Dyeing of Pretreated Jute Substrate, with Natural Dye Catechu (Katha)

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1. INTRODUCTION

Today great interest has been created in eco-friendly, biodegradable and non toxic natural products for the concern of environment. As there are risks involved during production and use of synthetic dyes, fibers and chemicals, trends towards natural textile is getting tremendous importance. Although synthetic fibers and dyes have easy care properties, light weight and durability but they have some limitations like they produce static charges which affects the skin of wearers and also causes pollution to the environment.

Jute is known as the “golden fiber”. Today jute has become one of the widely used fibers in the world. Jute has low wax content due to which it is very harsh. For this reason jute must be softened so that fibers could be separated and it must be lubricated. Suitable amount of water and oil is added to the fiber and then passed through a series of rollers until the desired change in character is attained. It is very difficult to remove the dark colour of jute but due to developments in bleaching of jute satisfactory results with little or no loss in strength and slight weight loss could be obtained. Due to these improvements, use of jute is increasing effectively. Jute could be flame proofed if it is treated with an aqueous solution of mineral salts. Often jute is combined with wool to make rugs where jute is used as backing. Being environment friendly and biodegradable enzymatic treatment of jute fabric has increased the scope in jute processing.

Natural dyes include those organic colorants which are obtained from plants animals and vegetable matter without chemical processing. They are mainly mordant dyes although some vat, solvent pigment, direct and acid types are known. Vegetable coloring matters are derived from roots. Catechu is among cheap extract form of natural dyes whose chief source is wood. It gives light brown to dark brown with acceptable fastness rating. Brown catechu is popularly used in painting as dye. Catechu is useful for arresting extra mucous discharges and checking hemorrhages. The resin obtained from heartwood of black catechu can be used to tan leather. Catechu is applied on textile material using some swelling agent enzyme mordant to see its effect on fastness properties.

Swelling agents are added to dye liquor which assists the dye to penetrate into fiber. They improve the dyeability of fiber as they help to swell the fiber and make it easier for dye molecules to enter the polymer system. Ethylene diamine, polyethylene glycol, sodium hydroxide, and liquid detergent are some swelling agents.

Enzymes are biological catalysts. They are themselves not living organism but present in living organisms. They are completely biodegraded hence eco-friendly in nature. Enzymes action is easy to control and can replace harsh chemicals. Cellulase is a

commonly used enzyme for processes such as bio- finishing, bio-polishing and softening of jute fabrics. They are also used in commercial formulation of detergents.

Mordants are the substances like aluminum, iron or tin oxide that produce permanent colour on textiles. Mordant is a colour fixative as the oxides bit the dye and hold it on fiber. They increase the fastness properties by forming a compound of dye and mordant within the fiber, Mordant are considered an integral part of natural dye and govern the colour obtained.

Most of the natural dye fastness properties ranges between lower to medium levels only, to overcome these problems, an attempt has been made in the present work to study the following:-

1. To study the effect of swelling agent, mordant, enzyme on percent dye absorption of catechu dye.
2. To optimum the condition for treatment of catechu dye and dyed jute fabric.
3. To check and compare the colour fastness properties of different dyed sample.

2. MATERIAL & METHODS

2.1 Materials

Fabric- Plain woven jute fabric having the following specification was used: weight-2.11 ounce/sq.yard; thread count-warp-15 /inch; & weft-16/inch; and thickness - .81mm
Dyes & Chemicals- Catechu dye, detergent, sodium carbonate, caustic soda, soda ash, sodium silicate, hydrogen peroxide; swelling agent:- polyethylene glycol, ethylene diamine, sodium hydroxide
Mordant: - Alum
Enzyme: - Acid Cellulose

2.2 Preparation of fabric:-

2.2.1 Scouring

The jute fabric was dipped in the bowl scouring solution 2g/l of sodium carbonate and 5g/l of soap and treated for duration of 30min. at 60˚c temperature. After scouring material being removed, the fabric was rinsed with tap water thoroughly and squeezed gently and then dried at room temperature.

