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Effects of Cationizer on Different Shade Percentage of Reactive Dye for Dyeing Cotton Knit Fabric.

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Abstract: *This research is mainly focusing on the influence of cationizer on color fastness and shade variation of cotton fabric dyed with bi-functional reactive dyes. Dyes which have been selected for the study contain both chloro triazine and sulphone reactive groups in the same molecule. After treating the fabric with cationizer, these samples are dyed in two different hues (Red & Blue) at three shade percentage (o.5%, 1.0%, 2.0%) followed by exhaust method. The fastness ratings are compared between the cationizer-free dyed samples and cationizer-treated dyed samples of the respective shade percentage. This experiment has revealed that the dyed fabric treated with cationizer has resulted in a general improvement in wash and rubbing fastness. Not only that, the color strength and color co-ordinate of the all the samples are measured by spectrophotometer to differentiate the cationizer treated samples to only dyed specimen. However, after testing of all samples, it is observed that fabric dyed after cationization process gives a satisfactory result than fabric dyed with only reactive dye.*

Keywords: *Reactive dye, cationizer, shade percentage, color fastness, color strength.*

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I. Introduction

Cotton is most popular cellulose based natural fiber due its enormous amiable characteristics such as comfortability, high tensile strength, amorphousness and its availability. On the other hand, reactive dye is extensively used in most of the textile industry for the coloration of cotton fabrics owing to its exceptional color fastness properties, wide variety of color gamut, compatibility with cotton fabrics, cost effectiveness and easy applications process. But this dye has some cons like fabric colored with reactive dye required plethora amount of salt and hydrolysis is another irresolvable problem which results in lower exhaustion rate of dye molecules in the cotton fabrics.

In addition to that, cationizer is a kind of modified agent which can be used in different areas of textile wet processing sectors to improve their hand feel, drape and sewing properties [1]. Cationizer can be easily dispersible in water and absorbed by the textile substrate so uniform deposition would be possible within a relatively short treatment time and generally, exhaustion could be take place in about 5min for the cationizer to be effective and economically usable [2].

II. Literature Review

For cotton and other fabrics various modified agents have used for ameliorating the properties and compatibility of dye fiber interaction. For instance, using two kinds of silicone polymers were used to improve the dimensional properties of wool fabric [3]. As well as Nihat et al. had worked on effects of nano-silicon softener on abrasion, pilling resistance and color fastness properties of knitted fabrics [4]. And results revealed that fabric treated with nano-silicon exhibited poor abrasion but better pilling resistance and have no substantial effect on color fastness properties.

Tae et al. studied the effects of silicone softeners on the dimensional properties of wool fabric [5]. While Ana et al. was worked on a article which titled as "The Influence of Pretreatment on Cotton Knitted Fabrics Handle properties" [6].

Considering the point of view of these above mentioned articles this experiment is an attempt to overcome the problem of reactive dye treated with a cationizer at different shade percentage.

III. Materials and methods

3.1 Materials

3.1.1 100 percent cotton knit fabric

GSM: 180

3.1.2 Dyes

a) C.I Reactive red 195

b) C.I Reactive Blue 62.

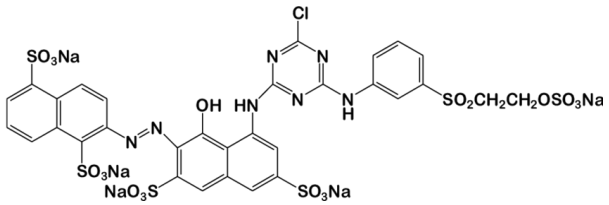

Fig. 2.1 C. I Reactive Red 195 [7]

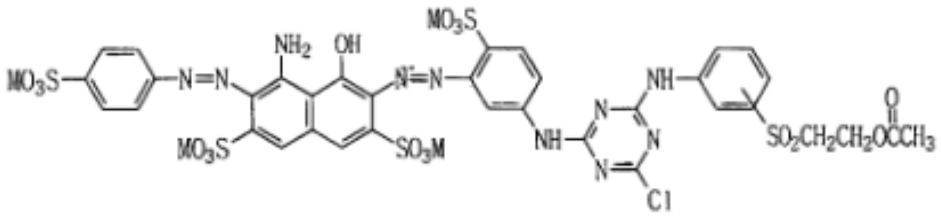

Fig. 2.2 C. I Reactive Blue 62 [8]

3.1.3 Cationizer

Dymax-PTC

3.1.4 Recipe for cationization

Cationizer (Liquid form) ———10 gm/L

NaOH ——————————10 gm/L

Temperature——————————90 ^{0}C

Dyeing time——————————40 minutes.

