Effect of Finishing Auxilliaries on the Color Perception of Cotton Knit Fabric Dyed with Reactive Dye

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Abstract

Dyed textiles are influenced by finishing treatments more or less strongly. Individual dyes as well as finishing products and conditions are responsible for this. An attempt has been made to assess the effects of some finishing auxiliaries on the color yield of reactive dyed cotton knit fabric. It was found that treatment with finishing auxiliaries decreased the shade depth to a considerable extent. The shade changes obtained after treating with fixing and soaping agent were found less than the treatment with caustic soda and combined caustic and glauber salt.

Keywords: Finishing, auxiliaries, cotton, color perception.

Introduction

Color sensation is a characteristic of human experience. Nature provides a particularly vivid display of color. An object viewed in white light, which consists of all wavelengths in the visible region (400–700 nm) in about equal proportions, will appear colored if there is selective absorption of some wavelengths and reflection or transmission of the others. Objects with high reflectance of all wavelengths of white light will appear white, whereas strong absorption of all wavelengths produces black (Broadbent, 2001).

Textile finishing gives a textile its final commercial character with regard to appearance, shine, handle, drape, fullness, usability, etc. Nearly all textiles are finished (Choudhury, 2017).

Textile finishing is therefore an extremely diverse field involving an extensive range of chemicals (Broadbent, 2001).

Besides fibres, water and dyes, and specific chemicals for preparation and finishing processes, the textile industry consumes vast quantities of auxiliary chemicals, other than simple acids, bases and salts. These auxiliary products include many kinds of complex organic chemicals used as detergents, wetting agents, dyeing assistants, dispersing and emulsifying agents, dyeing after-treatment chemicals, lubricants and softeners. Unfortunately, like dyestuffs, the brand names and identifying codes of these auxiliary products offer little or no information about their composition. Commercial auxiliary products are frequently mixtures, often containing much water. Any given product sold for a specific purpose can have multiple functions such as wetting, detergent, dispersing and dyeing control capability. For these reasons, the role of auxiliary chemicals in textile wet processing and dyeing is confusing (Broadbent, 2001).

Dye and print color can be more or less strongly influenced by finishing treatments, with the possibility that variations in both tone and intensity occur. Individual dyes as well as finishing products and conditions are responsible for this (Bellini et al. 2001).

Today's finisher deals with many points of concerns since he is responsible for the ultimate quality of the fabric. Among the points of concerns are those that deal with chemistry, i.e. reactions with the fabric, safe handling of bulk quantities of hazardous chemicals, worker safety and environmental issues involving air and water discharges. Another point of concern deals with the machines used to process the fabric and controlling them to produce first quality goods. Still another point of concern deals with economic factors, i.e. chemical and process costs, output, certification of quality and timely delivery of products to customers (Thomasino, 1992).

There is no previous analysis on the result of the color perception on applying chemicals after dyeing. Here an attempt has been made to find this missing link of finishing auxiliaries on color yield after reactive dyeing of cotton knit fabric.

Materials and method

Materials

100% cotton knit fabric dyed with 2.1% shade (SUNFIX BLUE SNR= 0.3% o.w.f. and SUNFIX TURQUISE BLUE G 266% =1.8% o.w.f) was used for this study. Laboratory graded Caustic soda, Glauber salt, Softener, Soaping agent, Fixing agent (Kappafix GG, Albafix ECO and

Avolin Isw) were used at various concentration for the variation of parameters.

Machine

Winch Dyeing Machine was used for the treatment of dyed fabric. Datacolor 650 Spectrophotometer (Dual beam reflectance spectrophotometer) and color matching software (Datacolor, USA) were used for measuring colorimetric values.

Methods

The experiment has been carried out after the cotton knit fabric is dyed with reactive dye at migration process at temperature of 80°C for about 1.5 hr. After dyeing the fabric is treated with the finishing auxiliaries and washed and then dried at stenter at a temperature of 100°C. The treatments carried out for the assessment of the effects of auxiliaries are shown in Table 1.

The colorimetric values of the treated textiles were assessed and compared under various light sources namely F11, D65 and A10 at 10 degree of angle of inclination using a standard light box.

Table 1: Variation of Parameters for the Assessment of Effects of Finishing Auxiliaries

Finishing Auxiliaries	Concentration (g/L)	Temperature	Time	Cycle time
Caustic Soda	20	60°C	20 minutes	2.5 minutes
	30			
	35			
	40			
Caustic Soda + Glauber Salt	40 + 20			
	30 + 10			
	20 + 30			
Kappafix GG	1			
	2			
	3			
Albafix ECO	1			
	2			
	3			
Avolin Isw	1			
	2			
	3			

Result and Discussion

Treatment with Caustic Soda

Caustic soda was used for the treatment of dyed textiles and the treated fabric was assessed at various light sources. The data obtained are represented below. The dyed sample is treated with caustic soda and the light source for determining the colorimetric values is F11 at 10 degree of angle of inclination. The colorimetric values are tabulated in Table 2 and shown graphically in Figure 1.

