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Effect of Varying Concentration of Soda Ash on Fastness Properties of Reactive Dyed Cotton Fabric

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Abstract- In this study, it was observed that the effect of soda ash on fastness properties of reactive dyed cotton fabric was compared with the varying concentration of soda ash. Here, five different concentration of soda ash (10g/l, 15g/l, 20g/l, 25g/l and 30g/l) were used to compare the fastness. Different fastness properties of cotton dyed fabric were investigated such as washing fastness, perspiration fastness, rubbing fastness, and light fastness. Most of the cases, the fabric fastness properties such as washing, rubbing, perspiration, and light were improved at soda 20gm/L after further increasing the amount of soda, the fastness properties were same. So, the result of fastness properties at 20gm/L concentration of soda ash was excellent.

Keywords: reactive dye, soda ash, cotton knitted fabric, fastness properties.

I. INTRODUCTION

Cotton fiber is the most popular textile fiber in the world for their comfort and it is renowned for its breathability, strength and versatility. [1] Cellulosic fiber dyeing with reactive dyes is one of the most convenient and popular method. Cotton also favorable to dye with reactive dyes due to its hydroxyl group ($-OH$). Dyeing is the process of adding colour to textile products like fibers, yarns, and fabrics. Dyeing is normally done in a solution, containing dyes and required chemicals. Dyeing of cotton with direct dye has poor wash fastness due to weak bond between dye-fiber molecules. [2] A dye, which is capable of reacting chemically with a substrate to form a covalent bond, is known as reactive dye. After dyeing, dye molecules have strong chemical bond with cellulosic fiber molecules. Here the dye contains a reactive group and these reactive groups make the covalent bond with the cellulosic fiber polymer and act as an integral part of fiber and give good wash fastness. [3] During the application of reactive dyes to cellulose (cotton) fibers under highly alkaline condition, a hydrolysis reaction takes place, originating the non-reactive oxi-dye form and those dye (oxi-dye) stay on fabric surface. As a

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result, most of the cases it is seen that fastness properties of reactive dyed cotton fabric is not good. Therefore, fixing agent is applied on reactive dyed fabric to develop the different fastness properties in after treatment process. [4] The salt is associate in nursing exhausting agent to push the color towards polysaccharide molecules and therefore the alkali (soda ash) is hydrolyzing/fixing agent for the reactive colors. Sohel et. al Studied the effect of soda on dyeing of woven cotton fabric with reactive dye. They were found good result on colour fastness to wash, water, and Rubbing. They were used in this thesis 100% cotton woven fabric, 140 gsm, Reactive dye (Procion red H-3B, Reactive black B), soda percentage (5%,10%,15%). [5] Paul et. al study on the effect of alkali on dyeing of cotton fabric with reactive dye (shade 1%) and they found in their study the wash and rubbing fastness was good to excellent.[6] Now our paper deals with the Effect of Varying Concentration of Soda (other parameters was kept same) on Fastness Properties in Dyeing of Cotton Fabric with Reactive Dye. The aim of this paper is to examine the effect of varying of soda on different fastness properties. So the color fastness to washing, rubbing, perspiration, and light are tested and evaluated.

II. MATERIALS AND METHODS

a) Fabric used

100% bleached cotton knitted single jersey (160 GSM) were used in this research.

b) Chemicals used

Reactive dyes, Soda ash (Na_2CO_3), anhydrous Glauber salt (Na_2SO_4), Sequestering agent, leveling agent, and anti-creasing agent were used.



c) Dyeing Recipe

Table 1: Black Shade Recipe

Materials Name	Recipe 01	Recipe 02	Recipe 03	Recipe 04	Recipe 05
Nova. Sup. Black G	4.0%	4.0%	4.0%	4.0%	4.0%
Nova. Yellow S3R	0.5%	0.5%	0.5%	0.5%	0.5%
Nova. Ruby S3B	0.5%	0.5%	0.5%	0.5%	0.5%
Soda Ash	10 gm/L	15 gm/L	20 gm/L	25 gm/L	30 gm/L
Salt	80 gm/L	80 gm/L	80 gm/L	80 gm/L	80 gm/L
Time	60 min	60 min	60 min	60 min	60 min
Temperature	60°C	60°C	60°C	60°C	60°C
M:L	1:10	1:10	1:10	1:10	1:10

