EFFECT OF SOME FIXING AGENTS ON REACTIVE DYED COTTON KNITTED FABRICS FOR CHANGE IN SHADE AND DAY LIGHT FASTNESS

Shahid Saleem Shad, M. Iqbal Javed**, Mian Mohammad Bashir Kausar*** and Muhammad Tanveer*****

ABSTRACT

These studies were conducted in the Department of Fibre Technology, University of Agriculture, Faisalabad during 1998-99. Some formaldehyde and non-formaldehyde based fixing agents with different concentrations and temperatures were used on reactive dyed cotton knitted fabric. Non-formaldehyde fixing agents performed better than formaldehyde based agents for change of shade and day light fastness properties.

KEYWORDS: Cotton; Natural fabrics; Pakistan.

INTRODUCTION

The cotton textile industry is life blood of Pakistan's economy. It contains many processes like spinning, weaving, finishing and garments making. The industry also includes the knitwear units which has significantly progressed in recent years. Fabrics need many treatments like scouring, bleaching, mercerization for dyeing and printing processes.

Dying auxiliaries include fixing agents which are used as post treatments to improve the wet fastness properties of direct and reactive dyes on cellulosic fabrics. Kakinuma *et al.* (9) found that fixing of dye due to polyfunctional compounds gave good fastness to light. Takeo (15) mentioned the effects of soap and some cationic fixes on various colour fastness of cotton fabrics dyed with reactive dyes. According to him, fixation may cause light fastness lowering and discolouration. Rajni *et al.* (13) evaluated eight commercially available formaldehyde based and non-formaldehyde fixing agents and

*Assistant Professor, Department of Fibre Technology, ****M.Sc. Student. **Assistant Professor, Department of Math. & Stat., ***Associate Professor, Department of Cooperative and Credit, University of Agriculture, Faisalabad.

concluded that non-formal dehyde type finishing agents gave overall better performance in terms of less dye bleeding and less shade alteration, combined with excellent fastness to light.

The objective of this study was to select the type of fixing agent at particular concentration and temperature on reactive dyed cotton knitted fabrics for change of shade and light fastness.

MATERIALS AND METHODS

This research was carried out partially in the Department of Fibre Technology, University of Agriculture, Faisalabad and Kern Hosiery (Pvt) Ltd., Faisalabad during 1998-99. All the techniques used on fabrics for procreative post treatment and dyeing were kept constant according to the prescribed methods on particular fabrics.

Fabric specification

Grey cotton knitted fabric of 24's combed single jersey (having 47 coarses and 38 wales per inch) was selected from running material at Kern Hosiery (Pvt.) Ltd., Faisalabad. Grey cotton knitted fabric was given necessary pretreatments for further dyeing process in the hosiery.

Post treatment of dyeing with fixing agents procedure

Cotton knitted samples of 2 percent shade depth (yellow, red and blue) weighing 10g each were put into steel cylinders containing solutions of different concentrations of formaldehyde based and non-formaldehyde fixing agents with 1:2 liquor ratio and agitated in fixer solutions at Ahiba polymat of different temperatures at 7. The samples were then washed and dried. The standard methods were adopted (2, 4). The detail of fixing agents is given below.

(a) Formaldehyde-based fixing agents

F_1 = Sandofix WE (Clariant)
F_2 = Fixanol PN (IC)
F_3 = Tinofix WS (CIBA)

(b) Non-formaldehyde fixing agents

G_1 = Flofix SNF (Alka)
G_2 = Neofix R 755 (NICCA)

(c) Concentrations		(d) Temperatures	
C_1	= 0.5%	T_1	= 30°C
C_2	= 1%	T_2	= 40°C
C_3	= 1.5%	T_3	= 50°C
		T_4	= 60°C
		T_5	= 70°C

For testing of sample for cotton fastness standard techniques as suggested earlier (1, 5, 7) were used. Each untreated and treated sample was evaluated to assess shade change with the help of grey scale shade change as suggested by Gakkaishi (7).

