

Effect of dyeing of cotton fabric by using dye fixing agent

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Abstract

In these study, cotton fabric was dyed using reactive dyes using formaldehyde and non-formaldehyde dye-fixing agents. The samples of dyes and dye fixing agents were procured from reputed manufacturers. Fastness properties of dyed samples viz; fastness to water, rubbing, perspiration, and fastness to washing were evaluated by standard methods. Based on the work, it is observed that non-formaldehyde based dye-fixing agent gave superior fastness properties as compared to formaldehyde based fixing agent in reactive dyes. It is also pointed that the non-formaldehyde based fixing agent is eco-friendly and meets the environmental norms. Various colour fastness properties were evaluated and analysed.

Key words: Vinyl sulphone reactive dyes, Formaldehyde, Non-formaldehyde, dye-fixing agent.

I. Introduction

Cotton is the most widely used fibre in the world, due to good comfort and absorbency. Abundantly upto more than 50% consumption of textile is made up of cellulose [1]. These cotton fabric is dyed with different types of dyes, and this dyes are organic coloured compounds. Today customer needs good quality of cloth with good fastness properties and according to end use such as curtain should have good fastness to light, car seat cover should have good rubbing fastness. Reactive dyes are extensively used for exhaustion dyeing of cotton fibre, it provides wide range of shades of good light and washing fastness on cellulosic fibres. These dyes suffer the disadvantage that dye fibre reaction is not 100% efficient. Exhaustion of the dye is incomplete due to the dyes are not react only with the fibre nucleophile reactive sites but also with nucleophiles present in the dye bath, to dye hydrolysis [2]. To improve the fastness properties of reactive dyes cotton fabric we should use cationic dye fixing agents [3]. Reactive dyes are the most important class of dyes used for cellulosic substrate because their high wet fastness, brilliance and range of hues [4-6]. The most attractive feature of the use of these dyes is the simple dyeing process. The improvements in the wet fastness properties of this reactive (anionic) dyes can be brought about by pre-treatment or after treatment of textile fibres. Various pre-treatment and after treatments system have been developed but at the moment most widely used are formaldehyde based cationic dye fixing agents. Formaldehyde can be used as cationic dye fixing agents to improve wet fastness properties [7]. Every textile plant requires large volumes of water and produces high volumes of effluent wastewater. The typical textile dye effluent composition is quite complex due to usage of various chemicals and auxiliaries to assist dyeing and after treatment [8].

II. Materials and Method

Material-

Material used for the experiment were 100% cotton fabric. We have procured open market knitted cotton fabric of 180GSM, woven fabric 50GSM, Machine used for dyeing the knitted and woven fabric in rota dyer machine. Evaluation of fastness properties was done in PSSGL dyeing house laboratory.

Different Fastness properties -

Number of testing procedures have been followed for the testing of colour fastness properties and colour difference values among the dyed samples before and after dye-fixing treatment are:

Colour fastness to rubbing- ISO 105X12, fastness to washing - ISO 105 CO6/C2, fastness to water - ISO 105 EO1, fastness to Perspiration -ISO 105 EO4

Methodology

Dyeing procedure of reactive and direct dyes of woven and knitted fabric was carried out by using various chemicals and auxiliaries by exhaust method. The fabric was dyed using reactive dyes in lab scale with sample size of 5gm. These samples were dyed with formaldehyde cationic dye fixing agent and non-formaldehyde polyamine cationic dye fixing agent respectively. The results were analysed by various methods of fastness testing according to ISO standards.

Process for reactive dyeing- Turquoise shade

- Time-120 min and Temp- 80° C

Process for reactive dyeing- Navy blue shade

- Time-120 min and Temp- 60°C

Chemical used in dyeing –

Acetic acid, Soda ash(sodium carbonate), Caustic soda(Sodium hydroxide), Glauber's salt, Wetting agent etc.

Description about dye fixer –

Polyamine Non-Formaldehyde Dye Fixing (PANF) agent chemically is amine condensate product, its appearance is colourless to pale yellow clear liquid, percentage of solid content is 63-65%, and solubility is soluble in water

Polyamine non-formaldehyde dye fixing (PANF) agent-

This is an alternative method of dye-fixing which utilizes amine containing organic compounds, that amine containing compound is couple with dye to increase the molecular weight and reduce solubility of the dye molecules [9]. Polyamine non-formaldehyde dye fixing agent used, it is a polyamide based non-formaldehyde cationic dye-fixing agent for reactive dyes. Polyamine non-formaldehyde dye fixing agent improve washing fastness, fastness to perspiration & fastness to water. Polyamine non-formaldehyde dye fixing agent minimum effect on light fastness on the shade of the treated fabric. This dye fixing agent can be applied by exhaust as well as by pad application its physical appearance is light yellow liquid, ionic nature is cationic and soluble in water

III. Result and Discussion

Table 1. Reactive dye for Turquoise shade Polyamine Non-Formaldehyde Dye Fixing Agent dye (PANF) fixer used (Company A)

		Grey scale grading	
Fastness properties		Untreated sample without dye fixer	Treated sample with dye fixer
Fastness to washing		3-0	3-4
Fastness to water		3-0	4-0
Fastness to rubbing	Dry	4-5	4-5
	Wet	3-4	4-0
Fastness to Perspiration	Alkaline	3-0	4-0
	Acidic	3-0	4-0

Turquoise shade is a very complicated shade for fixation. Following table shows that untreated sample without dye fixer shows moderate fastness properties whereas treated sample shows improvement in all over fastness properties i.e.4.

