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The Mechanical / Chemical Properties / SEM Analysis of Natural Reinforced Hybrid Composites

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Abstract: **The chemical, impact, tensile properties of Bamboo/Grass/Onion fibres reinforced polyester hybrid composites were studied. The effect of alkali treatment for Bamboo/Grass/Onion fibres on these properties was also studied. It was absorbed that tensile properties of hybrid composites increase with bamboo fibre content. These properties found to be higher when alkaline treated bamboo fibres were used in the hybrid composites. The elimination of amorphous hemi – cellulose with alkali treated leading to higher crystallinity of the bamboo fibres with alkali treatment may be responsible for these observations. The effect of alkali treatment on the bonding between Bamboo/Grass/Onion fibres was also studied. The chemical resistance of Bamboo/Grass/Onion reinforced polyester composites to acetic acid, nitric acid, hydrochloric acid, sodium hydroxide, sodium carbonate, benzene, toluene, carbon tetrachloride and water was studied. The bonding between fibres and matrix was studied by metallographic (Scanning Electron Microscope) analysis.**

***Key Words*— Bamboo Fiber, Grass Fiber, Chemical Resistance, Polyester, Tensile Strength, Impact Strength.**

1. INTRODUCTION

Several studies on the composites made from different matrices and natural fibres like Bamboo, Grass, Banana for bugass were reported in the literature. Jindal [1] reported the development of Bamboo fiber reinforced plastic composites using araldite (CIBA CY 230) resin as matrix. Though, Bamboo is extensively used as a valuable material from times immemorial. The studies on this fiber reinforced plastics are meager. In this present work Bamboo, Onion and Grass fiber reinforced high performance polyester hybrid composites were developed and their tensile, impact and chemical properties were studied (with varying ratio of Bamboo / Grass / Onion fiber). The author also investigated the chemical properties of these fibres.

2. MATERIALS AND METHODS

High performance polyester resign and the curing agent hardener HY 951 system were used as the matrix. Bamboo fibers / Grass fiber / Onion fiber were soaked in 1% NAOH solution for 30 Minutes to remove any greasy material and hemicelluloses, washed thoroughly in distilled water and dried under the sun for one week.

2.1 Preparation of Mould

For making a composite, a moulding box was prepared with glass of 200mm x 200mm x 3mm (Length x Width x Thickness).

Preparation of Composite and the Test Specimens: the mould was coated with a thin layer of aqueous solution of Poly Vinyl Alcohol (PVA) which acts as a releasing agent. Further a thin coating of hard wax was layed over it and finally another thin layer of PVA as coated. Each coat was allowed to dry for 20 min in at r00m temperature. Then, the moulding was loaded with the matrix mixture, Bamboo, grass & Onion in random orientation (with varying percentage) and was placed in a vacuum oven which is maintained at 1000 for three hours to complete curing. After curing the plate was removed from the moulding box. With simple tapering and it was cut into samples for impact test with dimensions 120mm X 13 mm x 3mm are cut ASTM specifications. For tensile stress the sample was prepared 150 x 20x 3. And for chemical test with dimension 10mm x 5mm x 5mm. for comparison sake the specimen for matrix are also prepared in similar lines.

2.2 Tensile and Impact Load Measurement

The tensile strength was determined using instron 3367 model UTM. The cross head speed for tensile test was maintained at 10mm/min. The temperature and humidity for this test were maintained at 180 and 25% respectively. In each case five samples were tested and average values are reported.

The impact strength is determined using IZOD impact tester. The test specimens with dimensions 120mm × 13mm × 3 mm are cut as per ASTM D 256-88 specifications. In each case five specimens are tested and average value is recorded.

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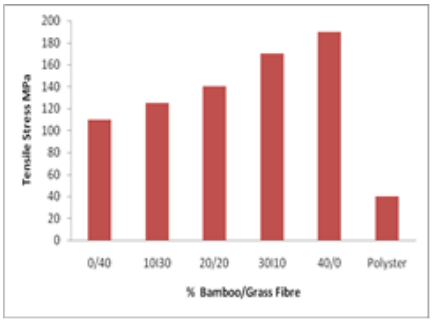

