

Effective Surface Active Agents for Improving Colorfastness of Reactive Dyeing

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Abstract: *Now-a-days consumers are sensible not only for color, style and comfort, but also for quality of product. Apparel manufacturers must be a constant endeavour to produce good quality products. Customers make many purchase adoptions based on product color. Therefore, a fabric's ability to retain its original color is considered as one of the most imperative criteria of a textile product. Dyeing is the crucial step to impart color on fabric and the process of inserting color to textile materials by the treatment with a dye is called dyeing. After dyeing the use of different types of after-treatment agent can change the performance of cloths such as color fastness, fabric handling etc. The aim of this paper is to evaluate the effects of after-treatment agents for improving colorfastness properties of reactive Dye. We have taken Single jersey, (1*1) Rib and Pique fabrics dyed with reactive dye for assessing colorfastness properties. It was observed that the color fastness properties of dyed fabrics were improved by treating with cationic dye fixing agent rather than copper salt, and acetic acid.*

Keywords: Reactive dye, Dye hydrolysis, Covalent bond, Color fastness, After-treatment process.

1. Introduction

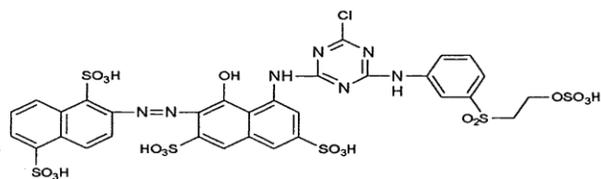
Having very bright shades, excellent wet fastness properties, good reproducibility, reasonable price and simple application procedure Reactive dyes have a worldwide acceptance to the dyers for the coloration of cotton fibre. Reactive dye molecules are anchored to the cellulose fiber by forming a strong covalent bond which acts as an integral part of the fibre in the presence of alkali where electrolyte improves the exhaustion process of dyeing. But the reactive group of such dyes may react with water as the increase of temperature which simply referred to hydrolysis. Vinyl sulphone are additive-type of reactive dyes which have more substantivity for fibres whereas hydrolyzed dyes show lower substantivity. The hydrolyzed dyes cannot react with fibre and it results wastage of dyestuffs, which further leads to greater effluent load. After dyeing, unfixed and hydrolyzed dyes must be removed from fabric surface for better color fastness through subsequent washing. This leads to attenuation in the color yield [1, 2]. The cationic polymers i.e. cationic fixing agent readily deposits on dyed cellulosic fibers by forming a complex with anionic dyes and it minimizes color bleeding in the subsequent washing procedure [3]. Rahbar R.S et al, who examined that the cationic fixing agents used for dye transfer reduction on cotton fabrics during home laundering, the washing were carried out by detergent with or without two selective cationic fixing agents for commercially available direct and reactive dyes [4]. Shad S.s et al, also showed that non-formaldehyde based fixing agent gives better results than

formaldehyde based fixing agents on the change of shade and light fastness properties of cotton knitted fabrics dyed with reactive dye [5]. Mazumder S. et al, studied the influence of fixing agent on the cotton fabric dyed with reactive dyes in where color fastness properties and color difference values were measured on dyed fabric before and after using fixing agent [6]. Iftikhar M. et al, who observed the effects of salt, alkali and dyes on rubbing, ironing and dry-cleaning fastness of reactive dyed cotton knitted fabrics [7]. Thiagarajan P. et al, perceived some commonly used antioxidants and UV absorber effects for improve light fastness property of reactive dyed cotton fabric by exhaust method. . The antioxidants such as gallic acid, vitamin C and cafeic acid, and the UV absorbers such as 2-hydroxybenzophenone and phenyl salicylate have been applied on fabrics which were dyed with three commercial reactive dyes. The result showed the most effective light fastness improvement was found by the application of vitamin C [8]. Doyal M. et al, studied on the effects of laundering on the colorfast properties of reactive- and direct-dyed cotton fibers, where the fabrics were dyed with Procion Red MX 350 reactive dye and Diazol C 380 Basic Red direct dye. .Laundering introduced a difference on the reactive- and direct-dyed cotton fibers in that color was lost through each laundering period. On the whole, the reactive dye produced a lighter colored cotton fiber than the direct dye [9]. Ikiz Y. et al, made comparison between visual and instrumental color fastness results by using developed PF/3 factor .This results showed that the instrumental and visual evaluations of color fastness tests exhibit 87.65% agreement even in the worst case [10].

