

# The Effect of Pretreatment on the Properties of Jute Yarn and Dyed Yarn Performance Analysis

<sup>1</sup>Md. Nazmul Ehsan <sup>2</sup>Karima Ali <sup>3</sup>Moinul Hossain Tousif <sup>4</sup>Shake Md. Zakaria

**Abstract** - A study on different pretreatment possibilities for jute yarn was done to observe the quality parameter depending on the process. Jute yarn was bio scoured using enzyme followed by scouring and bleaching with H<sub>2</sub>O<sub>2</sub>. Conventional combined scouring and bleaching was performed using different concentration of H<sub>2</sub>O<sub>2</sub> and NaOH. Jute yarn is bleached and scoured with enzyme without conventional scouring. All three pretreated samples were dyed with Basic dye and reactive dye for comparison. Color fastness to wash test, absorbency test and single yarn strength test were done for different pretreated samples for assessment. It has been observed that scouring of jute yarn with sodium hydroxide started to show loss of strength compare to enzyme process.

**Index Terms** - Jute yarn, scouring, bleaching, enzyme, wash fastness, staining fastness strength, Absorbency test.

## 1. Introduction

Jute fiber is an abundant natural biodegradable fiber, which occupies the second place in terms of world production levels of cellulosic fibers [1]. Ecological concern has resulted in a renewed interest in natural materials for their recyclability, light weight and non-pollution. Important issues such as recyclability and environmental safety need to be addressed when new materials and products are introduced. The chemical composition of natural fibers varies depending upon the type of fiber. Primarily, fibers contain cellulose, hemicellulose, pectin, and lignin. The properties of each constituent contribute to the overall properties of the fiber. The percentage composition of each of these components varies for different fibers.

Hemicellulose is responsible for the biodegradation, moisture absorption, and thermal degradation of the fiber as it shows least resistance whereas lignin is thermally stable but is responsible for the UV degradation. Generally, the fibers contain 60–80% cellulose, 5–20% lignin, and up to 20% moisture. [2–5]. The components of natural fibers include cellulose, hemicellulose, lignin, pectin, waxes and water soluble substances.[6-7]. Thus, alkaline processing directly influences the cellulosic fibril, the degree of polymerization and the extraction of lignin and hemi-cellulosic compounds [8].

## 2. Materials and Methods

### 2.1 Yarn Description

Content	TPI	Count
100% Jute	4	28 lbs/spyndle

### 2.2 Chemicals

<sup>1</sup>Md. Nazmul Ehsan, Assistant professor, Department of textile Engineering, Southeast University

<sup>2</sup>Karima Ali, Textile Graduate, Southeast University

<sup>3</sup>Moinul Hossain Tousif, Officer, Fakir Knitwares Ltd

<sup>4</sup>Shake Md. Zakaria, Textile Graduate, Southeast University

Wetting Agent, Leveling agent, Multi-functional Agent, Detergent, Enzyme, Peroxide Stabilizer, Caustic Soda, H<sub>2</sub>O<sub>2</sub> (50%), Acetic Acid, Soap, Sequestering Agent, Reactive dye, Basic dye were of commercial grade chemicals.

## 2.3 Treatments and methods of analysis of sample

In this study four different batches of jute yarn are treated for evaluation. 25 gm grey jute yarn is taken for combined scouring bleaching and set the bath with auxiliary agent, stabilizer and caustic soda. Started to raise the temperature. Add hydrogen peroxide after few minutes raised the temperature to 95<sup>o</sup> C. Run the bath for 40 minutes. Similarly enzyme wash, scouring and bleaching is done in three different bath. For batch 2, 25 gm of grey jute yarn is taken and set the bath with substrate at room temperature. Add wetting agent, detergent and sequestering agent. Add alkalis after few minutes raised the temperature to 95<sup>o</sup> C. Run the bath for 60 minutes. Again set the bath with this scoured jute yarn at room temperature for enzyme wash. Raise the temperature to 60<sup>o</sup> C and run the bath for 30 min. Another 25 gm jute yarn is enzyme washed using 2 g/l enzyme followed by bleaching with H<sub>2</sub>O<sub>2</sub> for batch 3. Batch 4 is only bleached using 6 g/l H<sub>2</sub>O<sub>2</sub>.