M: L——————————1:20

3.1.5 Recipe for dyeing

Dyeing recipe**:**

Reactive Dyes——————————0.5%, 1%, 2%.

Sequestering agent——————0.5 gm/L

Wetting agent——————————0.10.5 gm/L

Salt——————————1080 gm/L

Soda ash ——————————— 2220 gm/L

Temperature——————————60 ^{0}C

Dyeing time——————————60 minutes

P^H——————————— 11

M: L——————————1:8

3.2 Methods

3.2.1 Treating fabric with cationizer

Firstly, solid cationizer is converted into liquid form by adding required amount of water with it at standard room temperature and in atmospheric condition. Then half of the fabric samples are processed with cationizer at 90^{0}C for 40 minutes along with equal amount of NaOH.

3.2.2 Fabric dyeing with or without cationization

All type of the samples dyed with red and blue reactive dye on Fong's sample dyeing machine. Keeping the material to liquor ratio 1: 8 for each of the shade percentage 0.5%, 1%, 2%

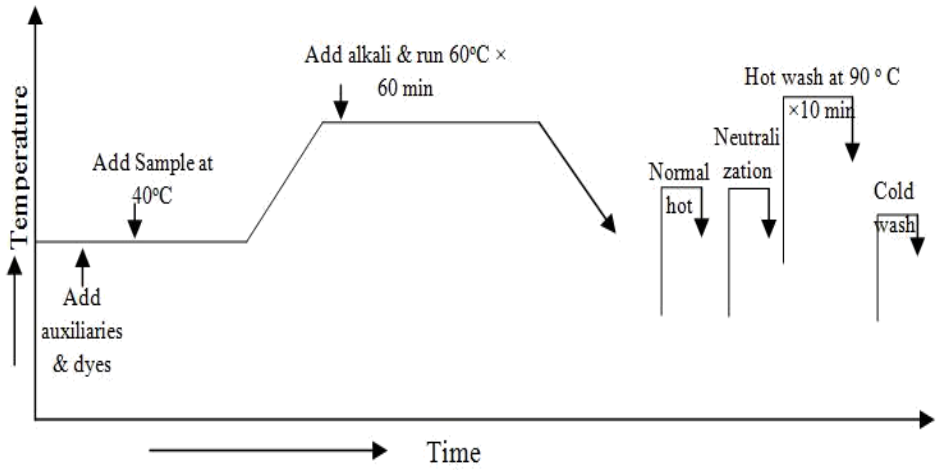

Fig. 3.1 Process curve of cotton fabric dyeing with reactive dyes.

3.2.3 Color fastness to wash (ISO 105-C10-2006)

To measure the color fastness to wash properties of the dyed samples, following parameters are maintained. As well as for assessing color change (ISO 105 A02) and color staining (ISO105 A03) standard gray scales are utilized to obtain ratings.

Table 3.1 Parameters of color fastness to wash test.

Test Method	Temperature	Time	Steel balls	Reagents	Liquor ratio
ISO 105-C10-2006	40 ^{0}C	30 minutes	10	Soap, 5gm/L Soda, 2 gm/L	50:1

3.2.4 Color fastness to wet and dry rubbing (ISO 105×12)

Dyed samples are mounted on the crock meter and finger of the crock meter covered with a desized 5× 5 crocking cloth. The specimen rubbed with the finger of the crock meter at 10 turns within 10 seconds. But for wet rubbing test this process is followed after soaking the fabric at 100% pickup.

3.2.5 Measurement of color co-ordinate

Through Data color 650® Spectrophotometer, the color co-ordinate values of all dyed specimen are measured by following CIE Lab or CIE LCH method.

3.2.6 Color strength test

Reflectance value (R) of all dyed samples determined between the wavelength 400-700 nm within 10 intervals using Data color 650® Spectrophotometer. Putting these values of R into the Kubelka-Munk theory to find out the color strength (K/S) of each specimen.

$$\text{Color Strength, } K/S = (1-R)^2 / 2R$$

IV. Results and Discussion

4.1 Visual comparison

From visual perspective it is found that the samples treated with cationizer exhibit deeper color than the untreated ones considering the same shade percentage for both red and blue hue.

