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Value Addition of Mulberry Silk/ Wool Blended Fabric with Vinyl Sulphone Reactive Dye Printing (Reactive Red 198, Reactive Blue 21 Dye)

Sushila[1] & Sandeep Bains[2]
[1] Department of Apparel and Textile Science, college of home science, Punjab Agricultural University, Ludhiana, Punjab, India
[2]Department of Apparel and Textile Science, college of home science, Punjab Agricultural University, Ludhiana Punjab, India
Email: sushila.03ct@gmail.com

ABSTRACT
The present study was taken up to investigate the conceivable outcomes of printing mulberry silk/wool blended fabric with vinyl sulphone reactive dyes (reactive red 198 and reactive blue 21). Sodium alginate concentration, steaming time and steaming temperature were optimized for the printing. Samples were assessed for CIE Lab values and K/S value before and after washing and percent fixation was additionally recorded. Printed samples were also assessed for colour fastness to various agencies.

Key words: Blend, printing, reactive red 198 dye, reactive blue 21 dye, silk, vinyl suphone dyes, wool.

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INTRODUCTION

Textiles dyeing and printing are the earliest procedures of textile decoration. Regardless of the culture, use of colour was, and is, universal. It was in 2600 BC when earliest written records of the use of dyestuffs were found in China [2]. The term textile printing is used to signify the production, by various means of coloured patterns or design on all sorts of textile fabrics. Textile printing is really a form of dyeing, but differs from that art in that the cloth, instead of being uniformly coloured throughout by immersion in a solution of dyestuff has one or more thickened colours or mordants applied to it locally [3].

The reactive dyes differ from all other classes in that they contain functional groups capable of forming covalent bonds with the fiber, imparting good wet-fastness properties to the dyed fabrics. Their chemical structure consists essentially or a simple, highly sulfonated acid dye or the azo, anthraquinonoid, or phthalocyaniae type, to which is attached a grouping through which reaction with appropriate groups in the fiber can take place. In contrast to metal-complex and chrome dyes, high wet-fastness is associated with bright hues, so reactive dyes offer the possibility of producing shrink-resist wool garments in almost any color, the dye as well as the fabric being resistant to the hot detergent solutions used in domestic washing machines [1].

The classic wool printed article, wool muslin, has lost much of its importance in recent years, particularly as a result of the rapid progress made by synthetic fiber materials. In recent years, the dyestuff manufacturers have closed this gap in wool printing by marketing extremely suitable reactive (dyestuffs especially for the dyeing and printing of wool. For the printing of silk, practically the same dyestuff groups are used as for the printing of wool. Silk is more stable to alkalis than wool and direct dyestuffs may therefore be applied to silk by the method used for cellulosic fibers [4].

MATERIALS AND METHODS

Materials

Mulberry silk waste/wool fabric blended in the proportion of 65:35 and hand woven was used for the research work. Two vinyl sulphone hot reactive dye i.e. reactive red 198 dye and reactive blue 21 dye were chosen for the study.

Methodology

Optimization of printing variables for reactive dyes

Optimization of thickener for hot reactive dyes

For thickening agent sodium alginate was used. To optimize the quantity of sodium alginate three printing pastes were prepared with varying concentration i.e. 3%, 4%, and 5% separately for each of reactive dye. Sodium bicarbonate was used as dye fixing agent, urea as anticracking agent, diethylene glycol as levelling agent and sodium tripolyphosphate was used to restrict build up of metallic salts. All the chemicals were blended thoroughly in required amount of water to prepare the printing paste. After printing the fabric was tested for CIE Lab, K/S value and percent dye fixation. The percent of dye fixation (%F) was figured using equation:

$$\%F = \frac{\text{K/S after dyeing}}{\text{K/S before dyeing}} \times 100$$

Where, K/S is the colour yield value. The sodium alginate concentration at which the samples gave the best result was considered optimized thickener concentration.