2.2.1 Bleaching

Bleaching of grey jute fabric was carried out in an open bath. It was completely immersed in bleaching liquor. The fabric was treated for 2 hours at 80- 90˚c and PH between 10 and 11 and after procedure being completed; fabric was rinsed thoroughly and dried.

2.3 Selection of various variables

2.3.1 Effective dye extraction time

3gm of dye material was taken in 100ml. of water boiled for 1 hour for the determination of effective time required for maximum extraction of dye material. Then contents were

cooled at room temperature and filtered. The dye was they taken and by diluting it 8 times the optical density was obtained.

2.3.2 Effective dyeing time

The soaked dye was used for dyeing to find out the optimum dyeing time. The samples were dyed for 30 min. and 60 min, this was repeated for 24 hours soaked and 48 hours soaked dye. By taking optical density before and after dyeing, the difference in dye exhaustion was obtained .for further treatments; the best result thus obtained was used as reference.

2.4 Pretreatment of fabric

2.4.1 Swelling agent treatment

(a) Ethylene diamine treatment

Jute fabric was treated with 75 %(w/w) aqueous solution of ethylene diamine at 21˚c for 1hour with constant stirring keeping the M: L ratio at 1:30. The samples were subsequently washed thoroughly with distilled water and dried in air.

(b) Sodium hydroxide treatment

Jute fabric was treated with 7.5 N aqueous solution of Sodium hydroxide at 27˚c for 1hour with constant stirring keeping the M: L ratio at 1:30. The samples were subsequently washed thoroughly with distilled water and dried in air.

(c) Polyethylene glycol treatment

Jute fabric treated with 100g/l aqueous solution of polyethylene glycol at 60˚c for 1 hour with constant stirring keeping the M: L Ratio at 1:30 .The samples were subsequently washed thoroughly with distilled water and dried in air.

2.4.2 Enzymatic treatment

Enzymatic bath was prepared with 4% w/v acid cellulose enzyme. The PH of bath was maintained in between using sodium acetate acetic acid buffer solution into enzymatic bath. Fabric sample was introduced at room temperature keeping M: L ratio at 1:40. Then temperature of bath was raised to 45˚ c and kept for 1hour .The enzyme treated sample was then rinsed with hot water. Followed by cold water, soaped air-dried.

2.4.3 Mordanting

Jute fabric was introduced into the mordanting bath containing 5% alum at room temperature for 1 hour, keeping M: L ratio at 1:30, the sample were subsequently washed thoroughly with distilled water and dried in air.

2.5 Dyeing

The jute fabrics were dyed with dye extract keeping material to liquor ratio at 1:30 at 90˚c temperatures over 1 hour. Finally the samples were washed thoroughly with cold water Squeezed and dried.

3. RESULT AND DISCUSSION

Table 1- Selection of Dyeing Condition

Soaking Time	Dyeing Time (min.)	Optical density before dyeing	Optical density after dyeing	% dye absorption
24 hours				
a)	30	.46	.37	19%
b)	60	.48	.33	31%
48 hours				
a)	30	.63	.40	36%
b)	60	.65	.31	52%

The above table shows that when the jute fabric was dyed with catechu dye after soaking for 24 hour and 48 hour followed by 30 min. and 60 min. dyeing after each soaking time, then it was found that out of the condition taken for soaking and dyeing, maximum % dye absorption (52%) was found to be at 60 min. dyeing time after soaking the dye for 48hour which has optical density of .65.

This shows that a colour yield increase with the increase in soaking time of dye. The same is the case for dyeing time.

Table 2-Effect of Swelling Agent on Dye Uptake

Treatment	Optical density before dyeing	Optical density after dyeing	% dye absorption
Control	0.20	0.17	15%
Polyethylene Glycol	0.30	0.10	66%
Sodium Hydroxide	0.30	0.07	76%
Ethylene Diamine	0.25	0.08	68%

Above table shows that when dyeing was done after treatment of samples with three different swelling agents, then maximum percent exhaustion that is 76% was in the sample which was treated with sodium hydroxide prior to dyeing in comparison to 68% dye absorption when treated with ethylene diamine and 66% dye absorption when treated with poly ethylene glycol .It can also be seen from the table that % dye absorption.

