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Effects of Salt Concentration on the Dyeing of Various Cotton Fabrics with Reactive Dyes

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Abstract Reactive dyes square is measured very fashionable for clothes as they're environmentally safe and having sensible overall fastness properties. However application of those dyes needs an awfully high concentration of salt. The salt discharged from garment coloring is increased salinity in drain water stream that incorporates a negative impact on environmental ecology. The current work aims to eliminate the usage of salt throughout coloring of cotton merchandise with reactive dyes. The method of the concentration of salt in cotton coloring was supported the principle of cationisation (to develop a positive charge) of cotton. The treated cotton once bleached from slightly acidic tub generates positive sites attributable to protonation within the amino. The reactive dyes being anionic (negatively charged) in resolution get interested in the positive charges on the fiber that eliminates the salt needs for satisfactory dye exhaustion. After finished our work we found that Salt concentration for reactive dyes on textile materials is more important to show the good colorfastness, wash fastness, rubbing fastness.

Keywords Cotton, Salt, Reactive Dyes, Fabrics, Effect

1. Introduction

The physical-chemical necessity of the utilization of salt and soda in reactive coloring is standard to any or all technicians. 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 color.

In current follow, plastic fibers are preponderantly colored with reactive dyes within the presence of a substantial quantity of salt and glued underneath alkalescent conditions. However, dye fixation potency on plastic fibres is usually low (varying from 50%-90%). This, ends up in an extremely colored dye effluent that is unfavorable on environmental grounds. What is more, the high concentrations (40-100g/L) of solution and alkali (5-20 g/L) needed in polysaccharide fiber coloring might create further effluent issues [1]. During this work, a brand new fiber modification technique supported ion acrylic polymer. Pretreatment of synthetic fiber with chemical compound is believed to supply a chance for increasing each the substantively and reactivity of fibers towards reactive dyes underneath neutral conditions [1]. The character of a reactive chemical compound organic compound is specified it's going to react with nucleophile sites in synthetic fibers or within the chemical compound itself, therefore fixing the chemical compound to the substrate. Throughout future coloring, any reactions between the chemical compound and therefore the color, the fiber and therefore the color, and therefore the fiber and therefore the chemical compound and might be expected to require place, forming crosslink inside the fibers [2].

Salt may be a mineral comprised chiefly of the two components, metallic element and chloride. Common salt or common salt is that the substance NaCl, composed of the weather metallic element and chloride. Common salt crystals are solid in kind. Salt consists of small cubes tightly sure along through ionic bonding of the metallic element and chloride ions. The salt crystal is commonly used as Associate in nursing example of crystalline structure [3] so as to know the depth of the topic, one ought to perceive the fundamentals behind the term "salt" with relation to textile process.

The textile substrate and dye molecule, not essentially ought to have of uniform characteristics to mix with one another. In such case, we tend to need some catalyst to facilitate colouring action on material. Salt plays this significant role of catalyst. Salt has an especially high affinity for water. Generally, Salt is critical in three ways, firstly, to drive dye into textile throughout the colouring method in textile. Secondly, use of salt results in most exhaustion of dye molecules throughout coloring method in

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textiles [4]. Third it's used as Associate in nursing solution for migration, sorption and fixation of the coloring material to the polysaccharide material. Salt increase the exhaustion and the attraction between the dye molecule and textile material [5]. Typically dye (direct & reactive) molecules have charges and therefore the material has also negative charge on its surface. Salt decreases the repulsion of negative-negative charges and thence improves exhaustion [6].

Within the simplest terms, all reactive dyes are created from 3 basic units, a chormophore, a bridge Associate in nursing a reactive group/ teams (either a haloheteocycle or an activated double bond) [7]. These dyes are used for coloring of plastic fibers Associate in nursingd once these are applied to a plastic fiber in an alkalic dye bathtub, they kind a bond with hydroxyl of the fiber by with chemicals reacting with fiber [8]. The bond shaped between the dye molecule and fiber build dye molecule a locality of the fiber molecule [9].