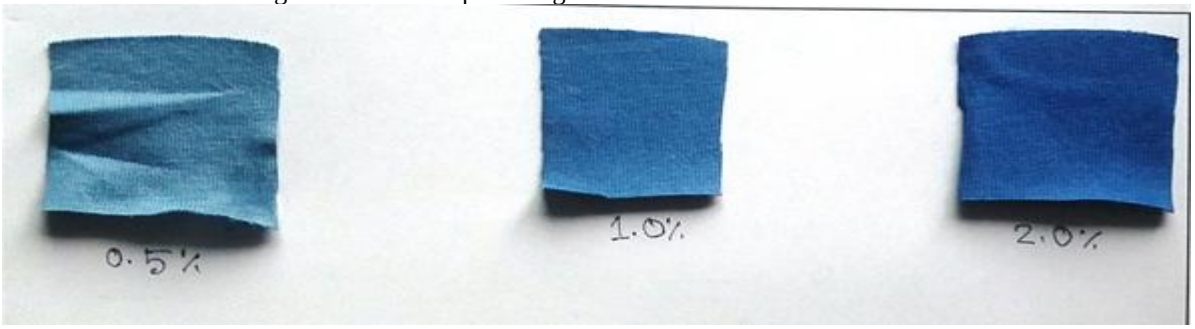

Figure 4.1 Fabric dyed with CI Reactive Blue 62 without cationizer.

Figure 4.2 Fabric dyed with CI Reactive Blue 62 after treating with cationizer.

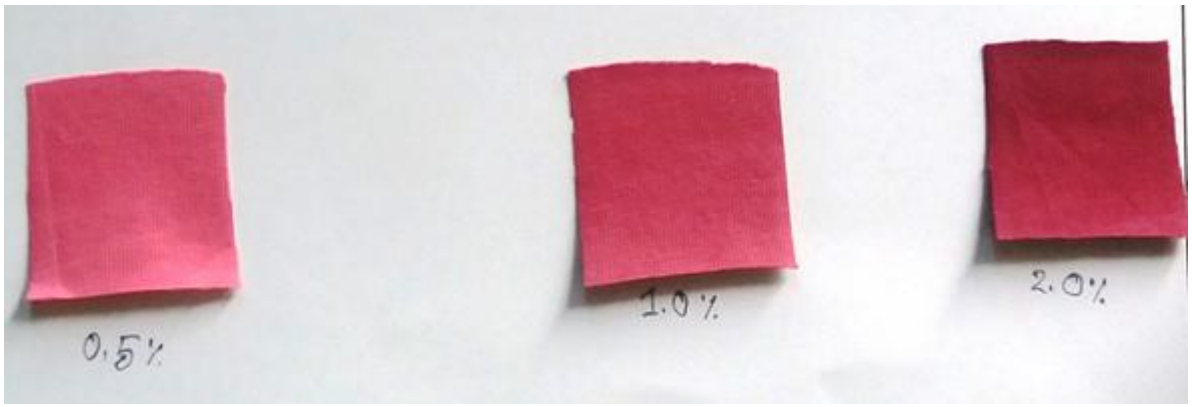

Figure 4.3 Fabric dyed with CI Reactive Red 195 without cationizer.