For day light fastness (BS 1001 ISO 105/BOI) the method reported by Anonymous (5) was used.

Description

Specimen, Opaque card board standard Blue scale, Meraeus sun-test cps[+]

Procedure

Half portion of treated samples was covered with opaque card board and then the samples were placed in the Meraeus sun-test cps + apparatus. The apparatus was set according to the requirements for ten hours. After that the apparatus automatically stopped and test was completed. The sample was taken out of the apparatus. Card board was removed and sample was assessed with the help of standard Blue scale.

RESULTS AND DISCUSSION

1. Change of Shade

The results (Table 1 a) show that change of shade grating according to grey scale for yellow and red samples for formaldehyde-based fixing agents (F_1, F_2, F_3) at concentrations of C_1 and C_2 for all temperatures was 4-5 (very good). For these fixing agents change of shade for yellow and red samples at concentration C_3 was very good and for blue samples, it was good to very good (3-4).

Table 1(a): Change of shade of samples treated with formaldehyde based fixing agents.

Fixing agents	Concentration (%)	Temperature	Change of shade		
			D_1	D_2	D_3
F_1 (Sandofix WE)	C_1 (0.5%)	T_1 = 30	4-5	4-5	4
		T_2 = 40	4-5	4-5	4
		T_3 = 50	4-5	4-5	4
		T_4 = 60	4-5	4-5	4
		T_5 = 70	4-5	4-5	4
	C_2 (1.0%)	T_1 = 30	4-5	4-5	4
		T_2 = 40	4-5	4-5	4
		T_3 = 50	4-5	4-5	4
		T_4 = 60	4-5	4-5	4
		T_5 = 70	4-5	4-5	4
	C_3 (1.5%)	T_1 = 30	4	4	3-4
		T_2 = 40	4	4	3-4
		T_3 = 50	4	4	3-4
		T_4 = 60	4	4	3-4
		T_5 = 70	4	4	3-4
F_2 (Fixanol PN)	C_1 (0.5%)	T_1 = 30	4-5	4-5	4
		T_2 = 40	4-5	4-5	4
		T_3 = 50	4-5	4-5	4
		T_4 = 60	4-5	4-5	4
		T_5 = 70	4-5	4-5	4
	C_2 (1.0%)	T_1 = 30	4-5	4-5	4
		T_2 = 40	4-5	4-5	4
		T_3 = 50	4-5	4-5	4
		T_4 = 60	4-5	4-5	4
		T_5 = 70	4-5	4-5	4
	C_3 (1.5%)	T_1 = 30	4	4	3-4
		T_2 = 40	4	4	3-4
		T_3 = 50	4	4	3-4
		T_4 = 60	4	4	3-4
		T_5 = 70	4	4	3-4
F_3 (Tinofix WS)	C_1 (0.5%)	T_1 = 30	4-5	4-5	4
		T_2 = 40	4-5	4-5	4
		T_3 = 50	4-5	4-5	4
		T_4 = 60	4-5	4-5	4
		T_5 = 70	4-5	4-5	4
	C_2 (1.0%)	T_1 = 30	4-5	4-5	4
		T_2 = 40	4-5	4-5	4
		T_3 = 50	4-5	4-5	4
		T_4 = 60	4-5	4-5	4
		T_5 = 70	4-5	4-5	4
	C_3 (1.5%)	T_1 = 30	4	4	3-4
		T_2 = 40	4	4	3-4
		T_3 = 50	4	4	3-4
		T_4 = 60	4	4	3-4
		T_5 = 70	4	4	3-4

Standard scale rating: 5 = Excellent, 4 = Very good, 3 = Good, 2 = Moderate, 1 = Poor

D_1 = Tiafix Yellow e RT
D_2 = Tiafix Red 3 BT
D_3 = Tiafix Blue R

The data further (Table 1 b) show that change of shade rating according to grey scale for yellow and red samples for both non-formaldehyde fixing agents (G_1, G_2) at concentration C_1 and C_2 and at all temperatures was 5 (excellent), whereas for blue samples it was 4-5 (very good to excellent). For blue sample at C_3 it was 4 (very good). For these fixing agents at C_3 and at all temperatures, rating for yellow and red samples was 4-5 (very good to excellent).

