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Investigations of color build up on cotton fabrics with reactive dyestuff after Alkali and bio-scouring and their comparison

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ABSTRACT:
While traditional scouring of cotton is the most widely used method of eliminating fiber impurities to make the fiber absorbent for commercial wet processing of textiles, it has a significant negative impact on the environment. Enzymatic scouring has therefore replaced the environmentally beneficial alkali scouring method. It is also clear from this thesis that the color strength, fabric strength, and fastness characteristics of cotton fabric that has been dyed using alkali and bio-scouring are compared. When compared to alkali-scoured colored fabric, it can be shown that bio-scoured dyed cloth has better overall qualities. Furthermore, compared to traditional alkali scouring, the bio-scouring procedure is more economical.

Keywords: Color Strength, Reactive dye, Alkali and Bio-Scouring

I. INTRODUCTION

Scouring is the most important process in textile wet processing technology which is also considered as pretreatment process for dyeing the textile substrate. Cotton is most popular nad mostly used textile substrate. The whole cotton fibre contains 88 to 96.5% of cellulose where near about 6-8% natural impurities in the cotton fiber, such as oil, wax, fat etc. contain. All the impurities should be removed from the cotton fiber i.e. cotton fabrics for getting the uniform dyeing effect. Scouring produced clean and hydrophilic textile materials. It increases the water absorbency of textile materials without undergoing any physical and chemical damage, so that the maximum dye molecules can penetrate into the fiber structure. The quality of dyeing, printing and finishing depends greatly on the quality of scouring [1].

There are several processes used in our factory to remove such type of impurities cotton fabrics. One of the most used methods is alkali scouring. Alkali scouring is very popular for removing impurities in all over the world. Different scouring chemicals are used in the textile industry like Na_2CO_3, NaOH etc, but Caustic soda (NaOH) is used mostly for the scouring. The alkali scouring is done at the temperature of 90^oC to 100^oC using NaOH for 45 to 60 min [2].

The higher the caustic soda concentration, the shorter will be the dwell time. In other words, for the shorter dwell time, the higher concentration of the chemical is required. The caustic soda concentration normally employed neither affects the ash content nor the average degree of polymerization [DP] of cotton. High concentration of the chemical may result in the reduction of DP as well as yellowing of the cotton fiber. The higher the concentration, the greater will be the fat removal. Due to the high degree of fat removal, the absorbency will also increase but there may be harshness in the handle of the material [3].

This is an environment friendly process, as it uses an environment friendly enzyme (pectinase enzyme) [4]. Recently Instead of harsh alkaline chemicals, Epygen has developed specially designed Enzymes with required Pectinase, Hemi-Cellulase and Lipase activity profiles that can be used for removal of the non-cellulosic components

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found in native cotton as well as impurities such as machinery and size lubricants.

Epygen Bio-scouring process results in substantial saving in process rinsing water and cellulose structure of fabric stays intact which improves strength properties and process ability. By replacing harsh chemicals, Bio-Scouring reduces pollution load drastically [5]. It is also not necessary to neutralize the fabric after the process, which is just in case of alkali scouring. It can be said that the bio-scouring process reduces the water and additional chemical cost and safe the environment as the process create no effluent. Alkali scouring required high temperature, which increase both the strength loss and energy cost. On the other hand, for bio-scouring only pectinase enzymes do the same task without strength loss of substrate, as the function of enzymes are very specific. Pectinase enzymes promote efficient interruption of the matrix to achieve good water absorbance without the negative side effect of cellulose destruction [6].

Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) of enzymatic scouring process are 20-45 % as compared to alkaline scouring (100 %). Total Dissolved Solid (TDS) of enzymatic scouring process is 20-50% as compared to alkaline scouring (100%) [7].

Hand feel is very soft in enzymatic scouring compared to alkaline scouring process. Enzymatic scouring makes it possible to effectively scour fabric without negatively affecting the fabric or the environment. It also minimizes health risks hence operators are not exposed to aggressive chemicals.

Enzymatic processing enables the textile industry not only to reduce production costs but also to reduce the environmental impact of the overall process and to improve the quality and functionality of the final products. The present study focuses on the development of optimum scouring process of cotton fabric to produce high quality dyed products. For this purposes, conventional scouring (alkali scouring) and enzymatic scouring are used before dyeing the cotton fabric with reactive dyes. Finally, the color strength values and colorfastness properties of the dyed fabrics are evaluated and compared with each other to find out the best scouring process.

Dismissal of wax is partly initiated here. Wax is the dominator for unwettability. Basically pectin works as a sticking agent for cellulose and wax. During the destruction of pectin, wax seems to become helpless and thus gets easily emulsified. For catalytic action, sequestering agent could help propagating the emulsification by entrapping Ca^{++} of the system. Most of the pectin is extracted and dissolved in this segment of operation. Thus condition of dyeing, i.e. absorbency is imparted. The temperature should be at least the melting temp of wax [8].

Pectinase destroy the cotton cuticle structure by digesting the pectin and removing the connection between the cuticle and the body of cotton fibre whereas cellulase can destroy cuticle structure by digesting the primary wall cellulose immediately under the cuticle of cotton. But at present, the only commercial bio-scouring enzyme products are based on pectinases [9].

