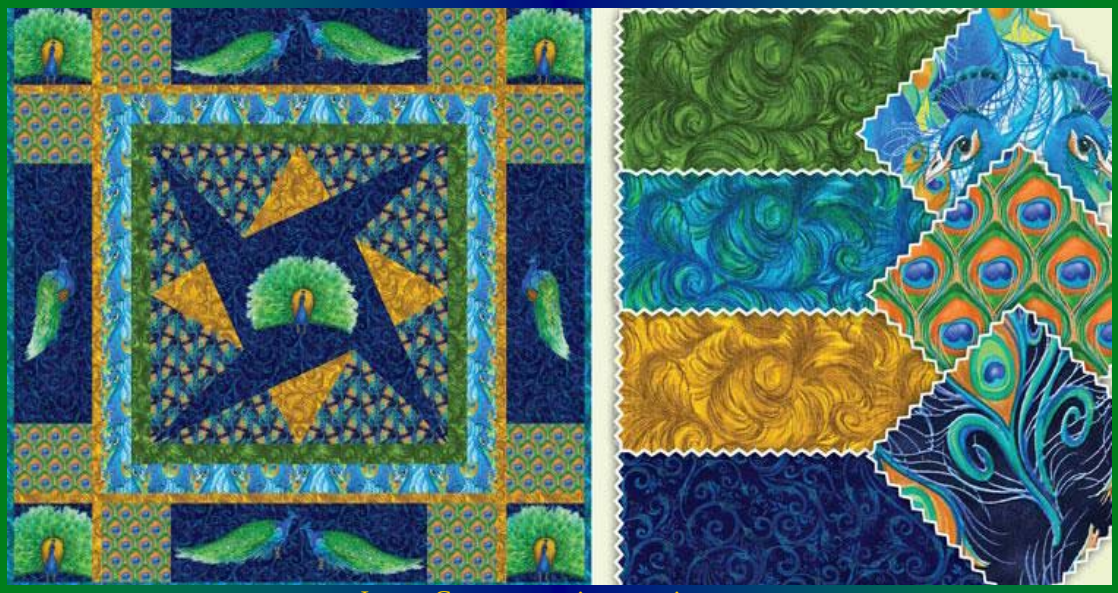
Free Salt Dyeing Of Cotton Fabric with Reactive Dyes



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Source: Textile Review

Free Salt Dyeing Of Cotton Fabric with Reactive Dyes

By: Jitendra Meena

Cationization of cotton is emerging as an effective tool to solve the environmental problem associated with dyeing of cotton with anionic dyes between normal or existing method of reactive dyeing of cotton with the use of cationizing agents like "X" chemical and "DICHLORO ETHANE" "along with "METHYLAMINE" to dye cotton without alkali and salt i.e. "FREE SALT DYEING". The effect of cationization on colour strength and colour fastness of various reactive dyes was found and cationization show lighter increase in light shades and lesser increase in dark shade than normal cotton dyeing. The impact on the environmental pollution and the dyed fabric quality were ascertained and compared with existing dyeing system and the cationization gives very less environmental pollution. The cationized cotton show similar kind of fabric quality as like normal dyeing of cotton. Cationization of cotton was found to be cheaper than the normal dyeing process.

The fibre reactive dyes are known as the best for cotton for its wide range of application and better fastness properties. However, all the reactive dyeing systems require huge amount of electrolyte and alkali to exhaust and fix the dye respectively.

These electrolytes are neither exhausted nor destroyed and hence remain in the dye bath after dyeing. All the above, only 60-65% dye utilization is attainable even with the use of salt in the normal dyeing systems.

When alkalinity is introduced in the bath in order to facilitate the formation of covalent bond between the fibre and the functional groups of the reactive dye, the abundance of hydroxyl ions causes significant hydrolysis of reactive dyes. Those hydrolyzed dyes are called "Dead" dyes as they have no affinity towards cotton and hence remains in the dye bath, deposition of the same on the fibre significantly lower the fastness properties, that calls on severe wash-offs.

