Printing properties of novel regenerated cellulosic fibers

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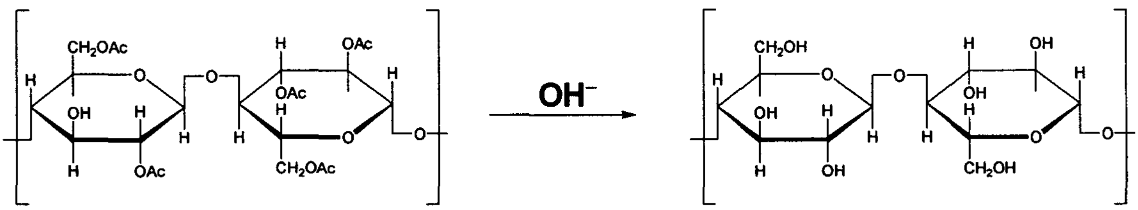
1. Introduction

Recently, SK Chemicals introduced a novel regenerated cellulosic fiber, *enVix* which was prepared from a cellulose acetate fiber with a degree of substitution of 2.0 or higher by saponifying 75% or greater of the total acetyl groups of the cellulose acetate fiber into hydroxyl groups and has a composite crystalline structure of cellulose II and IV (Scheme 1) [1-3]. This regenerated fiber is claimed to offer environmental advantages over other conventional regenerated fibers because it dose not emit toxic materials such as carbon disulfide and heavy metal ions.



Scheme 1. Alkali-hydrolysis of cellulose acetate fibers.

In previous work, supramolecular structures of *enVix* and viscose rayon were investigated in a comparative manner[3]. The crystallinity of *enVix* was found to be lower than that of viscose rayon and the orientation of crystallites along the fiber axis in the former somewhat lower according to measurements of birefringence. Also, careful comparison of the dyeing properties of two rayons confirms that there is a correlation between supramolecular structures and the dyeing properties [4,5]

The reactive printing properties of regular viscose rayon and a new regenerated cellulosic fiber which was prepared from cellulose acetate fiber was investigated in a comparative manner the effect of thickeners, urea, alkali, and steaming time on the printing properties was compared between two regenerated cellulosic fibers.

2. Experimental

2.1 Materials

Viscose rayon fabric (Interlock, 58inch, 360g/yd) and new regenerated cellulosic fabrics (Interlock, 58inch, 360g/yd) obtained from cellulose acetate fibers by alkali-hydrolysis [1-3] were generously supplied by SK Chemicals (South Korea).

The reactive dye used was commercial samples that were not purified prior to use; Sunicion Blue P-3R (C.I. Reactive Blue 49) waskindly supplied by Ohyoung Corp. A commercial sample of synthetic thickener (XTN, polyacrylic acid) (Table 1) and soaping agent (SNOGEN CS-940N, non-ionic) were supplied by Libert Chemicals and Daeyoung Chemicals, respectively. All other reagents were of general purpose grade.

2.2 Printing

The printing paste was prepared by first dissolving 8% of the thickener in water at a liquor ratio of 8:100. The dissolved reactive dye (2.0wt% based on the print paste) either in the masked or free form was then added to the thickener solution with continuous stirring. Finally the other additives used were added to the printing paste

The flat screen printing technique was applied. The fabric to be printed is put under the silk screen and the printing paste is then applied on the fabric by using a wooden applicator with a rubber edge. All prints were carried out with one squeegee wipe with high reproducibility.

The printed fabric was left to air dry and steaming was carried out at 102C for 15 min in an autoclave using superheated steam. The steamed fabrics were then washed with cold water, hot water for 5 min and finally at 80C for 2min with a solution containing 1 g/l non-ionic detergent (SNOGEN CS-940N). The printed fabrics were rinsed in cold water and air dried (Table 3).

3. Results and Discussion

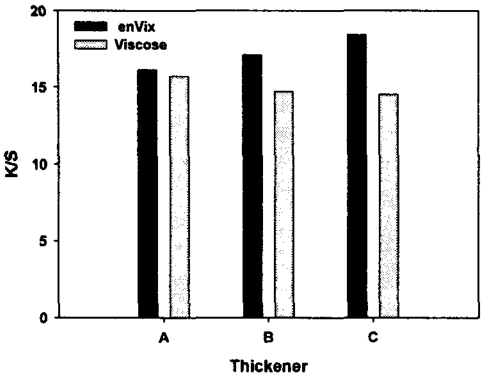


Figure 1.Effect of various thickeners on the color strength of printed fabrics (2.0% of C.I. Reactive Blue 49).

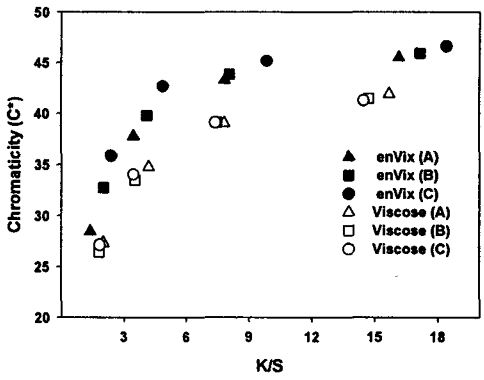


Figure 2. Effect of various thickeners on the chromaticity (C*) of printed fabrics (0.25, 0.5, 1.0 and 2.0% of C.I. Reactive Blue 49, Thickeners A, B and C).

