uptake and fixation when cotton fabric is dyed with reactive dyes [4]. But it causes environmental pollution [5, 6]. Lately, salt-free reactive dyeing is studied by many researchers. The cationic modified treatment is the most effective method to realize salt-free reactive dyeing [4, 7, 8]. Now, there are many cationic modified agents, but different kinds of modified agents have different dyeing effectiveness. At present, biodegradable agent is the topic of interest [9-15]. Chicken-feather protein is a biodegradable material, and its quantity is vast because there are large amounts of abandoned chicken feather in the world every day [16]. As a result many researches have been conducted on the waste chicken-feathers [17-20]. In our previous research, we had studied the salt-free reactive dyeing properties of the cotton fabrics treated by WLS-10 and WLS [21-23]. The results have been found that the treated cotton fabrics can avoid the use of salts and improve dyeing ability remarkably. In this paper, cotton fabrics were treated by WLS-10 and WLS, respectively. The dyeing properties of the treated cotton fabrics dyed with different concentrations and different types reactive dyes without added salt were discussed. The aim of this study was to compare the difference of the dyeing abilities of the cotton fabrics treated by the two agents.

2 Experimental

2.1 Materials and Instruments

Cotton fabric used in this paper was manufactured by the YOUNGOR Co., Ltd. (Zhejiang, China), and its specifications: Ends/in.: 60, picks/in.: 60, warp count: 20 s, weft count: 20 s. Chicken-feather was obtained from an abattoir (Xi'an, China). Reactive Brilliant Red M-8B was manufactured by Shang Hai Dye Co., Ltd. (Shanghai, China). Reactive Black DS-DH was manufactured by Jiangsu Wujiang Taoyuan Dye Co., Ltd. (in China). Reactive Blue CD-2BG and Reactive Orange CD-2BR were manufactured by Guangdong Foshan Ruigao Chemical Industry Co., Ltd. (in China). Cationic chicken-feather keratin auxiliary WLS-10 and linking cationic auxiliary WLS were self-prepared (The structures of WLS and WLS-10 are shown Fig. 1 and Fig. 2, respectively. In Fig. 2, *Protein* represents a dissolved chicken-feather keratin molecular chain; *X* represents NH, O or S. 722 type spectrophotometer was manufactured by Shanghai Third Analytical Instrument Factory (Shanghai, China). HD500 type laboratory water bath oscillator was manufactured by Nantong Experimental Instrument Co. (in China). The SF-300 SRICI spectrophotometer was manufactured by SRICI Color Science and Technology Co., Ltd. (Shenyang, China). The LFY-304 rubbing fastness tester was manufactured by Shandong Textile

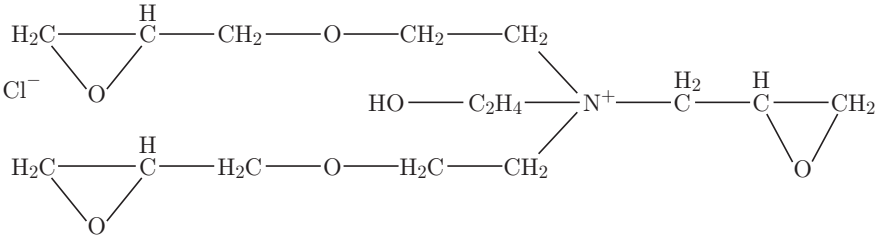

Fig. 1: The structure of WLS