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Dyeability Improvement of Cationized Corona Discharge Treated Cotton Fabric

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In this research, cotton fabric was exposed to corona discharge at different level of passages. Un-treated and treated fabrics were cationized by a cationic agent (Levogen BF) then samples were dyed with reactive dyes (Remazol Black B, Levafix Red E4-BA). The colour parameter and colour fastness of samples were measured. The results show that by increasing passages of corona treatment up to the specified level of passages, dyed cationized corona treated cotton becomes darker (L* decreases) and in some cases, L* increases again. For remazol black B dye, cationized corona treated cotton causes to darker, less green, less blue samples and for Levafix Red E4-BA, it leads to darker, redder and less blue samples.

Key Words: Dyeability Improvement, Corona Discharge, Cotton Fabric.

INTRODUCTION

Conventional surface treatments of fabrics to improve bonding characteristics often include chemical processes. Chemical modification of cotton is performed by reaction with functional groups present in the fiber. The effect of chemical modification on dyeing processes has been carried out and cationization of cotton to improve its dyeability towards anionic dyes has been reviewed[1-3].

Corona discharge treatment forms an economical and environmentally friendly process. It operates at atmospheric pressure and air. Plasmas and coronas contain neutral molecules and atoms, charged ions, free radicals

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and electrons. Treating fibers in corona produces free radicals on the surface of polymers and textiles which plays an important role in reactions. Corona discharge treatment is a useful technique to modify a polymer surface and leads to polymerization, grafting and cross linking, adhesion, cleaning surface, hydrophilic surfaces and aged look effect of denim. It is more suitable for industrial purposes and gaining more popularity due to the ease in incorporating them into continuous textile finishing[4-7].

In this research, cotton fabric was treated by corona discharge at different number of passages. Then corona treated cotton fabrics were cationized by a cationic agent (Levogen BF) and were dyed by reactive dyes (Remazol black B, Levafix Red E4-BA). Colorimeteric parameters and colour fastnesses of samples were determined. Increasing of passages of corona treatment, up to the specific level of passages, can increase dye absorption. It indicates that dyed cationized corona treated cotton becomes darker (L* decreases) and in some cases, L* increases again. For Remazol Black B dye, cationization of corona treated cotton causes to darker, less green, less blue samples and for Levafix Red E4-BA, it leads to darker, redder and less blue. Colour fastnesses of untreated and treated samples shows that in some cases, wet rubbing fastnesses slightly decrease and it is related to ring dyeing effect of dyed cationized cotton.

EXPERIMENTAL

Woven cotton fabric (desized, scoured, bleached), Levogen BF, Remazol Black B, Levafix Red E4-BA, sodium sulfate, sodium carbonate, detergent (Tinegal W). X-rite CA22 spectrophotometer, Rotawash fastness tester (shirley), light fastness tester (shirley), crockometer (shirley).

Corona generator: The corona generator was made in Azad electrical industries-Iran. The reactor consist of 2 electrodes: silicon coated roller with parallel electrodes on it. The distance between two electrodes is 3 mm and velocity of roller and power are changeable. In this project, the velocity and power were set at 2 m/min and 660 w, respectively. Fig. 1 shows schematic diagram of corona generator[6].

Methods: Cotton fabric (desized, scoured, bleached) was exposed to corona discharge at different number of passages (1,2,4,5,7,9,11,13,15 passages). Then corona treated samples were cationized using Levogen BF (3 % owf) for 10 min at 80 ºC. The liquor ratio was 30:1. After cationization, samples were dried at ambient temperature.

Two types of dyestuff were employed for dyeing process: Remazol Black B and Levafix Red E4-BA. Dyeabilities of cotton fabrics were carried out using Remazol Black B dye (3 % owf) and 40 g/L sodium sulfate for exhaustion and 10 g/L sodium carbonate for fixation. The liquor ratio was 50:1. Samples were dyed for 1 h at 60 ºC. Levafix Red E4-BA dye (3 % owf)

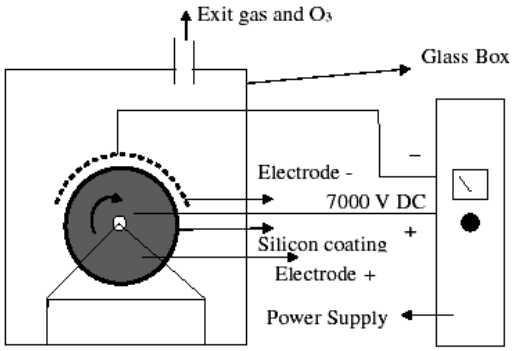

Fig. 1. Schematic diagram of corona discharge generator

was used with 40 g/L (sodium sulfate) and 10 g/L sodium carbonate. The liquor ratio was 50:1. The samples were dyed for 1 h at 80 ºC[7].

After dyeing, the fabrics were rinsed with cold-hot-cold water, then dried at room temperature. Colour parameters of dyed fabrics were measured using X-Rite CA22 spectrophotometer. Washing, light and rubbing fastnesses were measured using standard methods ISO-CO4-1989, ISO105-BO2-1989, ISO 105-X12-1993, respectively.

RESULTS AND DISCUSSION

Colorimetric results: Colour measurements of dyed samples (Remazol Black B and Levafix Red E4-BA) have been shown in Tables 1 and 2 and Fig. 2 and 3, respectively. As shown in Table-1, for untreated sample, L* is 26.58 and for treated fabrics L* decreases. All the treated samples seem darker than untreated sample. a* and b* increase in treated samples as compared to untreated sample. Samples are less green and less blue. With increasing number of passages up to the 5 passages, samples become darker but after 5 passages it becomes slightly lighter and after that L* begins to reduce again. It is related to corona surface treatment of fabric that can remove low molecular weight particles from the surface of fabric which these particles remain on the surface and by further increasing passages, corona discharge can affect on these particles and less effect on fabric surface. As shown in Table-2, for untreated sample, L* is 46.80, but by treating L* reduces and dyed cationized corona treated fabrics become darker redder and less blue.