2. Methodology

2.1 Materials and Sample Preparation

For this investigation we chose scoured and bleached, fluorescent brightener free three different fabric structures as Single Jersey, Rib (1x1) and Pique. The whole study was carried out with 100% cotton in where single jersey is specified as yarn count-28's,WPI-58, CPI-52, GSM-160 ; rib(1*1) as yarn count- 26's,WPI-52, CPI-40, GSM-220 and pique contains yarn count-40's,WPI-52, CPI-54, GSM-140. 20 grams of sample was taken for each fabric. Dyeing of fabrics was carried out with 1% Solazol Reactive Red SP-3B, CI Reactive Red 195. The chemical structure of the dye is shown in below-



C.I. Reactive Red 195

The dye baths were prepared with 25 g/l glauber salt, 10 g/l soda ash for about 60 grams (3x20 grams) in the liquor ratio of 1:10. The dyeing was carried out at 60°C for 45 minutes. After the completion of dyeing the soaping was done with 1g/l soaping agent at 90°C for 5 minutes. For better colorfastness properties after treatment process is very imperative. Firstly, each sample was cut into 3 pieces of 6 grams. That was same for other two structures. Then from every structure of fabric 1 piece of sample is kept untreated, other 2 pieces of samples were treated with copper salt, and acetic acid and cationic dye fixing agent as stipulated in the following table 1. Albafix ECO was used as cationic fixing agent collected from Swiss Colours Bangladesh Ltd.

Table 1: Recipe of After-treatment Process on dyed samples.

Description	After-treatment with cationic fixing agent	After-treatment with copper salt and acetic acid
Reagent	Cationic fixing agent	Copper salt and acetic acid
Amount (g/L)	1.0	1.5
		0.8
Temperature (° C)	45	60
Time (min)	20	20
pH	6.3	4.8
M:L (Liquor ratio)	1:10	1:10

2.2 Methods of Assessment

Different standard testing procedures have been followed for the assessment of color fastness properties among all dyed samples before and after fixing treatment. The following color fastness properties were evaluated to observe the effects.

- Color fastness to wash(ISO105 C04 B2S)
- Color fastness to water (ISO105 E01)
- Color fastness to rubbing(ISO 105 X12)
 - Color fastness to perspiration (ISO 105 E04)
 - Color fastness to light (ISO 105 B02)
 - Color fastness to saliva (GB/T 18886:2002)

3. Discussion of Results

All the tests were performed in standard testing atmosphere (65±2% R.H and 20±2°C).The obtained results from different tests are recorded in the appendix (tables A-F). From the colorfastness ratings following figures have been drawn.

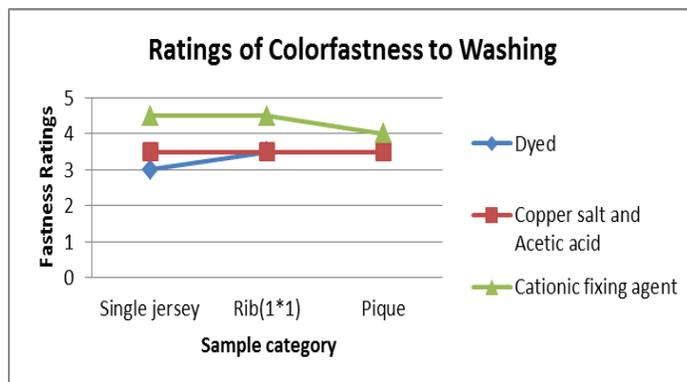


Fig. 1: Bar diagram represents the ratings of colorfastness to washing under various conditions.

From this above diagram we can observe that the colorfastness to washing is better in case of cationic fixing agent for all fabrics rather than dyed fabrics and treatment with copper salt, and acetic acid. Mainly single jersey and rib fabric render better results than pique.

