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EFFECT OF SHADE DEPTH ON LEA STRENGTH, WEIGHT LOSS AND WASH FASTNESS PROPERTIES OF REACTIVE DYED COTTON YARN

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Abstract— Analysis of the change in lea strength, weight loss percentage and wash fastness properties of 100 percent cotton reactive dyed yarn with various shade depth (1% to 4%) is carried out to represent correlation between the specified yarn properties with shade depth change in two different yarn counts. It is observed that increase in shade depth increases the yarn lea strength but shows a decreasing rate in wash fastness and weight loss (%). Finer yarn shows wash fastness rating of 4/5 whereas coarser yarn shows higher value in weight loss (%) and yarn lea strength.

Keywords: *Lea Strength; weight loss; shade depth; wash fastness; Cotton yarn; Reactive dye.*

1. INTRODUCTION

Cotton fiber is the most conspicuous natural fiber and the most genuine source of cellulose. It is the most popular natural textile fiber in the world. In the global market, the economic impact of cotton is obvious for its' maximum share (over 50%) among fibers and textile goods [1].

In 1950s, the reactive dyes that came to light was mainly introduced for cellulose based fibers but new classes have been developed for silk, nylon and wool. At present, reactive dyes are mostly accepted because of the versatility in application on protein and cellulosic fibers, high brilliancy, broad shade ranges and better fastness to color. While dyeing the reactive groups of reactive dyes forms covalent bond between fiber polymer and dye which makes dye integral part of fibre. Hence, they are known for its enhanced fastness property [8]. Reactive dyes are not banned yet for any noxious chemical. Oxidation reduction process is not required for reactive dyeing. That is why effluent is produced because oxidation-reduction is about to zero. Small amount of alkali can fix reactive dye that is why harmful chemical is not required [2] because versatile ranges of color are also used for cellulosic materials printing.

Reactive dyes have a low utilization degree compared to other types of dyestuff, since the functional group also bonds to water and creating hydrolysis [10]. These dyes have stable electron arrangement which protect fiber from the adverse effect of ultra-violet rays [9]. Dyeing with the cold brand of these dyes can be done at room temperature for the presence of two chlorine atoms [3].

In our research we had used medium brand reactive dyes whereas dyeing was carried out at 60oC temperature. Alkali addition neutralizes the acid form during the covalent bond formation between reactive dye and cotton [4].

Reactive dyes are vastly used for wet processing industries in Bangladesh. Under influence of temperature and alkali, the reactive part of the reactive dyes reacts with functional group of the fiber [5]. For the broad range of application and better color fastness properties, reactive dyes are known as supreme for cotton fiber [6].

In our textile industry, dyeing of yarn is the most significant thing. Yarns are dyed earlier to make them fabrics either by weaving or knitting. Dyed yarns of different-colored are applied to create fascinating fabrics like checks, stripes and plaids in the weaving process. It is also applicable in the knitting process for auto stripe and engineering stripe production. Dye stuff penetrates into the core of fibers of the dyed yarn [7].

In this work, an attempt was made to investigate the effect of shade depth as well as to observe the effect of color fastness and lea strength on 100% cotton yarn dyed with reactive dye. Two yarns of different yarns were dyed with four different shade % of reactive dye. Finally lea strength, colorfastness and weight loss was measured.

2. MATERIALS AND METHODS

A. Materials:

Samples weighted 10 gm of Scoured and bleached 100% cotton yarn of both Ne 20/2 and Ne 32/2 are dyed with medium brand reactive dye. As a reactive dye we had used Sunfix Red-SPD. The commercial Sunfix Red SPD was supplied by Oh-Young (a Korean company).

B. Methods:

1) ***Dyeing*** *:*

Samples of both yarn count, required amount of dye and auxiliaries are taken manually in a water bath shake (cotton

dyeing machine). After 60 minutes, soap and acid wash is done. With a Mini Hydro and an oven, all the eight samples are dried. Table 1 shows the recipe.

