American Journal of Engineering Research (AJER) 2016
American Journal of Engineering Research (AJER)
e-ISSN: 2320-0847 p-ISSN : 2320-0936
Volume-5, Issue-6, 167-182
www.ajer.org
Research Paper Open Access

Using Enzymes as an Aid of Better and Eco-Friendly Scouring Processing

S. M. Azizul Hoque[1], Abu Yousuf Mohamamd Anwarul Azim[2]
[1]*Department Of Textile Engineering, Bangladesh University Of Business And Technology*
[2]*Department Of Fashion & Design, Bangabandhu Textile Engineering College, Tangail, Bangladesh*

ABSTRACT : *Introduction of enzyme in textile processing has brought a major contribution towards textile processing specially textile wet processing. Conventionally wet processed products have a lot of limitations that can be resolved by using enzymes in processing. As still most of the factories use conventional technique for pre treatment, they come up with higher fibre damage, high amount of liquor consumption most of which have adverse affect on environment hence making the water released by them harmful. If we use enzyme instead of chemicals used in conventional processing the fibre damage will be less, cost will come down, the processes will be eco friendly so do the water released by then and most importantly the effect will be better in this case. In short we can say, we will get a better quality product with eco friendly process if we use enzyme instead of conventional chemicals. The paper mainly focuses on scouring process, significant comparison between enzymatic and traditional scouring processes, contribution of enzyme to reduce cost and the pressure on environment and discusses some integrated Eco balancing aspects. But we cannot ensure it as an only substitute since it does not give desired result in some cases. Still conventional scouring of cotton is the most widespread process for removing the fibers impurities to make the fiber absorbent for textile wet processing in commercial world. Though both have some restriction in the textile sector, they can be properly utilized by evaluating their respective advantages and disadvantages .This study provides a set of experimental results, discussion and comparison between the two processes.*

Keywords*: Absorbency test, Bio scouring, Bleaching, Conventional Scouring, Cotton structure, Dyeing, Methodology, Scouring mechanism.*

I. INTRODUCTION

Greige fibers, yarns or fabrics contain different types of impurities such as seed fragments, coat fragments, pesticides, dirt, oil, wax, chemical residue, metallic salt etc. These impurities are removed during pre treatment in textile wet processing. The composition of cotton fibre is cellulose (90%-94%), waxes (0.6%-1.3%), pectin substances (0.9%-1.2%), protein (0.6%-1.3%), ash (up to 1.2%), organic acids (up to 0.8%) and others (1.2%) [1]. The main target of scouring is to remove waxes, pectin's, hemi-celluloses and minerals from the raw cotton fibres during the early stage of textile wet processing to make the fibres highly absorbent, which is necessary for the subsequent processes such as mercerizing, bleaching, dyeing, printing and finishing. For this purpose, Caustic soda (NaOH) treatment is used in conventional scouring, whereas, Enzymes (Cutinizes, Pectinase etc.) treatment is applied in bio scouring process. Different chemicals like $NaCO_3$, Ca $(OH)_2$ etc., alkaline (NaOH-sodium hydroxide) are used mostly for the scouring. These chemicals are supported by some auxiliaries like reducing agents, detergent, sequestering agent (also called chelating agents or sequestrate), and wetting agent ect. Each chemical have its own function in the process, for example sequestering agent reduces the water hardness, reducing agent prevent oxidation of cellulose, detergent acts as emulsifier to assist in removing waxy substances and wetting agent reduces the surface tension of water which helps fibres to swell and so on. But, these chemicals are toxic and harsh and also the temperature needed for the conventional process in pretty high. Also, the fibre damage due to this conventional process is also high causing reduced fibre strength hence the strength of the fabric. These chemicals make the water released from wet processing shed very toxic. This needs a lot of cost in ETP to purify them which is a primary cause of factories not to do proper treatment of effluents. So, the water released untreated or treated mildly causes serious harm to the eco-system causing lot of pollution and leading to a lot of waterborne animal and trees to death. This is a very alarming thing because we use a huge amount of water (around 20,000-45,000 L/1000 kg of products) only for scouring [2].

Enzymes are one of the most blessed introductions in textile wet processing pretreatments. Enzymes are biological molecules. There is believe that enzymes are living things actually they are not. Enzymes are inanimate like materials made by living cells [3]. The enzymes can be effectively used for scouring in textile wet processing. The process is effective enough to crack the waxy film of cotton surface that is sufficient to increase the wetting power of the cloth [4]. The end result is better than the conventional scouring. This can be proved from the increase in scouring effect, dye-ability and colorfastness properties of the fabric. Also, enzymatic process involves a few numbers of chemicals. This also solves the problem of toxic water in processing bath hence the liquor released after treatment is eco-friendly. Bio scouring waste water contains 40%-50% less COD and 60% less TDS as compared to conventional scouring waste water [5]. Also, lower amount of heat reduces the energy and the reduced number of chemicals reduces the cost of the process. The fabrics treated with harsh chemicals are also unsafe for human health (may affect on human skin) but bio scoured fabrics are completely safe. So, a better quality eco-friendly economic product is the possible outcome if we replace the conventional chemical scouring process with enzyme.