Colour fastness results: Colour fastnesses of dyed samples by Remazol Black B have been shown in Table-3. The comparison of untreated *vs.* treated fabrics indicates that the ratings of light, dry rubbing and wash

TABLE-1
COLORIMETRIC PARAMETER OF REMAZOL BLACK B DYED CATIONIZED CORONA TREATED COTTON

	Untreated	1	2	4	5	7	9	11	13	15
L*	26.58	21.99	21.42	21.06	22.48	21.91	22.03	22.10	22.97	22.63
a*	-4.53	-2.76	-2.27	-2.19	-2.90	-2.39	-2.58	-2.58	-3.00	-2.82
b*	-15.51	-13.88	-13.37	-13.05	-14.23	-13.14	-13.5	-13.44	-13.89	-13.99

TABLE-2
COLORIMETRIC PARAMETER OF LEVAFIX RED E4-BA DYED CATIONIZED CORONA TREATED COTTON

	Untreated	1	2	4	5	7	9	11	13	15
L*	46.8	44.93	45.44	45.42	44.93	44.43	43.91	44.20	45.10	44.08
a*	61.18	61.43	61.15	61.09	61.39	61.78	61.81	61.83	61.39	61.53
b*	-3.22	-1.68	-2.17	-2.19	-1.67	-0.94	-0.46	-0.90	-1.55	-0.69

TABLE-3
COLOUR FASTNESS OF DYED SAMPLES BY REMAZOL BLACK B (CT: COTTON, W: WOOL)

		Untreated	1	2	4	5	7	9	11	13	15
	Light	3-4	3-4	3-4	3-4	3-4	3-4	3-4	3-4	3-4	3-4
Rubbing	Dry	5	5	5	5	5	5	5	5	5	5
	Wet	4	4	4	3-4	4	3-4	4	4	4	4
Washing	Colour changes	4-5	4-5	4-5	4-5	4-5	4-5	4-5	4-5	4-5	4-5
	Staining (ct)	5	5	5	5	5	5	5	5	5	5
	(w)	5	5	5	5	5	5	5	5	5	5

TABLE-4
COLOUR FASTNESS OF DYED SAMPLES BY LEVAFIX RED E4-BA (CT: COTTON, W: WOOL)

		Untreated	1	2	4	5	7	9	11	13	15
	Light	4-5	4-5	4-5	4-5	4-5	4-5	4-5	4-5	4-5	4-5
Rubbing	Dry	5	5	5	5	5	5	5	5	5	5
	Wet	4	4	4	4	4	3-4	4	4	4	4
Washing	Colour changes	5	5	5	5	5	5	5	5	5	5
	Staining (ct)	4-5	4-5	4-5	4-5	4-5	4-5	4-5	4-5	4-5	4-5
	(w)	5	5	5	5	5	5	5	5	5	5

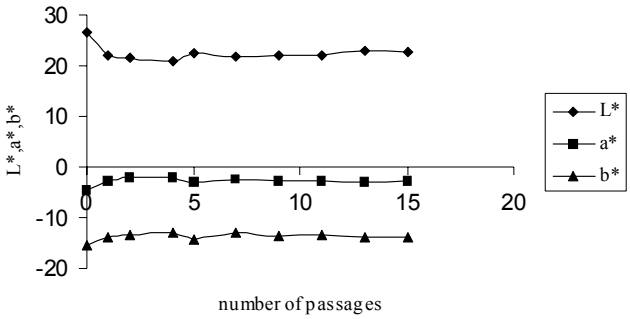

Fig. 2. Colour variations of Remazol black B dyed cationized corona treated cotton

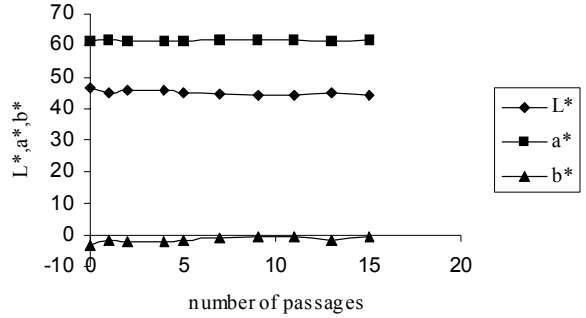

Fig. 3. Colour variations of Levafix Red E4-BA dyed cationized corona treated cotton

fastness for all the samples are quite similar. But wet rubbing fastness decreases slightly for treated samples at 4 passages. The corona discharge treatment modifies fabric surface, dyeing of cationized corona treated fabric would cause a ring dyeing effect and it might be the reason for reducing wet rubbing fastness. Similar results were obtained from Levafix Red E4-BA dyed samples. As demonstrated in Table-4, there is a slightly decreasing in wet rubbing fastness at 9 passages corona treatment. It is due to ring dyeing effect of cationized corona treated fabric[5,6].

Conclusion

This research investigates corona treatment of cotton fabric that aims to improve dyeability related to the cationisation. It seems that using cationization of corona treated fabric, anionic surface of cotton fabric can be changed to a cationic surface and can improve dyeability of cotton[6,7]. This improvement can carry out at optimum conditions of corona treatment that can give good colour properties.

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