Table 1(b): Change of shade of samples treated with formaldehyde based fixing agents.

Fixing agents	Concentration	Temperature (°C)	Change of shade		
			D_1	D_2	D_3
	C_1 (0.5%)	T_1 = 30	5	5	4-5
		T_2 = 40	5	5	4-5
		T_3 = 50	5	5	4-5
		T_4 = 60	5	5	4-5
G_1		T_5 = 70	5	5	4-5
(Flofix SNF Alka)	C_2 (1%)	T_1 = 30	5	5	4-5
		T_2 = 40	5	5	4-5
		T_3 = 50	5	5	4-5
		T_4 = 60	5	5	4-5
		T_5 = 70	5	5	4-5
	C_3 (1.5%)	T_1 = 30	4-5	4-5	4
		T_2 = 40	4-5	4-5	4
		T_3 = 50	4-5	4-5	4
		T_4 = 60	4-5	4-5	4
		T_5 = 70	4-5	4-5	4
	C_1 (0.5%)	T_1 = 30	5	5	4-5
		T_2 = 40	5	5	4-5
		T_3 = 50	5	5	4-5
		T_4 = 60	5	5	4-5
G_2		T_5 = 70	5	5	4-5
(Neofix R755 (NICCA)	C_2 (1%)	T_1 = 30	5	5	4-5
		T_2 = 40	5	5	4-5
		T_3 = 50	5	5	4-5
		T_4 = 60	5	5	4-5
		T_5 = 70	5	5	4-5
	C_3 (1.5%)	T_1 = 30	4-5	4-5	4
		T_2 = 40	4-5	4-5	4
		T_3 = 50	4-5	4-5	4
		T_4 = 60	4-5	4-5	4
		T_5 = 70	4-5	4-5	4

Standard scale rating: 5 = Excellent, 4 = Very good, 3 = Good, 2 = Moderate, 1 = Poor

D_1 = Tiafix Yellow e RT

D_2 = Tiafix Red 3 BT

D_3 = Tiafix Blue R

It is evident from the results that shade change of cotton knitted samples treated with formaldehyde-based and non-formaldehyde fixing agents was slightly increased with the increase of concentration of fixer at all temperatures. This finding agrees to the statement of Trotman (16) who reported that quantity of fixer which was necessary, not only depended upon the depth of shade but also on product concentration.

The results also indicated that non-formaldehyde fixing agents gave better results at all concentrations and temperatures as compared to formaldehyde-based fixing agents. Similar results have been quoted by Rajni *et al.* (13). Kahle (10) reported that formaldehyde-based fixing agents affected the dyed shade and found polyammonium compounds as preferable after treatment.

2. Day light fastness

The data (Table 2 a) show that blue scale rating for shade change of yellow and red samples for all formaldehyde-based fixing agents at C_1 and C_2 concentrations and at temperature of T_1, T_2 was 4 (good) whereas and at T_3, T_4, T_5 change of shade rating was 3-4 (moderate to good). For blue samples it was 5 (good). The change of shade rating of yellow and red samples at concentration C_3 and temperatures T_1 and T_2 was 3-4 (moderate to good) whereas, for blue samples it was 5 (good). Yellow and red samples at concentration C_3 but at temperatures T_3, T4 and T_5 showed rating 3 (moderate) whereas, in blue samples it was 4-5 (good).

Blue scale rating for shade change of yellow and red samples for non-formaldehyde fixing agents (G_1, G_2) with concentrations C_1, C_2 and at temperatures T_1 and T_2 was 5 (good) whereas for blue samples, it was 6-7 (very good). Both the yellow and red samples C_1 and C_2 concentrations but at temperatures. T_3, T_4 and T_5, showed rating of 5-6(good to very good) whereas, blue samples showed 7(very good).

