Effect of Finishing on Fastness properties of Reactive Dyes

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Abstract

Reactive dyes have a great usage due to having a wide color range and a greater color fastness rating. Most of the wet processing industries are using reactive dyes on textiles for coloration purposes. In most of the dyeing the final shade and fastness properties of the dyed fabric after finishing are affected by the type of finish. In this project, the effect of finishes on reactive dyed materials was studied. The finishing has adverse effect on fastness properties and it also reduced or increases the colour strength of dyed material. Effect of finishing on fastness varies with type of finishing agent.

Key words: reactive dye, dyeing, softener, cross-linking agent, colour fastness, finish

I. INTRODUCTION

Chemical finishing is defined as and includes all processes after coloration that provides better properties and that enable the qualified use of the treated textiles. But dyers and printers are often responsible for finishes that improve color fastness. Nowadays colored textiles have to fulfill many requirements. Therefore improvement in the color fastness is a type of chemical finishing of particular practical interest and importance. Properties provided by these finishes are mostly improved wet fastness, for example washing, water, perspiration and ironing fastness, then better light fastness and only to a small extent improved crocking and rubbing fastness. For other kinds of color fastness, for example dry ironing, chlorine, peroxide and carbonization, there are no known possibilities for improvement by an after treatment. The market importance of these finishes is based on customer preferences and economic production demands. Poor color fastness in textile products is a major source of customer complaint. The fastness of a color can vary with the type of dye, the particular shade used, the depth of shade and how well the dyeing process has been carried out. Dyes can also behave differently when in contact with different agents, for instance dyes which may be fast to dry-cleaning may not be fast to washing in water. It is therefore important to test any dyed or printed product for the fastness of the colors that have been used in its decoration. There are a number of agencies that the colored item may encounter during its lifetime which can cause the color either to fade or to bleed onto an adjacent uncolored or light colored item. These factors vary with the end use for which the product is intended. The agencies that affect colored materials include light, washing, dry-cleaning, water, perspiration and ironing. There are a large number of color fastness tests in existence which deal with these agencies and a full list will be found in the British Standard. There are presently three main processes in use worldwide for continuous dyeing of woven cellulosic fabrics using reactive dyes namely, Pad batch or CPB process, Pad-dry thermo fixing process and E-control process.

The cold pad batch requires the smallest machine range, whilst the other two demand more or less complex ranges. Cold pad batch dyeing is a more environmentally sound and higher quality dyeing method for woven and knitted cotton/viscose fibers. The process removes salt from the effluent, reduces the use of water, energy, reduces the volume of effluent and occupies less space on the production floor. In actual practice, cold pad - batch is used for dyeing of dark shades using vinyl sulphone and cold brand reactive dyes. Properly prepared fabric is padded with the liquor containing the cold brand reactive dye and the suitable alkali at temperature 20°C to 30°C (the lower temperature is preferred on the grounds of bath stability). The temperature should be kept constant by jacketing and circulating chiller water to avoid variation in shade, especially when mixtures of dyes of different reactivity are dyed. High padding speeds with adequate wetting-out of the fabric are preferred. Small volume troughs are recommended. After padding the batches are wrapped in polyethylene sheet and stored at room temperature. Since, batching time is 12 to 16 hours in wet stage, wetting agent may not be necessary. Batches may be stored over-night, if necessary. During the storage period, the rolls must be kept slowly rotating to prevent seepage of dye liquor. However, with a good expression of padding mangle and moderate size batches, the danger of seepage is small. When the required batching time is passed, the cloth is washed off. This is economical process of dyeing but final shade will be known only after 12 to 16 hours' fixation and washing. Thus intermediate correction in the recipe is not possible.

Finishing

Finishing is carried out to improve the appearance and quality of fabric, imparting to them certain special feature and making them fit for use. The aim of finishing is to make the fabric attractive and of good feel, un-shrinkable if possible and with a high fastness both of the fibrous material itself and of the colour to various effects – laundering, abrasion, and weather conditions and so on. Thus, the purpose of finishing is to increase the fabric service life.

Color fastness

Colour fastness is the resistance of a material to change in any of its colour characteristics, to the transfer of its colourants to adjacent materials or both. Fading means that the colour changes and lightens. Bleeding is the transfer of colour to a secondary, accompanying fibre material. This is often expressed as soiling or staining meaning that the accompanying material gets soiled or stained. Generally fastness properties are expressed in ratings of fastness. Normally they range from rating 5, which means unchanged to rating 1, which means major changes. Only the light fastness ratings range up to eight for the best behavior. Color fastness to washing is the common quality parameter, which is considered very important from the point of view of consumers. This test determines the loss & change of colour in the washing process by a consumer and the possible staining of other garments or lighter portion that may be washed with it. This test is used to predict the performance of any dyed or printed textile product to the common washing process using a detergent and additives. Some of the test conditions in ISO and all the AATCC conditions are designed to simulate the behaviour of the textile after 5 domestic or commercial launderings. Everybody who has sat with blue jeans on a pale sofa or an upholstery chair knows about the importance of the crocking fastness. Of course, indigo-dyed clothing is famous for poor crocking and rubbing fastness. This disadvantage is a desirable quality in other cultures: the Tuareg and other nomads in Africa like to colour their skin and hair by rubbing it with dark dyed indigo fabrics.