Table 2: Data for light source F11 10 deg using caustic soda

Conc. of Caustic Soda	Colorimetric Values							Pass /Fail
	Dl*	Da*	Db*	DC*	DH*	DE*	DE CMC	
20 g/l	2.25	0.82	2.24	0.93	2.2	3.29	1.78	Fail
30 g/l	1.19	0.59	1.38	0.5	1.42	1.92	1.07	Fail
35 g/l	1.79	1	2.25	0.81	2.32	3.04	1.72	Fail
40 g/l	1.98	0.6	1.9	0.86	1.8	2.81	1.51	Fail

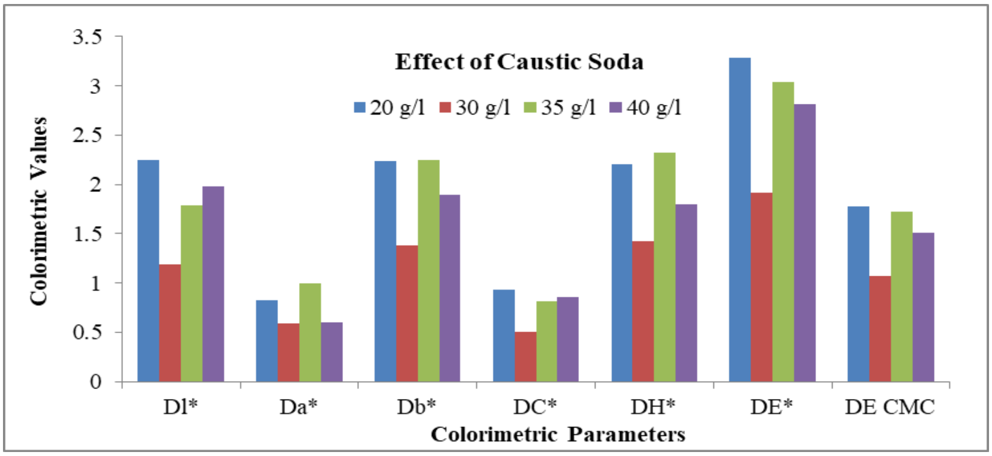

Figure 1: Effect of Caustic Soda on the Colorimetric Value at light source F11 10 deg.

It exhibits the changes of the shade from the original one. With the increment of the concentration of caustic, the colorimetric values also increase with some little exceptions. Since the DE CMC variation is more than 1, the results have been shown as failed in color matching as pass/fail comments of the treated samples in comparison with the original one.

The dyed sample is treated with caustic soda and the light source for determining the colorimetric values is D 65 at 10 degree of angle of inclination. The colorimetric values are tabulated in Table 3 and shown graphically in Figure 2.

Table 3: Data for light source D65 10 deg using caustic soda

Conc. of Caustic Soda	Colorimetric Values							Pass /Fail
	Dl*	Da*	Db*	DC*	DH*	DE*	DE CMC	
20 g/l	2.25	1.42	2.04	0.03	2.49	3.36	1.87	Fail
30 g/l	1.12	0.93	1.28	0.04	1.59	1.99	1.14	Fail
35 g/l	1.79	1.5	2.03	0.04	2.52	3.09	1.78	Fail
40 g/l	1.97	1.11	1.74	0.09	2.06	2.85	1.57	Fail

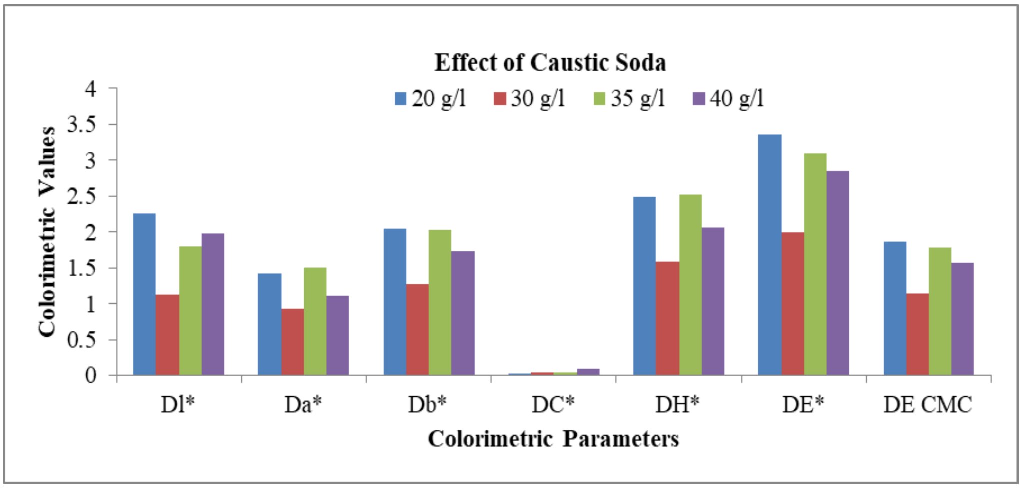

Figure 2: Effect of Caustic Soda on the Colorimetric Value at light source D65 10 deg.

It exhibits the changes of the shade from the original one. With the increment of the concentration of caustic, the colorimetric values decrease with some little exceptions. Since the DE CMC variation is more than 1, the results have been shown as failed in color matching as pass/fail comments of the treated samples in comparison with the original one.

The dyed sample is treated with caustic soda and the light source for determining the colorimetric values is A10 at 10 degree of angle of inclination. The colorimetric values are tabulated in Table 4 and shown graphically in Figure 3.

Table 4: Data for light source A10 10 deg using caustic soda

Conc. of Caustic Soda	Colorimetric Values							Pass /Fail
	Dl*	Da*	Db*	DC*	DH*	DE*	DE CMC	
20 g/l	1.19	0.46	1.91	0.87	1.77	2.95	1.47	Fail
30 g/l	1.16	0.37	1.21	0.48	1.17	1.72	0.87	Pass
35 g/l	1.74	0.58	1.9	0.77	1.83	2.64	1.34	Fail
40 g/l	1.91	0.26	1.65	0.85	1.44	2.54	1.25	Fail