II. WHY BIO-SCOURING: (PROBLEMS OF TRADITIONAL SCOURING)

It has become an essential demand for the mill managers to sort out an alternative for the traditional caustic scouring process for some of its unavoidable limitations:

I. ***Less fiber strength:*** In traditional scouring process caustic soda works on swelling method and attacks the secondary cell wall being almost pure cellulose which I have discussed earlier and it causes to damage the fiber and its strength as well.

II. ***Excessive weight loss:*** The recommended weight loss for caustic scouring is 3-8%, but in practice it is around 8-12% which means an excessive loss of fabric weight unnecessarily. The factory has to pay extra money for this unavoidable fabric loss which should not be accepted.

III. ***Dye loss:*** Said earlier that caustic works on swelling method by which all the necessary and unnecessary particles are removed from cotton fiber and most importantly it damages the actual structure of cotton fiber which inspires the dye molecules not to fix according to our requirements and it causes a significant amount of dye loss.

IV. ***Energy and time concern:*** In caustic scouring it takes around 105°C temperature and to raise the temperature at this degree it requires a huge amount of energy on which sector we are struggling. Not only has that to raise and lower this temperature and also for several rinsing it takes more time which reduced the productivity.

V. ***Rinsing and neutralization:*** In caustic scouring several rinsing steps are practiced which increase the demand of amount of water volume and as this process is carried out at a high pH range (12-14), it needs to neutralize the scouring bath for the processes ahead.

VI. ***Effluent concern:*** A lot of harsh chemicals are used in traditional scouring process which is very much responsible to increase the amount of BOD, COD and TDS in the effluent water and increase the unwanted pressure on environment. Caustic scouring is responsible for the lion parts of the total effluent of a factory. It produces -----

- 54% to the total BOD
- 49% to the total COD
- 10-20% of the total pollution load generated during entire textile processing operation.

VII. ***Risk in chemical handling:*** The handling of harsh chemicals increase the possibilities of accident and most importantly the longevity of the workers are badly affected by the handling of this harsh chemicals.

III. MECHANISM INVOLVED IN BIO-SCOURING

The following two stages mechanisms are involved in bio scouring---

Stage 1:

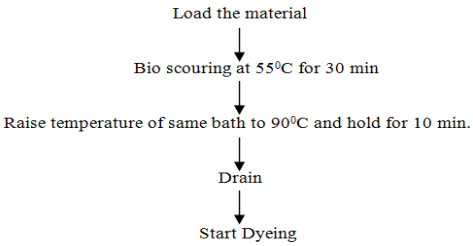
- Removal of wax (a major part being fatty acids, alcohols and esters) is the critical factor for improved wettability. Pectin functions as a 'glue' binding wax to the fibre. Pectin removal does not by itself result in wax removal or improved wettability but it renders wax extractable or emulsifiable.
- Presence of Ca^{2+} slows down the removal pectin and fatty acid, so a sequestrate should, if compatible, be applied with the enzyme – otherwise after the enzyme reaction.

Stage 2:

- 2/3 or more of the pectin must be dissolved in order to be able to emulsify enough wax for a good wettability for dyeing.
- Emulsification is strongly enhanced at temperatures above the wax melting point, i.e. >70°C

IV. OPERATIONAL SEQUENCES OF BIO - SCOURING

The process route that has to be used for carrying out bio scouring operation is:



V. MATERIAL AND METHOD

Raw Materials :

The used raw materials are

- 100% cotton fabrics (Grey) Fabric
- Scouring, bleaching and dyeing chemicals

Fabric Construction:

- Types of fabrics: 100% Cotton (Grey)
- Count: 26^{s}
- GSM: 130

Methodology:

Though this study is based on the effectiveness scouring comparison, performances should also be judged after subsequent processes so that their overall Efficacy can be measured. For this purpose, effectiveness and performance are tested evaluated after different steps, even after dyeing and finishing. During experintation following steps are followed for each process:

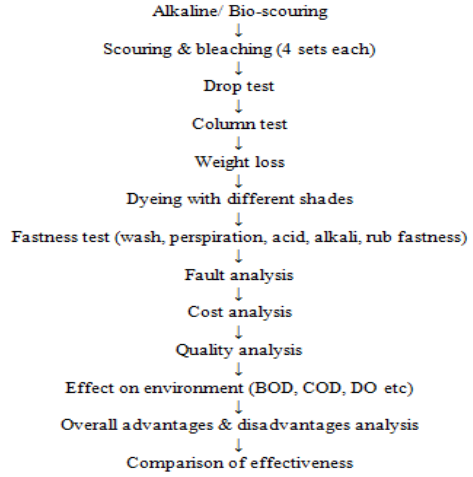


Table – 1 : Recipe of Traditional Scouring for Cotton Fabrics

Sample no	Caustic soda g/L	Wetting agent cc/L	Detergent cc/L	Temperature ^{0}C	Time min	p^H	M:L	Sample weight gm
1	1	0.5	0.5	100 ^{0}C	45	10.5	1:15	10
2	1.50	0.75	0.75	100 ^{0}C	45	10.5	1:15	10
3	2	1	1	100 ^{0}C	45	10.5	1:15	10
4	2.5	1.5	1.5	100 ^{0}C	45	10.5	1:15	10
5	3	2	2	100 ^{0}C	45	10.5	1:15	10
6	3.5	2.5	2.5	100 ^{0}C	45	10.5	1:15	10
7	4	3	3	100 ^{0}C	45	10.5	1:15	10
8	4.5	3.5	3.5	100 ^{0}C	45	10.5	1:15	10
9	5	4	4	100 ^{0}C	45	10.5	1:15	10
10	5. 5	4.5	4.5	100 ^{0}C	45	10.5	1:15	10

Table -2: Recipe of Bio - Scouring Cotton Fabrics

Sample no	Coenzyme dl g/L	Wetting agent g/L	Emulsion	Detergent g/L	Temp ^{0}C	Time min	pH	M:L	Sample weight gm
1	1	0.5	0.5	0.5	55 ^{0}C	30	4.5 – 5	1:15	10
2	1.50	0.75	0.75	0.75	55 ^{0}C	30	4.5 – 5	1:15	10
3	2	1	1	1	55 ^{0}C	30	4.5 – 5	1:15	10
4	2.5	1.5	1.5	1.5	55 ^{0}C	30	4.5 – 5	1:15	10
5	3	2	2	2	55 ^{0}C	30	4.5 – 5	1:15	10
6	3.5	2.5	2.5	2.5	55 ^{0}C	30	4.5 – 5	1:15	10
7	4	3	3	3	55 ^{0}C	30	4.5 – 5	1:15	10
8	4.5	3.5	3.5	3.5	55 ^{0}C	30	4.5 – 5	1:15	10
9	5	4	4	4	55 ^{0}C	30	4.5 – 5	1:15	10
10	5.5	4.5	4.5	4.5	55 ^{0}C	30	4.5 – 5	1:15	10

VI. RESULTS & DISCUSSIONS

Table – 3: Variation in concentration for scouring (Weight loss %)

Sample no	Weight (gm) Before	Weight (gm) after	Weight Loss % = {(sample weight before scouring – ample weight after scouring) / sample weight before scouring}*100
1	10	9.967	3.3
2	10	9.963	3.7
3	10	9.956	4.4
4	10	9.945	5.7
5	10	9.937	6.3
6	10	9.931	6.9
7	10	9.926	7.4
8	10	9.915	8.5
9	10	9.910	9
10	10	9.903	9.3

Table – 4: Variation in concentration for bio – scouring (Weight loss %)

Sample no	Weight (gm) Before	Weight (gm) after	Weight Loss % = {(sample weight before scouring – ample weight after scouring) / sample weight before scouring}*100
1	10	9.97	2.3
2	10	9.971	2.9
3	10	9.967	3.3
4	10	9.959	4.1
5	10	9.941	5.9
6	10	9.934	6.6
7	10	9.928	7.2
8	10	9.921	7.9
9	10	9.916	8.4
10	10	9.912	8.8

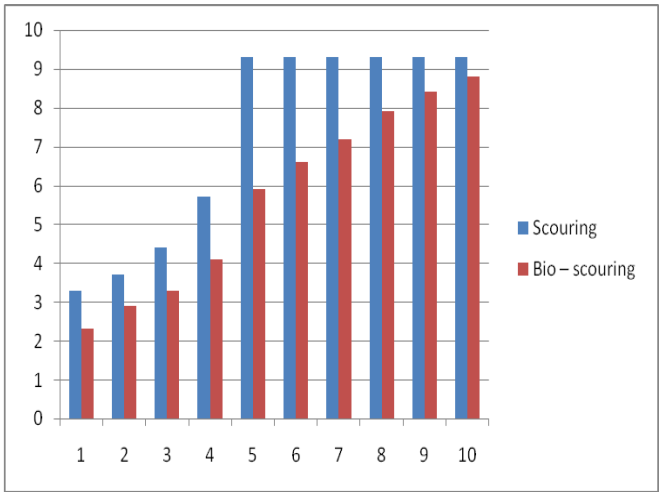
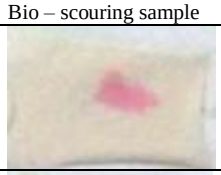
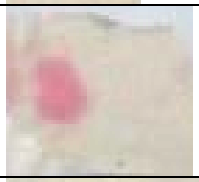
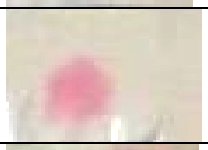
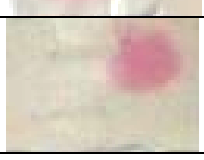