2. Materials and Methods

100% grey cotton Plain weave, Single jersey & Rib (Double jersey) fabric was used in this project work. Dye, Wetting Agent, Detergent, Anticreasing Agent, Sequestering Agent, Antifoaming Agent, Salt, Alkali, Acetic Acid & Peroxide Killer. Pipette, Conical flask, GSM cutter, Balance & Dye bath Preparation of the fabric for dyeing

- The scoured and bleached fabric is taken for dyeing process with reactive dyes.
- Then the fabric is conditioned in the room temperature.

Dyeing process for 100% cotton fabric

Fabric Type	: Plain weave, Single jersey & Rib (Double jersey)
Shade	: Violet
Batch Weight	: 05g
M: L	: 1:8
Total Liquor	: 40 cc

Recipe for salt requirement (15% less)

Yellow SP3R	: 0.07% (Stock solution 1%)
Red SP3B	: 0.835% (Stock solution 1%)
N. Blue 2GL	: 0.51% (Stock solution 1%)
Salt	: 25 (Stock solution 25%)
Soda	: 15 (Stock solution 20%)

Recipe for actual salt requirement

Yellow SP3R	: 0.07% (Stock solution 1%)
Red SP3B	: 0.835% (Stock solution 1%)
N. Blue 2GL	: 0.51% (Stock solution 1%)
Salt	: 40 (Stock solution 25%)
Soda	: 15 (Stock solution 20%)

Recipe for salt requirement (15% addition)

Yellow SP3R	: 0.07% (Stock solution 1%)
Red SP3B	: 0.835% (Stock solution 1%)
N. Blue 2GL	: 0.51% (Stock solution 1%)
Salt	: 55 (Stock solution 25%)
Soda	: 15 (Stock solution 20%)

General dyes calculation formula

$$\text{Dyes} = \frac{\text{Sample weight} \times \text{Shade \%}}{\text{Conc. Of stock \% of dyes solution}}$$

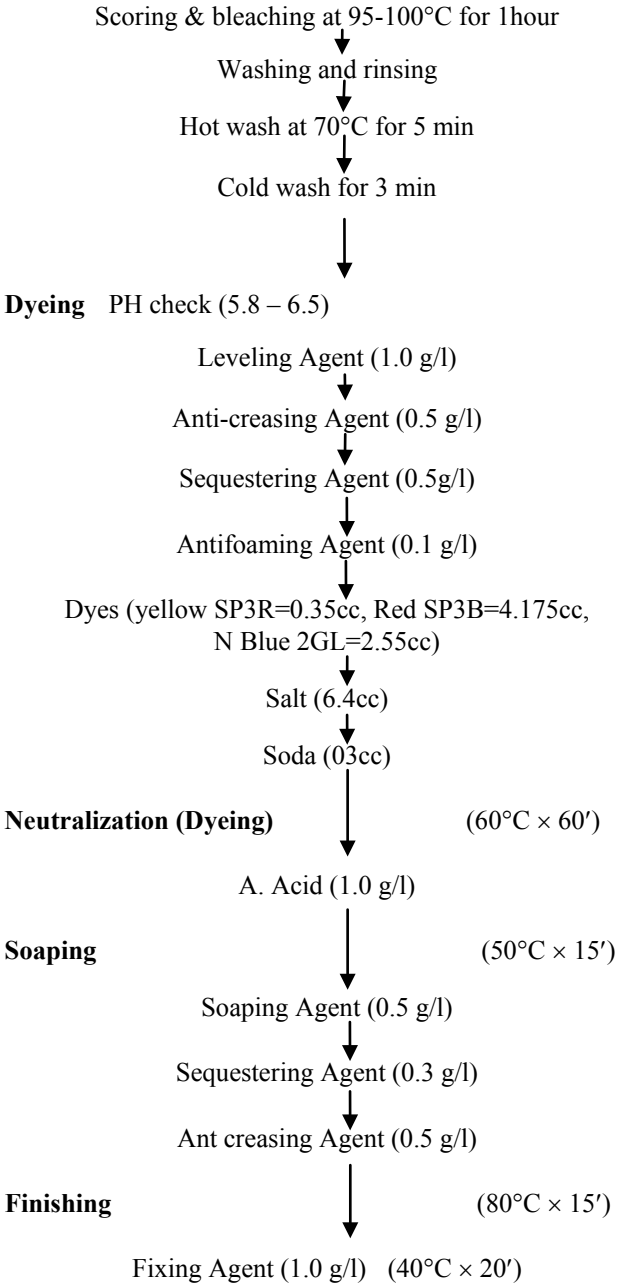
Equation 1

General chemicals calculation formula

$$\text{Chemical} = \frac{\text{Total Liquor} \times \text{Chemical amount (gm/l)}}{1000 \times \text{Conc. Of stock \% of chemical}}$$