Table 3-Effect of pretreatment (Swelling Agent + Enzyme) on Dye Uptake

Treatment	Optical density before dyeing	Optical density after dyeing	% dye absorption
Control	0.20	0.17	15%
Enzyme	0.10	0.08	20%
Polyethylene Glycol + E	0.09	0.07	22%
Sodium Hydroxide + E	0.10	0.02	80%
Ethylene Diamine + E	0.08	0.05	37%

Table shows that when the effectiveness of swelling agent in combination of enzymes was checked and compared with enzyme treatment alone then sample treated with sodium hydroxide and enzymes shows maximum dye absorption i.e. 80% which was much more than % dye absorption in samples only treated with enzymes i.e. 20%.

Table 4-Effect of pretreatment (Swelling Agent + Mordant) on Dye Uptake

Treatment	Optical density before dyeing	Optical density after dyeing	% dye absorption
Control	0.20	0.17	15%
Mordant	0.11	0.09	18%
Polyethylene glycol + M	0.09	0.07	22%
Sodium hydroxide + M	0.10	0.04	60%
Ethylene diamine + M	0.09	0.06	33%

Table shows that when jute samples were treated with swelling agent and mordant followed by dyeing then it was found that sample treated with sodium hydroxide and mordant proved to be most effective with % dye absorption as 60% which is much more than % dye absorption of sample treated with only mordant i.e. 18%.

Table 5- Colour Fastness Test of Sunlight & Washing

Dyed Method	Percent Dye Concentration	Sunlight Fastness	Fastness to Washing	
			CS	CC
Control Sample	3%	5	3	3
Polyethylene glycol	3%	5	3	¾
Sodium hydroxide	3%	5	4	¾
Ethylene diamine	3%	5	3	¾
Enzyme	3%	5	4	¾
Polyethylene glycol +E	3%	5	¾	4
Sodium hydroxide + E	3%	5	4	4
Ethylene diamine +E	3%	5	3	4
Mordent	3%	5	4	¾
Polyethylene glycol +M	3%	5	3	¾
Sodium hydroxide + M	3%	5	4	¾
Ethylene diamine +M	3%	5	3	¾

The above table shows that when all treated samples were subjected to check the fastness properties towards sunlight, then it was seen that all samples showed an excellent fastness to sunlight.

Here it shows that the samples treated with different swelling agent shows moderate fastness to colour change and noticeable colour staining and samples treated with enzyme and swelling agent with enzymes shows moderate to good fastness to colour change and slight colour staining, samples treated with mordant and swelling agent with mordant shows moderate to good fastness to colour change and slight staining.

Table 5- Colour Fastness Test of Ironing

Dyed Method	Ironing					
	Dry		Damp		Wet	
	CS	CC	CS	CC	CS	CC
Control Sample	5	5	5	5	3	4
Polyethylene glycol	5	5	5	5	3	3
Sodium hydroxide	5	5	5	5	5	5
Ethylene diamine	5	5	5	5	¾	4
Enzyme	5	5	5	5	4	¾

Polyethylene glycol +E	5	5	5	5	3	¾
Sodium hydroxide + E	5	5	5	5	4	4
Ethylene diamine +E	5	5	5	5	4	¾
Mordent	5	5	5	5	3	¾
Polyethylene glycol +M	5	5	5	5	3	4
Sodium hydroxide + M	5	5	5	5	4	4
Ethylene diamine +M	5	5	5	5	3	4

Table shows that samples have good to excellent fastness to dry and damp ironing with regard to colour change and negligible colour staining, while wet ironing showed average to good colour fastness and noticeable colour staining.

4. CONCLUSIONS

The fact that swelling agent increasing the absorbency of fabric for dyes and enzymes subsequently worked for the fastness of these dyes. Therefore combination treatment is much more beneficial than the enzymes or swelling agent treatment separately.

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