Table 2: Turquoise Shade Recipe

Materials Name	Recipe 01	Recipe 02	Recipe 03	Recipe 04	Recipe 05
Nova. Turq. Blue GN	0.10%	0.10%	0.10%	0.10%	0.10%
Nova. Blue TS3G	0.56%	0.56%	0.56%	0.56%	0.56%
Avi. Brill. Yellow SE	0.02%	0.02%	0.02%	0.02%	0.02%
Soda Ash	10 gm/L	15 gm/L	20 gm/L	25 gm/L	30 gm/L
Salt	40 gm/L	40 gm/L	40 gm/L	40 gm/L	40 gm/L
Time	60 min	60 min	60 min	60 min	60 min
Temperature	60°C	60°C	60°C	60°C	60°C
M:L	1:10	1:10	1:10	1:10	1:10

Table 3: Red Shade Recipe

Materials Name	Recipe 01	Recipe 02	Recipe 03	Recipe 04	Recipe 05
Nova. Blue TS3G	0.02%	0.02%	0.02%	0.02%	0.02%
Nova. Ruby S3B	2.0%	2.0%	2.0%	2.0%	2.0%
Nova. Yellow S3R	1.0%	1.0%	1.0%	1.0%	1.0%
Soda Ash	5 gm/L	10 gm/L	15 gm/L	20 gm/L	25 gm/L
Salt	55 gm/L	55 gm/L	55 gm/L	55 gm/L	55 gm/L
Albatex DBC	1.0 gm/L	1.0 gm/L	1.0 gm/L	1.0 gm/L	1.0 gm/L
Time	60 min	60 min	60 min	60 min	60 min
Temperature	60°C	60°C	60°C	60°C	60°C
M:L	1:10	1:10	1:10	1:10	1:10

d) *Dyeing Process*

Dyeing of cotton fabric was done with Reactive dye, the fabric sample was immersed in the dyeing solution (dye bath liquor) at 60°C for 60 minutes. Dyeing

was performed in stainless-steel beaker. After dyeing washed the sample in shaker bath at 90°C with shopping agent (Dekol SN) then washing dry the sample and ironing.