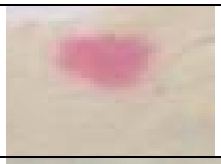
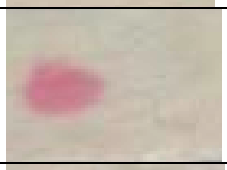
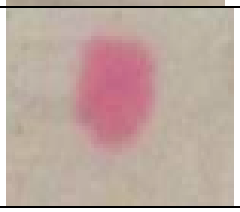
Fig – 1: Comparison between Bio-Scoured & Conventional scoured in terms of weight loss %

Observation: From the results we see that the weight loss % is higher in conventional process compared to the bio-process. So we can assume that more impurities have been removed from the fabric treated by conventional alkaline process and are more effective in this case than the bio-process (particularly in removing motes).

Absorbency Test of Bio and Traditional Scouring (Drop test) sample

Table – 5: Absorbency Test of Bio and Traditional Scouring Drop test sample

Serial No	Bio – scouring sample	Traditional scouring sample
1		
2		
3		
4		
5		
6		

7		
8		
9		
10		

Observation: From the results we see that the bio scoured sample was well scoured over traditional scoured sample. It also shows that bio scoured sample is more effectively remove the impurities than traditional without damaging the chemicals structure of the cotton.

Absorbency test of bio and traditional scouring (wicking test) sample

Table – 6: Absorbency test of bio and traditional scouring (wicking test) sample

Serial No	Bio – scouring sample	Traditional scouring sample
1		
2		

3		
4		
5		
6		

7		
8		
9		
10		

Observation: From the result we see that most of the bio – scoured samples are in acceptable absorbing length than traditional scoured sample. Bio – scoured sample. This also shows clear differences among traditional scouring and bio scouring.

Color Fastness to Wash (color staining) ISO 105 CO3 method is used
Color Fastness to Wash (bio – scouring)

Table – 7: Color Fastness to Wash (bio – scouring)

Serial No	Change in color	Grade					
		Acetate	Cotton	Nylon	Polyester	Acrylic	Wool
1	3.5	4	3.5	4	3.5	3.5	3
2	4	4.0	4.0	4.0	3.5	3.5	3
3	4	4.5	4.5	4.5	4	4	2.5
4	4.5	4.5	4.5	4.5	4.5	4.5	3.5
5	3.5	4	3.5	3	3.5	3.5	3
6	4	4	3.5	4	4.5	4.5	3
7	4	4	3.5	4	4.5	4.5	3.5
8	4.5	4.5	4	4.5	4.5	4.5	4
9	3	3.5	2	3	3.5	2.5	3
10	3.5	4.5	3	4.5	4.5	4	4

Color Fastness to Wash (traditional scouring)

Table - 8: Color Fastness to Wash (traditional scouring)

Serial No	Change in color	Grade					
		Acetate	Cotton	Nylon	Polyester	Acrylic	Wool
1	3	4	3	3	3	3.5	2.5
2	4	3.5	3	4	4.5	4	3.5
3	4	3.5	2.5	4	4.5	4	3.5
4	3.5	3.5	3.5	3	3.5	3	3
5	3	4	2	3	3.5	3	2
6	3.5	4	2.5	3.5	4.5	4.5	2.5
7	4	4	3	4	4.5	4.5	3.5
8	3.5	4	3	4.5	4.5	4.5	3.0
9	2.5	3	1.5	2.5	3	2	2.5
10	3	4	2.5	4	4.5	4	3.5

Report: Color fastness to wash for bio – scouring and traditional scouring is very to shade by shade even in same shade.

