A study on simultaneous fixation of Reactive dye printing and crease resist finishing on cotton fabric (Effect of DMDHEU concentration, types of catalyst and drying conditions)

S. M. Mortazavi, M. A. Alsharif, M. Jannesari

Department of Textile Engineering, Isfahan University of Technology, PO Box 84156-83111, Isfahan, IRAN

Abstract

Single step process for simultaneous reactive dyeing and easy care finishing using DMDHEU on cotton fabrics have been investigated by some workers. Reducing the cost of treated fabrics and saving energy is necessary in printing of textiles. So the aim of this work is performing the fixation process for crease resist finishing and printing of reactive dyes on cotton fabrics at the same time. In this study a new process of simultaneous crease resist finishing and reactive dye printing on cotton fabric was performed. Concurrent fixation has some advantages such as economizing energy and at the same time reducing the cost of eliminated processes. It was observed that it is possible to have a good color pick up and at the same time having good crease resistance finishing on cotton fabric. The present work showed that on increasing DMDHEU concentration and also time and drying temperature for resin finishing, DCR (Dry Crease Recovery) and k/s of the dye were improved. On the other hand, the types of catalyst for resin finishing also had the same effect on DCR and k/s. It was found that there is a regression between inverse of k/s and DCR.

Keywords: Cotton fabric printing; Easy care finishing; DMDHEU; Reactive dyes; DCR; k/s

1. Introduction

In order to modify the low-crease recovery of cotton fabrics various kinds of chemicals, such as dimethyloldihydroxy-ethyleneurea (DMDHEU) are used [1].

Reactive dyes are one of the most commonly used dyes for cotton printing because of their high fastness, brilliant colors, and variety of hue [2]. Approximately 25% of the total production in the world is performance by Reactive printing . In general, the reactive dyes used in printing often have a degree of only 60% can be achieved [4].

The usual procedure for printing (or dyeing) and resin finishing of fabrics involves the application of the two processes separately and in succession.

Many attempts for effecting both treatments (dyeing and resin finishing) of cotton fabrics, in a single operation are reported [5-8]. But very few studies have been reported on simultaneously printing and resin finishing of cotton fabrics.

The single step of fixation of the two processes (printing and finishing) have very advantages, such as saving energy (because of reducing of time consuming, energy intensive and expensive washing-off procedures), and then this operation is very economic.

The present work describes a new approach for concurrent printing and finishing of cotton fabric, which aims to study factors affecting this single operation to understand the role of resin concentration, types of catalyst and drying time and temperature in the fixation of printing-finishing process.

2. Experimental

2.1. Materials

A scoured, desized, bleached and plain weave cotton fabric, with a weight of 112.5g/m^2 and density of 27 (threads/cm) in the warp and 15 (threads/cm) in the weft directions was used in this study.

The commercial DMDHEU resin (Ciba-Geigy). As a catalyst for DMDHEU resin, $MgCl_2$ and urea nitrate (commercially was used).

The reactive dye used was: C. I. Reactive Orange 5.Other chemicals used in this study were commercially available: sodium alginate (a natural thickener), sodium bicarbonate, urea, anti reduction (lodigol) and non-ionic detergent.

2.2. Methods

Simultaneously printing and resin finishing of cotton fabric was carried out as follows: in the first stage the fabric was immersed in an aqueous solution consisting of DMDHEU (100g/l); catalyst (15g/l), then squeezed to obtain a 70% wet pick up. The wet fabric was dried at 100 ºC for 3 min.

In the second stage the treated fabric was printed. The stock paste was prepared according to the following recipe: urea 150 g/kg, sodium alginate (5%) 450g/kg, sodium bicarbonate 24g/kg, lodigol 10g/kg and the reactive dye 20g/kg. Each printing paste was adjusted to a constant viscosity by adding the necessary amount of water. The samples were dried at 100º C for 3 min.

And in the third stage, the printed and treated with resin fabric was fixed at 180 ºC for 3 min., and then washed according to washing-off procedure. The washed samples were dried at 100º C.

2.3. Dyeing test

The color properties of the printed samples were determined using Tex-flash spectrophotometer, and reflectance values (R) were measured. The color strength (K/S) values were then established according to the Kubelka Mank equation [10].

2.4. Crease recovery test

The crease recovery angle of the fabric was measured under standard according to AATCC test method 66-19990, using the wrinkle recovery tester. The wider crease angle shows the higher crease recovery.

3. Results and discussion

The influence of DMDHEU concentration (100, 140, 160 and 200 g/l) on dry crease recovery (DCR) and color strength (k/s) of finished-printed cotton fabrics are shown in figure (1) and figure (2), respectively. It can be observed that the DCR decrease then increase by concentration of resin. It is clear that increasing DMDHEU concentration is accompanied by a significant improvement in the extent of cross linking reaction, expressed as dry crease recovery value. In the other hand, the decrease of DCR value during the first increase of DMDHEU concentration is a direct consequence of the increase extent of reactive dye interaction with DMDHEU resin.