Equation 2

Process of Dyeing Flowchart



Method of testing Color fastness to Rubbing

Principle

This test is designed to determine the degree of color which may be transferred from the surface of a colored fabric to a specific test cloth for rubbing (dry + wet).

Equipment

- Crock meter, Cotton rubbing cotton, Grey scale, Stop watch & Color matching cabinet

Size of fabric

4×5 cm two pieces of sample (one warp direction/wale direction & another weft/course direction).

Test procedure

- Lock the test specimen onto the base of the crock meter.
- Using the spinal spring clip, set 5cm×5cm of the white cotton fabric to the finger of the crock meter.
- Lower the covered finger on the test sample.
- Turn hand crank at the rate of one turn per second (10×10 sec).
- Remove the white rubbing test cloth and evaluate with grey scale.

Evaluation

Evaluation the contrast between the treated and untreated white rubbing cloth with grey scale and rated 1-5.

Method of testing Color fastness to wash

Color fastness to wash is very important for lab-dip. There are varieties of testing procedure, because-

- The methods depend on the use of dyed goods.

The degree of fading and staining of dyed goods for washing depends upon the following factors:

- Temperature range may be from 40°C-95°C.
- The type and amount of detergent added to the washing bath. In many testing procedure a standard detergent is used. The washing liquor to goods ratio is 50:01.

Principle of wash fastness

A specimen (lab-dip) in contact with specified adjacent fabric or fabric or fabric is laundered, rinsed and dried. The specimen/composite sample is treated under appropriate condition in a chemical bath for short time. The abrasive action is accomplished by the use of a liquor ratio and an appropriate number of steel balls. The change in color of the specimen (dyed sample) and the staining of the adjacent fabric is assessed by recommended Grey scale (1-5) [10].

Apparatus and materials

- Wash –wheel with a thermostatically controlled water bath and rating speed of (40±2) rpm.
- Stainless steel container (capacity 55±50 ml)
- Stainless steel ball (dia = 0.6cm, weight = 1 gm)
- SDC, Multifibre fabric (Acetate, cotton, nylon, polyester, acrylic, wool)
- Thermometer, Sewing machine, Dryer, Color matching cabinet and ISO Grey Scales.

Reagents

- Sodium perborate ($NaBo_2.H_2O.3H_2O$)
- ECE without brightening agent & Distilled water

Test specimen

Test specimen cut a sample of dyed goods 10*4cm and sew it with same size multifibre fabric. This is the composite test sample.

Evaluation of wash fastness

Compare the contrast between the treated and untreated sample with Grey Scale for changing color of dyed sample and staining of adjacent fabric in a color matching cabinet. Numerical rating for color changing is the shade and staining to adjacent fabric. Number of method used.

Assessment of color fastness

Table 1. Grey Scale

Grey Scale	
Numerical rating	**For wash and rubbing**
1	Poor/ Little
2	Moderate
3	Average
4	Good
5	Excellent

3. Results and Discussion

Physical results of Plain weave and Single jersey, Rib (Double jersey) Knit fabric

Sample name	Plain weave	Single jersey	Rib (Double jersey)
Fiber name	100% cotton fiber	100% cotton fiber	100% cotton fiber
Fabric structure	1/1	Plain	(1*1) Rib
E.P.I / WPI	85	30	26
P.P.I / CPI	75	60	52
Twist direction	'Z' twist	'Z' twist	'Z' twist
T.P.I	Warp 34 & Weft 34	22 twist	32 twist
GSM	79.9	143.3	232.5
Count	Warp 57 & Weft 60	29 Ne	22 Ne
Stitch Length	---	8 cm	12 cm
Initial stitch length	---	1 yard	1 yard