Fig. 1 % of Fibre (Bamboo/Grass) vs Tensile Stress

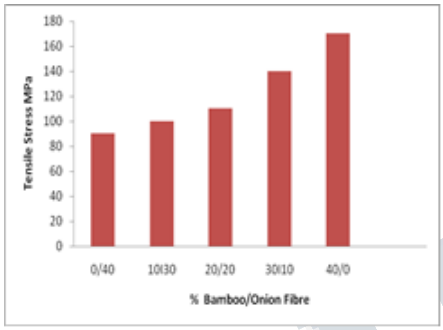

Fig. 2 % of Fibre(Bamboo/Onion) vs Tensile Stress

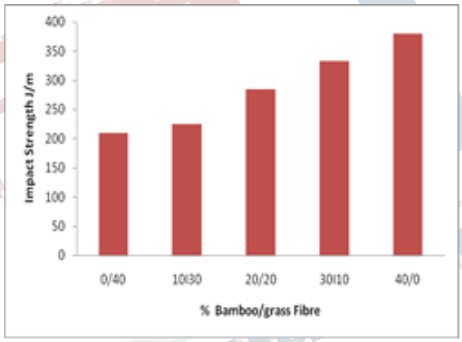

Fig.3 % of Fibre (Bamboo/Grass) vs Impact Strength

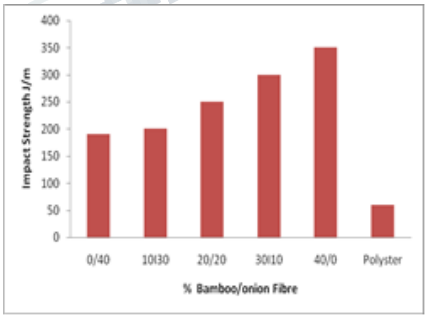

Fig.4 % of Fibre(Bamboo/Onion) vs Impact Strength

2.3 Chemical Resistance of Composites:

The chemical resistance of the composites was studied as per ASTM D 543-87 method. For chemical resistance test, the acids namely concentrated hydrochloric acid (10%), concentrated nitric acid (40%) and glacial acetic acid (8%), the alkalis namely aqueous solutions of sodium hydroxide (10%), ammonium hydroxide (10%) and sodium carbonate (20%) and the solvents- Benzene, Carbon tetra chloride, Toluene and Water were selected. In each case, ten pre-weighted samples were dipped in the respective chemicals under study for 24 hours, removed and immediately washed thoroughly with distilled water and dried by pressing them on both sides by filter papers. The final weight of the samples and % weight loss/gain was determined. The resistance test was repeated for ten samples in each case and the average values are reported.

Table -1 Resistance of Hybrid (Bamboo/Grass) composite reinforced Polyster to chemical regents

% of change in weight after immersion for 24 Hours

Chemical	Matrix	Composite
40 % nitric acid	+0.1359	+0.22491
10% Hydrochloric acid	+0.7665	+0.21491
8% Acetic acid	+0.1965	+2.1299
10% sodium hydroxide	-0.3361	-2.2191
20% sodium carbonate	+0.477	-3.2756
10% Ammonium Hydroxide	- 0.1973	-2.2185
Benzene	-1.171	-1.146
Toluene	-0.491	-1.960
Carbon tetrachloride	-0.834	+3.4458
Water	-0.812	-0.926

2.4 SEM Analysis:

To probe the bonding between the reinforcement and matrix, the Scanning Electron micrograms of fractured surfaces of Bamboo, Onion, and Grass reinforced polyester composites were recorded. These micrograms were recorded at different magnifications and regions. The analysis of the micrograms of the composites prepared under different conditions is presented in the following paragraphs.

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Fig. 5(a)

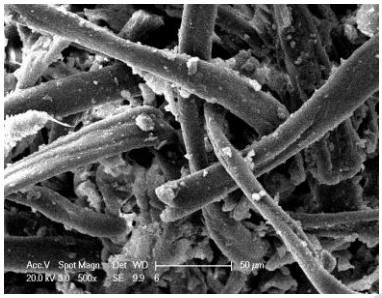

Fig. 5(b)

Fig. 5(a) & (b) represents the fractograms of bamboo/Grass fibre, Bamboo/Onion with a magnification of 200x

3. RESULTS & DISCUSSION:

The variation of Tensile stress with percentage Bamboo / Grass / Onion fibre ratio is presented in Fig.1 & 2 respectively. For comparison these values for the matrix are also presented in the same figure. From both these figures it is evident that the tensile properties are enhanced when Bamboo fibers percentage was increased in the hybrid composites. This is understandable as the hemi cellulose and lignin contents decrease leading to higher percentage of crystalline α–cellulose in bamboo fibers on alkali treatment. The minimum and maximum values of tensile stress for these composites are found to be 80 and 180 MPa respectively. Similar observation was made by Varada Rajulu et a1 [2-7] in the case of some fiber composites and polymer coated bamboo fibers. The variation of impact strength with % of Bamboo fibre in these composites represented in fig 3 and 4. In this case also the hybrid composites are found to have good impact properties with bamboo fibre % increases.

CONCLUSION:

The hybrid composites of bamboo/ Grass /Onion fiber reinforced polyester were made and their Tensile and impact and chemical resistance properties were studied. The effect of bamboo percentage on these fibers properties was studied. These hybrid composites were found to exhibit good tensile, impact and chemical resistance properties. The hybrid composites with bamboo fibers were found to possess higher tensile, impact properties. The composites were found to be resistant to some acids, alkalis and solvents. The elimination of amorphous weak hemi cellulose components from the bamboo fibers may be responsible for this behavior.

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