Reactive dye is the most popular dye for the coloration of cellulosic fibres It is capable of reacting chemically with a substrate to form a covalent bond between dye and substrate. Here the dye contains a reactive group and this reactive group makes covalent bond with the fibre polymer and act as an integral part of fibre.

The covalent bond is formed between the dye molecules and the terminal –OH (hydroxyl) group of cellulosic fibres on between the dye molecules [10].

During dyeing the H atom in the cellulose molecule combines with reactive group of the dye molecule and the covalent bond formation occur. The dyes not only react with the cellulose but also react with hydroxyl ions present in the dye bath and causes dye hydrolysis. Fiber reactive dyes are the most permanent of all dye types. Unlike other dyes, it actually forms a covalent bond with the cellulose or protein molecule. Once the bond is formed, the dye molecule has become an actual part of the cellulose fiber molecule. Dyestuffs with only one functional group are sometimes enough for getting high degree of fixation.

The Basic information required for the measuring the color strength and color match prediction is the relationship between reflectance of the dyed materials and concentration of the dyestuffs. Color strength of dyed fabrics is determined in term of the K/S value by using spectrophotometer. The most common spectrophotometers are used in the UV and visible regions of the spectrum and some of these instruments also operate into the near-infrared region as well [11].

Visible region 400–700 nm spectrophotometry is used extensively in colorimetry science. Ink manufacturers, printing companies, textiles vendors, and many more, need the data provided through colorimetry. They take readings in the region of every 5–20 nanometers along the visible region, and produce a spectral reflectance curve or a data stream for alternative presentations. These curves can be used to test a new batch of colorant to check if it makes a match to specifications, e.g., ISO printing standards.

Color strength can be measured directly by the spectrophotometer, for this it followed the Kubelka Munk theory as in equation (1):

$$\frac{K}{S} = \frac{(1-R)^2}{2R} \quad \text{.................................... (1)}$$

Where,

K= absorption co-efficient of the sample
S=Scattering co-efficient of the sample
R=Degree of reflection
K/S value is increased with increasing the shade% of Dyed sample

2.1 Materials & machine used

Fabric used

Cotton fabrics are collected from delta knitting industries for performed this experiment, which is single jersey knitted fabric and the GSM is 170.

Chemical used

Caustic Soda (NaOH), sequestering agent (2207), Detergent (WBL), Acetic acid (CH_3COOH), Bio-Scouring agent (pectinase enzyme) is used in this experiment. Reactive Dye (NOVACRON BRILLIANT RED FN-3GL), Soda Ash (Na_2CO_3), Leveling agent are also used, which are collected from Delta knitting industries.

Machines used

We use the several numbers of machines in this experiment.

II. EXPERIMENTAL DETAILS

Sample Dyeing M/C : used for scouring and dyeing of cotton fabrics
Machine Capacity : 50Kg
Spectrophotometer : used for measuring the color strength of dyed sample
ICI Pilling Tester : used for measuring the pilling effect of fabrics
Bursting Tester : used for measuring the fabric strength
Washing M/C : used for measuring the color fastness to wash.
Crock meter : for rubbing fastness
Light fastness tester : for measuring light fastness

2.2 Process of scouring

2.2.1 Alkali scouring process

For alkali scouring caustic soda (NaOH) is used and other chemicals like Detergent, Sequestering agent are also added. The amount of auxiliaries in the recipe for this experiment was same but variation was only in main chemical i.e. amount of caustic soda. Here we varied the recipe amount of caustic soda for evaluating the effect of scouring by changing the amount of caustic soda as in **Table 3**.

Table 1: Recipe for alkali Scouring

Chemicals/ Parameters	**Recipe-1**	**Recipe-2**	**Recipe-3**
Caustic Soda (NaOH)	**1.5 g/l**	**1.8 g/l**	**2.0 g/l**
Detergent	1.0 g/l	1.0 g/l	1.0 g/l
Sequestering agent	0.5 g/l	0.5 g/l	0.5 g/l
M: L	1: 20	1: 20	1: 20
Temperature	95-100° C	95-100° C	95-100° C
Time	60 min	60 min	60 min
pH	12	12	12

Description of the scouring process

At first the fabric is fed in the machine. The m/c is run with fabric at room temperature with required amount of water. Then Sequestering agent and detergent are added in the machine. After few min. alkali is added and raised the temperature to 95-100° C. The machine is run in this temperature for 60 minutes. After completing scouring drain out the liquor from the machine. Rinse twice with hot (around 70°C) and cold water. Neutralize the fabric with acetic acid (1cc/l) treatment and carry out next process.