II. EXPERIMENTAL WORK

Materials: Materials used for the experiments were 100 % cotton fabrics of different qualities used for the home textiles. The fabrics taken for dyeing were singed, desized, scoured, bleached i.e., ready for dyeing. The qualities of fabrics used for the experiments are listed below Table A.

Table A: List of Sample with their Quality and Dyeing recipe

Sample No	Fabric quality	Construction	Fabric weave	Recipe for dyeing
1	400Tc	60×60/175×69	plain weave	Novacron Yellow RGB = 11.5 g/l Novacron Red RGB = 26g/l
2	400Tc	60×60/175×69	plain weave	Novacron Yellow S3R = 2.5g/l Novacron Red C2BL = 5.6g/l Novacron Navy SGI = 3.5g/l
3	400Tc	60×60/175×69	plain weave	Novacron Yellow S3R = 2.4g/l Novacron Red C2BL = 9.3g/l Novacron Navy SGI = 9.4g/l
4	Poplin	40×40/92×88	Twill weave	Novacron Blue SGI = 3.5 g/l Corafix Red GDB = 3g/l Corafix Yellow GD3R
5	Poplin	40×40/92×88	Twill weave	Jakazol Black CECL = 7 g/l Novacron Red CD = 4 g/l
6	210Tc	60×60/ 130×52	plain weave	Corafix Yellow GD3R = 1.8 g/l Corafix Red GDB = 0.84 g/l Corafix Navy Blue GDG = 1.2 g/l
7	210Tc	60×60/ 130×52	plain weave	Novacron Yellow S3R = 3.3 g/l Novacron Turg Blue HGN = 9.5g/l Novacron Navy SGI = 19 g/l
8	300Tc satin	40×40/132×78	satin weave	Tulactive Rubine CB = 27 g/l CBfix Blue CGB = 21 g/l
9	300Tc satin	40×40/132×78	satin weave	Jakazol Yellow GR = 12 g/l Novacron Turq Blue HGN = 9 g/l Novacron dark Blue SGL = 12 g/l
10	Lycra	20×20/44×33	Twill weave	Corafix Yellow GD3R = 2.4 g/l Corafix Red GDB = 22 g/l
11	Lycra	20×20/44×33	Twill weave	Corafix Yellow GD3R = 5 g/l Corafix Red GDB = 3 g/l Novacron dark Blue SGL = 3 g/l

Dyeing

Dyeing was carried out using pad-batch method. The dye bath was prepared as per the recipe and then the fabric samples of different qualities (as given in Table No. A) were dipped for one min. in the dye baths. Then these samples were passed through padding mangle at 70% expression. After removal of excess dye stuff the fabric is subsequently "batched". This batching is done by either storing it in rolls or in boxes. It takes a minimum of 4-12 hours. The batches are generally enclosed by plastic films. This prevents absorption of carbon dioxide and water evaporation. Finally as the reaction is complete the fabrics are washed. This is done by becks, beams, or any other washing devices.

Dye bath composition:

Sodium hydroxide = 20 – 60 ml/l (38ºBe sodium hydroxide, as per conc. of dye))
Sodium Silicate = 100 g/l
Dye = X g/l
Penetrator = 2 g/l
Sequestering agent = 1 g/l

After dyeing, the fabric samples were dried and finished for softening, anti-crease and stiffness with following recipe

Recipe for softening

Ultra 196 (Silicon Softener) = 30 g/l
PE Emulsion (Non ionic) = 20 g/l
Acetic acid (PH Maintain) = 2 g/l