Comparison between Bio-Scoured & Conventional scoured colorfastness to wash test

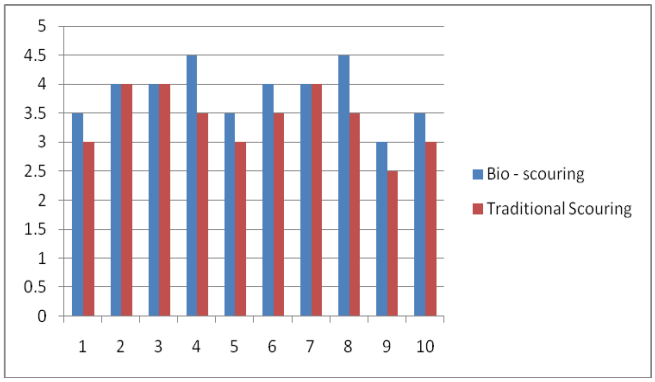
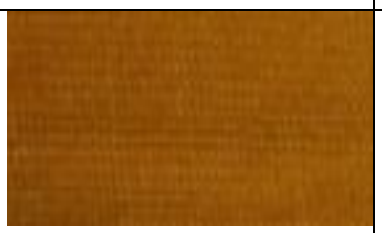
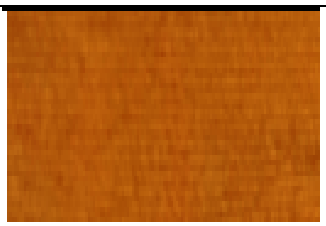
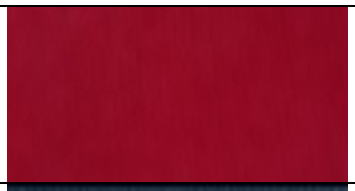


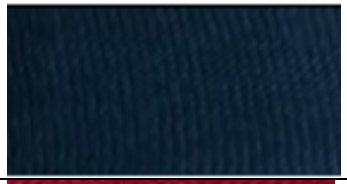
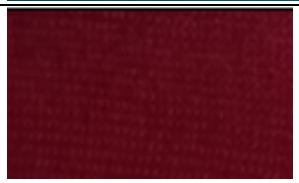
Figure – 2: Comparison between Bio-Scoured & Conventional scoured colorfastness to wash test

Observation: This color fastness to wash shows the results in terms of color staining. These results shows us that depend on the nature of color fastness to wash sample was vary in traditional scoured sample and bio – scoured sample. As we see in the graphs that within the same hue color fastness to wash doesn't shows a significant changes but the differences are well observable.

Dyeing of bio and traditional scoured sample:

Table – 9: Dyeing of bio and traditional scoured sample

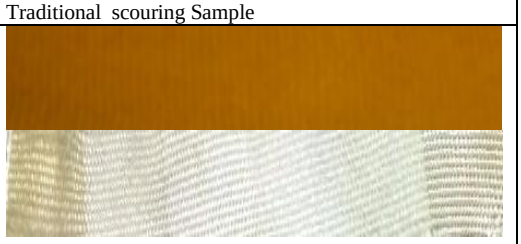
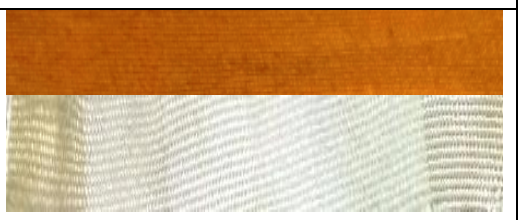
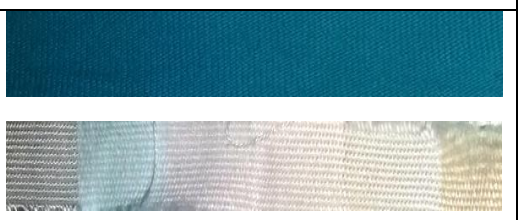
Serial No	Nature of Shade	Bio – scouring Sample	Traditional scouring Sample
1	Light		
2	Medium		
3	Medium		
4	Medium		
5	Medium		
6	Medium		
7	Dark		
8	Dark		

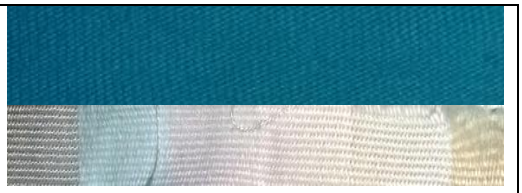
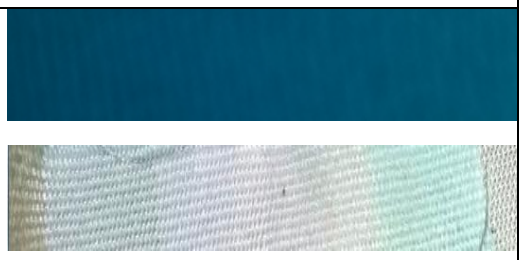
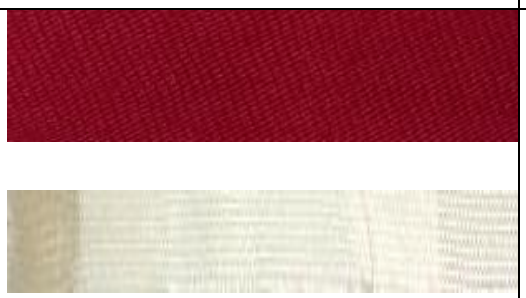
9	Dark		
10	Dark		

Observation: By observing the above dyed sample of traditional scoured and bio scoured sample we easily found that the bio – scoured sample uptake more dyes than the traditional scoured one. We also saw that there was a significant change between them. For the same percentage of dyes and other chemicals the sample and others properties are also changes significantly. This result also gave us a clear idea to take the bio - scouring process over traditional scouring process.