Scouring Curve with alkali

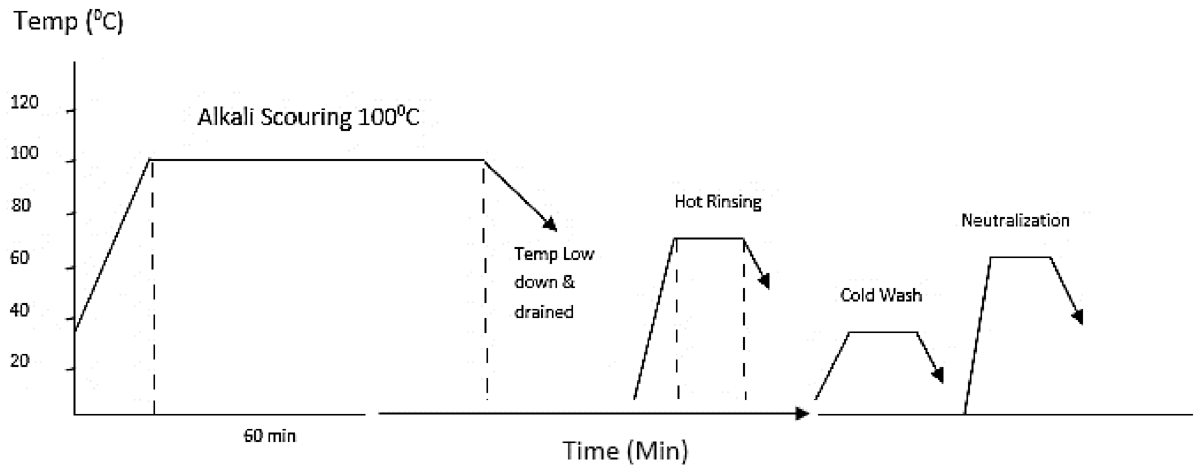

Figure 1: Scouring Curve with alkali

Bio-scouring process

For Bio-scouring we used an enzyme (Pectinase types of enzyme), which is introduced as Scourzyme L commercially and also other chemical like detergent, sequestering agent are also used as alkali scouring. For this experiment we used same amount of auxiliaries' chemicals as alkali scouring but changed in the main scouring chemical. Here we varied the recipe amount of Enzyme for evaluating the effect of scouring by changing the amount of Enzyme as **Table 4**.

Table 2: Recipe for Bio-scouring

Parameters	**Recipe-1**	**Recipe-2**	**Recipe-3**
Scourzyme -L	0.5 gm/l	0.75gm/l	1.0 gm/l
Detergent	1.0 gm/l	1.0 gm/l.	1.0 gm/l
Sequestering Agent	0.5 gm/l	0.5 gm/l	0.5 gm/l
Temperature	60°C.	60°C.	60°C.
Time	45 min	45 min.	45 min
P^H	7	7	7
M: L	1:20	1:20	1:20

Description of bio-scouring process

The m/c is set with fabric at room temperature with required amount of water. Sequestering agent and detergent are then added. The temperature set at 40°C and kept it about 15 minutes. Then the Bio-Scouring agent added and raises the temperature to 60°C, kept it for 30 minutes.

Cool down the bath temperature and drain out the liquor from the machine. Washed in 80°C for 5 minutes. Then the samples were rinsed with cooled water and dry it by using dryer. Then it's prepared for next process.

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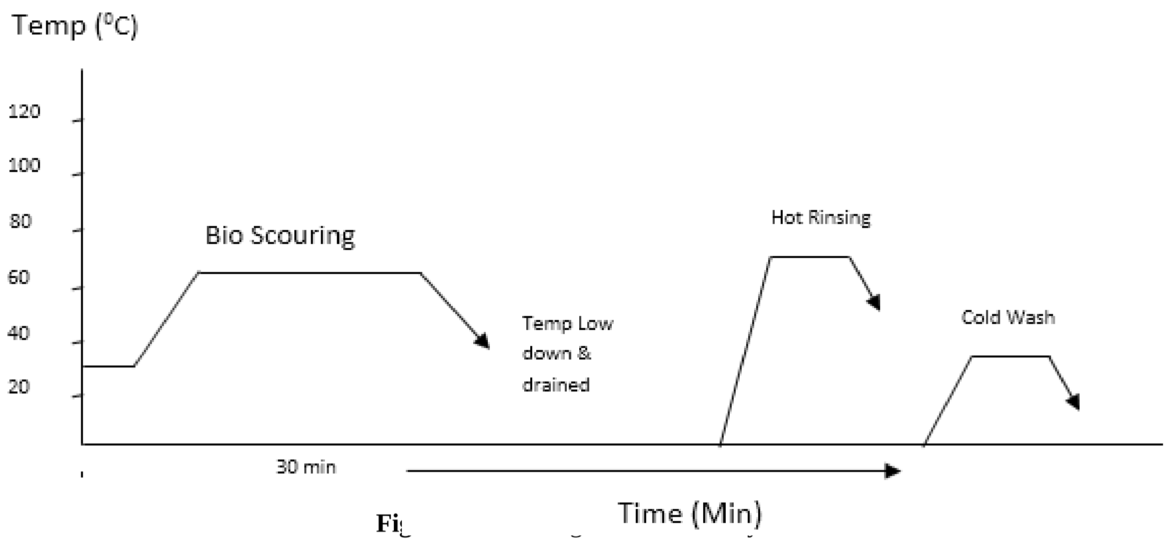
Scouring curve with enzyme



2.3 Estimation of scouring effect

Successful scouring ensures the better dye absorption into fabric .It can be assessed in different ways. In practice, estimation of scouring effect can be carried out one of the following tests:

(a) Measurement of weight loss
(b) Absorbency test
 (i) Immersion test
 (ii) Drop test
 (iii) Wicking test

2.3.1 Weight loss%

Since a considerable amount of impurities (oil, waxes) are removed in scouring process, the loss in weight of fabric can be a parameter for determining scouring effect. The loss in weight of fabric during scouring shows that a considerable amount of impurities are removed. The weights of unscoured and scoured samples are taken separately at the same moisture content and then the weight loss is measured in percentage.

$$\text{Weight loss\%} = \frac{(\text{sample weight before scouring} - \text{sample weight after scouring})}{\text{Sample weight before scouring}} \times 100$$

Using balance we measured the weight of fabrics before scouring and then again measured the weight fabric after scouring. Then using the above equation we measured the weight loss. This is converted in percentage and noted the data in our information book.