Reactive dyeing thus pollutes the environment by discharging highly colored reactive dye bath and higher electrolyte concentration.

Higher electrolyte concentration in the effluents causes worst effects such as-

- Impairing the delicate biochemistry of aquatic organism.
- Destructive attacks on concrete pipes if sodium sulphate is used as electrolyte due to the formation of alumino-sulphato complexes which swell and crack concretes with considerable alumina content.
- Evolution of hydrogen sulphide gas under anaerobic conditions when sodium sulphate is used as the electrolyte.
- Dissolution of such sulphides and subsequent bacterial oxidation to the harmful sulphuric acid.

Option for reduction of salt and alkali-

- Shifting from exhaust to pad batch dyeing.
- Shifting from high liquor ratio to low liquor ratio machines.
- Recycling the salt contaminated dye bath after eliminating the hydrolyzed dye.

- Molecular engineering of reactive dyes to have high affinity and good wash off properties.
- Molecular modification of fibre to have greater affinity and attraction towards anionic dyes.

The last option totally eliminates the salt and reduces the alkali considerably that leads to-

- Reduction of colorant in the effluent.
- Lower COD (Chemical Oxygen Demand), BOD (Biological Oxygen Demand), TDS (Total Dissolved Solvents) and no AOX (Absorbable Organic Halogens) in the effluent.
- Reduced number of wash offs and elimination of neutralizing.
- Reduced effluent volume.
- Increased dye utilization.
- Reduced cost of dyeing and cost of effluent treatment.
- Possibility to create one bath dyeing of polyester/cotton blends.

In this research work, an attempt has been made to optimize the process, conditions required to cationize the cotton with "X" cationzing agent and to critically analyze the influence of process variables on the cationization efficiency.

Materials and Methods

Material

1. Fabric: 100% grey cotton fabric
2. Chemical used:

Cationizing Agent: "X" (Special chemical used as cationic dye fixing agent) And 1,2-Dichloroethane along with Methylamine as Strong cationic agent.

Other Chemicals: Sodium Hydroxide, Sodium Carbonate, Sodium sulphate, Acetic Acid, Sodium Silicate, Hydrogen Peroxide, non ionic wetting agent, non ionic detergent

Dyes Used:

Cold Brand	Ramazol	ME Brand
Procion Yellow M3R	Everzol Red LX	Cbfix Blue ME2BF

Preparation of Fabric

1. *Desizing:* The grey fabric was desized using 2% enzyme under slightly acidic pH at 60-700 C for 2 hours in a laboratory jigger. The enzyme was deactivated by boiling at 950C for 30 min and the degraded starch products were thoroughly washed out.

2. *Scouring:* The fabric was scoured using the above recipe in a laboratory jigger at boiling temp. for 2 hours. Then the fabric was given a hot wash and a cold wash.

Recipe for scouring of the fabric:

NaOH 3%

Na,CO,	2%
Non ionic wetting agent	0.5%

3. *Bleaching:* The fabric was bleached with 2 vol of H,O, at 85-95°C in jigger at pH 10.5-10.8 buffed with sodium hydroxide and stabilized with sodium silicate for 2 hours. Then the fabric was given a wash, neutralized with 0.5% sulphuric acid and washed thoroughly.

4. *Conventional Dyeing:* The bleached fabric was dyed with vinyl sulphone reactive dyes, cold brand and ME reactive dyes for different shade percentage i.e. 0.5%, 1 %, 2%. The laboratory-dyeing machine with the liquor ratio of 1:30 was used throughout this work. The fabric was entered at room temperature. 1 g/l non-ionic surfactant, dye solution and half of 50 g/l salt were added and the temp. was raised to 60°, 40°, 80°C respectively depend on class of reactive dye used. Remaining salt was added and the dyeing was continued for another 30 min then 2 g/l NaOH and 10 g/l Na_2CO_3 were added in the bath and the dyeing was continued for another 45 min. the fabric was rinsed at 50°C for 3 times for 20 min. each neutralized with 2.5 g/l acetic acid for 30 min. and hot soap at 60°C for 30 min.