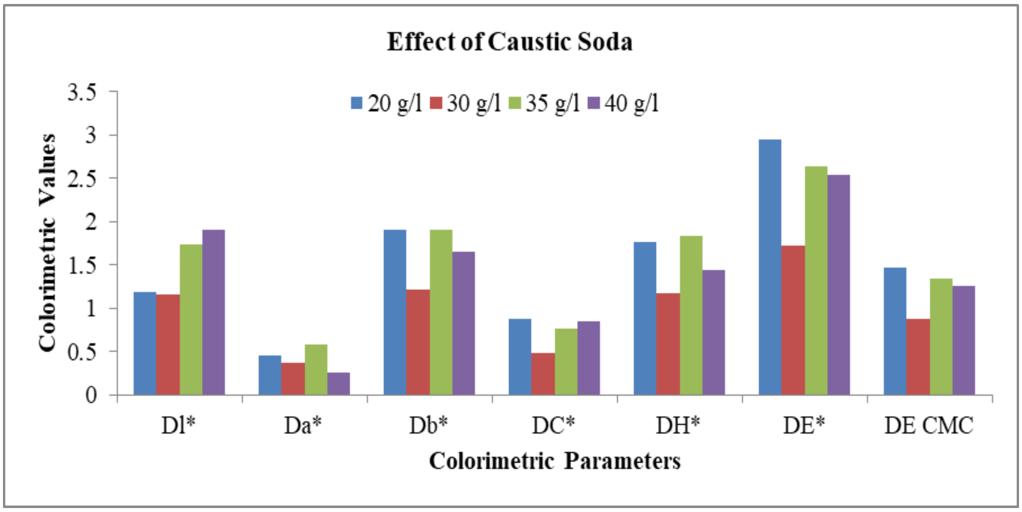

Figure 3: Effect of Caustic Soda on the Colorimetric Value at light source A10 10 deg.

It exhibits the changes of the shade from the original one. With the increment of the concentration of caustic, the colorimetric values decrease with some little exceptions. Since the DE CMC variation is more than 1 in all concentrations except 30 g/l, the results have been shown as failed in color matching as pass/fail comments of the treated samples in comparison with the original one.

Treatment with Caustic Soda and Glauber Salt

Caustic soda was used for the treatment of dyed textiles and the treated fabric was assessed at various light sources. The data obtained are represented below.

The dyed sample is treated with combination of caustic soda and glauber salt and the light source for determining sample color difference is F11 at 10 degree of angle of inclination. The colorimetric values are tabulated in Table 5 and shown graphically in Figure 4.

Table 5: Data for light source F11 10 deg treated with caustic soda and glauber salt

Conc. of Caustic Soda + Glauber Salt	Colorimetric Values							Pass /Fail
	Dl*	Da*	Db*	DC*	DH*	DE*	DE CMC	
40 g/l + 20g/l	0.94	0.06	0.07	0.01	0.1	0.94	0.42	Pass
30g/l+10g/l	0.79	0.04	0	-0.03	0.02	0.79	0.36	Pass
20g/l+30g/l	0.42	-0.25	-0.13	0.27	-0.07	0.24	0.24	Pass

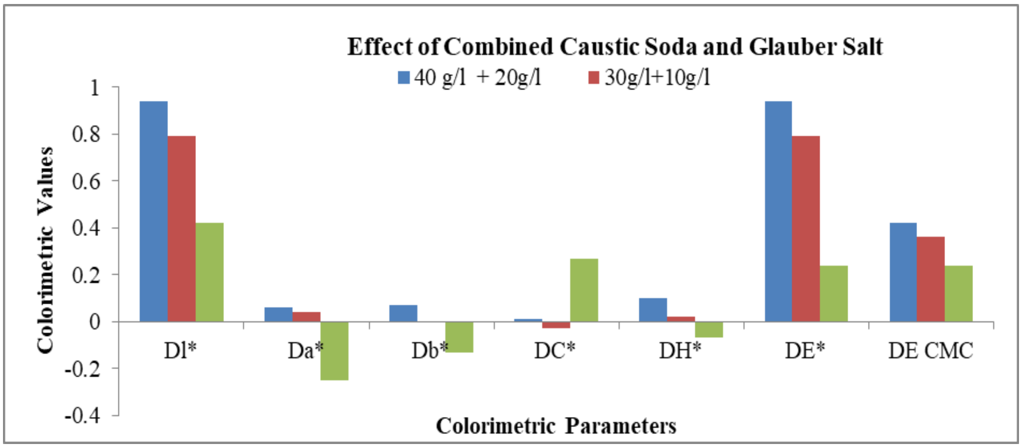

Figure 4: Effect of Combined Caustic Soda and Glauber Salt on the Colorimetric Value at light source F11 10 deg.

It exhibits the changes of the shade from the original one. With the decrement of the concentration of caustic, the colorimetric values decrease. Since the DE CMC variation is less than 1 in all concentrations the results have been shown pass in color matching as pass/fail comments of the treated samples in comparison with the original one.

Table 6: Data for light source D65 10 deg treated with caustic soda and glauber salt

Conc. of Caustic Soda + Glauber salt	**Colorimetric Values**							**Pass /Fail**
	Dl*	**Da***	**Db***	**DC***	**DH***	**DE***	**DE CMC**	
40 g/l + 20g/l	0.94	0.1	0.06	0.04	0.11	0.95	0.45	Pass
30g/l+10g/l	0.76	0.08	-0.03	-0.05	0.07	0.77	0.34	Pass
20g/l+30g/l	0.44	-0.27	-0.1	0.29	-0.06	0.53	0.24	Pass