Evaluation procedure

- Standard range for wt. loss due to scouring is 4 – 8 % (Sometimes 9%).
- If weight loss < 4%: fabric is not well scoured i.e. unacceptable scouring.
- If weight loss >8%: more weight loss for scouring and here fibre damage has also occurred and so fabric is damaged. So scouring is unacceptable.

2.3.2 Drop test

In a pipette a solution of 0.1% direct red is taken and is dropped on the fabric sample. Then the absorption of the colored drop is observed visually. There required some second to spread the drop. We noted the time taken to spread the drop.

We also capture some image to differentiate the shape of the drop and compare them to the standard shape. It is important to the same amount of color dropped on the fabrics; otherwise the result may be changed. So extra care should be taken to drop color solution on the fabric.

Evaluation procedure

- A standard scoured sample will take 0.5- 1.0 sec for absorption of the drop.
- If the absorbed area forms a uniform circle and less area of spreading- indicates even but incomplete scouring.
- If the absorbed area forms a bigger and uniform circle – indicates even and complete scouring.
- If the spot shapes are irregular- indicates uneven scouring.

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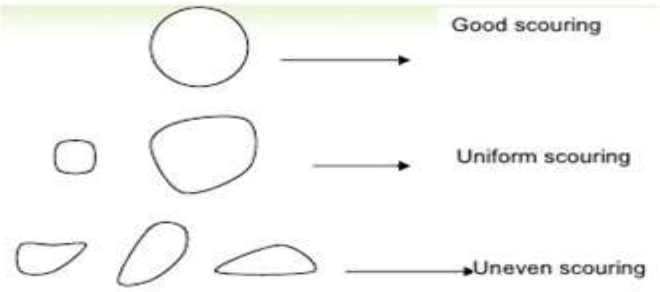

Figure 3: **Drop test for evaluating scouring effect**

2.3.3 Scoured Fabrics Strength Test

There are two processes for evaluating the fabric strength. One is tensile strength for woven fabrics and another is bursting strength test for knitted fabrics. Bursting strength test are two types: Diaphragm bursting test, Ball bursting test. In this experiment, Ball Bursting test has been introduced.

Ball Bursting Test

According to ASTM D3787, this test is done by coated fabric not for ordinary knitted fabrics .This test measure only force not the force per unit area. As a laboratory sample for acceptance testing, take a full width swatch 1 m (1 yd) long from the end of each roll of fabric in the lot sample, after first discarding a minimum of 1 m (1 yd) of fabric from the very outside of the roll. From each roll or piece of circular knit fabric selected from the lot sample, cut a band at least 305 mm (1 ft) wide. Specimen being 30mm Dia, 113mm Dia.

2.4 Dyeing of scoured fabric with Reactive Dye

For dyeing the scoured fabrics, which are obtained after the process of alkali scouring and Bio- Scouring, the following recipes are used to dye the fabrics.

Table 3: Recipe for dyeing cotton fabric (alkali and bio-scoured) with Reactive dye

Shade %	Salt (NaCl) g/l	Soda ash (Na_2CO_3) g/l	Temperature (^oC)	Time (Min)	P^H	M:L
1	40	10	60	60	10.5	1:8
2	60	15	60	60	10.5	1:8
3	70	17	60	60	10.5	1:8
4	80	20	60	60	10.5	1:8