Cationization of Cotton

Pretreatment of cotton: Cotton fabric was cationized using the exhaust method. Cationization was carried in laboratory with a M:L of 1 :30 by using cationising agent.

1. "X" chemical: Cationization was carried in laboratory with a M:L of 1 :30 at optimize concentration of "X" (using 20 % "X" on weight of fabric) at 60°C for 45-60 minutes.
2. 1,2-Dichloroethane along with methylamine (DCE+MA): Cationization was carried in laboratory with a M:L of 1 :30 at optimize concentration of 1, 2-dichloroethane (using 20 % on weight of fabric) at 60°C for 45-60 minutes followed by methylamine (using 20% on weight of fabric)in slight acidic pH(5.5-6.5) at 60°C for 45-60 minutes to introduce amino groups in the cotton fabric.

Method

The cationized fabric was dyed in laboratory with M:L of 1 :30 using reactive dyes in different shade percentage i.e. 0.5%, 1 %, 2%. Dyes used are as followed:

Cold Brand	Ramazol	ME Brand
Procion Yellow M3R	Everzol Red LX	Cbfix Blue ME2BF

The bleached fabric was dyed with vinyl sulphone reactive dyes, cold brand and ME reactive dyes for different shade percentage i.e. 0.5%, 1 %, 2%. The laboratory-dyeing machine with the liquor ratio of 1:30 was used throughout this work. The fabric was entered at room temperature. 1 g/l non-ionic surfactant, dye solution and the temp. was raised to 60°, 40°, 80°C respectively depend on class of reactive dye used. The dyeing was continued for another 30 min and the fabric was rinsed at 50°C for 3 times for 20 min. each neutralized with 2.5 g/l acetic acid for 30 min. and hot soap at 60°C for 30 min.

Results and Discussions

I compare the results of normal dyeing procedure with the cationized pretreated cotton as per the experimentation method