Colorfastness to wash test of Bio and traditional scoured sample

Table – 10: Colorfastness to wash test of Bio and traditional scoured sample

Serial No	Bio – scouring Sample	Traditional scouring Sample
1		
2		
3		
4		

5		
6		
7		
8		
9		
10		

Colorfastness to rubbing
ISO 105 x 12: 1993 method is used
Colorfastness to rubbing (bio – scouring)

Table – 11: Colorfastness to rubbing (bio – scouring)

Serial No	Method of Rubbing	Gray Scale Rating
1	Wet Rub	3 /4
	Dry Rub	4
2	Wet Rub	3 /4
	Dry Rub	4
3	Wet Rub	4
	Dry Rub	4/5
4	Wet Rub	3 /4
	Dry Rub	4
5	Wet Rub	3 /4
	Dry Rub	4
6	Wet Rub	4
	Dry Rub	4/5
7	Wet Rub	3/4
	Dry Rub	4
8	Wet Rub	3 /4
	Dry Rub	4
9	Wet Rub	4
	Dry Rub	4/5
10	Wet Rub	4
	Dry Rub	4/5

Colorfastness to rubbing (traditional scouring)

Table – 12: Colorfastness to rubbing (traditional scouring)

Serial No	Method of Rubbing	Gray Scale Rating
1	Wet Rub	2/3
	Dry Rub	3
2	Wet Rub	3
	Dry Rub	3/4
3	Wet Rub	3
	Dry Rub	3/4
4	Wet Rub	3
	Dry Rub	3/4
5	Wet Rub	3
	Dry Rub	3/4
6	Wet Rub	4
	Dry Rub	4/5
7	Wet Rub	3/4
	Dry Rub	4
8	Wet Rub	3 /4
	Dry Rub	4
9	Wet Rub	4
	Dry Rub	4/5
10	Wet Rub	3/4
	Dry Rub	4

Report: Color fastness to rubbing cotton fabric is moderate to good (Rating 3/4 to 4 for wet rub & for dry rub the rating is 4).

Observation: Colorfastness to rubbing shows us a result about how the bio – scoured and traditional scoured sample reacts or changes when it rubs with others materials. For this experiments all of samples includes traditional and bio – scoured are put in a open place for three to four days then tests it. The results show us a clear differences among traditional and bio – scoured sample.

Energy saving:

Traditional Scouring	Bio - Scouring	Temp. Saving
105°C	55°C	45%

Explanation*:* In bio scouring process, enzymes done its works properly at a temperature of 55^0C on the other hand to work out the scouring process traditional scouring needs a temperature of 105^0C. Now if we applied bio – scouring process over traditional one than we save 45% energy.

Time saving:

Parameter	Traditional Scouring	Bio - Scouring
Time (Appx)	4 Hour	1hour 30min

Explanation: In Traditional scouring process to completes scouring process chemicals a total time of four hour. On the other hand, in bio – scouring process in took only one and half hour to complete the entire scouring process. So, it clearly a huge time saving if we take the bio – scouring process instead of traditional scouring process.

Less Water Consumption:

Parameter	Traditional Scouring	Bio - Scouring
Rinsing(Appx)	4 times	2 times

Explanation*:* In traditional scouring we use a numerous chemicals to complete the process. As a result we also need a lot of water for rinsing. On the other hand, on traditional scouring we use enzyme instead of using chemicals. It results a less water use in this process. In the experiment we found that we need less water in fact half the amount we used in traditional scouring if we used bio – scouring. This is helps us to maintain the environmental balance and protects it from being polluted.