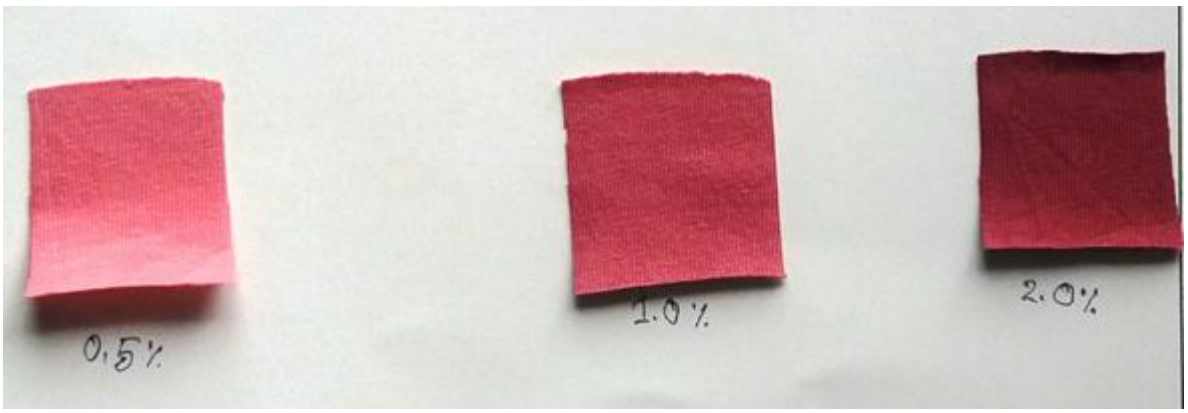

Figure 4.4 Fabric dyed with CI Reactive Red 195 after treating with cationizer.

4.2 Color fastness to wash

After washing fastness test it is found that tantamount color change (4-5) for 0.5%, 1% shade of both blue and red samples are occurred, which indicate that the application of cationizer does not affect the color fastness to wash property. But for 2% shade of blue hue and red hue, improvement in colorfastness is observed on those specimens which are treated with cationizer.

On the other hand, color staining for all samples of both red and blue hues processed with cationizer exhibit better wash fastness rating than the only reactive dyed samples.

Table 4.1 Ratings of color fastness to wash test for different samples.

Fabric Sample	Color Change	Color fastness to color staining					
		Acetate	Cotton	Nylon	Polyester	Acrylic	Wool
Blue (0.5%)Without Cationizer	4-5	4-5	4-5	5	5	4-5	4-5
Blue (0.5%)With Cationizer	4-5	4-5	4-5	5	5	5	5
Blue (1%)Without Cationizer	4-5	4-5	4	5	4-5	4-5	4-5
Blue (1%)With Cationizer	4-5	4-5	4-5	5	5	5	5
Blue (2%)Without Cationizer	3-4	4	3-4	4-5	4-5	4-5	4
Blue (2%)With Cationizer	4-5	4-5	4-5	5	5	4-5	4-5
Red (0.5%)Without Cationizer	4-5	4-5	4	4-5	4-5	4-5	4-5
Red (0.5%)With Cationizer	4-5	4-5	4-5	5	5	5	4-5
Red (1%)Without Cationizer	4	4	3-4	4-5	4-5	4-5	4-5
Red (1%)With Cationizer	4-5	4-5	4-5	5	5	4-5	5
Red (2%)Without Cationizer	3-4	3-4	3	4-5	4	4-5	4
Red (2%)With Cationizer	4-5	4-5	4	5	4-5	4-5	4-5

4.3 Color fastness to rubbing

By considering the following data, it can be assumed that for low percentage of shade (i.e. for 0.5% shade), rubbing fastness values are not influenced by the application of cationizer and it is applicable for both red and blue color. But with the increase of shade percentage of both red and blue hue (i.e. for 1% or 2% shade), both wet and dry rubbing fastness increases slightly for cationizer treated samples.

Table 4.2 Rating of fastness to rubbing (wet and dry) for all types of dyed fabrics.

Fabric sample	Dry rubbing fastness	Wet rubbing fastness
Blue (0.5%)Without Cationizer	5	4-5
Blue (0.5%)With Cationizer	5	4-5
Blue (1%)Without Cationizer	5	4
Blue (1%)With Cationizer	5	4-5
Blue (2%)Without Cationizer	4-5	3-4
Blue (2%)With Cationizer	5	4-5
Red (0.5%)Without Cationizer	5	4-5
Red (0.5%)With Cationizer	5	4-5
Red (1%)Without Cationizer	4-5	4
Red (1%)With Cationizer	5	4-5
Red (2%)Without Cationizer	4-5	3-4
Red (2%)With Cationizer	5	4-5

4.4 Color co-ordinate

Assessing the color co-ordinate values, it can be deducted that the value of Lightness (L) decreases slightly when cationizer is applied for all ranges of shade% and colors. Besides higher the shade percentage of dyes, reduction in lightness value also increases.

Table 4.3 Colorimetric values for blue and red colored samples.