It is evident from Figure 1, the K/S values of the dyeings on *enVix* are higher than that on viscose rayon, irrespective of each of three thickeners, and these results are consistent with the previous work investigating their supramolecular structures and dyeing properties in a comparative manner [3-5]. The excellent color yields on *enVix* can be ascribed to the lower crystallinity (%) values (*enVix* 27%, viscose rayon 39%) and degree of orientation (*enVix*1.93, viscose rayon 3.63); as a useful generalization, fibers may be regarded as structures in which there is a spread of molecular order, ranging from highly ordered crystalline domains to disordered amorphous regions [7]. The strength originates in the crystalline material while the amorphous material provides the flexibility, porosity and the regions generally accessible to liquids, dyes and other reagents such as thickeners.

Also, taking a closer look reveals that, *enVix* showed higher color yield when the mixed thickener rather than other thickeners (sodium alginate or synthetic thickener only) was used. The quality of print depends largely on the chemical and physical properties of the thickeners used. To a certain extent the depth, brightness of color and especially sharpness and smoothness of the print depend on nature of the thickeners.

The essential requirements of thickeners are desirable physical and chemical properties such as viscosity, flow property, ability to wet and adhere to the surface of printing machine. It should give a good color yield, must be economical and abundantly available. The thickener paste must not have any affinity for or reactivity with the dye and should not withhold the diffusion of the dye into the fabric. It should also be easily washable once the printing is over [6].

Figure 2 shows the chromaticity values (C*) of *enVix* were higher than those of viscose rayon, irrespective of thickeners used. Although it is not easy to guess the clear reason for the brighter color properties on *enVix* compared with the viscose rayon, it seems to have a relation to the difference in their supramolecular structure.

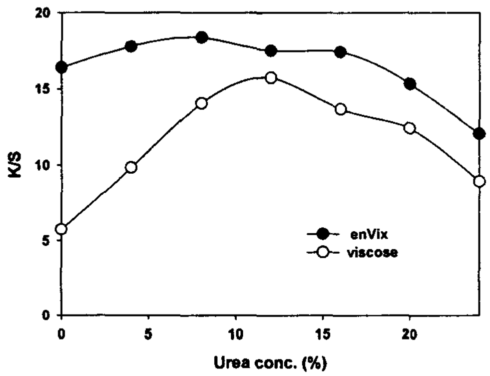


Figure 3. Effect of urea concentration on the color strength of printed fabrics (2.0% of C.I. Reactive Blue 49, Thickener C).

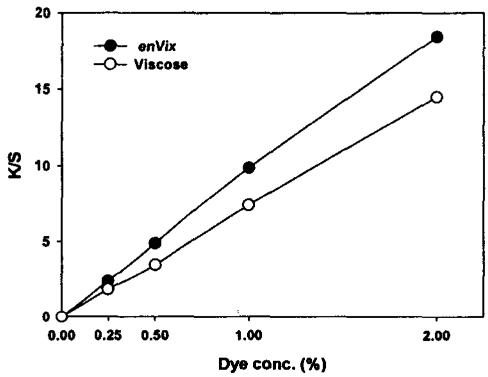


Figure 4. Build-up properties of C.I. Reactive Blue 49 on regenerated cellulosic fibers (Thickeners C)

Figure 3 shows that the less amount of urea is required for *enVix* than viscose rayon to get the highest color strength ; the optimum concentration urea for *enVix* was 8.0% and that for viscose rayon was 12%, respectively. Therefore, it can be stated that lower concentration of urea is required for the printing of *enVix* and consequently, the amount of urea in the wastewater can be reduced. Once again, the color yield (K/S) of the printings on *enVix* is higher than that on viscose rayon and this result is also consistent with the previous work investigating exhaust dyeing properties [3-5]. Furthermore, taking a closer look reveals that *enVix* is relatively insensitive to the urea concentration, compared with viscose rayon in the range of 0-24 %.

Further evidence that the printing properties of *enVix* is better than that of viscose rayon was provided by the results of build-up properties obtained for Reactive Blue 49 (Figure 4) ; *enVix* exhibited a deeper shade than viscose rayon (higher K/S values by 27.1% in 2.0% printing).

4. Conclusions

The reactive printing properties of regular viscose rayon and a new regenerated cellulosic fiber (*enVix*) which was prepared from cellulose acetate fiber was investigated in a comparative manner. From the results, it was found that *enVix* exhibited better printing properties than regular viscose rayon. It showed stable final color yields, irrespective of the amount of thickener, hence reproducibility of printing of *enVix* is expected to be excellent. In addition, urea requirements were less for the printings on *enVix* than for the corresponding printing on viscose rayon. Therefore, *enVix*is also expected to reduce the amount of the urea which causes environmental problems in dyehouse effluent.

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