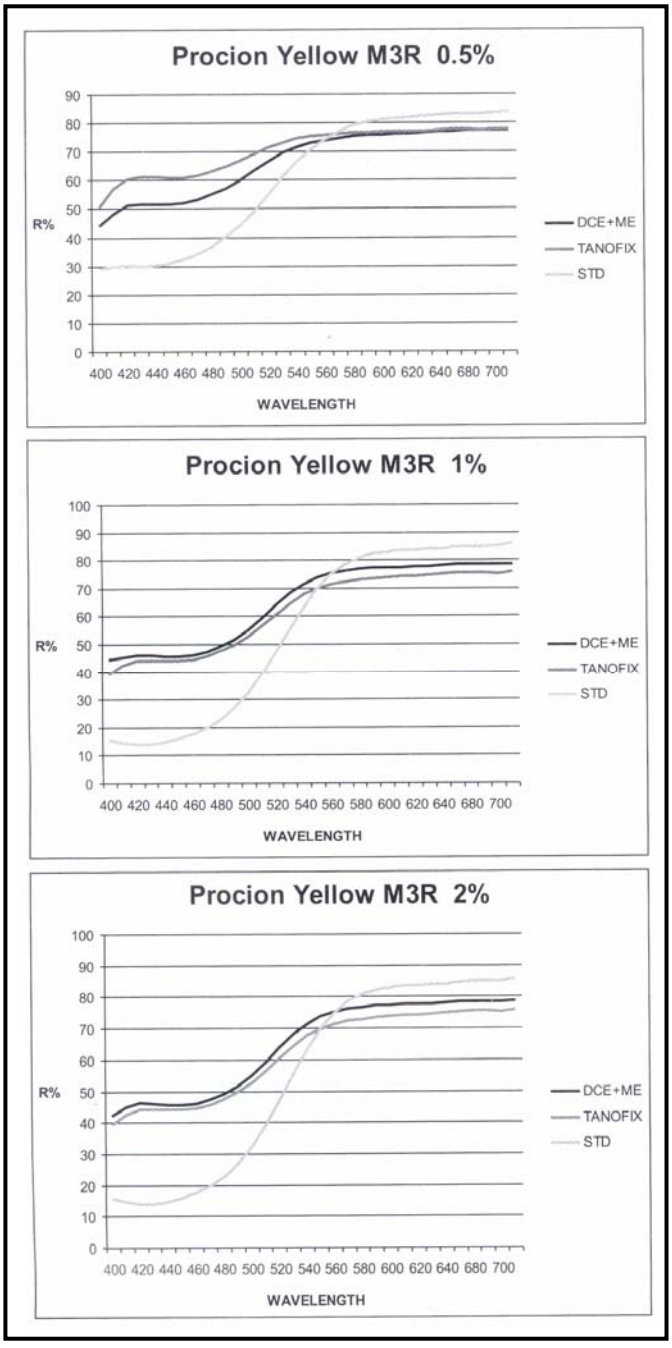
1. Cold Brand Dyes

Sr.	Dye with % Shade	Wave-length	R%	Strength	K/S	dE
1.	Procian Yellow M3R 0.5%	410nm				
	• Std		29.94	1	.86	.8
	• X Chemical		57.04	.2	.11	1.5
	• DCE+MA		42.16	.33	.43	2.0
2.	Procian Yellow M3R 1%	430nm				
	• Std		20.59	1	1.6	1.0
	• X Chemical		56.13	.11	.11	1.8
	• DCE+MA		51.24	.15	.23	1.5
3.	Procian Yellow M3R 2%					
	• Std		19.97	1	1.9	1.1
	• X Chemical		44.25	.13	.35	2.5
	• DCE+MA		45.9	.12	33	2.1