Finishing was carried out at 150ºC for 1-2 min

Evaluation of samples for fastness properties

1. **Colour fastness for washing:** Specimens are cut of the size of 4 x 10 cm. A multi-fibre swatch is attached to the specimens. The composite specimen with multi-fibre is placed in the wash wheel pot containing wash water and detergent. The wash wheel is then run for the appropriate time duration. The specimens are then removed, rinsed and dried in air at temperatures not exceeding 60°C. Finally samples were evaluated for washing fastness rating.
2. **Colour fastness to rubbing:** The specimen is mounted on the baseboard of the Crockmeter. The Long direction of the specimen is parallel to the track of rubbing. Ensure the specimen lays flat on the baseboard. Two tests are performed, one along the direction of the warp/length and the other of the weft/width. Mount a dry rubbing cloth flat over the end of the peg on the Crockmeter and hold it taut by means of the spring clip provided. Ensure that the rubbing cloth is not placed on the diagonal in the direction that the peg is moving. Rest the finger on the specimen, ensuring that the spring clip is not in contact with the test specimen. Rub the specimen back and forth over a straight track 100mm+8mm long for 10 complete cycles (i.e.10 times back and forth) at a rate of 1 second for each cycle. Colour transferred from dyed samples to the white is measured with the help of grey scale. Bothe dry and wet rubbing fastness was measured

III. RESULTS AND DISCUSSION

Fabric samples were dyed and then finished in laboratory. Different cotton fabric samples (as mentioned in Table A) were dyed and the finished. The finished samples were evaluated for CIELab value and results are given in Table I.

Note: Dyed sample before finishing were considered as standard sample.

From Table I, it was observed that all the dyed samples showed considerable change in strengths and CIELab values after finishing with softener. The change in strengths and tone vary with the quality and dyeing recipe. Thus different dyes showed different change in strength and CIELab values for the quality and the same finish. This could be due poor compatibility of dyes with the finish given by softener.

Among all the dyeings, some dyed samples showed lower colour strength, whereas some dyes gave higher strength. Higher strengths after finishing may be due migration of dye at the surface of fabric. However, lower strength of the dyed fabrics may be due to instability of dye at higher temperature.

Table I: CCM colour difference values of dyed samples after softener finishing

Sample No	**Washing fastness**				**Rubbing fastness**			
	Change in colour		**Staining**					
	Before finish	**After Finish**	**Before finish**	**After Finish**	**Before finish**		**After Finish**	
					Dry	**Wet**	**Dry**	**Wet**
1	4-5	4-5	4	4-5	4-5	2	4-5	2-3
2	4-5	4-5	3-4	4	4-5	3-4	4-5	3
3	4-5	4-5	4-5	3-4	4-5	3	4-5	3

4	4-5	5	1-2	2	4-5	2-3	4-5	2-3
5	4-5	4-5	3	4	4	3	4-5	3-4
6	4	4-5	4	4-5	4-5	3	4-5	2-3
7	4	4-5	2	2	4-5	2-3	4-5	3
8	4-5	4-5	3	3	4-5	3	4	2-3
9	3-4	3-4	4	4-5	4-5	2-3	4-5	2-3
10	4-5	4-5	4	4-5	4	3	4-5	3
11	4-5	4	4	4	4-5	4	4-5	3-4

All the finished samples were also evaluated for the washing fastness and rubbing fastness properties and results are given in Table II.

Table II: Effect of softener finish on washing fastness of dyed samples

From Table II, it was noticed that the softener finishing have not showed any considerable changes in fastness to washing and rubbing. Washing and rubbing fastness properties were slightly reduced after finishing. This decrease in fastness properties vary with the dyes.

The marginal decrease in washing and rubbing fastness properties could be contributed to the migration of dyes at the fabric surface in the presence of softener.

IV. CONCLUSION

The different finishing agents have adverse effect on the dyed or printed samples. Different finishes have different impact on the colour values and fastness properties of the dyed or printed samples. Considering the effect of finishes on colour values and fastness properties, one should select the finishing agent to get the desired effect. If

Sample No.	DL*	Da*	Db*	Dc*	DH	DE	Decision	Strength
1	-0.36	-0.43	-0.22	-0.18	-0.03	0.40	Pass	106.39%
2	-0.63	0.40	0.66	0.24	0.65	0.94	Warm	109.59%
3	0.46	0.36	-0.01	-0.22	0.28	0.55	Pass	96.29%
4	-0.75	0.40	0.23	0.20	-0.32	0.84	Warm	95.29%
5	0.86	0.30	0.19	0.09	0.36	0.88	Warm	91.57%
6	-0.30	0.95	-0.47	0.37	-1.61	1.68	Fail	105.62%
7	-2.51	0.96	0.08	-0.53	0.44	2.61	Fail	140.76%
8	-0.83	-1.07	0.53	-0.53	-0.19	1.00	Fail	109.96%
9	-1.52	0.27	-0.23	-0.17	0.13	1.53	Fail	123.18%
10	0.10	-1.43	-2.26	-0.67	-1.14	1.33	Fail	92%
11	-0.12	0.58	-0.26	0.18	-0.93	0.96	Warm	103%

the selection of finishing agent is not possible, one should adjust the colour values during dyeing so that the after finishing required strength may be produced. This work is important for selection of finish or dyeing recipe or final shade of the material.

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