Table 1. Recipe

Dyes	Amount	Chemicals with Amount		
		Leveling agent (RL)	*Na_2SO_4 (Salt)*	*NaOH*
Sunfix Red-S3B (1% stock solution)	1%	1 g/l	30 g/l	10 g/l
	2%		50 g/l	15 g/l
	3%		60 g/l	20 g/l
	4%		70 g/l	30 g/l
Sample weight			10 gm	
M:L			1:10	
Time			60 min	
Temperature			60°C	

*2) **Colorfastness to wash(IS:764:79):***

Yarns have been taken approximately equivalent to half of the total quantity of adjacent fabric. They are then embeded between a 4cm×10cm adjacent multifiber fabric and 4cm×10cm fabric that is unable to dye (polypropylene fiber). A combined sample is formed by a neat sewing along the four edges.

In the test, color change and color staining on the adjacent fabrics are assessed. Five measurements of each sample were taken.

*3) **Weight loss:***

Weight loss of the materials were measured according to the equation and for each sample five measurements were taken.

$$\text{Weight loss\%} = \frac{\text{Before Dyeing weight} - \text{After dyeing weight}}{\text{Before dyeing weight}} \times 100$$

*4) **Lea Strength (ASTM D1578):***

This test method determines the yarn lea strength in skein form by lea strength tester. Lea of yarn was made by using wrap reel machine. Five measurements were taken for each type sample.

3. RESULT AND DISCUSSION

A. Wash fastness of yarn:

Table 2 and Table 3 show the data for color fastness to wash for color change and staining. The experimental results of color change and color staining of both 32/2 Ne and 20/2 Ne yarns are shown in Table 2 and Table 3 respectively. As the value for color change and staining is same for same count of yarn, it is shown in one figure. Figure 1 shows moderate linear correlation between shade percentage and color fastness to wash for color change and color staining for yarn 32/2.

In figure 2 it shows strong linear correlation between shade percentage and color fastness to wash for both color change and staining of 20/2 yarn.

From these two figures it is clearly be seen that color fastness to wash has higher rating for finer yarn than coarser.

Table 2. color fastness to wash for color change

Yarn Count	Dye Concentration	Color change rating
32/2 Ne	1%	4/5
	2%	4/5
	3%	4/5
	4%	4
20/2 Ne	1%	4/5
	2%	4
	3%	4
	4%	¾

Table 3. color fastness to wash for color staining

Yarn Count	Dye Concentration	Color staining rating
32/2 Ne	1%	4/5
	2%	4/5
	3%	4/5
	4%	4
20/2 Ne	1%	4/5
	2%	4
	3%	4
	4%	¾

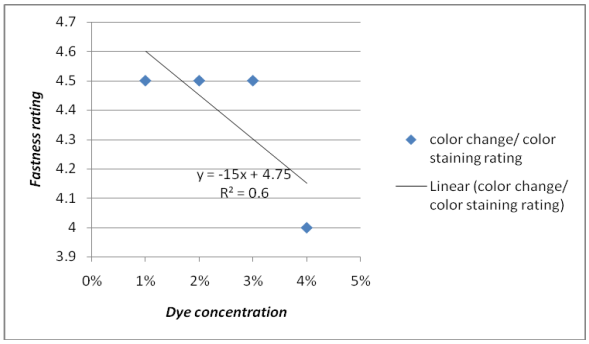

Fig. 1. Color fastness to wash (color change and color stain) for 32/2 Ne yarn depending on their shade depth

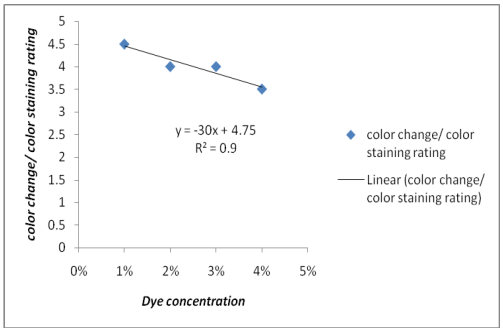

Fig. 2. Colorfastness to wash (color change and color stain) for 20/2 Ne yarn depending on their shade depth.