Dyeing curve

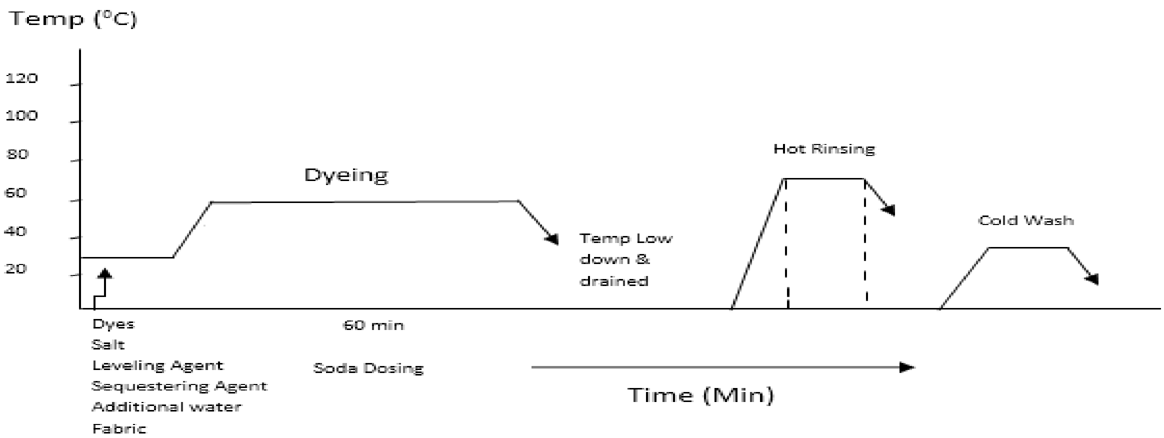

Figure 4: Dyeing curve

Description of dyeing process

The dye bath is set at 30^0C with the scoured fabrics and required water. Then sequestering agent, leveling agent are added and run it for 5 minute. The dye solution is added, after that the salt is added and run it for 5 min. Then soda is added by progressive dosing at 40^0c and run the m/c for 10 min. After that the temperature raised to 60^0C within 10 min. and the m/c is run 60 min for dyeing. Drop out the dye bath liquor after the dyeing process.

In after treatment process, the dyed fabric rinsed with cold water for 10 min. after rinsing the dyed fabric washed with soap and hot water. Then the dyed fabric dried by using dryer. And conditioning must be done before continuing the next process.

At first the original (undyed) fabric is set between the light sources and color detector. The light source illuminated the sample and the reflected light is collected on a detector and subsequently a graph of reflectance as a function of wavelength in the visible range is obtained. Then the dyed sample is illuminated by the light source and in the same way the reflectance is obtained in the same graph. Every dyed sample is measured in the same way and the K/S values are obtained directly from the instrument, which followed the Kubelka-Munk theory.

2.6 Evaluation of fastness properties

2.6.1 Wash fastness

Apparatus used for wash fastness are: Rotawash, Stainless Still Ball, SDC recommended Multi-fiber fabric, Grey scale for color changing, grey scale for color staining, Sewing machine, Thermometer, Color matching cabinet or light box, sewing m/c etc.

Recipe for preparing washing solution:

ECE detergent	: 4gm/litre
Sodium perborate	:1 gm/litre
Temperature	:60^oC
Time:	:30 min
Still ball:	:25 pcs

Wash fastness of the samples dyed under the optimized conditions was tested according to the IS0 687-1979 method. The test specimen of 10x4 sq. cm was placed in between the two adjacent, undyed test cloth pieces (cotton and wool for cotton and sewn along all four sides to form a composite specimen. Washing solution was taken with a liquor ratio of 1:50. The specimen was treated for 30 minutes at 60^0c in sample washing machine.

The specimen was removed and rinsed with cold water. The stitch was opened on three sides and dried in a dryer. Evaluation was done for change in color of the treated test specimen and the degree of staining of the two pieces of adjacent fabrics with the help of grey scale and the rating was also noted.

2.6.3 Rubbing fastness

Test Method: BS EN ISO 105 X12 & AATCC 8

Apparatus – Crock meter

Color fastness to Rubbing/crocking Test Procedure

0IS test method 766-1988 was followed to measure the rubbing fastness. For dry rubbing, a test specimen of 15x5 sq. cm was placed on the base of the crock meter so that it rests flat with its long dimension in the direction of rubbing. 5x5 sq. cm undyed bleached cotton was mounted on the tip of the finger. A spherical spiral wire clip holds the test cloth in place.

The crock meter as shown in figure is operated to rub the specimen in a straight line along a track of 10cm long for 10 times in 10 seconds with a downward force of 9N. After rubbing, the degree of staining on the undyed fabric is evaluated using grey scale.

2.7 Pilling test

Apparatus – Piling tester as shown in figure 9 is used for assessing the pilling effect.

Working Procedure

A piece of fabric measuring 10×10 sq. inch is sewn to a firm fit, which is placed in a round rubber tube (Rubber tube is 6inch long, 5/4" outer dia and 1/8" thick). The outer end of the fabric is covered by cellophane tape and metal plates are placed on the tester. The tester is run for 300 cycles. Then Remove the sample and compare the sample with standard.

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III. RESULT AND DISCUSSION

3.1 Result of scouring

3.1.1 Weight Loss%

Weight loss% of the scoured fabrics is very important factor because; the quality of dyeing depends on quality of scouring effect. It is also related with the dye exhaustion of the fabric. Weight loss%, which are found in the experiment are shown in **table 6**.

Table 4: weight loss percentage of scoured fabric

Sample	Wt.(gm) before Scoured	Wt.(gm) After Scoured	Wt loss (gm)	Wt. loss (%)
Alkali 1	500	450	50	10
Alkali 2	500	455	45	9
Alkali 3	500	445	55	11
Bio 1	500	465	35	7
Bio 2	500	460	40	8
Bio 3	500	455	45	9

Graphical Presentation of Weight Loss%

Figure 5: Weight loss Percentage

From the graph it is seen that the weight loss of alkali scoured fabric is greater than the bio-scoured fabric. It means the removal of impurities is greater in alkali scouring than the bio-scouring.