Combined scouring & Bleaching	Enzyme, Scouring & Bleaching	Enzyme bleach	Grey Bleach
Batch-1	Batch-2	Batch-3	Batch-4
	Scouring:	Enzyme- 2 g/l	Seques. Agent- 2 g/l
Seques. Agent- 2 g/l	Seques. Agent- 2 g/l	Detergent- 1 g/l	Detergent- 1 g/l
Detergent- 1 g/l	Detergent- 1 g/l	Time- 40 min	H <sub>2</sub> O <sub>2</sub> (50%) - 6 g/l
H <sub>2</sub> O <sub>2</sub> (50%) - 6 g/l	Caustic soda- 1 g/l	Temperature-60 <sup>o</sup> c	Soda ash- 4 g/l
Soda ash- 4 g/l	Soda ash- 4 g/l	M:L - 1:20	Wetting agent- 2
Wetting agent- 2 g/l	Wetting agent- 2 g/l	Wetting agent- 2 g/l	Time- 40 min
Time- 40 min	Time- 60 min	Detergent - 1 g/l	Temperature-95 <sup>o</sup> c
Temperature-95 <sup>o</sup> c	Temperature-95 <sup>o</sup> c	Caustic soda- 1g/l	pH - 10-10.5
pH - 10-10.5	pH - 10-10.5	Soda ash- 4 g/l	M:L - 1:20
M:L - 1:20	Enzyme:	H <sub>2</sub> O <sub>2</sub> (50%) - 6 g/l	
	Enzyme- 2 g/l	Time- 40 min	
	Time- 30 min	Temperature-90 <sup>o</sup> c	
	Temperature-60 <sup>o</sup> c	pH - 10.5-11	
	Bleaching:	M:L - 1:20	
	Detergent- 1 g/l		
	Wetting agent- 2 g/l		
	Na-silicate- 10 g/l		
	Caustic soda- 1 g/l		
	Soda ash- 4 g/l		
	H <sub>2</sub> O <sub>2</sub> (50%) - 6 g/l		

## 2.4 Process Recipes

Table: 1 Process recipes

## 3. Result and discussion

### 3.1 Single yarn strength test:

Batch	Strengt h @ break (N)	Elongati on @ break (mm)	Elongatio n percentag e @ break
RawJute	143.570	10.856	7.238
Batch-1	107.089	7.855	5.237
Batch-2	100.911	14.858	9.905
Batch-3	97.675	9.094	6.063
Batch-4	134.155	11.597	7.731

Batch	Tensile strengt h (N/m m)	Force@ UpYiel d (N)	Force @DownYiel d (N)
RawJute	1.436	110.914	117.386
Batch-1	1.071	103.264	100.322
Batch-2	1.009	11.796	69.725
Batch-3	0.977	81.788	71.785
Batch-4	1.342	90.320	95.909

The strength at break and Tensile strength of raw jute yarn are 143.570 N & 1.436 N/mm. After pre-treatment we found combined scouring & bleached yarn strength & tensile strength are 107.089 N & 1.0071 N/mm, scoured, bio-scoured & bleached yarn strength & tensile strength are 100.911 & 1.009, Grey bleached yarn strength & tensile strength are 134.155 & 1.342 and Bio-scoured & bleached yarn strength & tensile strength are 97.675 & 0.977. Jute is a cellulosic fiber that's why after pre-treatment it loses its strength. The breaking strength of batch 4 is highest then other batches. We saw that after scouring it loses its strength. After bleaching it loses less strength. So after single yarn strength test we saw that scouring causes losses of strength.

### 3.2 Color fastness to wash

Color change result for Reactive dyed yarn:

BATCH	Color fast to wash
Batch-1	3/4
Batch-2	3/4
Batch-3	3
Batch-4	3

Reactive dye has good affinity power to the cellulosic fiber. That's why the result of wash fastness is better with reactive dye to the jute yarn.

Color change result for Basic dyed yarn:

BATCH	Color fastness to wash
Batch-1	3
Batch-2	3
Batch-3	2/3
Batch-4	3

Color fastness to staining result for Reactive dye:

Proces s	A ce tat e	Cott on	Nyl on	Polye ster	Acry lic	Wo ol
Batch-1	4	3/4	4/5	4/5	4/5	4
Batch-2	4	3	4	4/5	4/5	3
Batch-3	4	3	4	4/5	4/5	3
Batch-4	4	3	4	4/5	4/5	3

Cotton is a cellulosic fiber. That's why it has good affinity towards Reactive dye. And Polyester, Acrylic, Acetate has good color fastness for staining

Color fastness to staining Result for Basic dye:

Proces s	Ace tate	Cot ton	Nyl on	Pol yes	Acr ylic	Wo ol
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				ter		
Batch-1	2/3	3	1/2	4	3/4	1/2
Batch-2	2/3	3	2	4	3	1/2
Batch-3	3	3/4	1/2	4	3	2
Batch-4	1/2	3	2	3/4	2/3	2

### 3.3 Absorbency test Result:

BATCH	Column test
Batch-1	40mm
Batch-2	30 mm
Batch-3	40 mm
Batch-4	35 mm

After absorbency test it has been observed that absorbency for batch 1 and batch 3 shows better absorbency due to scouring with sodium hydroxide.

## 4. CONCLUSION

This research is related to pretreatment of jute yarn and comparison of physical properties among different processes. It has been observed that scouring of jute yarn using sodium hydroxide have showed great loss of strength compare to enzyme process. The strength of grey bleached yarn is higher than other processes. But it was observed that of incase of combination scouring & bleaching the shades are brighter than non-bleached jute yarn. Bio-scoured jute yarn losses its strength after the process. On the other hand absorbency result are good. Due to the presence of lignin in the composition of jute fiber it is not suitable to do aggressive scouring.

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