B. *Weight loss of yarn:*

Table 4. Weigth loss % of yarns depending on their shade depth

Yarn Count	Dye concentration	Weight loss %
20/2 Ne	1%	2.905
	2%	0.179
	3%	0.129
	4%	0.059
32/2 Ne	1%	1.238
	2%	0.089
	3%	0.059
	4%	0.019

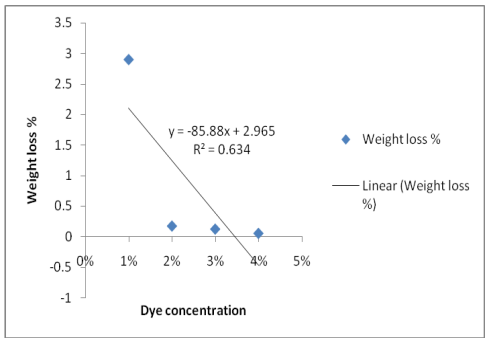

Fig. 3. Percentage of Weight loss on the basis of shade depth for 20/2 Ne yarn.

The experimental result of weight loss percentage on different shade is shown in Table 4. There is a moderate linear correlation between weigth loss and shade depth. With the increase of shade depth, weigth loss percentage decreases.
It is also observed that weigth loss percentage in finer yarn has lower value than coarser yarn with shade depth.

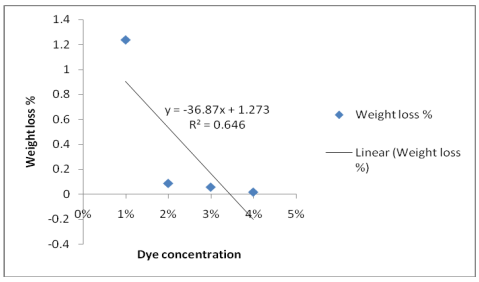

Fig. 4. Percentage of Weight loss on the basis of shade depth for 32/2 Ne yarn

C. *Lea Strength of yarn:*

The experimental result of yarn lea strength for different shade depth is shown in Table 5. There is a strong linear correlation between yarn lea strength and shade depth. With the increase of shade percentage yarn lea strength increases.
It is also found that coarser yarn lea strength is higher than finer yarn with shade depth.

Table 5. Lea Strength of yarns depending on their shade depth

Yarn Count	Dye concentration	Lea Strength (lb/Tex)
2/32 Ne	1%	5.49
	2%	5.73
	3%	5.93
	4%	6.19
2/20 Ne	1%	5.25
	2%	5.56
	3%	6.06
	4%	6.49

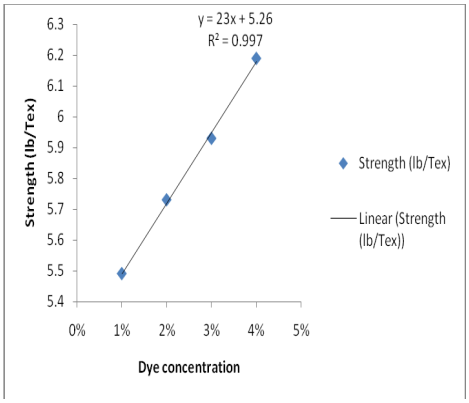

Fig. 5. Yarn lea strength change on the basis of shade depth for 32/2 Ne yarn

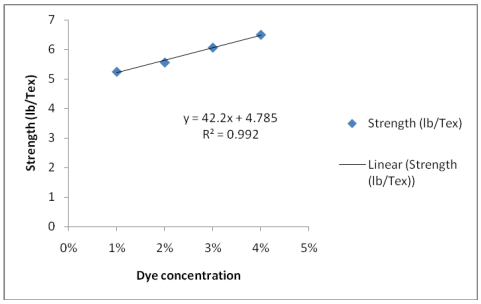

Fig. 6. Yarn lea strength change on the basis of shade depth for 20/2 Ne yarn

4. CONCLUSION

During our research work, we studied yarn of 100% cotton with two different count and identify wash fastness rating, weight loss percentage and yarn lea strength after dyeing with different shade depth percentage. There is high level of linear correlation (figure 2) between color fastness to wash for courser yarn (20/2 Ne) than finer yarn with the increase of shade depth. Weight loss percentage was higher for 1% shade. But with the increase of shade depth weight loss percentage decreased. A significant linear correlation between yarn lea strength and shade depth for both yarn count is observed and higher value obtained for coarser one.

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