Table 2. Reactive dye for Green Shade using Polyamine Non-Formaldehyde Dye Fixing (PANF) Agent dye fixer (Company A)

		Grey scale grading	
Fastness properties		Untreated sample without dye fixer	Treated sample with dye fixer
Fastness to washing		2-0	3-0
Fastness to water		2-0	3-4
Fastness to rubbing	Dry	4-5	4-5
	Wet	3-4	3-4
Fastness to Perspiration	Alkaline	2-0	3-0
	Acidic	2-0	4-0

Table 3: Reactive dye using PANF dye fixer:

		Grey scale grading	
Fastness properties		Untreated sample without dye fixer	Treated sample with dye fixer
Fastness to washing		2-0	3-0
Fastness to water		2-0	4-5
Fastness to rubbing	Dry	4-0	4-5

	Wet	3-4	3-4
Fastness to Perspiration	Alkaline	2-0	4-5
	Acidic	3-4	4-5

In this dye using with D2F2 dye fixer improve fastness properties than Polyamine Non-Formaldehyde Dye Fixing Agent (PNAF) dye fixer. D2F2 is a polyamide based non-formaldehyde cationic dye-fixing agent for reactive dyes. Polyamine non-formaldehyde dye fixing agent improve washing fastness, fastness to Perspiration & fastness to contact water. D2F2 minimum effect on light fastness on the shade of the treated fabric. D2F2 can be applied by exhaust as well as pad application.

Table 4: Effect of fastness properties of reactive dyes with non-formaldehyde based dye fixing (PANF) agent. Company B

Fastness properties		Grey scale grading	
		Untreated sample without dye fixer	Treated sample with dye fixer
Fastness to washing		4-5	4-5
Fastness to water		3-0	4-5
Fastness to rubbing	Dry	4-5	4-5
	Wet	3-0	3-4
Fastness to Perspiration	Alkaline	3-0	4-5
	Acidic	3-0	4-5

By using formaldehyde dye fixing agent Company B should give good fastness properties to washing in range of 4-5, dry-wet rubbing fastness 3-4 and alkaline-acidic perspiration is 3-5 after treatment with dye-fixing agent.

Table 5: Company C & D dyes fastness properties; Company C

Fastness properties		Grey scale grading	
		Untreated sample without dye fixer	Treated sample with dye fixer
Fastness to washing		2-0	3-0
Fastness to water		2-0	3-4
Fastness to rubbing	Dry	-	-
	Wet	-	-
Fastness to Perspiration	Alkaline	2-0	3-4
	Acidic	2-0	3-4

Company D

Fastness properties		Grey scale grading	
		Untreated sample without dye fixer	Treated sample with dye fixer
Fastness to washing		3-4	3-4
Fastness to water		3-0	3-4
Fastness to rubbing	Dry	-	-
	Wet	-	-
Fastness to Perspiration	Alkaline	2-0	3-4
	Acidic	2-0	3-4

In this table company C and D dye, dye's washing fastness is good and no change in after addition of dye fixer. But poor in Perspiration and water but addition with non-formaldehyde (PANF) dye fixing agent showed improved fastness proper

Company D

Table 6: Effect of fastness properties of blue shade on cotton by using formaldehyde and non-formaldehyde dye-fixing (PANF) agent (10 washing cycle)

Fastness properties		Grey scale grading	
		Untreated sample without dye fixer	Treated sample with dye fixer
Fastness to washing		3-0	3-4

% strength		2% lighter	1% lighter
Fastness to rubbing	Dry	4-5	4-5
	Wet	3-0	3-4

This shade gives 10 washing at 60°C temperature this shade 2% shade are lighter than original shade and this shade improved by adding dye fixer 1-0 % shade. Its check in spectrophotometer. Using Polyamine Non-Formaldehyde Dye Fixing Agent dye fixer. In Light shade dyed fabric all-over fastness properties is good before dye fixer and after dye fixer treatment because the pore available in fibre surface is packed with the dyes molecules and as a results the less dye molecule is available on the surface of the fabric which is unfixed.

IV. Conclusion

Formaldehyde containing fixing agents for reactive dyeing could be substituted by polyamine containing non-formaldehyde fixatives (PANF) without affecting the physical and chemical agencies (light, water and perspiration) of the finished goods. Choosing the suitable non-formaldehyde fixatives could actually produce better products than using the formaldehyde fixative. Commercially available non-formaldehyde and formaldehyde based dye fixing agents were used to assess the effect of the fixing agent on dyeing and fastness properties of dyed fabrics. Colour Fastness (CF) to washing, CF to perspiration, CF to water and CF to rubbing were assessed. It is observed that the fastness properties were superior in non-formaldehyde dye fixing agent as compared to formaldehyde based fixing agent in reactive dye dyeing. Non-formaldehyde dye fixing agent apart from showing superior properties, meets the environmental norms as eco-friendly chemical. It may be pointed out that formaldehyde based dye fixing agents have been banned across the globe as these are carcinogenic in nature. However, the Washing-fastness, perspiration fastness, water-fastness and rubbing fastness increasing due to the application of non-formaldehyde polyamine based fixatives were similar or more than that caused by the formaldehyde fixative.

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