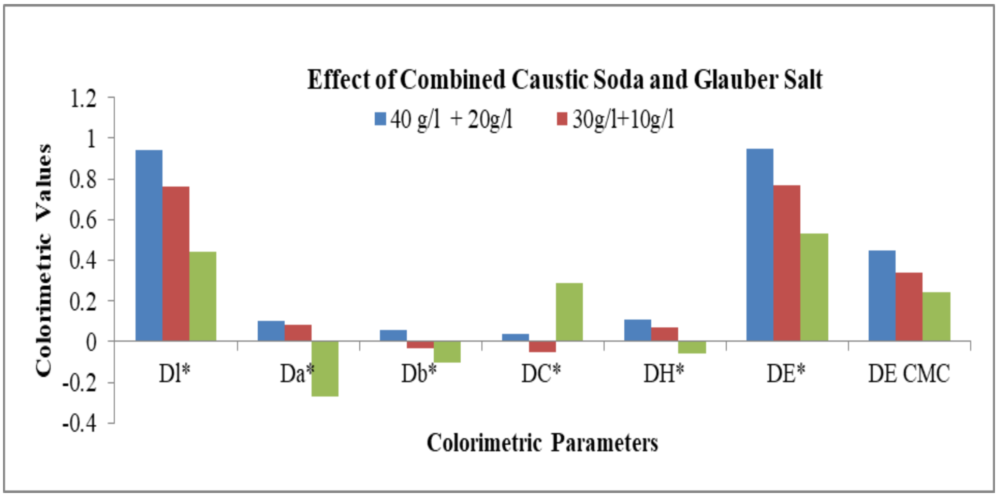

Figure 5: Effect of Combined Caustic Soda and Glauber Salt on the Colorimetric Value at light source D65 10 deg.

The dyed sample is treated with combination of caustic soda and glauber salt and the light source for determining sample color difference is D65 at 10 degree of angle of inclination. The colorimetric values are tabulated in Table 6 and shown graphically in Figure 5. It exhibits the changes of the shade from the original one. With the decrement of the concentration of caustic, the colorimetric values decrease. Since the DE CMC variation is less than 1 in all concentrations the results have been shown pass in color matching as pass/fail comments of the treated samples in comparison with the original one.

Table 7: Data for light source A10 10 deg treated with caustic soda and glauber salt

Conc. of Caustic Soda + Glauber Salt	Colorimetric Values							Pass /Fail
	Dl*	Da*	Db*	DC*	DH*	DE*	DE CMC	
40 g/l + 20g/l	0.95	0.05	0.06	0	0.08	0.95	0.44	Pass
30g/l+10g/l	0.77	0.09	0	-0.07	0.06	0.78	0.36	Pass
20g/l+30g/l	0.4	-0.36	-0.18	0.4	-0.08	0.57	0.25	Pass

The dyed sample is treated with combination of caustic soda and glauber salt and the light source for determining sample color difference is A10 at 10 degree of angle of inclination. The colorimetric values are tabulated in Table 7 and shown graphically in Figure 6. It exhibits the changes of the shade from the original one. With the decrement of the concentration of caustic, the colorimetric values decrease. Since the DE CMC variation is less than 1 in all concentrations the results have been shown pass in color matching as pass/fail comments of the treated samples in comparison with the original one.

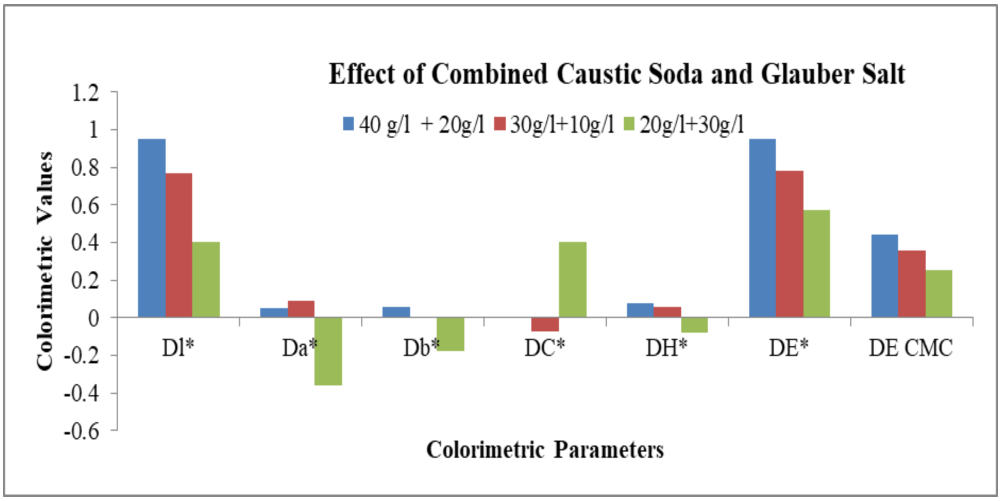

Figure 6: Effect of Combined Caustic Soda and Glauber Salt on the Colorimetric Value at light source A10 10 deg.

Treatment with Kappafix GG

Kappafix GG was used as fixing agent for the treatment of dyed textiles and the treated fabric was assessed at various light sources. The data obtained are represented below.

Table 8: Data for light source F11 10 deg treated with KAPPAFIX GG

Conc. of KAPPAFIX GG	Colorimetric Values							Pass /Fail
	Dl*	Da*	Db*	DC*	DH*	DE*	DE CMC	
1 g/l	0.76	0.15	0.13	0.2	0.03	0.78	0.35	Pass
2 g/l	0.82	0.04	0.17	0.06	0.17	0.84	0.38	Pass
3 g/l	1.02	0.14	0.15	0.2	0.05	1.04	0.47	Pass

The dyed sample is treated with kappafix GG and the light source for determining the colorimetric values is F11 at 10 degree of angle of inclination. The colorimetric values are tabulated in Table 8 and shown graphically in Figure 7. It exhibits the changes of the shade from the original one. With the increment of the concentration of caustic, the colorimetric values also increase with some little exceptions. Since the DE CMC variation is less than 1, the results have been shown as passed in color matching as pass/fail comments of the treated samples in comparison with the original one.