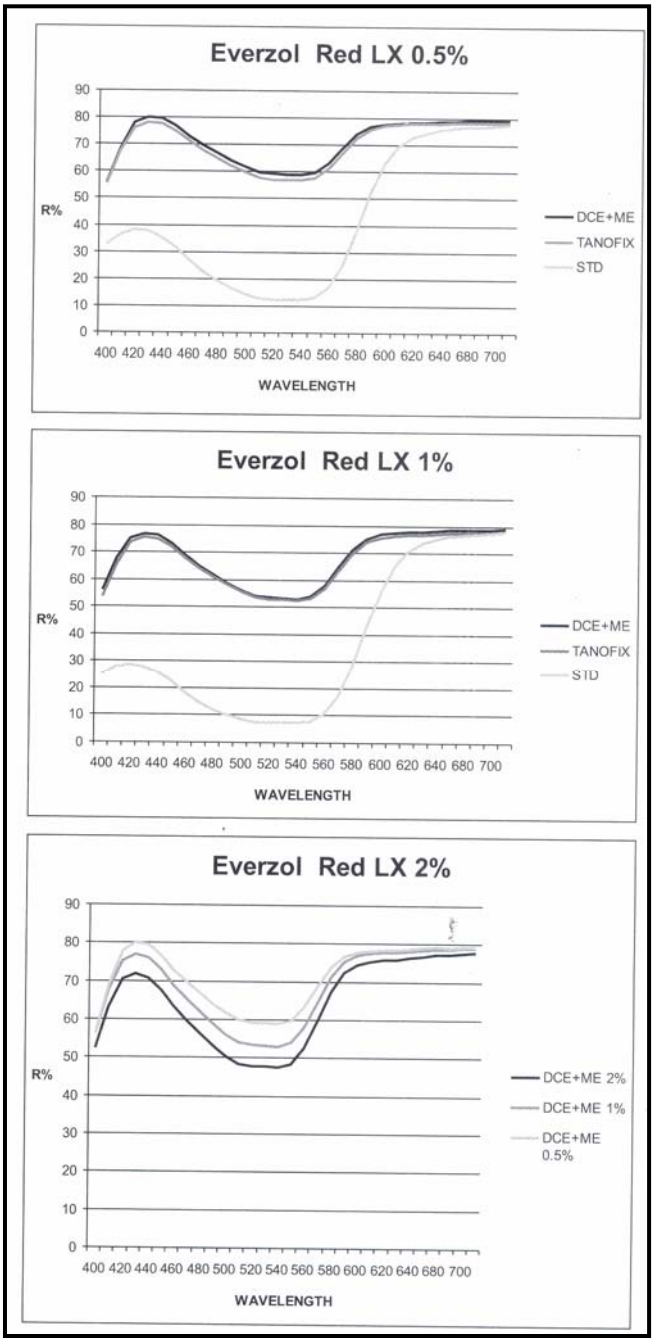
2. Ramazol Dyes

Sr.	Dye with % Shade	Wave-length	R%	Strength	K/S	dE
1.	Everzol red LX 0.5%	540nm				
	• Std		13.24	1	2.91	.7
	• X Chemical		57.64	.05	.16	1.2
	• DCE+MA		59.72	.05	.14	1.3
2.	Everzol red LX 1 %					
	• Std		7.91	1	.61	1.1
	• X Chemical		53.27	.04	.20	1.8
	• DCE+MA		53.94	.04	.20	2.0
3.	Everzol red LX 2%					
	• Std		5.41	1	.90	.8
	• X Chemical		47.48	.03	.29	1.2
	• DCE+MA		48.50	.03	.27	1.5