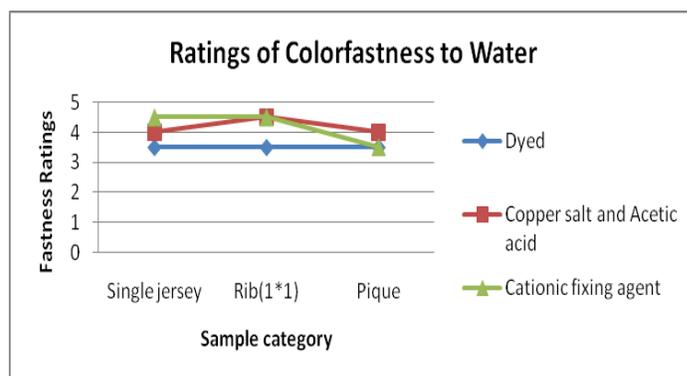


Fig.2: Bar diagram represents the ratings of colorfastness to water under various conditions.

From this above diagram we can observe that the colorfastness to water is better for cationic fixing agent than dyed fabric and treatment with copper salt, and acetic acid. The effect of copper salt, and acetic acid and cationic fixing agent on rib fabric gives the same result.

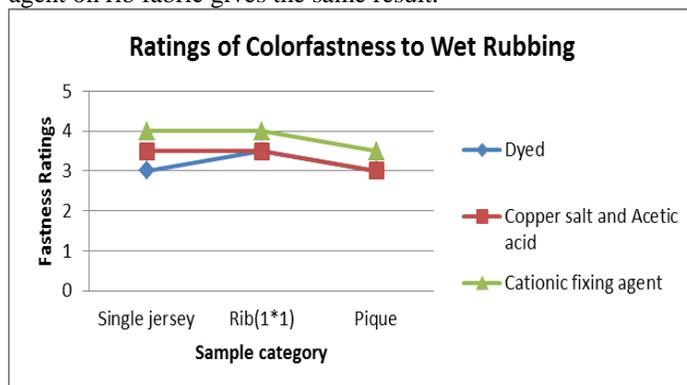


Fig.3: Bar diagram represents the ratings of colorfastness to wet rubbing under various conditions.

The ratings of colorfastness to dry rubbing (in appendix table C) is found to be better for all the process and fabrics but in case of wet rubbing the ratings sharply greater for cationic

fixing agent in case of all fabrics compared to the dyed fabrics and treatment with copper salt, and acetic Acid.

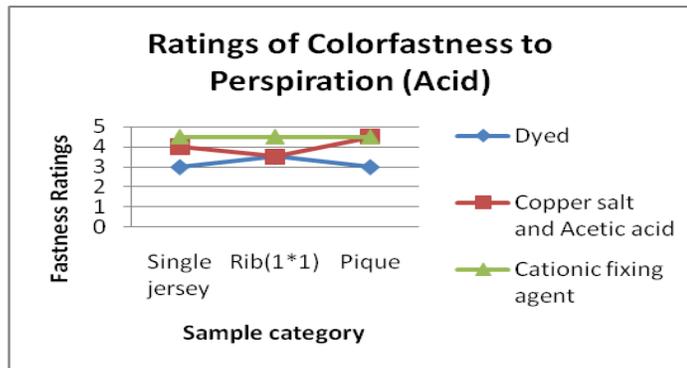


Fig.4: Bar diagram represents the ratings of colorfastness to perspiration (Acid) under various conditions.

The ratings of colorfastness to acidic perspiration is superior for cationic fixing agent in all fabric types compared to dyed fabric and treatment with copper salt, and acetic acid. Copper salt, and acetic acid and cationic fixing agent show same result in case of single jersey and rib fabric.

From the below bar chart we can see that the colorfastness to alkaline perspiration is better for single jersey and rib fabric after application of cationic fixing agent than dyed fabric and treatment with copper salt & acetic acid.

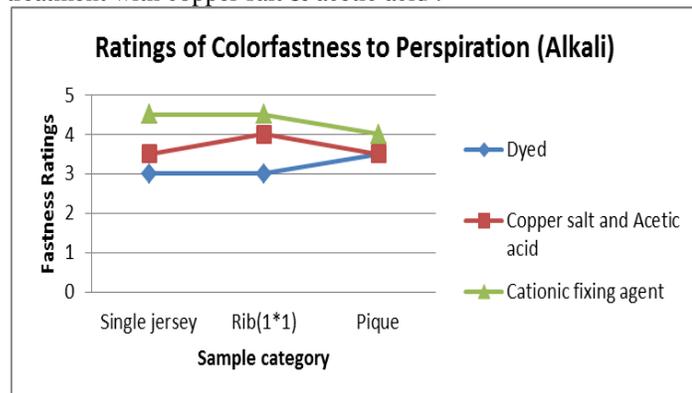


Fig.5: Bar diagram represents the ratings of colorfastness to perspiration (Alkali) under various conditions.