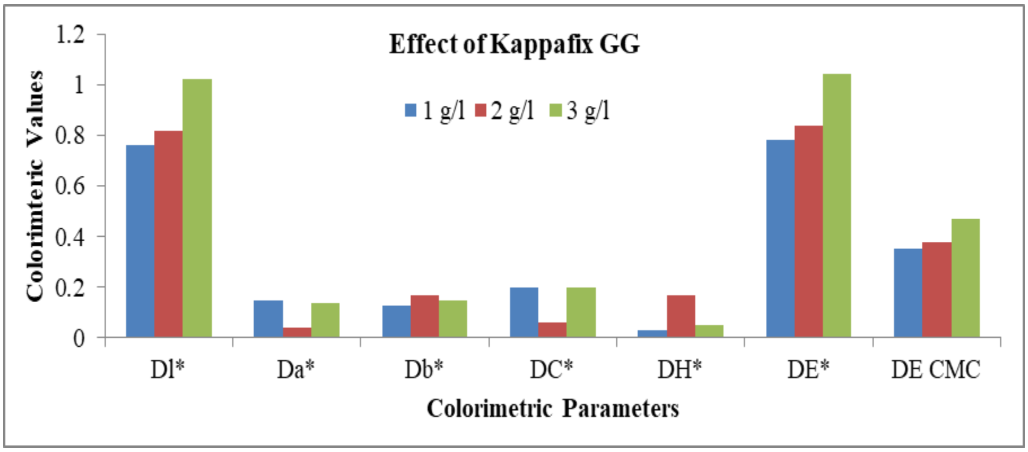

Figure 7: Effect of kappafix GG on the Colorimetric Value at light source F11 10 deg.

Table 9: Data for light source D65 10 deg treated with KAPPAFIX GG

Conc. of KAPPAFIX GG	Colorimetric Values							Pass /Fail
	Dl*	Da*	Db*	DC*	DH*	DE*	DE CMC	
1 g/l	0.79	0.32	0.2	0.37	0.04	0.87	0.4	Pass
2 g/l	0.84	0.02	0.19	0.14	0.14	0.86	0.4	Pass
3 g/l	0.99	0.16	0.19	0.24	0.05	1.02	0.48	Pass

The dyed sample is treated with kappafix GG and the light source for determining the colorimetric values is D65 at 10 degree of angle of inclination. The colorimetric values are tabulated in Table 9 and shown graphically in Figure 8. It exhibits the changes of the shade from the original one. With the increment of the concentration of caustic, the colorimetric values also increase with some little exceptions. Since the DE CMC variation is less than 1, the results have been shown as passed in color matching as pass/fail comments of the treated samples in comparison with the original one.

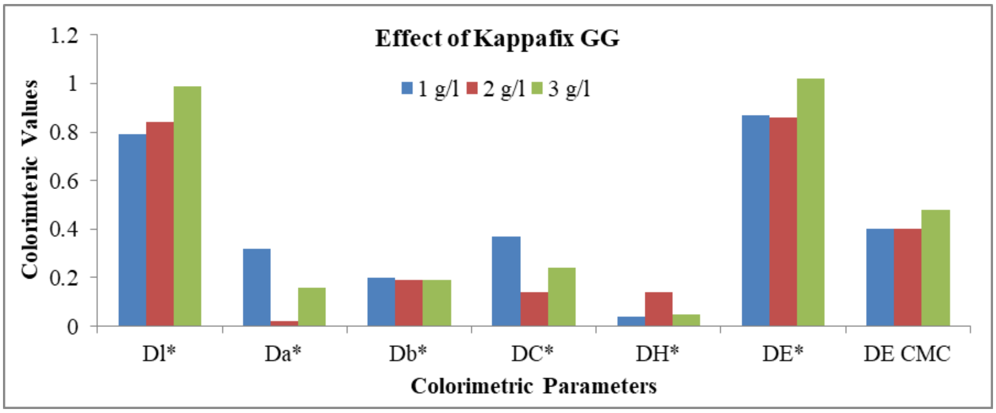

Figure 8: Effect of kappafix GG on the Colorimetric Value at light source D65 10 deg.

Table 10: Data for light source A10 10 deg treated with KAPPAFIX GG

Conc. of KAPPAFIX GG	Colorimetric Values							Pass /Fail
	Dl*	**Da***	**Db***	**DC***	**DH***	**DE***	**DE CMC**	
1 g/l	0.77	0.15	0.16	0.22	0.03	0.81	0.37	Pass
2 g/l	0.95	0.05	0.06	0	0.08	0.95	0.44	Pass
3 g/l	0.85	0.18	0.2	0	0.27	0.89	0.42	Pass

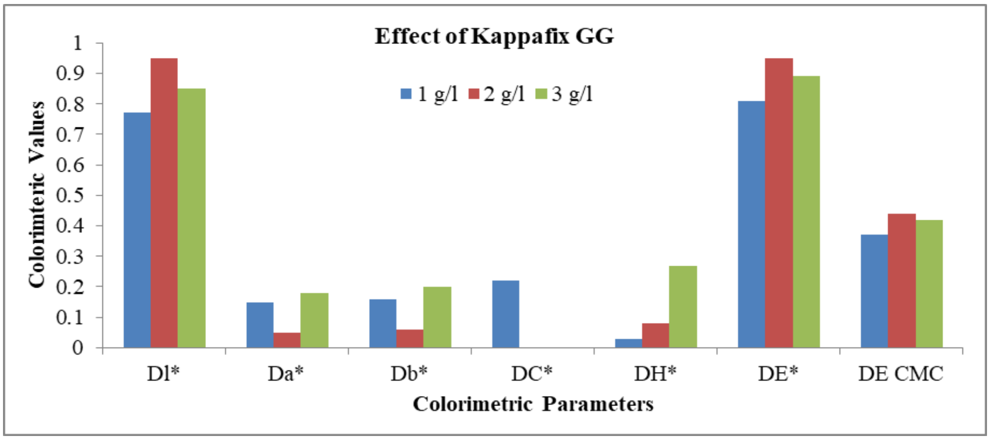

Figure 9: Effect of kappafix GG on the Colorimetric Value at light source A10 10 deg.