3.1.2 Result of drop test

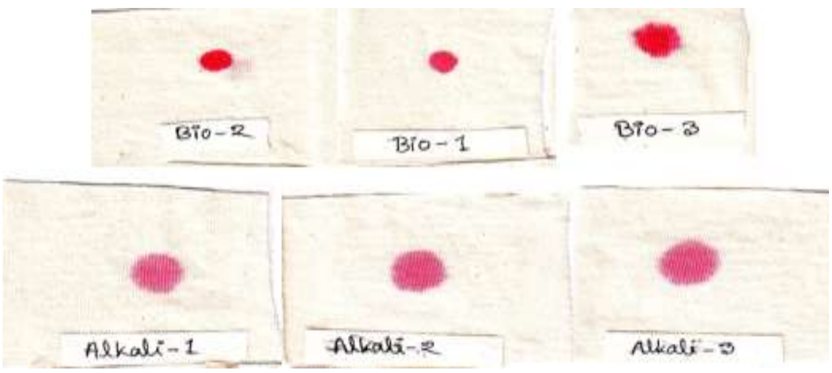

Figure 6: Result of drop test

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From the above figure 12 it can be seen that the absorbed area form by alkali scoured fabric is larger than the bio scoured fabric. Because from the table 6 it is found that the weight loss of alkali scoured fabric is more than the bio scoured fabric.

3.2 Result of color strength

Graphical Representation of Color Strength of alkali scoured Fabric:

From the **figure 12**, it can be seen that the color strength of the fabrics depends significantly on the effect of scouring. It is observed that color strength of the dyed fabrics are not same though the percentage of color are same. The results are found almost same for different shade%. The best result is found in terms of color strength value (K/S value) for alkali scouring (recipe 2).

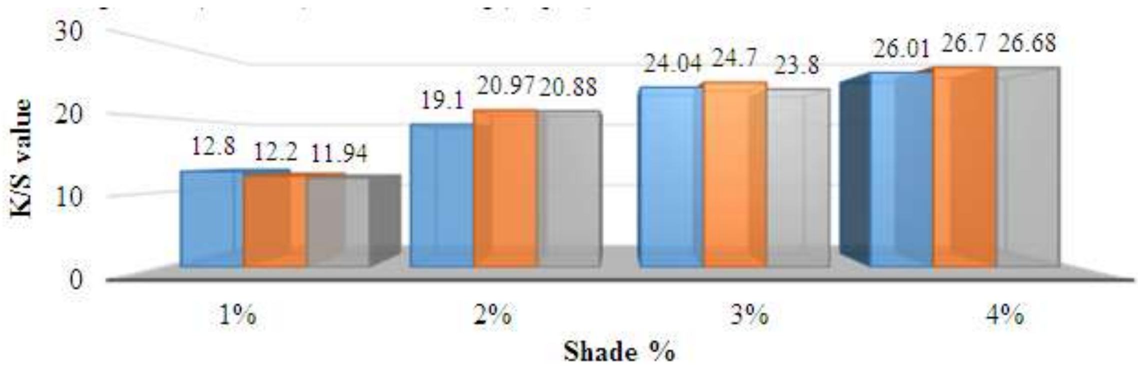

Figure 7: color strength value of alkali scoured dyed cotton fabric

Graphical Representation of Color Strength of Bio- scoured Fabric:

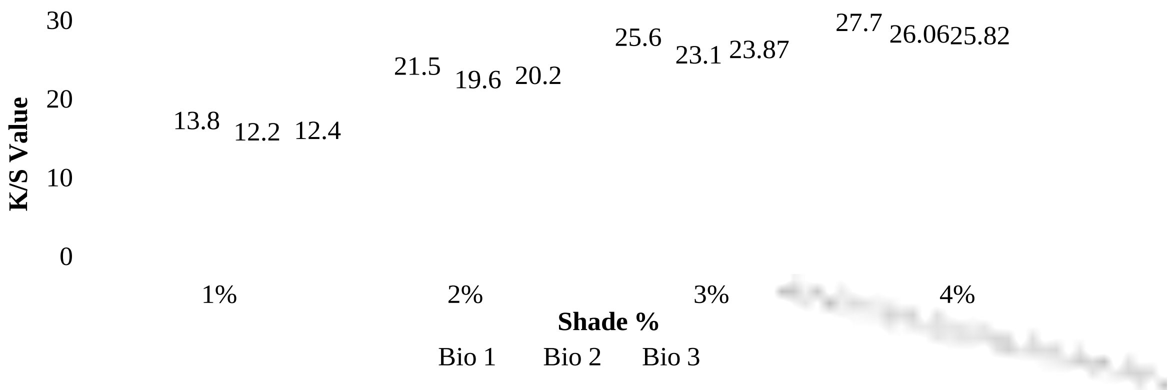

Figure 8: color strength value of bio scoured dyed cotton fabric

From the figure 13 & 14, it can be seen that the color strength of the fabrics depends significantly on the effect of scouring. It is observed that color strength of the dyed fabrics are not same though the percentage of color are same. The results are found almost same for different shade%. The best result is found in terms of color strength value (K/S value) for bio scouring (recipe 1).