The blue scale rating for shade change of yellow and red sample for same fixing agents at high concentration C_3 and temperatures T_1, T_2 was 5-6 (good to very good) whereas, for blue samples it was 7-8 (very good to excellent).

From the results (Table 2 a) it became clear that with increase of fixer concentration and temperature, the light fastness decreased in case of

Table 2(a): Rating for day light fastness of samples treated with formaldehyde based fixing agents..

Fixing agents	Concentration	Temperature (°c)	Change of shade		
			D_3	D_2	D_1
	C_1 (0.5%)	T_1 = 30	4	4	5-6
		T_2 = 40	4	4	5-6
		T_3 = 50	3-4	3-4	5
		T_4 = 60	3-4	3-4	5
F_1		T_5 = 70	3-4	3-4	5
(Sandofix WE)	C_2 (1.0%)	T_1 = 30	4	4	5-6
		T_2 = 40	4	4	5-6
		T_3 = 50	3-4	3-4	5
		T_4 = 60	3-4	3-4	5
		T_5 = 70	3-4	3-4	5
	C_3 (0.5%)	T_1 = 30	3-4	3-4	5
		T_2 = 40	3-4	3-4	5
		T_3 = 50	3	3	4-5
		T_4 = 60	3	3	4-5
		T_5 = 70	3	3	4-5
	C_1 (0.5%)	T_1 = 30	4	4	5-6
		T_2 = 40	4	4	5-6
		T_3 = 50	3-4	3-4	5
		T_4 = 60	3-4	3-4	5
F_2		T_5 = 70	3-4	3-4	5
(Prixanol PN)	C_2 (1.0%)	T_1 = 30	4	4	5-6
		T_2 = 40	4	4	5-6
		T_3 = 50	3-4	3-4	5
		T_4 = 60	3-4	3-4	5
		T_5 = 70	3-4	3-4	5
	C_3 (1.5%)	T_1 = 30	3-4	3-4	5
		T_2 = 40	3-4	3-4	5
		T_3 = 50	3	3	4-5
		T_4 = 60	3	3	4-5
		T_5 = 70	3	3	4-5
	C_1 (0.5%)	T_1 = 30	4	4	5-6
		T_2 = 40	4	4	5-6
		T_3 = 50	3-4	3-4	5
		T_4 = 60	3-4	3-4	5
F_3		T_5 = 70	3-4	3-4	5
(Unofix WS)	C_2 (1.0%)	T_1 = 30	4	4	5-6
		T_2 = 40	4	4	5-6
		T_3 = 50	3-4	3-4	5
		T_4 = 60	3-4	3-4	5
		T_5 = 70	3-4	3-4	5
	C_3 (1.5%)	T_1 = 30	3-4	3-4	5
		T_2 = 40	3-4	3-4	5
		T_3 = 50	3	3	4-5
		T_4 = 60	3	3	4-5
		T_5 = 70	3	3	4-5

Standard scale rating: 5 = Excellent, 4 = Very good, 3 = Good, 2 = Moderate, 1 = Poor

D_1 = Tiafix Yellow e RT
D_2 = Tiafix Red 3 BT
D_3 = Tiafix Blue R

Table 2(b): Day-light fastness of samples treated with non-formaldehyde fixing agents.