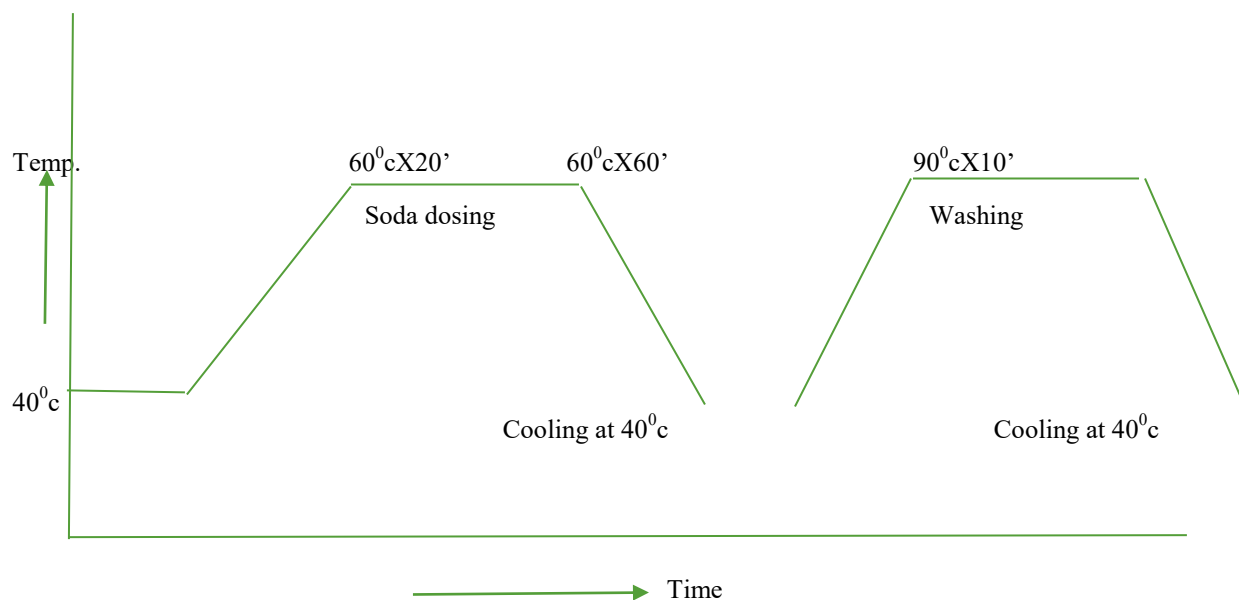


Figure 1: Dyeing Curve

e) *Methods of Testing*

Different standard testing procedures were followed for the assessment of the color fastness properties.

Color fastness to washing was assessed by following the standard method of ISO-105-C06-C2S. [7]

Color fastness to rubbing was evaluated by following the standard method of ISO-105X12. [8]

Color fastness to perspiration was assessed by following the standard method of ISO-105-E04. [9]

Color fastness to light was evaluated assessed by following the standard method of ISO-105-B02. [10]

III. RESULTS & DISCUSSIONS

a) For Black Shade

Table 4: Color Fastness to Washing

Soda gm/L	Change in Color	Color Staining					
		Acetate	Cotton	Nylon	Polyester	Acrylic	Wool
10	4	4-5	3	4-5	4-5	4-5	4-5
15	4	4-5	4	4-5	4-5	4-5	4-5
20	4	4-5	4-5	4-5	4-5	4-5	4-5
25	4	4-5	4-5	4-5	4-5	4-5	4-5
30	4	4-5	4-5	4-5	4-5	4-5	4-5

Table 5: Color Fastness to Perspiration (acid)

Soda gm/L	Change in Color	Color Staining					
		Acetate	Cotton	Nylon	Polyester	Acrylic	Wool
10	4	4-5	3-4	4-5	4-5	4-5	4-5
15	4	4-5	3-4	4-5	4-5	4-5	4-5
20	4	4-5	4	4-5	4-5	4-5	4-5
25	4	4-5	4	4-5	4-5	4-5	4-5
30	4	4-5	4	4-5	4-5	4-5	4-5

Table 6: Color Fastness to Perspiration (Alkali)

Soda gm/L	Change in Color	Color Staining					
		Acetate	Cotton	Nylon	Polyester	Acrylic	Wool
10	4	4-5	3	4-5	4-5	4-5	4-5
15	4	4-5	3	4-5	4-5	4-5	4-5
20	4	4-5	3-4	4-5	4-5	4-5	4-5
25	4	4-5	3-4	4-5	4-5	4-5	4-5
30	4	4-5	3-4	4-5	4-5	4-5	4-5

From the above table, it is shown that, the color fastness is increased with the increased of soda at a level of 20 gm/L and a further increasing of soda ash does not

effect on the color fastness. So it is concluding that, soda 20gm/L concentration result is best in case of color fastness.

