NOTES

Some Physical Properties of Pineapple Leaf Fiber (PALF) Influencing Its Textile Behavior

INTRODUCTION

Because of the lack of adequate knowledge of the physical and chemical properties of pineapple leaf fiber (PALF), it has not been properly utilized industrially. It contains cellulose and lignin[1,2] and, as such, it can be utilized as a raw material in pulp, paper, and other cellulose-based industries over and above its use as a textile fiber.

Some physical characteristics of the fiber were measured by Ghosh and Sinha,[3] and Chakraborty et al.[4] studied its tensile behavior and observed that the bundle strength of the fiber decreased up to 50% on wetting. Datta et al.[5] found the range of its crystallinity to be from 0.63 to 0.68 and showed that its dielectric behavior was comparable to jute.[6] As very little work has been done on the mechanical properties of the fiber, this work was undertaken to examine the dependence of the mechanical properties of the fiber on the noncellulosic incrustants and moisture content.

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EXPERIMENTAL

Delignification of the samples was carried out by the chlorite method[7] and lignin content was determined according to the method of Macmillan et al.[8] Removal of hemicelluloses was carried out by treatment with NaOH solution of different concentrations. Fiber properties that are recorded in Tables I–III were determined by standard techniques.[7-12]

RESULTS AND DISCUSSION

The tensile properties in air-dry and wet conditions are recorded in Tables I and II and the hemicellulose and lignin contents of the samples are recorded in Table III. Tables I and II show that the tensile strength of PALF decreases with the removal of both the noncellulosic incrustants. The data in Tables I and II are also illustrative of the dependence of mechanical properties on humidity. The increase in humidity results in a decrease in tenacity and Young's modulus and an increase in extensibility. Tables I and II are also indicative of the contribution of

Table I Tensile Properties of Raw and Chemically Modified PALF at 65% Relative Humidity

Sample	Fineness (tex)[a]	Av Br. Tenacity (g/tex)	C.V.[b] (%)	Av Br. Extension (%)	Initial Modulus (g/tex)
Raw	2.3	43.5	24.2	2.9	1500.0
5% NaOH tr.	2.1	39.8	23.6	3.4	1170.6
10% NaOH tr.	1.9	36.5	22.8	4.9	744.0
18% NaOH tr.	1.6	33.8	24.6	5.7	593.0
0.5% $NaClO_2$ tr. at 45°C	2.2	38.3	25.3	3.1	1235.5
0.5% $NaClO_2$ tr. at 80°C	2.1	32.7	23.5	3.2	1021.9
0.7% $NaClO_2$ tr.	1.9	28.9	21.9	3.4	850.0

[a] Tex = the weight in grams of 1 km of fiber.
[b] C.V. (%) = the standard deviation (σ) as a percentage of the mean (σ/x × 100).

Table II Tensile Properties of Raw and Chemically Modified PALF at 95% Relative Humidity

Sample	Fineness (tex)	Av Br. Tenacity (g/tex)	C.V. (%)	Av Br. Extension (%)	Initial Modulus (g/tex)
Raw	2.5	38.8	24.4	3.2	1212.5
5% NaOH tr.	2.3	34.4	24.3	3.6	955.6
10% NaOH tr.	2.1	31.5	23.1	5.5	572.7
18% NaOH tr.	1.8	28.8	22.7	6.8	423.5
0.5% $NaClO_2$ tr. at 45°C	2.4	34.0	23.6	3.2	1062.5
0.5% $NaClO_2$ tr. at 80°C	2.3	29.0	25.0	3.4	852.9
0.7% $NaClO_2$ tr. at 80°C	2.1	25.3	21.7	3.7	683.8

Table III Hemicellulose and Lignin Content in Raw and Chemically Treated Pineapple Leaf Fibers

Sample	Hemicel (%)	Lignin (%)
Raw	18.80	6.04
5% NaOH tr.	11.16	5.44
10% NaOH tr.	07.73	5.04
18% NaOH tr.	07.10	4.98
0.5% $NaClO_2$ tr. at 45°C	15.60	2.84
0.5% $NaClO_2$ tr. at 80°C	14.80	2.09
0.7% $NaClO_2$ tr. at 80°C	13.20	1.80

The calculations are based on an oven-dry condition.

both lignin and hemicelluloses to the strength of the fibers. The data in both these tables indicate that lignin has a greater role to play than does hemicellulose toward development of strength in the fiber.

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