The dyed sample is treated with kappafix GG and the light source for determining the colorimetric values is A10 at 10 degree of angle of inclination. The colorimetric values are tabulated in Table 10 and shown graphically in Figure 9. It exhibits the changes of the shade from the original one. Since the DE CMC variation is less than 1, the results have been shown as passed in color matching as pass/fail comments of the treated samples in comparison with the original one.

Treatment with ALBAFIX ECO

Albafix ECO was used as fixing agent for the treatment of dyed textiles and the treated fabric was assessed at various light sources. The data obtained are represented below.

Table 11: Data for light source F11 10 deg treated with ALBAFIX ECO

Conc. of ALBAFIX ECO	Colorimetric Values							Pass /Fail
	Dl*	Da*	Db*	DC*	DH*	DE*	DE CMC	
1 g/l	0.84	0.02	0.19	0.14	0.14	0.86	0.40	Pass
2 g/l	0.91	0.07	0.34	0.27	0.22	0.97	0.46	Pass
3 g/l	1.19	0.01	0.36	0.21	0.29	1.24	0.58	Pass

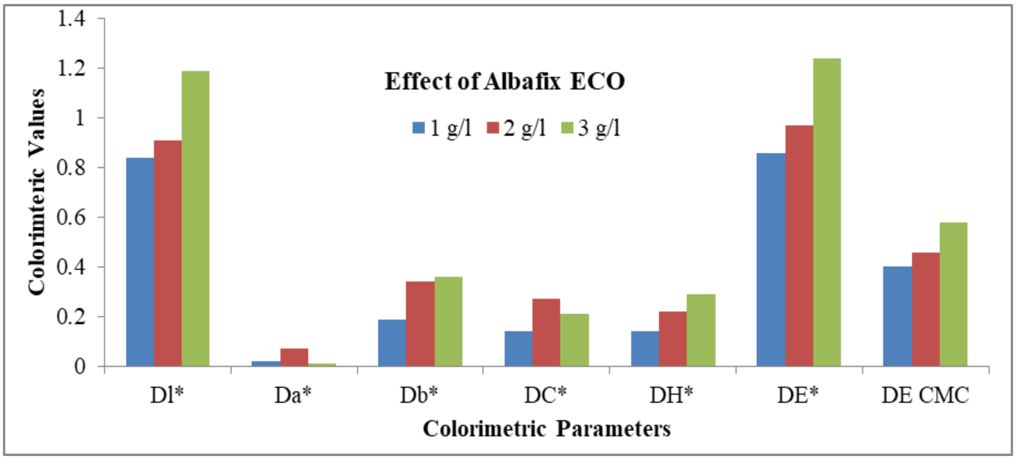

Figure 10: Effect of Albafix ECO on the Colorimetric Value at light source F11 10 deg.

The dyed sample is treated with Albafix ECO and the light source for determining the colorimetric values is F11 at 10 degree of angle of inclination. The colorimetric values are tabulated in Table 11 and shown graphically in Figure 10. It exhibits the changes of the shade from the original one. With the increment of the concentration of caustic, the colorimetric values also increase with some little exceptions. Since the DE CMC variation is less than 1, the results have been shown as passed in color matching as pass/fail comments of the treated samples in comparison with the original one.

Table 12: Data for light source D65 10 deg treated with ALBAFIX ECO

Conc. of Albafix ECO	Colorimetric Values							Pass /Fail
	Dl*	Da*	Db*	DC*	DH*	DE*	DE CMC	
1 g/l	0.82	0.04	0.17	0.06	0.17	0.84	0.38	Pass
2 g/l	0.88	0.05	0.3	0.12	0.27	0.93	0.43	Pass
3 g/l	1.16	0.13	0.32	0.07	0.34	1.21	0.56	Pass

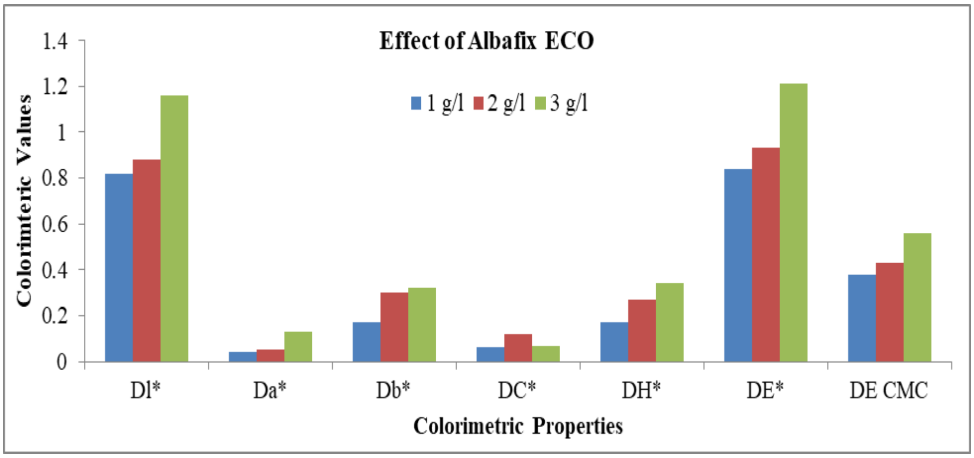

Figure 11: Effect of Albafix ECO on the Colorimetric Value at light source D65 10 deg.