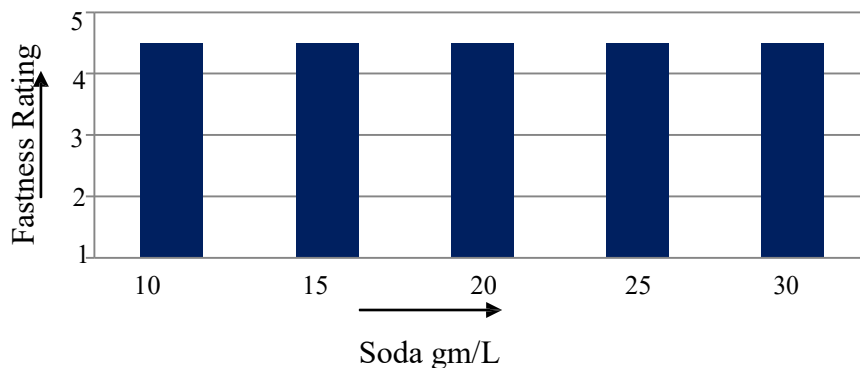


Figure 2: Color Fastness to Dry Rubbing

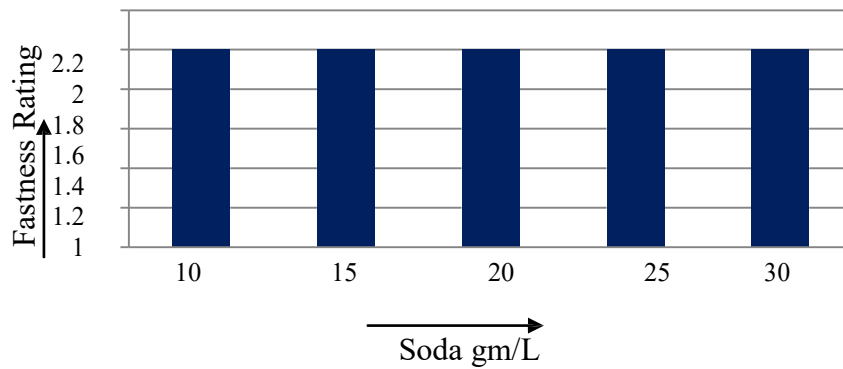


Figure 3: Color Fastness to Wet Rubbing

From the chart, it is found that color to wet rubbing is not up to the mark in relation to fastness to dry rubbing is excellent but colour fastness different concentration of soda.

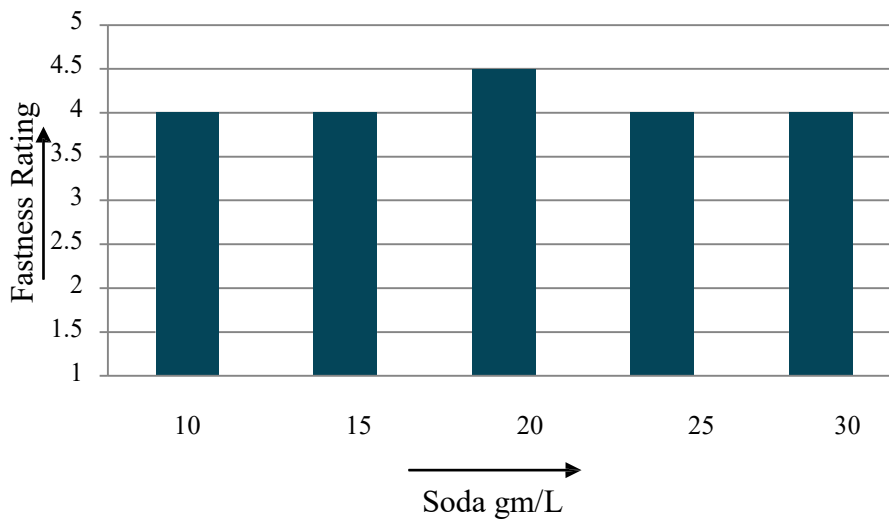


Figure 4: Color Fastness to Light

From figure- 4 it is concluded that, 20 gm/L soda ash concentration has better color fastness to light compare to other concentration of soda ash, though the properties of color fastness to light is excellent in all concentration.

b) For Turquoise Shade

Table 7: Color Fastness to Washing

Soda gm/L	Change in Color	Color Staining					
		Acetate	Cotton	Nylon	Polyester	Acrylic	Wool
10	4	4-5	3-4	4-5	4-5	4-5	4-5
15	4	4-5	3-4	4-5	4-5	4-5	4-5
20	4	4-5	4	4-5	4-5	4-5	4-5
25	4	4-5	4	4-5	4-5	4-5	4-5
30	4	4-5	4	4-5	4-5	4-5	4-5

Table 8: Color Fastness to Perspiration (Acid)

Soda gm/L	Change in Color	Color Staining					
		Acetate	Cotton	Nylon	Polyester	Acrylic	Wool
10	4	4	2	3-4	4	3-4	3-4
15	4	4	2	3	3-4	3	3-4
20	4	4-5	2	3-4	4	3-4	3-4
25	4	4-5	2	3-4	4	3-4	3-4
30	4	4-5	2	3-4	4	3-4	3-4

Table 9: Color Fastness to Perspiration (Alkali)

Soda gm/L	Change in Color	Color Staining					
		Acetate	Cotton	Nylon	Polyester	Acrylic	Wool
10	4	4	2-3	3-4	4	4	3-4
15	4	4	2-3	3	4	4	3-4
20	4	4-5	2-3	3-4	4-5	4-5	4
25	4	4-5	2-3	3-4	4-5	4	3-4
30	4	4-5	2-3	3-4	4-5	4-5	4

The results of the above tables show that, the properties of color fastness to perspiration (acid & alkali) are poor. Among this poor fastness property the 20 gm/L soda ash concentration has a comparatively better

result. Although fastness property to perspiration in all concentration is poor; 20 gm/L soda ash concentration has relatively better than other concentration.