Color fastness to Dry Rubbing

Table 2. Dry Rubbing Fastness results

No of Sample	Sample Name	Salt Concentration	Gray Scale Range	Result
01	Plain Woven Fabric	25	1-5	4/5
02	**Plain Woven Fabric**	**40**	**1-5**	**4/5**
03	Plain Woven Fabric	55	1-5	4/5
04	Single Jersey Fabric	25	1-5	4/5
05	**Single Jersey Fabric**	**40**	**1-5**	**4/5**
06	Single Jersey Fabric	55	1-5	4/5
07	Rib (1×1) Fabric	25	1-5	4
08	**Rib** (1×1) **Fabric**	**40**	**1-5**	**4/5**
09	Rib (1×1) Fabric	55	1-5	4

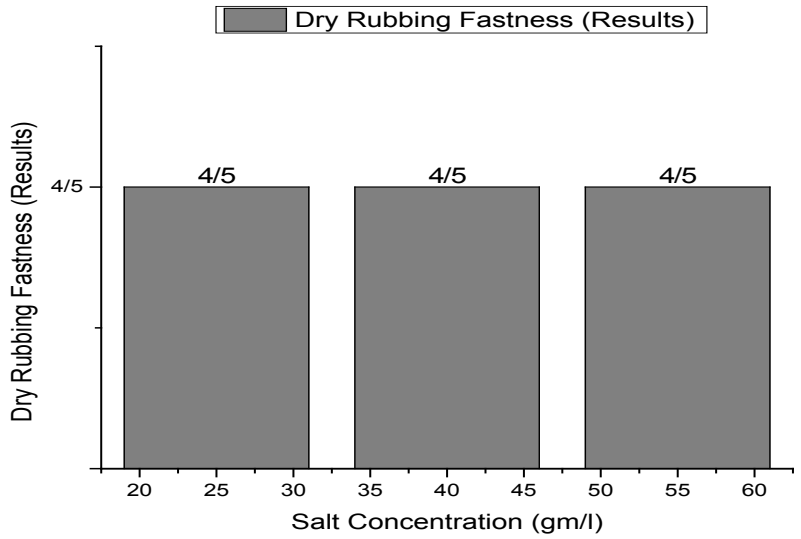


Figure 1. Plain Woven Fabric Dry rubbing fastness

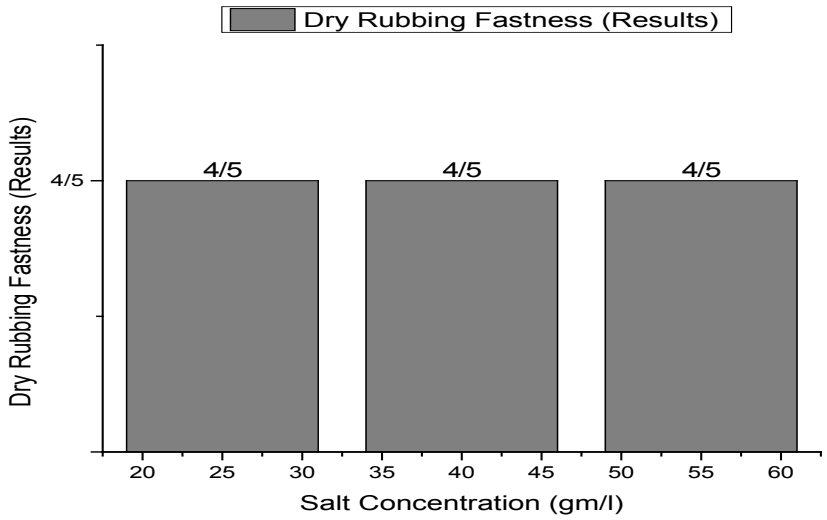


Figure 2. Single Jersey Fabric Dry rubbing fastness

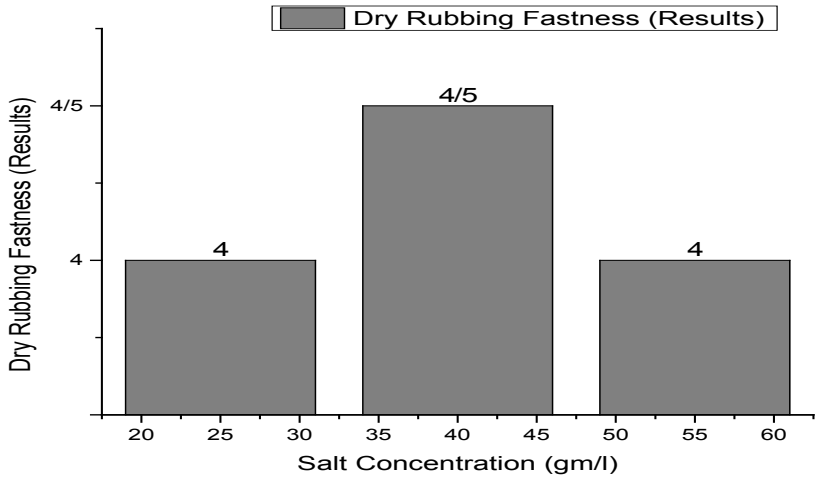


Figure 3. Rib (1×1) Fabric Dry rubbing fastness

From **Figure 1**, **Figure 2**, **Figure 3** we have seen actual amount of salt dyed sample was proper shade, less amount of salt give light and high amount of salt give deep shade. We have also seen color fastness to Rubbing test result give all sample approximately same. So we can say salt amount do not influence fastness property.

Color fastness to Wet Rubbing

Table 3. Wet Rubbing Fastness results

No of Sample	Sample Name	Salt Concentration	Gray Scale Range	Result
01	Plain Woven Fabric	25	1-5	¾
02	**Plain Woven Fabric**	**40**	**1-5**	**4**
03	Plain Woven Fabric	55	1-5	4
04	Single Jersey Fabric	25	1-5	4
05	**Single Jersey Fabric**	**40**	**1-5**	**¾**
06	Single Jersey Fabric	55	1-5	¾
07	Rib (1×1) Fabric	25	1-5	¾
08	**Rib (1×1) Fabric**	**40**	**1-5**	**3**
09	Rib (1×1) Fabric	55	1-5	¾