The dyed sample is treated with Albafix ECO and the light source for determining the colorimetric values is D65 at 10 degree of angle of inclination. The colorimetric values are tabulated in Table 12 and shown graphically in Figure 11. It exhibits the changes of the shade from the original one. With the increment of the concentration of caustic, the colorimetric values also increase with some little exceptions. Since the DE CMC variation is less than 1, the results have been shown as passed in color matching as pass/fail comments of the treated samples in comparison with the original one.

The colorimetric values for dyed sample treated with Albafix ECO and the light source for determining the colorimetric values of A10 at 10 degree of angle of inclination are tabulated in Table 13 and shown graphically in Figure 12.

Table 13: Data for light source A10 10 deg treated with ALBAFIX ECO

Conc. of Albafix ECO	Colorimetric Values							Pass /Fail
	Dl*	Da*	Db*	DC*	DH*	DE*	DE CMC	
1 g/l	0.85	0.18	0.2	0	0.27	0.89	0.42	Pass
2 g/l	0.92	0.18	0.35	0.09	0.38	1	0.49	Pass
3 g/l	1.21	0.29	0.39	0.03	0.49	1.31	0.64	Pass

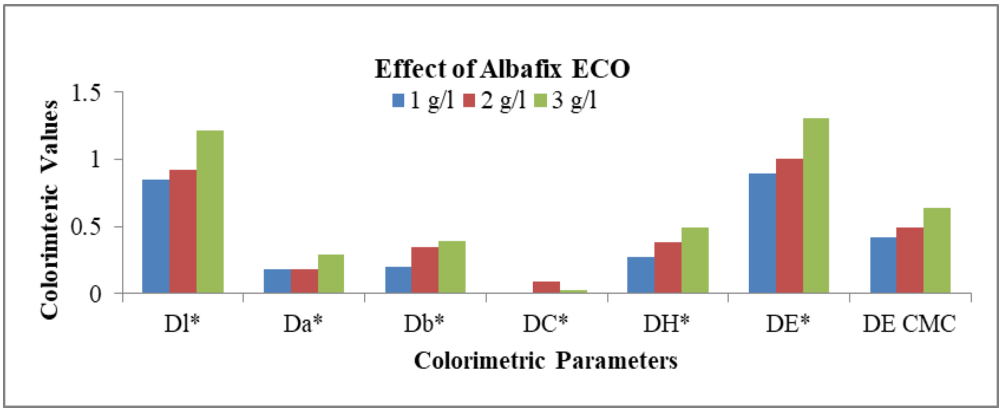

Figure 12: Effect of Albafix ECO on the Colorimetric Value at light source A10 10 deg.

It exhibits the changes of the shade from the original one. With the increment of the concentration of caustic, the colorimetric values also increase with some little exceptions. Since the DE CMC variation is less than 1, the results have been shown as passed in color matching as pass/fail comments of the treated samples in comparison with the original one.

Soaping with AVOLIN ISW

Avolin ISW was used as soaping agent for the treatment of dyed textiles and the treated fabric was assessed at various light sources. The data obtained are represented below.

Table 14: Data for light source F11 10 deg treated with AVOLIN ISW

Conc. of AVOLIN ISW	Colorimetric Values							Pass/Fail
	Dl*	Da*	Db*	DC*	DH*	DE*	DE CMC	
1 g/l	0.18	0.13	0.26	0.27	0.11	0.34	0.16	Pass
2 g/l	0.33	0.06	0.23	0.2	0.13	0.4	0.19	Pass
3 g/l	0.53	0.03	0.06	0.02	0.07	0.54	0.25	Pass

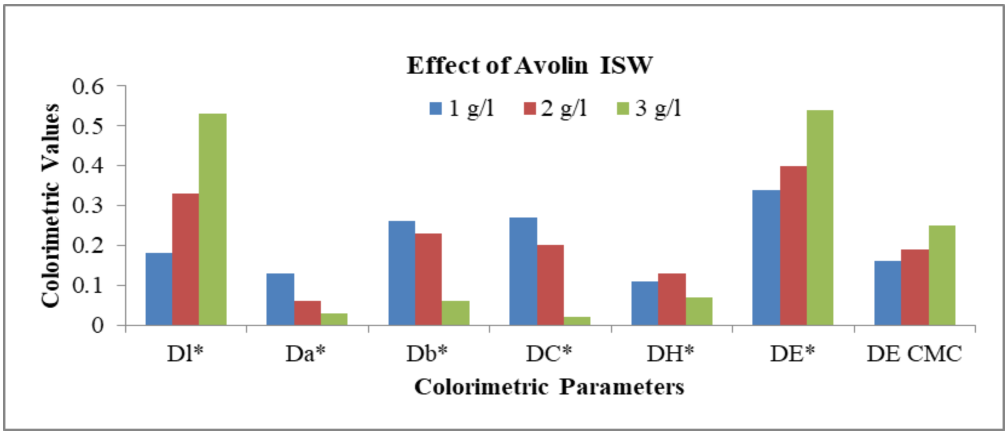

Figure 13: Effect of Avolin ISW on the Colorimetric Value at light source F11 10 deg.

The dyed sample is treated with Avolin ISW and the light source for determining the colorimetric values is F11 at 10 degree of angle of inclination. The colorimetric values are tabulated in Table 14 and shown graphically in Figure 13. It exhibits the changes of the shade from the original one. With the increment of the concentration of caustic, the colorimetric values also increase in some parameters while decrease in some parameters. Since the DE CMC variation is less than 1, the results have been shown as passed in color matching as pass/fail comments of the treated samples in comparison with the original one.