Fixing agents	Concentration	Temperature (°c)	Change of shade		
			D_1	D_2	D_3
	C_1 (0.5%)	T_1 = 30	5	5	6-7
		T_2 = 40	5	5	6-7
		T_3 = 50	5-6	5-6	7
		T_4 = 60	5-6	5-6	7
F_1		T_5 = 70	5-6	5-6	7
(Sandofix(WE)	C_2 (1.0%)	T_1 = 30	5	5	6-7
		T_2 = 40	5	5	6-7
		T_3 = 50	5-6	5-6	7
		T_4 = 60	5-6	5-6	7
		T_5 = 70	5-6	5-6	7
	C_3 (0.5%)	T_1 = 30	5-6	5-6	7
		T_2 = 40	5-6	5-6	7
		T_3 = 50	6	6	7-8
		T_4 = 60	6	6	7-8
		T_5 = 70	6	6	7-8
	C_1 (0.5%)	T_1 = 30	5	5	6-7
		T_2 = 40	5	5	6-7
		T_3 = 50	5-6	5-6	7
		T_4 = 60	5-6	5-6	7
F_2		T_5 = 70	5-6	5-6	7
(Fixanol PN)	C_2 (1%)	T_1 = 30	5	5	6-7
		T_2 = 40	5	5	6-7
		T_3 = 50	5-6	5-6	7
		T_4 = 60	5-6	5-6	7
		T_5 = 70	5-6	5-6	7
	C_3 (1.5%)	T_1 = 30	5-6	5-6	6
		T_2 = 40	5-6	5-6	6
		T_3 = 50	6	6	7-8
		T_4 = 60	6	6	7-8
		T_5 = 70	6	6	7-8

Standard scale rating: 8 = Excellent
6-7 = Very good
4.5 = Good,
3 = Moderate
2 = Poor
1 = v. Poor

D_1 = Tiafix Yellow e RT
D_2 = Tiafix Red 3 BT
D_3 = Tiafix Blue R

formaldehyde-based fixing agents. Also, light fastness increased with the increase of fixer concentration and temperature for samples treated with non-formaldehyde fixing agents (Table 2 b). This finding coincides with those of Trotman (16) who pointed out that quanity of fixer which was necessary, not only depended upon the depth of shade but also on the concentration of product. Anonymous (3) obtained the best colour yield by applying Tinofix WS at temperature 40-60 °C which resulted in reduced light fastness of fabric.

However, Anonymous (6) reported a non-formaldehyde fixative Neofix R-755 which was used to improve wet fastness of reactive dyed fabrics. In application method the fabric was treated with 1-3 percent fixing agent at 50-60°C for 10-20 minutes 2nd which resulted in improved light fastness of the fabrics.

The results indicated better performance in respect of fastness to light of non-formaldehyde fixing agents as compared to formaldehyde-based fixing agents. It has confirmed the findings of Kahle (10) and Rajni *et al.* (13) whereas Shad (14) found that due to improper selection of fixing agent, colour change and reduction in light fastness occurred after fixing treatment. Further some other scientists (8, 9, 11, 12) reported an improved light fastness for non-formaldehyde fixing agents.

CONCLUSION

It was concluded that non-formaldehyde fixing agents performed better for less dye bleeding and shade change of fabric than formaldehyde based fixing agents, whereas formaldehyde fixing agents resisted more for day light fastness.

REFERENCES

1. Anon. (1974). AATCC test method for colour fastness properties. Amer. Assoc. Text. Chem. Colourist, N.C. 27709:680-714.
2. ___. 1988. Per-treatment of cotton and polyester/cotton blends. Hypochlorite bleaching. Sandoz Pak. Ltd. Karachi. p. 20-23.
3. ___. 1989. Wet fastness improvement of dyeing. Technical Information Handbook. Swiss. Specialty Chemicals, Karachi: p. 1-6.
4. ___. 1992. Technical Handbook of Dyeing. Sandoz Chemicals Ltd. Faisalabad: 6-13.
5. ___. 1993. Fastness Standards. Sandoz Chemical Ltd. Muttenz. CH-4132: p. 9-20.
6. ___. 1997. Non-formaldehyde fixative. Neofix R-755. Technical and Processing Data. NICCA Chemical Co, Japan. p. 68-70.
7. Gakkaishi, S. 1980. Analysis of grey scale by depth value. J. Soc. Dyers and Colourists. London. 97(1):44.