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EFFECT OF CHEMICAL TREATMENT ON THE PHYSICAL PROPERTIES OF JUTE FIBRE

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ABSTRACT

Shamim ANM, Ullah ANMA, Afroz N, Bashar MM (2011) Effect of chemical treatment on the physical properties of jute fibre**.** *J. Innov. Dev. Strategy* 5(3), 75-77.

De-lignifications are an important step for jute fibre to make fine yarn. An investigation is described in which an attempt was made to elucidate the influence of lignin association in jute fibres, after a progressive delignification treatment, by means of scanning electron microscopy. De-lignifications of NaOH treated jute fiber was considered in this paper. Naturally weathered jute fibres were chemically modified using various treatments. The effects of bleaching with hydrogen peroxide (H_2O_2) and de-lignifications by sodium hydroxide or potassium hydroxide treatments on the reflectance, fineness and tensile properties were studied in Noakhali Textile Engineering College. The brightness of jute is found to be improved most effectively with minimum loss of tensile strength by bleaching with H_2O_2.

Key words: *lignin, fibre, yarn, jute, de-lignification*

INTRODUCTION

Jute is a natural biodegradable fibre with advantages. The demand of natural biodegradable and eco-friendly fibers is rising worldwide day by day. Ramie, flax, hemp and some other vegetable fibers have been used as textile materials, but jute fiber is basically used for traditional purposes such as manufacture of sackings, hessian, carpet backing and the like. Taking account of the costliness of cotton and the shortage in sources of flax, and the challenges from the synthetic fibers in the traditional jute products market, if jute could be used to replace cotton as textile material, not only the cost could be reduced but also a new market would be provided for jute products. Jute fiber is a bast fiber obtained from the bark of jute plant containing three main categories of chemical compounds namely cellulose (58~63%), hemicelluloses (20~24%) and lignin (12~15%), and some other small quantities of constituents like fats, pectin, aqueous extract. Jute fiber is composed of small units of cellulose surrounded and cemented together by lignin and hemi-cellulose. The low cellulose content, coarseness, stiffness, low extensibility, low grip performance and some other disadvantages seriously restrict the raw jute fiber from spinning. So a series of wet chemical processing sequences are needed to improve the spin ability of jute. The qualities of the fiber and yarn mostly depend on the degumming effect. So degumming is one of the most important sequences in the chemical processing of jute (Macmillan *et al.* 1954).

The tensile strength of jute materials increased when treated with 1% and 8% solution of sodium hydroxide. They have reported that jute fibres when treated with 18% sodium hydroxide at 30^0C pronounced cream development along with longitudinal contraction of 24%-26% and lateral 40% with no loss of tensile strength. Chakrovarty has investigated that jute fibre when treated with 17.5% sodium hydroxide solution at 50^0C the formation of the crimp is intensified. He also pointed out that crimp formation of the treated jute fibres was due to partial non-uniform dissolution of its constituents. Crimp developed in jute fibres was not only due to preferential dissolution of hemicellulose and other chemical constituents but also to the swelling of cellulose in the jute cells (Shaha *et al.* 1961).

The mechanical methods such as steam explosion microwave and ultrasonic have very limited effect on improving the spin ability of jute fiber. Biodegumming is an eco-friendly method has some advantages *viz.* mild conditions and high efficiency. However, the application of enzymes for degumming is hindered by some factors such as high substrate specificity, low activity stability, high cost, and low total gum decomposition. The chemical method is the most commonly used method for degumming, but this traditional method has some major disadvantages like serious environmental pollution, lengthy time required and high cost. Taking account of these problems, it is urgent to improve the degumming method for natural fibers. In this paper, we report the chemical degumming of the pre-chlorite treated jute fiber. The gum decomposition and the spin abilities *viz.* fineness, bundle strength and breaking twist and reflectance were tested (Samajpati *et al.* 1979).

MATERIALS AND METHODS

Jute: Four types of jute namely variety: O-9897, OM-1, CVE-3, BJC-7370 were collected from Manikgonj station of BJRI. BWB jute, Bachh pat (immature jute) was collected from different districts of the country.

Methods

(A) Cutting/ stapling of raw jute*:* At first raw jute was cut into three main portions like top, middle and bottom manually and then these three portions were cut into 40 mm staple length by a cutting machine (Chakravarty 1962).

(***B) Chemical modification****:* Stapled jute fibers were first treated with 20% NaOH solution at room temperature for 20 minutes. The fibres were hydro extracted to recover NaOH solution. They were then washed several times with water, neutralized with dilute sulhpuric acid and finally rinsed. The fibres were then bleached with Hydrogen peroxide (H_2O_2) (10% o.w.m) at a temperature of 85^0C for 1 hr. at pH of 10-10.5. These were then washed and dried (Lewin *et al.* 1959).

RESULTS

Physical properties such as strength, breaking twist fineness and Whiteness% of top, middle and bottom portions of bachh pat (jute fibres) of four varieties like O-9897, OM-1, CVE-3 and BJC-7370 have been determined. Measured physical properties are furnished below.