Cold Brand Dyes

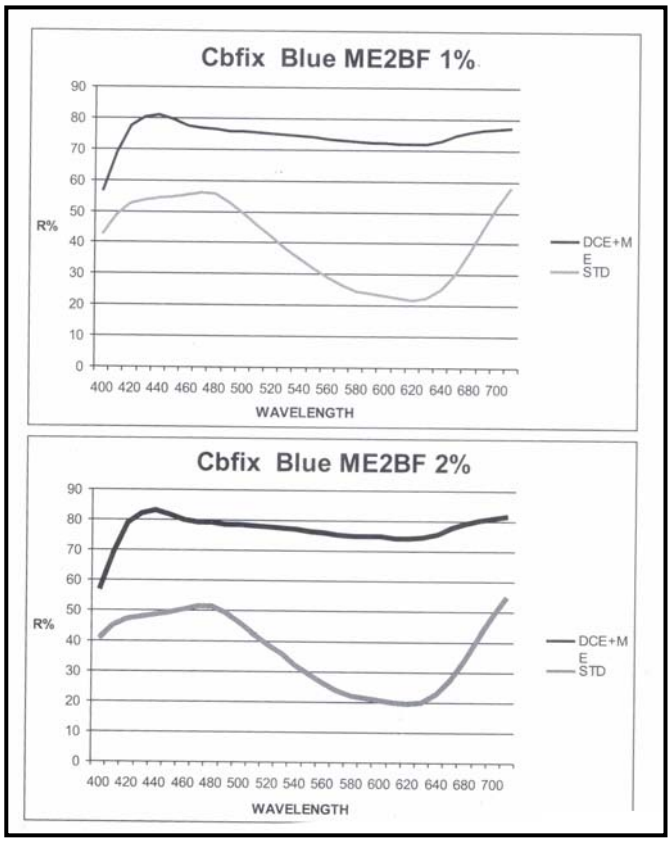


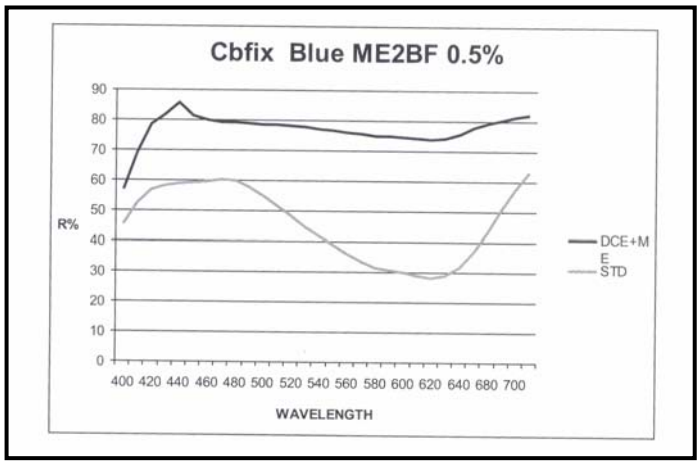
Ramazol Dyes



3. ME brand dyes

Sr.	Dye with % Shade	Wave-length	R%	Strength	K/S	dE
1.	CBFIX Blue ME2BFO.5%	620nm				
	• Std	28.94	1	.92	1.2	
	• X Chemical	NA	NA	NA	NA	
	• DCE+MA		60.0	.06	.040	1.8
2.	CBFIX Blue ME2BF 1 %					
	• Std		22.43	1	1.38	.9
	• X Chemical		NA	NA	NA	NA
	• DCE+MA	2%	80.0	.05	.060	1.2
3	CBFIX Blue ME2BF					
	• Std		20.07	1	1.68	1 .1
	• X Chemical		NA	NA	NA	NA
	• DCE+MA		65.0	.06	.09	1.3





Fastness Property of dyes

Standard Samples

Name of dyes	% Shad-E	Washing Fastness			Rubbing Fastness		Light Fastness
		Shade Change	Cotton Stain	Wool Stain	Dry	Wet	
Procian Yellow M3R	0.5%	5	5	5	5	5	6
	1.0%	5	5	5	5	5	6
	2.0%	4-5	4-5	5	5	5	6
Everzol Red LX	0.5%	4-5	4-5	5	5	5	6
	1.0%	4-5	4-5	5	4-5	4-5	5
	2.0%	4-5	4-5	5	4-5	4-5	5
CBFIX Blue ME2BF	0.5%	4-5	4-5	5	4-5	4-5	6
	1.0%	4-5	4	5	4-5	4	5
	2.0%	4	4	5	4-5	4	5

X Chemical (Cationic dye fixing agent)

Name Of Dyes	% Shade	Washing Fastness			Rubbing Fastness		Light Fastness
		Shade Change	Cotton Stain	Wool Stain	Dry	Wet	
Procian Yellow M3R	0.5%	5	5	5	4-5	4	5
	1.0%	5	5	5	4-5	4	5
	2.0%	4	4	4-5	4-5	4	5
Everzol Red LX	0.5%	4-5	4-5	5	4-5	4	5
	1.0%	4	4	5	4	4	5
	2.0%	3-4	3-4	4-5	4	4	5

MA+DCE treated samples

Name Of Dyes	% Shade	Washing Fastness			Rubbing Fastness		Light Fastness
		Shade Change	Cotton Stain	Wool Stain	Dry	Wet	
Procian Yellow M3R	0.5%	4-5	4-5	5	4	4	5
	1.0%	4-5	4-5	5	4	4	4
	2.0%	3-4	3-4	4-5	4	3-4	4
Everzol Red LX	0.5%	4	4	5	4	4	5
	1.0%	4	4	5	4	4	4
	2.0%	3-4	3-4	4-5	3-4	3-4	4
CBFIX Blue ME2BF	0.5%	4	4	5	4	3-4	4
	1.0%	3	3	4-5	3-4	3	3
	2.0%	3	3	4-5	3-4	3	3

Conclusions

1. X chemical (Cationic dye fixing agent)

2. Di chloro ethane + methylamine (cationizing agent)

Were selected for the pretreating process. The application of these agents to the cotton material before dyeing is the novel concept.

The result of cationized cotton dyed with reactive dye are quite good compare with the conventionally dyed fabric and fastness properties are as similar as in case of conventionally dyed fabric.

But problem arises with the depth of the shed and some time tone of the shed may also change.

The increase in color strength is much larger in light shade than in the dark shades.

In the case of cold brand dye it gives shade depth while not such in case of ME-brand dyes.

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