Optimization of steaming time for hot reactive dyes

After optimizing the concentration of thickening agent printing paste was prepared separately for each of the hot reactive dye. Printing paste was applied on the fabric and the steaming was carried out for three different durations i.e. 10 minutes, 15 minutes and 20 minutes after printing the fabric it was tested for CIE Lab, K/S value and percent dye fixation. The time duration at which the samples gave the best result was considered optimized steaming time.

Optimization of steaming temperature for hot reactive dyes

To optimize steaming temperature three printing paste were prepared separately with optimized thickening quantity and optimized steaming time for each of the hot reactive dye. Printing paste was prepared similarly as for thickening agent and steaming was carried out for three different temperatures i.e. 90°C, 95°C, 100°C. After printing the fabric it was tested for CIE Lab, K/S value and percent dye fixation. The steaming temperature at which the samples gave the best result was considered optimized steaming temperature.

Printing of silk/wool blended fabric using reactive dyes

Recipe for printing paste

The printing paste for hot reactive dye was prepared using the following recipe:

Dye	:	2 %
Sodium alginate	:	3-5%
Sodium bicarbonate	:	2%
Diethylene glycol	:	2%
Urea	:	10%
Soda tripolyphosphate	:	2%
Water	:	x %
Time	:	10-20 minutes
Temperature	:	90°C-100° C

Printing procedure

Printing paste was prepared using optimized concentration of sodium alginate with required amount of dye. Fabric sample was printed with prepared printing paste using screen printing. Steaming was carried out on optimized temperature for optimized time duration. After printing the samples were washed to remove excess dye and shade dried afterwards.

RESULT AND DISCUSSION

Optimization results

Printing conditions were optimized for two hot reactive dyes i.e. reactive red 198 dye and reactive blue 21 dye were optimized separately. Best printing results for reactive red 198 dye were obtained with 4% sodium alginate concentration at 95^{0}C steaming temperature using 15 minutes steaming time. Whereas

for reactive blue 21 dye, sodium alginate thickness was optimized at 4% sodium alginate concentration with 20 minutes steaming time at 100^0C steaming temperature.

Colour fastness results

Table 1 : Colour fastness grades of printed fabric

Fabric	Light fastness Grades	Washing fastness grades			Rubbing fastness grades				Perspiration fastness grades					
					Dry		Wet		Acidic			Alkaline		
		CC	CS		CC	CS	CC	CS	CC	CS		CC	CS	
			W	C						W	C		W	C
Reactive red 198	5	4/5	3/4	4	4	3/4	4	3	4	4	4	4	4	4
Reactive blue 21	5	4	4	4	4	3/4	3/4	3	4	4	4	4	3/4	3/4

Fabric printed with vinyl suphone reactive dyes shown good light fastness. The wash fastness grade for fabric printed with both reactive dyes in terms of colour change was found to be good and the printed fabric showed little staining on both cotton and wool fabrics. The grade for colour change for fabric printed using vinyl suphone reactive dye ranged between fair to good and slight staining was observed for dry rubbing on adjacent fabric. In case of wet rubbing fair grade were observed for colour change and noticeable to slight staining was observed on the adjacent fabric. Observation for perspiration fastness for the fabric printed with vinyl suphone reactive dye showed that the grade for colour change in acidic medium was good. Noticeable to slight staining was observed on wool fabric and noticeable staining was observed on cotton fabric. In alkaline medium the grade observed for change in colour was fair, slight staining was observed on wool fabrics and noticeable to slight staining was found on cotton fabric.

Printing on fabric

Mulberry silk waste / wool blended fabric was printed using screen printing method.

Plate 1: Screen printing using reactive red 198 (flower) and reactive blue 21 (stem and leaves) dye

CONCLUSION

The present study affirmed that printing of mulberry silk/wool blended fabric with vinyl sulphone reactive dye (reactive red 198 and reactive blue 21) is conceivable. The results also revealed that bright colured prints with good fastness properties can be obtained on mulberry silk/wool blended fabrics using vinyl sulphone reactive dyes.

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