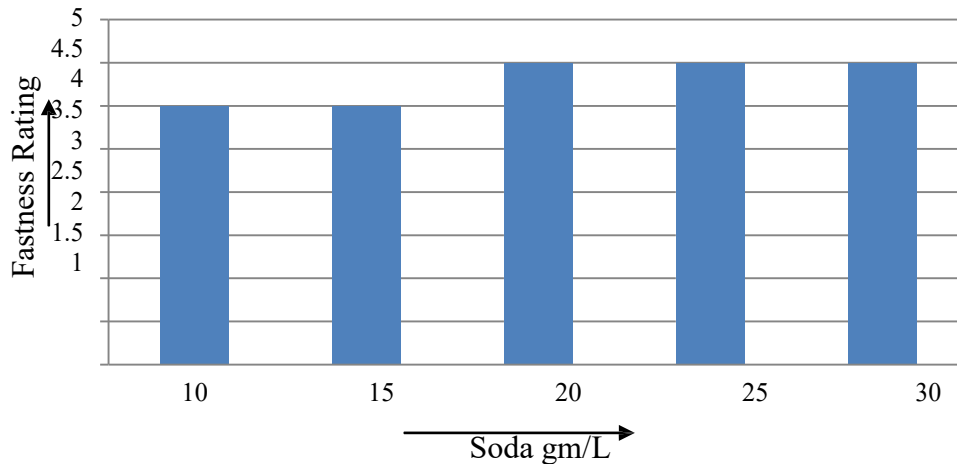


Figure 5: Color Fastness to Dry Rubbing

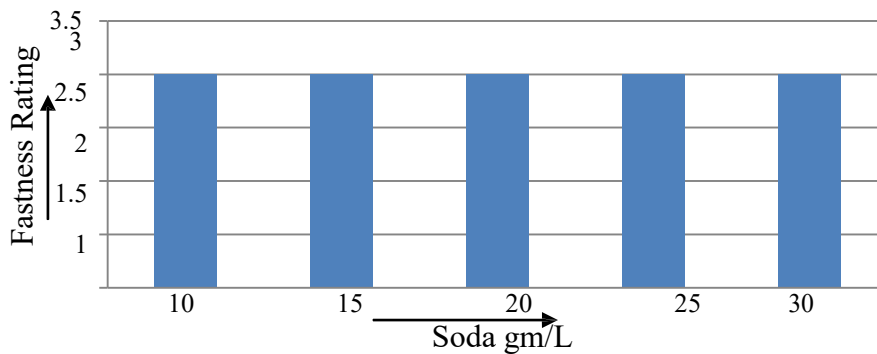


Figure 6: Color Fastness to Wet Rubbing

The above graphs show that, the color fastness to wet rubbing is same for all concentration of soda ash, whereas color fastness to dry rubbing is disparate in

different concentration. In wet rubbing optimum fastness properties found in 20, 25 & 30 gm/L soda ash concentration.