Cost of Bio-Scouring:

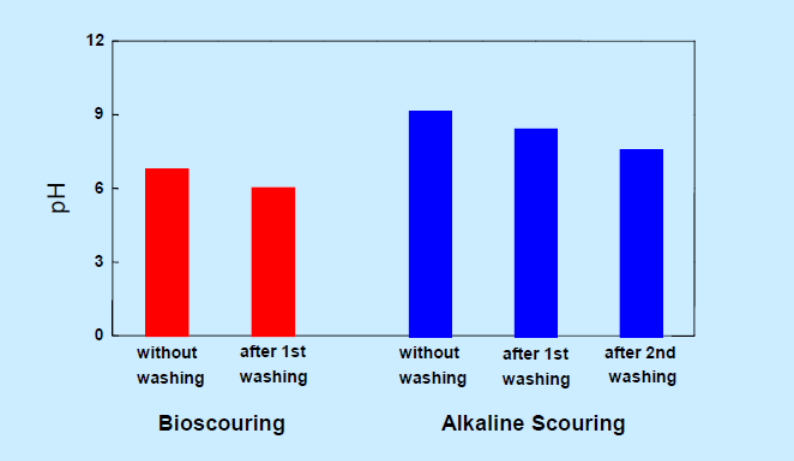
Table – 13: Cost of bio – scouring

Chemicals	**%, g/l**	**Rate**	**Qty/100 kg Fabric**	**Cost/100 kg Fabric**
Soda Ash	0.4	27.67	0.32	8.85
Scouring enzyme	0.8	258	0.64	165.12
Jet Detergent	0.7	235	0.56	131.6
Detergents	0.5	112	0.40	44.8
			Total Cost	**462.94**
			Cost/kg	**4.63**

Explanation: In table 5 and 6 we get an idea about the costing of traditional scouring and bio – scouring fabrics. It shows clear differences between two costs. In fact this amount becomes a huge one when we going to bulk production. Saving 1.40 tk may seem s a small amount but in the textile industries where we scoured a huge amount of fabrics gave us a huge opportunity to saves a lots of money and also saves the environment from being polluted.

Comparison of pH values – fabrics:

Figure 3: Comparison of pH values – fabrics



Explanation: On the bio – scouring process enzyme works on pH range of 6.5 to 6 on the other hand traditional scouring process it various into 10 to 8.5. So, to neutralize bio – scouring process took less chemicals than traditional one. So, if we took bio – scouring instead of traditional scouring it will help us to save money, environment and energy

VII. OVERALL COMPARISONS

Though comparison is the main topic of our research, our main target was to find out the usability and replace ability of bio-scouring process over conventional scouring processes. Thus we have tried to distinguish the advantages and the positive sides of bio - scouring. The prospect of bio – scouring can be assumed from the discussion below:

Fabric strength: Fabric losses it strength significantly in traditional scouring than bio – scouring because of the nature of chemicals used in traditional scouring are harsher than bio scoured chemicals. It also because of bio – scouring agents attacks primary cell wall of the fibres which is required for dye absorption but convention scouring agents attacks both primary and secondary cell wall and causes giher strength loss.

Whiteness: Conventional scouring produces whiter fabric than bio – scouring produces. Thus conventional scouring is more effective in manufacturing white-colored shades fabric. But to produce dark-colored shades fabrics bio – scouring gives same result. If bleaching is followed by bio – scouring, then white fabric can be produced.

Weight loss: Due to attacking also the secondary cell wall and high removal of pectin, though removal of pectin is not important for improving hydrophilicity or absorbency, fabrics weight loss (about 3-10%) is higher. For these losed fabrics, manufacturer has to pay extra cost.

Dye loss: Higher removal of pectin causes higher space in the fibres for dyestuff penetration, reaction and fixation. Thus conventional scoured fabrics dye-ing needs higher amount of dyestuffs than dyeing of bio – scouring fabrics need.

Energy and time required: bio – scouring needs not as high temperature as conventional scouring needs. bio – scouring is done below 70^0C but conventional caustic scouring is done around 90^0C-105°C temperature and to provide this higher temperature, higher heat production is needed. Thus high heat energy production increases cost in scouring. Moreover, after conventional scouring, two step washing is required for neutralizing high alkalinity. Which also increases additional time and cost.

Effluent concern: A lot of harsh chemicals are used in conventional scouring process which is very much responsible to increase the amount of BOD, COD, DO (Dissolved Oxygen) and TDS (Total Dissolved Solids) in the effluent water and increase the unwanted pres-sure on environment. Caustic scouring is responsible for the lion parts of the total effluent of a factory. 10-20% of the total pollution load generated during en-tire textile processing operation.

Color fastness: Color fastness of the dyed fabrics after bio – scouring and conventional has nearly same though it varies from types of dyestuff, dyeing process, depth of shade, finishing process and other factors.

Risk in handling: The handling of harsh chemicals increases the possibilities of accident. It may affect on workers health. Moreover, some health-hazard chemicals may stay in the fabrics even after finishing processes which can affect on human health.

