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ORIGINAL PAPER

Dyeing of multiple types of fabrics with a single reactive azo disperse dye

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Three novel reactive azo disperse dyes were prepared using 7-acetamide-4-hydroxy-2-naphthalene sodium sulphate as the precursor. The structure of the dyes has the combined characteristics of reactive, disperse, and cationic dyes. Under alkaline conditions (pH 9), the dyes can be applied to cotton, silk, wool, and nylon. Under neutral conditions, they can be used to dye polyester. Under acidic conditions (pH 4.5), they can colour acrylic fabric after conversion of the tertiary amine group to the quaternary ammonium cation. The colour-fastness of the dyed fabrics were also evaluated.

Keywords: reactive dye, disperse dye, cationic dye, synthesis of dye, coloration, affinity

Introduction

For any given type of fabric, only a limited range of dyes can be applied to obtain the desired aesthetic effect with satisfactory exhaustion values and fastness properties (Gordon & Gregory, 1987). Owing to the distinctive properties of each dye, different dyeing processes are necessary and multiple types of dyeing facilities are needed. In addition, each dyeing process produces its own effluent, which requires unique treatment prior to discharge into the environment. All these factors contribute to increasing the cost of dyeing. If one dye can be applied to all types of fabrics, both the dyeing process and the effluent treatment can effectively be simplified. Moreover, as the dye bath may be reused, the amount of dyeing effluent can be reduced substantially. It is evident that the development of a novel type of dyes that can be applicable to multiple types of fabric will not only reduce the dyeing cost but will also provide an environmental advantage.

As conventional dyeing processes have already attained their mature stage, the modification of fabric and the modification of dye are regarded as two feasible approaches to achieving this goal. Lewis and Broadbent (1997) modified the structure of wool and cotton by the benzoylating reaction and used a disperse dye to colour wool and cotton. They also investigated the coloration properties of benzoylated cotton with a disperse dye in supercritical carbon dioxide (Özcan et al., 1998). In these cases, disperse dyes were used to dye hydrophilic fabric instead of the hydrophobic one, which clearly extends the application range of disperse dyes. The effect of this treatment on the wearability of fabric remains uncertain, and this method has not achieved significant commercial success to date. In parallel, various approaches have been proposed to modify the structure of dyestuffs. Lee and Kim (1999) and Lee et al. (2002) used temporarily solubilised disperse dyes to dye polyester in the absence of a dispersing agent and they further extended the application of this kind of dyestuff to wool (Lee et al., 2001). Sokolowska-Gajda and Freeman (1990) and Suwanruji et al. (2004) incorporated a dichlorotriazine reactive group to the structure of acidic dye, and applied the resultant dye to poly(ethyleneterephthalate), polyester, and acrylic fibres. They noted that the presence of naphthalene sulphonamide might account for the good sublimation fastness on polyester, and ascribed the low exhaustion on cotton to the hydrophobic nature of the dye molecules.

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