Comparison of color strength between Alkali and Bio scoured dyed cotton fabric on the basis of best result

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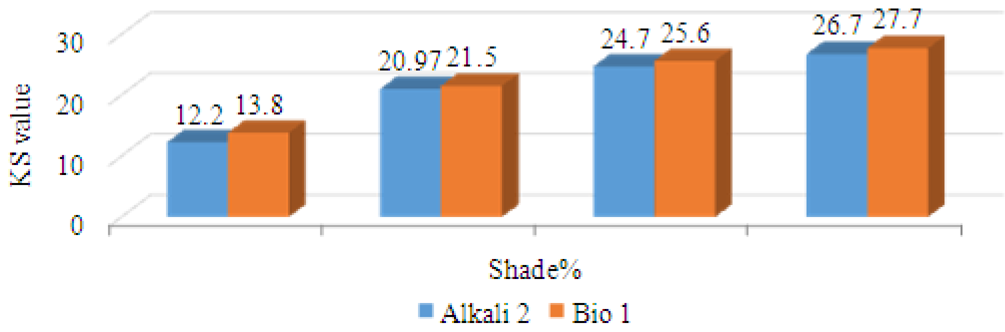

Figure 9: Comparison of color strength between alkali-2 and bio-1 recipe

Comparison of color strength between Alkali and Bio scoured dyed cotton fabric on the basis of best result as shown in figure 14 .It observed that the best result is found for bio scoured fabric (recipe 1) compare with alkali scoured (recipe 2).

3.3 Fastness properties
3.3.1 Result of Wash fastness

Table 5: Result of wash fastness rating for bio scoured dyed cotton fabric

Scoured Sample	Shade%	Grading					
		Acetate	Cotton	Nylon	Polyester	Acrylic	Wool
Bio-1	1	4-5	2-3	4-5	4-5	4-5	4-5
Bio-1	2	4-5	2-3	4-5	4-5	4-5	4-5
Bio-1	3	4-5	2-3	4-5	4-5	4-5	4-5
Bio-1	4	4-5	2-3	4-5	4-5	4-5	4-5
Bio-2	1	4-5	2-3	4-5	4-5	4-5	4-5
Bio-2	2	4-5	2-3	4-5	4-5	4-5	4-5
Bio-2	3	4-5	2-3	4-5	4-5	4-5	4-5
Bio-2	4	4-5	2-3	4-5	4-5	4-5	4-5
Bio-3	1	4-5	4	4-5	4-5	4-5	4-5
Bio-3	2	4-5	3-4	4-5	4-5	4-5	4-5
Bio-3	3	4-5	3	4-5	4-5	4-5	4-5
Bio-3	4	4-5	2	4-5	4-5	4-5	4-5

Table 6: Result of wash fastness rating for alkali scoured dyed cotton fabric

Scoured Sample	Shade%	Grading					
		Acetate	Cotton	Nylon	Polyester	Acrylic	Wool
Alkali-1	1	4-5	2	4-5	4-5	4-5	4-5
Alkali -1	2	4-5	2	4-5	4-5	4-5	4-5
Alkali -1	3	4-5	2	4-5	4-5	4-5	4-5
Alkali -1	4	4-5	2	4-5	4-5	4-5	4-5
Alkali -2	1	4-5	2/3	4-5	4-5	4-5	4-5
Alkali -2	2	4-5	2/3	4-5	4-5	4-5	4-5
Alkali -2	3	4-5	2	4-5	4-5	4-5	4-5
Alkali -2	4	4-5	2	4-5	4-5	4-5	4-5
Alkali -3	1	4-5	3-4	4-5	4-5	4-5	4-5
Alkali -3	2	4-5	3	4-5	4-5	4-5	4-5
Alkali -3	3	4-5	2	4-5	4-5	4-5	4-5
Alkali -3	4	4-5	2	4-5	4-5	4-5	4-5

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From the table 7 and 8 it can be said that wash fastness properties of bio-scoured and alkali scoured cotton dyed fabrics are almost same. So, wash fastness rating does not depend on the type of scouring chemical greatly except the staining properties of the dyed fabric. It is seen in figure 16 that the staining ratings of cotton fabric are better in case of bio-scoured dyed fabric.