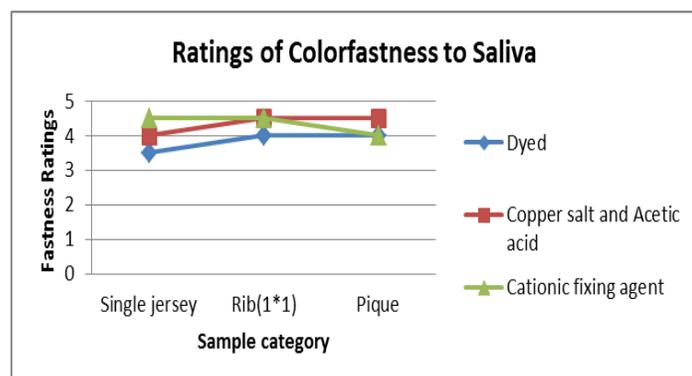


Fig. 6: Bar diagram represents the ratings of colorfastness to saliva under various conditions.

The colorfastness to saliva shows better effects on rib and pique fabrics for copper salt, and acetic acid treatment than cationic fixing agent but in case of single jersey and rib fabrics colorfastness is better for cationic fixing agent.

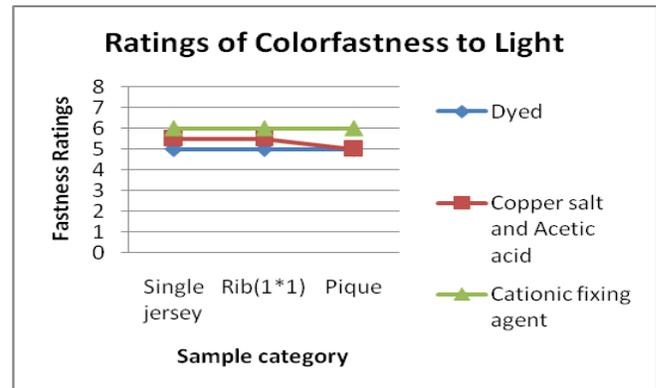


Fig.7: Bar diagram represents the ratings of colorfastness to light under various conditions.

From this above diagram the colorfastness to light is improved in all fabrics by treating with cationic fixing agent and copper salt, and acetic acid but it has a great significance on rib and pique fabric.

4. Conclusion

The research mainly underscores to select suitable after-treatment agent to be used for achieving best color performance after dyeing cotton with different surface active agents. After the conduction of research work it was possible to investigate and thus interpret the following outcomes.

It was observed that, cat-ionic fixing agents always rendered enormous results as compare to other surface active agents (copper salt). It is very imperative to stipulate that the research not only led by the evaluation of few colorfastness properties of dyed fabrics and most important and versatile colorfastness properties were also assessed. Among different fabric samples it was observed that only single jersey fabric shows best colorfastness properties if cat-ionic fixing agent is used on dyed fabrics. In case of rib (1*1) fabric colorfastness to water, saliva and light were found similar on treatment with copper salt, and acetic acid and cat-ionic fixing agent. Besides, if the effects for pique are compared with single jersey and (1*1) rib then it was found with poor ratings for all conditions. There may be the only reason due to fabric structure.

The research work was vital to conduct and to recommend the universal application of cat-ionic dye fixing agent to improve the colorfastness properties of reactive dyed fabrics.