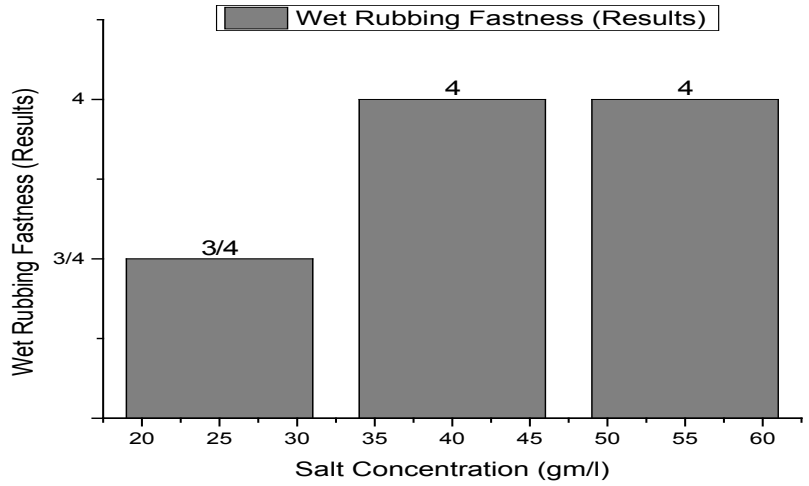


Figure 4. Plain Woven Fabric Wet rubbing fastness

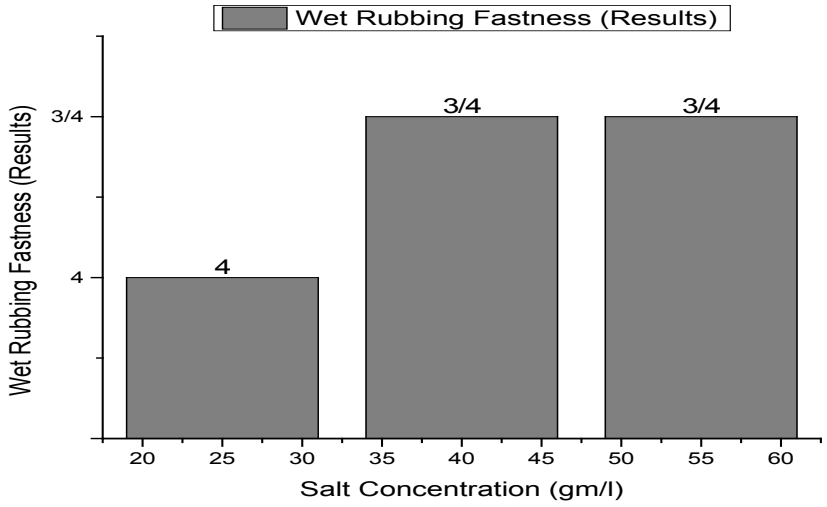


Figure 5. Single Jersey Fabric Wet rubbing fastness

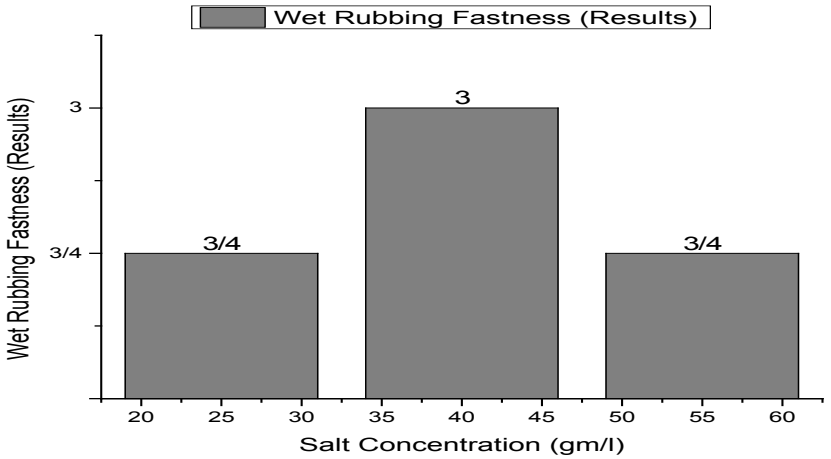


Figure 6. Rib (1×1) Fabric Dry rubbing fastness

From **Figure 4**, **Figure 5**, **Figure 6** we have seen actual amount of salt dyed sample was proper shade, less amount of salt give light and high amount of salt give deep shade. We have also seen color fastness to Rubbing test result give all sample approximately same. So we can say salt amount do not influence fastness property.

Color fastness to wash

Table 4. Wash Fastness results

No of Sample	Sample Name	Salt Concentration	Gray Scale Range	Result
01	Plain Woven Fabric	25	1-5	¾
02	**Plain Woven Fabric**	**40**	**1-5**	**¾**
03	Plain Woven Fabric	55	1-5	4
04	Single Jersey Fabric	25	1-5	4/5
05	**Single Jersey Fabric**	**40**	**1-5**	**4**
06	Single Jersey Fabric	55	1-5	4/5
07	Rib (1×1) Fabric	25	1-5	4/5
08	**Rib** (1×1) **Fabric**	**40**	**1-5**	¾
09	Rib (1×1) Fabric	55	1-5	4/5