VIII. LIMITATION

Scouring is a process that specifically targets non-cellulosic impurities with pectinases. Technical feasibility of bio-scouring has been recognized. Yet it is not clear why bio-scouring has not yet been widely accepted by dye houses. Some probable limitations are discussed - Undoubtedly, the primary limitation is that bio-process has little effect on mote removal. Although bioprocess positions itself as a pretreatment only for the dark shades, it sometimes cannot prevent the appearance of motes even in the dark shaded fabrics. Another factor limiting the wide use of bio-scouring is its inability to give any whiteness improvement to treated fabrics. The process thus cannot be used to pre-treat full white, pale and medium shade fabrics. Finally, inability to remove wax impurity has greatly restricted bio-scouring from being accepted.

IX. CONCLUSIONS

Though the conventional scouring process is extremely using now-a-days, it has great bad effect on environment. Therefore, many of the developed countries are avoiding the convention-al scouring process

replacing enzymatic, eco friendly, scouring processes. Since bio – scouring is an eco-friendly scouring process it has great future. The new enzymatic procedure is corresponding with a significant role in minimizing the demand of energy, water, chemicals, time and therefore costs. After bio – scouring, fabric can be dyed directly without bleaching, which also reduces additional cost in this step. But in this process, light-colored shades cannot be produced or very difficult match. Whereas, in conventional scouring and bleaching, it is easier to produce light-colored shades dyed fabrics. Though both processes have some merits and demerits, eco-friendly and cheaper bio – scouring process, though it some complexities in operation, has a good prospect to be substituted of conventional scouring in next world textile wet processing.

REFERENCES

[1]. Zawawi Daud, Mohd Zainuri Mohd Hatta, Angzzas Sari Mohd Kassim, Halizah Awang , Ashuvila Mohd Aripin, Analysis The Chemical Composition And Fiber Morphology Structure Of Corn Stalk (Australian Journal Of Basic And Applied Sciences, 7(9): 401-405, 2013 Issn 1991-8178)

[2]. Rachana S. Harane,, Neha R. Mehra, Priti B. Tayade, Ravindra V. Adivarekar, A Facile Energy And Water-Conserving Process For Cotton Dyeing; Int J Energy Environ Eng (2014) 5:96

[3]. Md. Mahabub Hasan, Farhatun Nabi And Rezwan Mahmud, Benefits Of Enzymatic Process In Textile Wet Processing, International Journal Of Fiber And Textile Research Ssn 2277-7156 International Journal Of Fiber And Textile Research 2015; 5(2): 16-19

[4]. J Venkata Rao . Developments In Grey Preparatory Processes Of Cotton Textile Materials, Indian Journal Of Fibre & Textile Research Vol. 26, March-June 2001, Pp. 78-92

[5]. D. Jothi , Application Of Enzyme Extracted From Aloe Vera Plan In Chemical Pretreatment Of Cotton Knitted Textile To Reduce Pollution Load, World Journal Of Engineering And Technology,2015, 3, 37-44

[6]. Dr. V.A. Shenai , Technology Of Textile Processing Pp-80, 82)

[7]. Yan Va N Dy K E, Practical Applications Of Protease Enzymes In Paper Conservation, The Book And Paper Group Annual 23 (2004) 93

[8]. Kiro Mojsov , Biotechnological Applications Of Pectinases In Textile Processing And Bioscouring Of Cotton Fibers, International Conference Industrial Engineering And Environmental Protection 2012 (Iizs 2012), Volume: Proceedings. 10/2012, Pp. 314-322.

[9]. Ripon Kumar Prasad, Dr. Md. Abdus Shahid, Nurunnabi, Marzia Dulal , A Comparative Study Between One Bath Dyeing Method For Polyester Cotton (Pc) Blended Fabric Over Conventional Two Bath Dyeing Method, European Scientific Journal November 2015 Edition Vol.11, No.33 Issn: 1857 – 7881 (Print) E - Issn 1857- 7431

[10]. Ms. Sonia Hossain, Md. Koushic Uddin, Comparative Analysis Between Conventional Pre-Treatment And Bio-Preparation International Journal Of Engineering & Technology Ijet-Ijens Vol: 11 No: 03; 112503-8787 Ijet-Ijens @ June 2011 Ijens

[11]. Professor D.Jothi , A Revolutionary Enzymatic Process For Textile Industries, International Journal Of Scientific & Engineering Research, Volume 4, Issue 6, June-2013 2970 Issn 2229-5518

[12]. Mojsov Kiro, Comparison Between Conventional Chemical Processes And Bioprocesses In Cotton Fabrics , Tekstilna Industrija 2015, Vol. 62(1), 21-25)

[13]. Michaela Dina Stănescu, Mihaela Dochia, Magdalena Fogoraşi, Monica Pustianu, Mircea Sorin Bucur , Enzimes In Cotton Bio-Scouring, U.P.B. Sci. Bull., Series B, Vol. 72, Iss. 3, 2010 Issn 1454-2331