Fabric Sample	Color co-ordinate					
	L	A	B	c	H	ΔE
Blue (0.5%)Without Cationizer	40.93	-3.91	-14.78	15.88	75.18	0.6
Blue (0.5%)With Cationizer	39.12	-4.45	- 13.56	14.27	71.83	0.65
Blue (1%)Without Cationizer	37.22	-7.71	-16.73	18.42	65.2	0.2
Blue (1%)With Cationizer	36.45	-9.23	-19.62	21.68	64.81	0.3
Blue (2%)Without Cationizer	35.04	-11.54	-22.04	24.87	62.36	0.2
Blue (2%)With Cationizer	31.23	-14.86	-23.16	27.51	49.90	0.3
Red (0.5%)Without Cationizer	51.76	55.09	0.75	55.09	0.77	0.4
Red (0.5%)With Cationizer	50.45	55.98	1.52	56.00	1.55	0.4
Red (1%)Without Cationizer	47.48	57.09	1.61	57.11	1.61	0.17
Red (1%)With Cationizer	45.12	57.15	1.71	57.17	1.71	0.18
Red (2%)Without Cationizer	43.67	59.43	1.56	59.45	1.50	0.2
Red (2%)With Cationizer	40.08	60.08	1.48	60.09	1.41	0.3

4.5 Color strength

After determining the K/S values for all the samples, irrespective to percentage of shade and hue, it is evident that color strength increases a little for all the cationizer treated samples.

Table 4.4 Values of color strength for all samples at their highest peak of spectrum.

Fabric Sample	Color Strength (K/S) value
Blue (0.5%)Without Cationizer	37.53
Blue (0.5%)With Cationizer	38.12
Blue (1%)Without Cationizer	40.28
Blue (1%)With Cationizer	42.09
Blue (2%)Without Cationizer	43.43
Blue (2%)With Cationizer	45,89
Red (0.5%)Without Cationizer	82.83
Red (0.5%)With Cationizer	83.32
Red (1%)Without Cationizer	85.79
Red (1%)With Cationizer	87.75
Red (2%)Without Cationizer	88.16
Red (2%)With Cationizer	90.23

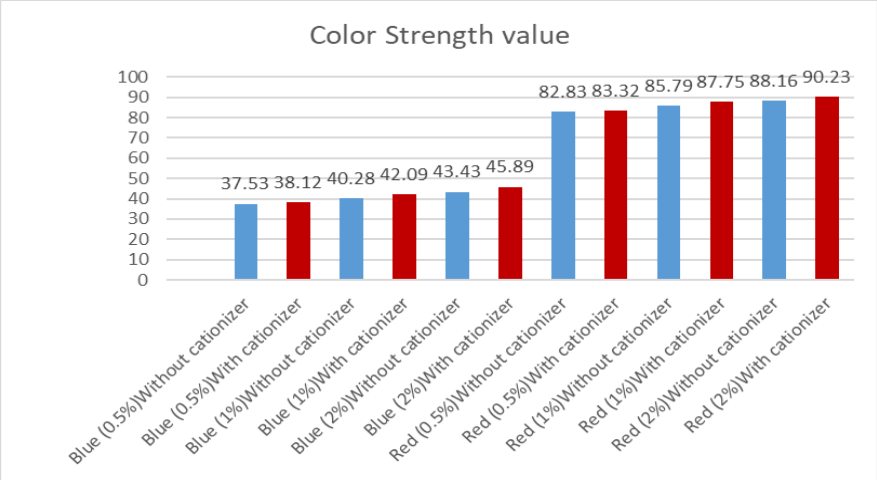

Fig 4.1 Color strength value of all specimen.

V. Conclusion

This study only concerns with the influence of cationizer on reactive dyed cotton fabric at different shade percentage. Effects are calculated by considering the properties like color fastness to washing, color fastness to rubbing (Dry and wet), colorimetric values, color strength and visual impact etc. It can be assumed from the experiment that the influence of cationizer on reactive dyed cotton fabric is nothing at low percentage of shade but with the increasing shade percentage, cationizer effects both washing fastness and rubbing fastness properties. Deeper perception of the same shade percentage can be achieved only by adding cationizer because lightness value decreases on cationizer treated sample. Color strength values also elevated with the application of cationizer. Therefore, it is obvious from the above discussions that the effect of cationizer on the higher shade percentage of reactive dye is more prominent than the lower shade percentage.

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