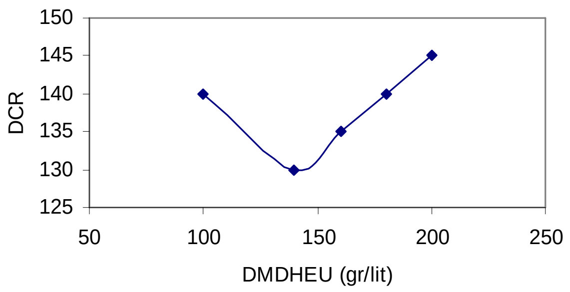

Fig. 1. Influence of DMDHEU concentration on dry crease recovery.

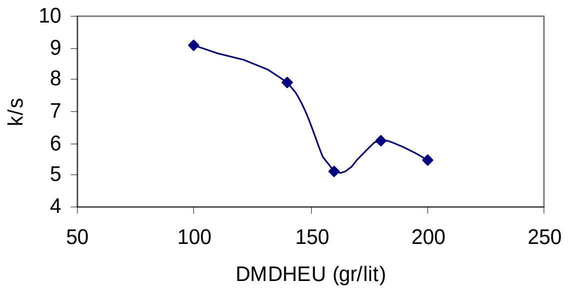

Fig. 2. Influence of DMDHEU concentration on color strength.

Figure (2) shows the effect of DMDHEU concentration on the k/s of simultaneously finished and printed cotton fabrics. Color strength decreased by concentration of resin. This is direct consequence of the decreased extent of dyestuff-substrate links via: (a) dyestuff interaction with DMDHEU resin in their vicinity, (b) increase extent of DMDHEU-substrate cross links and decreasing of mobilized substrate's active sites for the molecules of reactive dye, (c) formation a thin layer of resin and as a result decreasing the susceptibility and affinity for the dyestuff under investigation.

Table 1. Influence of catalyst types on dry crease recovery and color strength.

Type of catalyst	k/s	DCR
Magnesium chloride	10.9	100
Magnesium chloride	8.7	110
Urea nitrate	6.8	165
Urea nitrate	5.6	165

Table 2. Influence of drying conditions on dry crease recovery and color strength.

Temperature (^{o}C)	Time (minutes)	k/s	DCR
60	3	7.5	208
60	5	8.7	190
100	3	5.1	149
100	5	5.9	146

The result of color strength and dry crease recovery indicated that the types of catalyst for resin finishing had expensive effect on finished-printed cotton fabrics (table 1). Samples which catalyzed by urea nitrate (30 g/l) have DCR value greater than those catalyzed by magnesium chloride (15 g/l), and less k/s value. The results reflecting the effect of acidic nature of urea nitrate. The urea nitrate is an excellent catalyst for DMDHEU easy care finishing, but it can not recommended in concurrent finishing and printing.

The data in table (2) illustrate effect of drying conditions on DCR and k/s of concurrent finished and printed cotton fabrics. The results signify that the samples which dried at 60^{o} C have greater k/s and DCR values than those dried at 100 ^{o} C. The decrement in the color strength beyond 60^{o} C is a direct consequence of decomposition of some reactive dyes via acid hydrolysis and/or thermal degradation.

Table (2) show that, by lengthening the drying duration up to 5 minutes, there is a significant enhancement in color strength, and a decrement in dry crease recovery. This is a direct consequence of the decreased extent of cross linking reaction and increase of reactive dye interaction. Current data further suggest that to achieve the best properties as well as to avoid over-dry it is better to carry out the drying step at 60^{o} C for 5 minutes.

Figure (3) shows the relationship between inverse of k/s and DCR by a regression curve. The R^2 value is 0.70. It means that there is a relatively acceptable relation between aforementioned properties. In one word, the DCR value of samples decreases by increasing of k/s value.

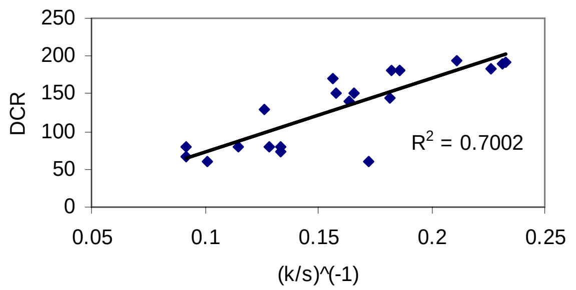

Figure 3. Regression curve between inverse of k/s and DCR.

4. Conclusion

The effect of DMDHEU concentration, types of catalyst and drying conditions on simultaneous fixation of Reactive dye printing and crease resist finishing on cotton fabric were investigated. It was found that, the color strength and dry crease recovery had optimized value at 100 (g/l) concentration of DMDHEU with magnesium chloride as a catalyst. Current data further suggest that to achieve the best properties as well as to avoid over-dry it is better to carry out the drying step at 60^{o}C for 5 minutes.

5. References

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