Table 15: Data for light source D65 10 deg treated with AVOLIN ISW

Conc. of AVOLIN ISW	Colorimetric Values							Pass /Fail
	Dl*	Da*	Db*	DC*	DH*	DE*	DE CMC	
1 g/l	0.2	0.14	0.23	0.24	0.11	0.33	0.16	Pass
2 g/l	0.33	0.02	0.21	0.13	0.16	0.39	0.19	Pass
3 g/l	0.52	0.09	0.08	0.03	0.12	0.53	0.24	Pass

The dyed sample is treated with Avolin ISW and the light source for determining the colorimetric values is D65 at 10 degree of angle of inclination. The colorimetric values are tabulated in Table 15 and shown graphically in Figure 14. It exhibits the changes of the shade from the original one. With the increment of the concentration of caustic, the colorimetric values also increase in some parameters while decrease in some parameters. Since the DE CMC variation is less than 1, the results have been shown as passed in color matching as pass/fail comments of the treated samples in comparison with the original one.

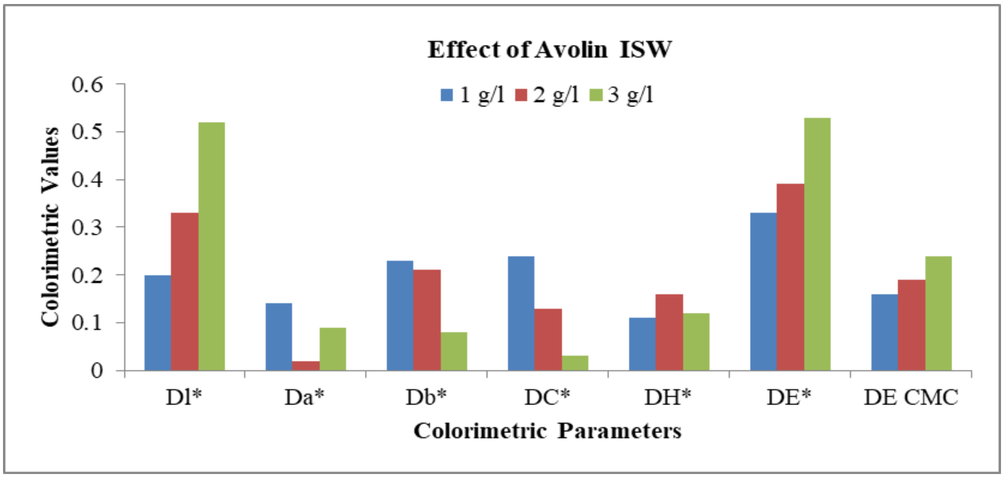

Figure 14: Effect of Avolin ISW on the Colorimetric Value at light source D65 10 deg.

The dyed sample is treated with Avolin ISW and the light source for determining the colorimetric values is A10 at 10 degree of angle of inclination. The colorimetric values are tabulated in Table 16 and shown graphically in Figure 15.

Table 16: Data for light source A10 10 deg treated with AVOLIN ISW

Conc. of AVOLIN ISW	Colorimetric Values							Pass /Fail
	Dl*	Da*	Db*	DC*	DH*	DE*	DE CMC	
1 g/l	0.16	0.25	0.29	0.37	0.07	0.41	0.18	Pass
2 g/l	0.31	0.12	0.23	0.24	0.11	0.4	0.18	Pass
3 g/l	0.52	0.08	0.06	0.03	0.1	0.53	0.25	Pass

It exhibits the changes of the shade from the original one. With the increment of the concentration of caustic, the colorimetric values also increase in some parameters while decrease in some parameters. Since the DE CMC variation is less than 1, the results have been shown as passed in color matching as pass/fail comments of the treated samples in comparison with the original one.

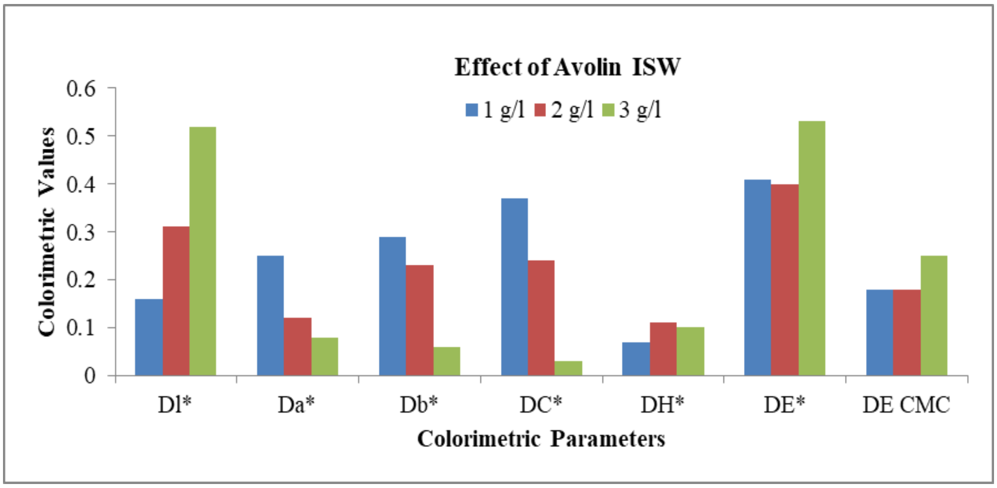

Figure 15: Effect of Avolin ISW on the Colorimetric Value at light source A10 10 deg.

Conclusion

The shades obtained after treatment with caustic, combined caustic and salt, Kappafix GG, Albafix ECO and Alovin ISW were found lighter. In most cases, the increment of concentration of the chemical decreased the shade depth. In case of treating with fixing and soaping agent, the changes were less than the changes obtained during treatment with caustic and combined caustic and salt. Thus, for the fulfillment of the buyer requirement by the slight change of shade obtained after dyeing, these auxiliaries can be a better alternative of re-dyeing of textiles.

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