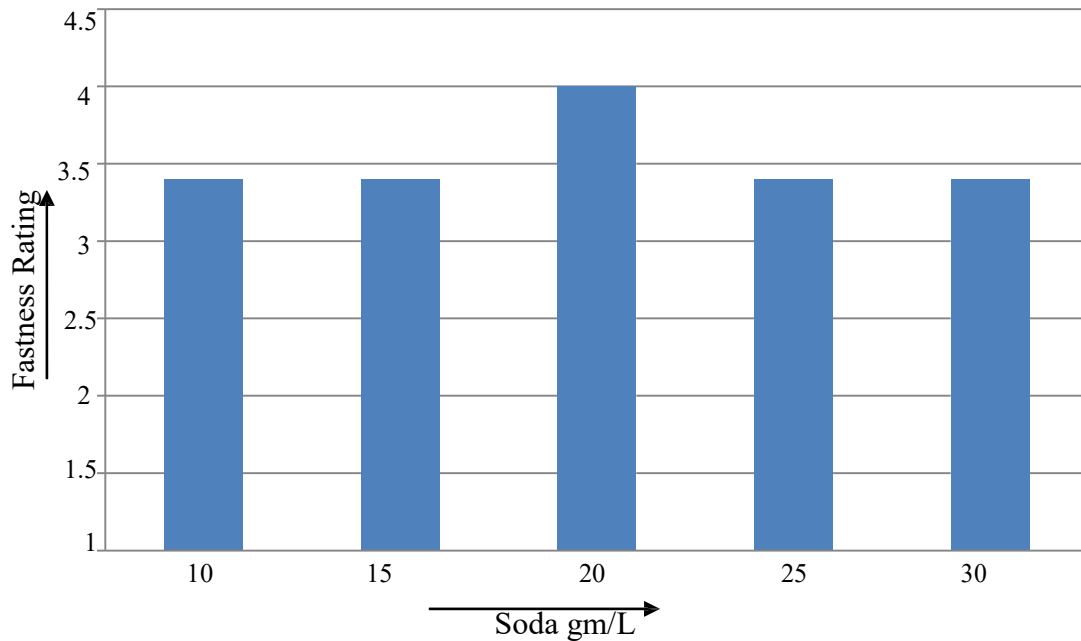


Figure 7: Color Fastness to Light

From the above graph, the result of color soda gm/L is a peak at 20 gm/L soda ash concentration.

c) For red shade

Table 10: Color Fastness to Washing

Soda gm/L	Change in Color	Color Staining					
		Acetate	Cotton	Nylon	Polyester	Acrylic	Wool
10	4	4-5	3-4	4-5	4-5	4-5	4-5
15	4	4-5	3-4	4-5	4-5	4-5	4-5
20	4	4-5	4	4-5	4-5	4-5	4-5
25	4	4-5	4	4-5	4-5	4-5	4-5
30	4	4-5	4	4-5	4-5	4-5	4-5

Table 11: Color Fastness to Perspiration (Acid)

Soda gm/L	Change in Color	Color Staining					
		Acetate	Cotton	Nylon	Polyester	Acrylic	Wool
10	4	4	2	4	4	3	3
15	4	4	2	3-4	4	3	3
20	4	4	2	3	4	3	3
25	4	4	2	3-4	4	3	3
30	4	4	2	3-4	4	3	3

Table 12: Color Fastness to Perspiration (Alkali)

Soda gm/L	Change in Color	Color Staining					
		Acetate	Cotton	Nylon	Polyester	Acrylic	Wool
10	4	4	2	3	4	3	3
15	4	4	2	3	4	3	3
20	4	4	2	4	4	3	3
25	4	4	2	4	4	3	3
30	4	4	2	4	4	3	3

From the above tables it is shown that, 20, 25 & 30 gm/L concentration give the best result of color fastness to washing.