Table 1. Fiber strength and fineness of different portions of collected jute fiber before treatment

Varieties	Fibre strength: pressly index(lb/mg)				Fineness/Diameter (µ)		
	Statistics	Top	Middle	Bottom	Top	Middle	Bottom
O-9897	Avg	10.27	10.91	11.21	22.2	24.3	21.4
	SD	0.46	0.42	1.36			
	CV%	4.5	3.89	12.14			
OM-1	Avg	9.75	11.26	10.72	22.5	23.6	22.7
	SD	0.95	0.93	1.26			
	CV%	9.81	9.12	11.75			
CVE-3	Avg	10.60	10.63	11.50	23.4	24.3	24.4
	SD	0.75	0.97	0.99			
	CV%	7.07	8.22	8.59			
7370	Avg	11.94	11.67	10.50	26.2	24.0	27.7
	SD	0.87	0.92	1.10			
	CV%	7.35	7.95	10.49			

Table 2. Fiber strength and fineness of different portions of collected jute fiber after treatment

Varieties	Fibre strength: pressly index(lb/mg)				Fineness/Diameter (µ)		
	Statistics	Top	Middle	Bottom	Top	Middle	Bottom
O-9897	Avg	9.50	10.15	11.00	21.5	24.00	21.00
	SD	0.75	0.45	1.36			
	CV%	7.89	4.43	12.36			
OM-1	Avg	8.25	10.75	10.00	20.25	22.00	22.15
	SD	1.00	0.95	1.25			
	CV%	12.12	8.83	12.50			
CVE-3	Avg	9.00	10.25	11.00	21.15	23.00	23.75
	SD	0.65	0.85	1.15			
	CV%	7.22	8.29	10.45			
7370	Avg	10.25	10.85	10.15	24.25	22.50	26.15
	SD	0.87	0.75	1.25			
	CV%	8.45	6.91	12.32			

Table 3. Whiteness (%) and the Breaking Twist of different portions of collected jute fibre before chemical treatment

Varieties	Whiteness(%)				Breaking Twist/inch		
	Statistics	Top	Middle	Bottom	Top	Middle	Bottom
O-9897	Avg	42.50	42.00	35.25	45.12	50.25	38.16
	CV%	10.50	11.25	12.00	25.25	20.10	15.00
OM-1	Avg	50.35	48.12	25.00	28.25	15.26	27.12
	CV%	07.45	07.50	08.00	18.35	15.27	12.32
CVE-3	Avg	55.70	47.15	52.05	15.12	13.02	26.25
	CV%	09.85	12.35	17.50	11.75	09.75	13.25
BJC-7370	Avg	54.20	55.35	42.15	35.65	33.00	27.25
	CV%	11.25	12.00	09.15	10.52	07.81	09.45

Table 4. Whiteness (%) and the Breaking Twist of different portions of collected jute fibre after chemical treatment

Varieties	Whiteness (%)				Breaking Twist/inch		
	Statistics	Top	Middle	Bottom	Top	Middle	Bottom
O-9897	Avg	55.00	52.00	47.00	30.00	38.00	35.00
	CV%	15.25	25.45	21.24	25.65	17.45	28.23
OM-1	Avg	52.00	46.00	44.45	25.36	30.16	27.00
	CV%	32.15	19.25	24.00	19.17	15.54	20.25
CVE-3	Avg	45.25	47.12	28.35	35.00	30..00	31.50
	CV%	18.00	25.24	26.25	22.60	18.56	23.75
BJC-7370	Avg	55.50	44.00	42.00	22.00	25.00	23.00
	CV%	22.85	32.00	24.00	26.33	21.25	19.17

DISCUSSION

Jute and cotton fibres are completely different in nature and in their physical properties. So jute fibres were chemically treated to make them soft and improve inter fibre cohesion so as to make them suitable and compatible for blending with opened cotton. From Table 2 it is seen that strength loss of the bottom portion of different varieties from 3.3% to 6.71% for middle portion 3.75% to 7.00% and for top portion 7.69% to 15.38%. From data it is clear that top portion strength loss of the different varieties is higher than other portions. From Table 3 it is seen that whiteness (%) and breaking twist of middle portions of all varieties are better than other fibres. From Table 4 it is seen that whiteness (%) of top, middle and bottom portions of all varieties are increased and breaking twist is decreased due to bleaching and alkali treatment (Rattee and Breuep, 1974).

CONCLUSION

Jute fibre is woody, coarse, rigid, brittle and heterogeneous in nature. In contrast to cotton, silk and synthetic fibre, jute fibre is unyielding to external forces and lacks in “fibre to fibre cohesion. Chemical modification of jute fibre reduces incrustation of lignin and hemi cellulose and modifies the constitutional and dimensional properties of the ultimate fibre cell of jute fibre. Jute and cotton fibre are completely different by nature and their properties. So it is very difficult to spin together. Some chemical and mechanical processing are needed to overcome this main problem. If these problems are minimized correctly then huge amount of jute-cotton blended yarn could be produced.

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