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References

- i. Arthur D Broadbent, *Reactive Dyes, Basic principles of Textile Coloration (Society of Dyers and Colorists, 2001)* 346-347.
- ii. Dr. V.A. Shenai, *Reactive Dyes, Technology of Textile processing, Vol-II (Sevak Publications, Bombay, 1993)*557.
- iii. E. R Tortman, *The direct dyes, Dyeing and Chemical technology of Textile Fibre (Charles Giffin and Company LTD, 2012-2013)* 453.
- iv. R. S. Rahbar, S. Peyvandi, S.A.M Shoushtari and F. mazaheri, *Using selective cationic fixing agents for the reduction of dye transfer in cotton fabrics during home laundry, Research Journal of Textile and Apparel, 11 (1), 2007, 28-35.*
- v. S.S. Shad, M.I. Javed, M.M.B Kausar and M. Tanveer, *Effect of some fixing agents on reactive dyed cotton knitted fabric for change in shade and dye light fastness, Journal of Agricultural Research, 43 (1),2005, 75-83.*
- vi. S. Mazumder and Md. Mahbulul Haque, *Effect of fixing agent on the color fastness of reactive dyestuff originated from various dye manufacturers, Pakistan Textile Journal, 2011, 44-47.*
- vii. M. Iftikhar, N. A. Jamil and B. Shahbaz, *Rubbing, ironing and dry-cleaning fastness of reactive dyed cotton knitted fabric as influenced by salt, alkali and dye, International Journal of Agriculture and Biology,3 (1), 2001, 109-112.*
- viii. P. Thiagarajan and G. Nalankilli, *Improving light fastness of reactive dyed cotton fabric with antioxidant and UV absorbers ,Indian Journal of Fibre and Textile Research,38,2013,161-164.*
- ix. M. Doyal and M. Warnock, *Effects of laundering on the colorfast properties of reactive- and direct-dyed cotton fibers, Summaries of Arkansas Cotton Research, 2005, 263-265.*
- x. Y. Ikiz and R. Keskin, *Fastness and PF/3 evaluations of reactive dyestuffs, Scientific Research and Essays, 6(7),2011,1498-1506.*

APPENDICES

(Ratings obtained from the colorfastness tests)

Table A: Ratings of colorfastness to washing

Type of fabric	Treatment	Colorfastness to washing (color change)	
Single Jersey	Dyed	3	
	Copper salt and Acetic acid	3-4	
	Cationic fixing agent	4-5	
Rib (1*1)	Dyed	3-4	
	Copper salt and Acetic acid	3-4	
	Cationic fixing agent	4-5	
Pique	Dyed	3-4	
	Copper salt and Acetic acid	3-4	
	Cationic fixing agent	4	

Table B: Ratings of colorfastness to water

Type of fabric	Treatment	Colorfastness to water (color change)	
Single Jersey	Dyed	3-4	
	Copper salt and Acetic acid	4	
	Cationic fixing agent	4-5	
Rib (1*1)	Dyed	3-4	
	Copper salt and Acetic acid	4-5	
	Cationic fixing agent	4-5	
Pique	Dyed	3-4	
	Copper salt and Acetic acid	4	
	Cationic fixing agent	4	

Table C: Ratings of colorfastness to rubbing

Type of fabric	Treatment	Colorfastness to rubbing (color staining)	
		Dry	Wet
Single Jersey	Dyed	4-5	3
	Copper salt and Acetic acid	4-5	3-4
	Cationic fixing agent	4-5	4
Rib (1*1)	Dyed	4-5	3-4
	Copper salt and Acetic acid	4-5	3-4
	Cationic fixing agent	4-5	4
Pique	Dyed	4-5	3
	Copper salt and Acetic acid	4-5	3
	Cationic fixing agent	4-5	3-4

Table D: Ratings of colorfastness to perspiration

Type of fabric	Treatment	Colorfastness to perspiration (color change)	
		Acid	Alkali
Single Jersey	Dyed	3	3
	Copper salt and Acetic acid	4	3-4
	Cationic fixing agent	4-5	4-5
Rib (1*1)	Dyed	3-4	3
	Copper salt and Acetic acid	3-4	4
	Cationic fixing agent	4-5	4-5
Pique	Dyed	3	3-4
	Copper salt and Acetic acid	4-5	3-4
	Cationic fixing agent	4-5	4

Table E: Ratings of colorfastness to saliva

Type of fabric	Treatment	Colorfastness to saliva (color change)
Single Jersey	Dyed	3-4
	Copper salt and Acetic acid	4
	Cationic fixing agent	4-5
Rib (1*1)	Dyed	4
	Copper salt and Acetic acid	4-5
	Cationic fixing agent	4-5
Pique	Dyed	4
	Copper salt and Acetic acid	4-5
	Cationic fixing agent	4

Table F: Ratings of colorfastness to light

Type of fabric	Treatment	Colorfastness to light (color change by acid dyed blue scales)
Single jersey	Dyed	5
	Copper salt and Acetic acid	5-6
	Cationic fixing agent	6
Rib(1*1)	Dyed	5
	Copper salt and Acetic acid	5-6
	Cationic fixing agent	6
Pique	Dyed	5
	Copper salt and Acetic acid	5
	Cationic fixing agent	6