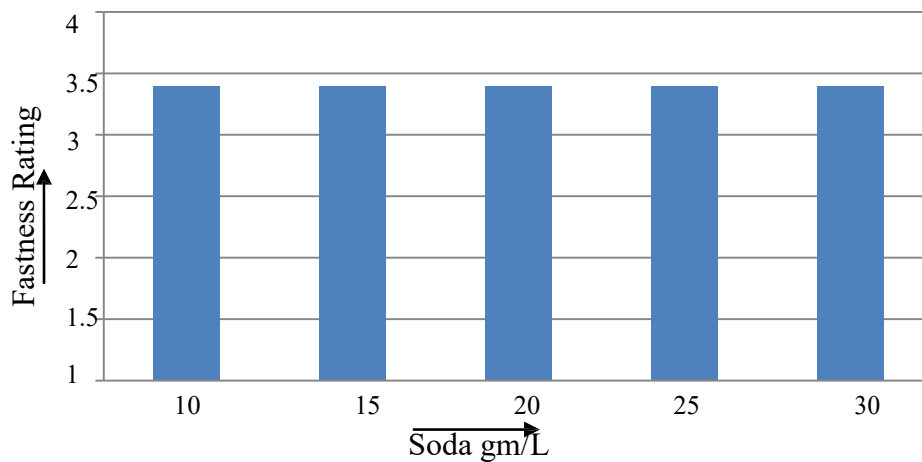


Figure 8: Color Fastness to Dry Rubbing

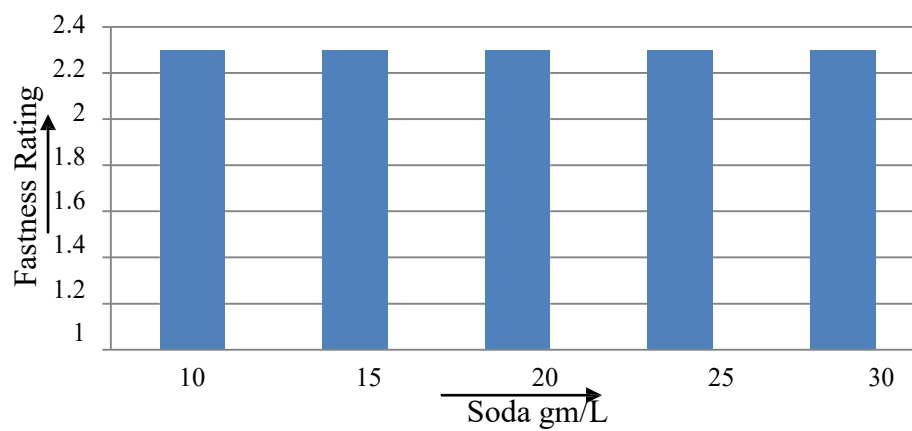


Figure 9: Color Fastness to Wet Rubbing

From figures 8 & 9, it is found that color fastness to wet rubbing and dry rubbing are almost same in all concentration of soda ash.

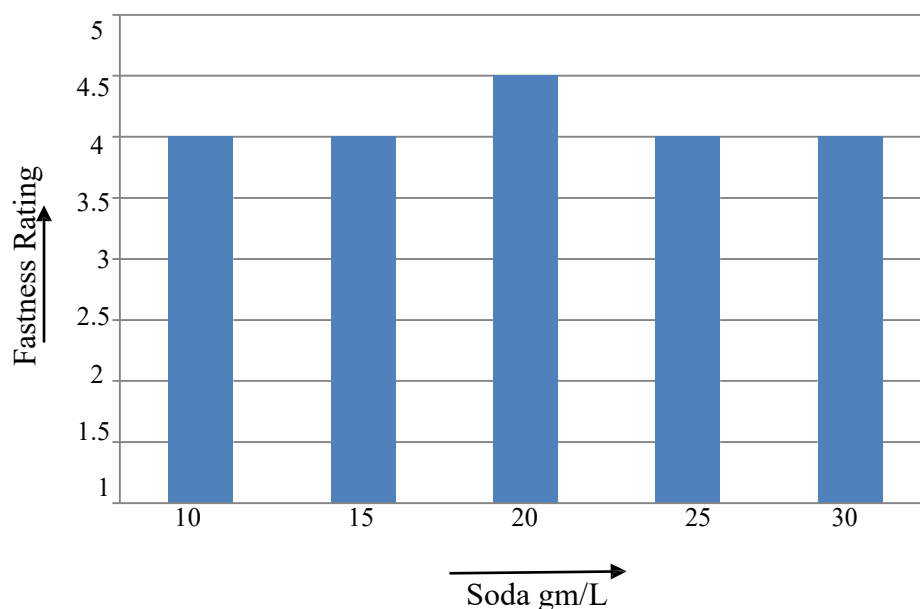


Figure 10: Color Fastness to Light

Figure 10 shows that, color fastness to light for red shade is best at 20 gm/L soda ash concentration.

IV. CONCLUSION

In this research work finally it is conclude that, the varying of soda ash concentration has effects on fastness properties of reactive dyed cotton fabric with various shades. With the increase of soda ash, fastness properties increased due to much amount of dye fixation into the fiber. But it was also shown that 20gm/L soda ash concentration provides the best results rather than other concentration of soda ash. Over 20 gm/L concentration of soda ash also give, similar result so it is unwise to use more soda ash as it is one kind of wastage of soda ash.

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