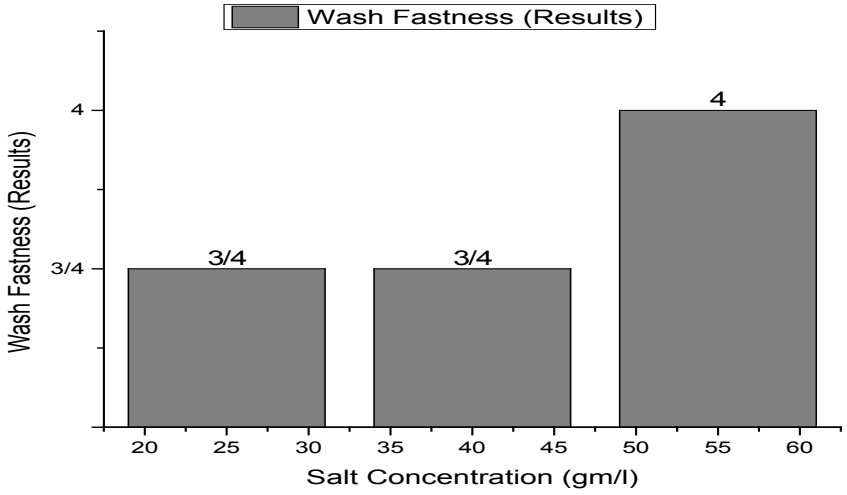


Figure 7. Plain Woven Fabric Wash fastness

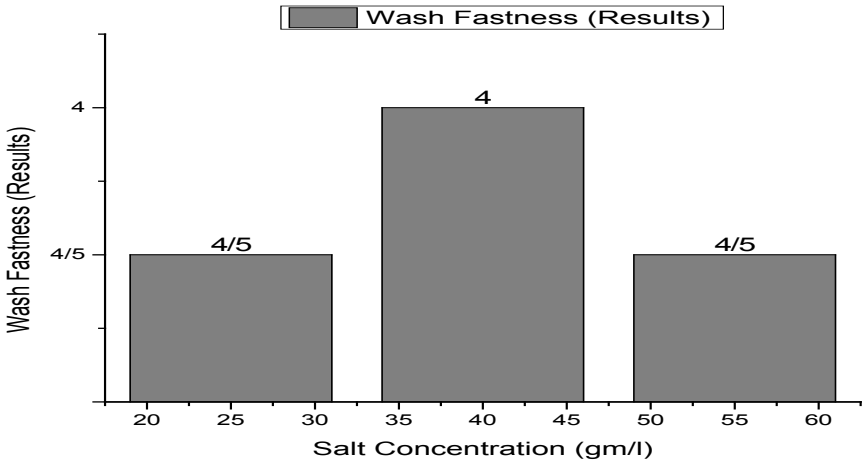


Figure 8. Single Jersey Fabric Wash fastness

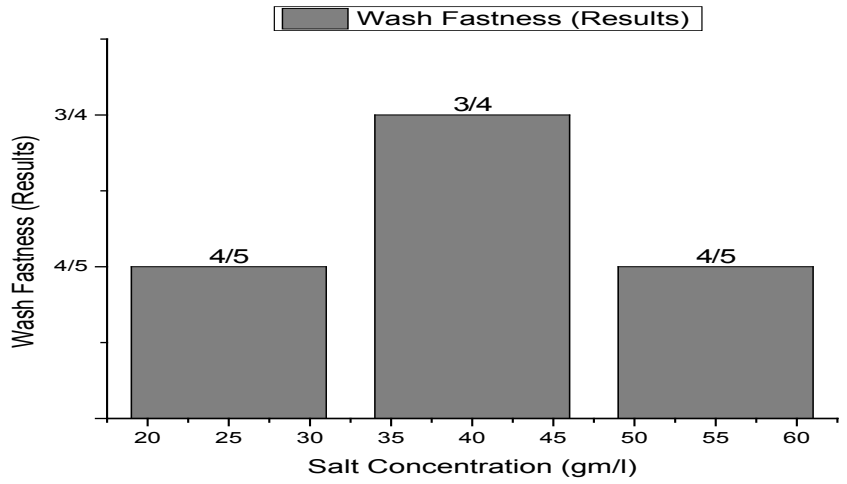


Figure 9. Rib (1×1) Fabric Wash fastness

From **Figure 7**, **Figure 8**, **Figure 9** we have seen actual amount of salt dyed sample was proper shade, less amount of salt give light and high amount of salt give deep shade. We have also seen color fastness to Wash test result give all sample approximately same. So we can say salt amount do not influence fastness property.

4. Conclusions

The pretreatment, is applied through pad-dry-cure process, brings about some salt change in the treated fabric. Fastness properties are adequate and quite comparable with conventionally dyed samples. The rubbing fastness of the dyed fabric change slightly. When dyeing the modified substrates, reactive Dyes can be much more efficiently exhausted and fixed onto Cellulosic fabric under neutral condition in the variation of Salt concentration. The modified Dyeing don't suffer either from a significant drop in wash fastness and perspiration fastness. There has significant effect on dyed fabric appearance and quality for the variation use of different concentration of salt with reactive dyes. That was showed good all fastness properties for different types of structural fabric on salt concentration.

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