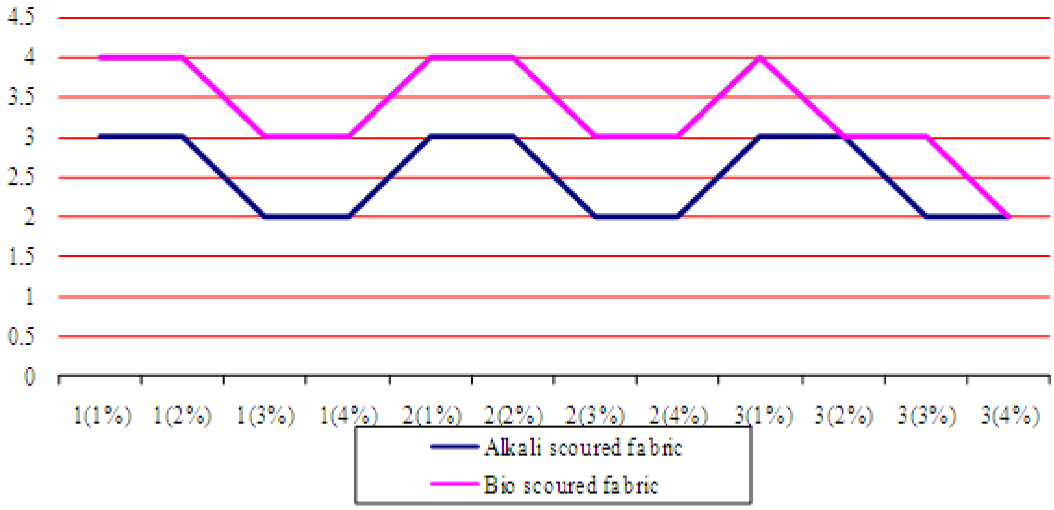

Figure 10: staining of cotton fabric dyed with reactive dye

3.3.3 Rubbing fastness

Table 7: Result of Rubbing Fastness test of Bio Scoured Fabric

Scoured Sample	Shade%	Grading Dry	Grading Wet
Bio-1	1	4-5	2/3
Bio-1	2	4-5	2/3
Bio-1	3	4-5	2
Bio-1	4	4-5	2
Bio-2	1	4-5	2
Bio-2	2	4-5	2
Bio-2	3	4-5	2
Bio-2	4	4-5	2
Bio-3	1	4-5	2-3
Bio-3	2	4-5	2
Bio-3	3	4	2
Bio-3	4	4-5	2

Table 8: Result of Rubbing Fastness test of Alkali Scoured Fabric

Scoured Sample	Shade%	Grading Dry	Grading Wet
Alkali-1	1	4-5	2
Alkali-1	2	4-5	2
Alkali-1	3	4-5	2
Alkali-1	4	4	2
Alkali-2	1	4-5	2
Alkali-2	2	4-5	2
Alkali-2	3	4-5	2
Alkali-2	4	4-5	2
Alkali-3	1	4-5	2
Alkali-3	2	3-4	2
Alkali -3	3	4-5	2
Alkali -3	4	4-5	2

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3.4 Fabric strength

Graphical Representation of Fabric Strength

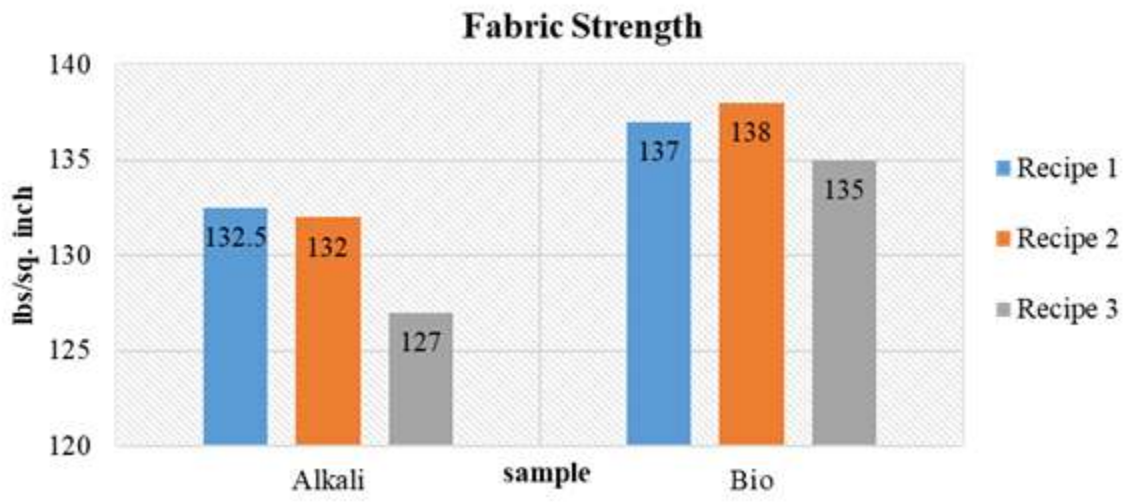

Figure 11: Fabric Strength

From the above **Figure 12** it is observed that more strength loss is found in case of alkali scouring. It is also found that the strength loss is increased if the amount of alkali is increased. So alkali affects greatly on the structure of cotton fabric .It can be concluded that more than 5% strength loss is occurred in case of alkali scouring compare to bio scouring.

3.5 Pilling Test Result

Table 9. Result of Pilling Test

Scoured Sample	Shade%	Grading
Bio -3	1	4-5
Bio -3	2	4
Bio -3	3	4-5
Bio -3	4	4-5
Alkali-3	1	4
Alkali-3	2	4-5
Alkali-3	3	4-5
Alkali-3	4	4-5

No significant difference is found between alkali and bio scoured dyed fabric, which is shown in table 12 but it is visually seen that bio scoured dyed cotton fabric produced less pill than alkali scoured dyed cotton fabric.

IV. CONCLUSION

Though conventional scouring of cotton is the most wide spread process for removing the fiber impurities to make the fiber absorbent for textile wet processing in commercially but it has a great effect on environment. For this reason enzymatic scouring is replacing on alkali scouring which is eco-friendly .it also seen that from this thesis the color strength, fabric strength, fastness properties of alkali scoured dyed fabric are compared with bio scoured dyed cotton fabric. It is seen that all the properties of bio scoured dyed fabric are better than the alkali scoured dyed fabric. Finally, the bio-scouring process is also cost effective than conventional alkali scouring process.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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