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Short Communications

Chemical resistance and tensile properties of epoxy-coated bamboo fibres

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The chemical resistance and tensile load at break of bamboo fibres (*Dendrocalamus strictus*) before and after coating with a high performance epoxy resin (Araldite LY 5052/Hardner 5052 system) have been studied. It is observed that the tensile load at break and chemical resistance of bamboo fibres increase on coating, indicating that epoxy resin and bamboo fibres are favourable materials for making the composites.

Keywords: Bamboo fibre, Composites, *Dendrocalamus strictus*, Epoxy resin, Tensile load

Several studies[1-7] on the composites made from epoxy matrix and natural fibres like jute, wood, banana, sisal, cotton, coir and wheat straw have been reported in the literature. Jindal[8] studied the development of bamboo fibre reinforced plastic composites using Araldite (Ciba-CY 230) resin as matrix. Though bamboo is extensively used as a valuable material from times immemorial because of its high strength and low weight, the studies on this fibre are meagre. In the present study, the bamboo fibres (*Dendrocalamus strictus*) have been coated with a high performance Araldite LY 5052/Hardner 5052 system and their chemical resistance and tensile load at break studied to ascertain whether this matrix-fibre system can be effectively used for making the composites.

Bamboo fibres (*Dendrocalamus strictus*) were procured from Tripura in the dried form. The fibres were soaked in 1% aqueous NaOH solution for 30 min to remove any greasy material and lignin, washed thoroughly in distilled water and dried under the sun for two weeks. The fibres were 22 cm long having rectangular cross-section and thickness varying from 0.1 mm to 0.6 mm. The fibres with a thickness of 0.2 mm were selected and cut to a length of 15 cm for studying tensile load at break and to 2 cm for studying chemical resistance.

Glacial acetic acid, conc. nitric acid, conc. hydrochloric acid, conc. ammonium hydroxide, aqueous sodium carbonate (20%) and aqueous sodium hydroxide (60%) were used. The solvents benzene, carbon tetrachloride and toluene were dried using calcium chloride before use. The resin matrix system, Araldite LY 5052/Hardner 5052, supplied by M/s Hindustan Ciba-Geigy, was used.

For tensile test, the dried bamboo fibres were soaked in the resin and hardner mixture taken in the ratio of 100 and 38 parts by weight respectively. The soaked fibres were then hanged on a wooden frame in the vertical position and kept in a vacuum oven, maintained at 65°C, for 18 h to complete the curing.

For chemical tests, the short fibres were soaked in the resin mixture. The excess resin was removed by placing the fibres in vertical position. The fibres were then placed on glazed polyester sheet and cured as described above.

The tensile load at break of the bamboo fibres with and without epoxy coating was determined using Mikrotech Tensometer employing disc wire chucks. Ten samples were tested in each case and the average tensile load determined.

The chemical resistance of the bamboo fibres with and without epoxy coating was studied using ASTM D543-87 method[9]. In each case, ten preweighed samples were dipped in the respective chemical for 24 h, removed and immediately washed with distilled water and dried by pressing them between the filter papers. The treated samples were then weighed and the % weight loss/gain was determined.

The average tensile load at break of the bamboo fibres before and after coating with epoxy resin was found to be 1.41 kg and 3.4 kg respectively (the average thickness of the coating being 100 μm), thus showing an improvement of 140%.

The per cent weight loss/gain for the fibres treated with different chemicals is shown in Table 1. It is observed that on acetic acid treatment, both uncoated and coated fibres show gain in weight. Uncoated fibre shows 29% weight gain, indicating the inclusion of acetic acid in the samples. Epoxy-coated fibre shows 80.6% weight gain. This is understandable as the corsslinked

Table 1 — Resistance of bamboo fibres to chemical reagents

Chemical	% change in weight after dipping for 24 h	
	Uncoated fibre	Coated fibre
Acetic acid	+29.0	+80.6
Hydrochloric acid	−14.6	+26.8
Nitric acid	Completely dissolved	+54.4
Sodium hydroxide	−14.5	+21.1
Sodium carbonate	−36.6	+16.0
Ammonium hydroxide	−10.7	+21.6
Benzene	−35.8	+18.1
Carbon tetrachloride	−36.5	+17.6
Toluene	−19.1	+29.4

epoxy does not dissolve in many chemicals but only swells as it is chemically inert.

In all the other chemicals, a decrease in weight is observed for uncoated fibres whereas reverse is the trend for epoxy-coated fibres, indicating swelling of the epoxy layer because of crosslinking. The loss in weight indicates the corrosion of uncoated fibres due to chemicals. In nitric acid treatment, uncoated fibres completely dissolved within 150 min.

The above observations clearly indicate that the tensile load at break and chemical resistance of bamboo fibres increase on coating them with Araldite LY 5052/Hardner 5052 system.

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