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Impact and Chemical Properties of Natural Fiber Reinforced Polyester Composites

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ABSTRACT: In this work the natural fiber sample of Indian black wood (*Hardwickia Binata*) of *Caesal Pinceae* plant family skin species are collected from BIRLUTY Check Post of NALLAMALA FOREST. The fiber composites are made by reinforcing the *hardwickia* with polyester matrix. The Impact test is carried out by Izod Impact Tester to evaluate the impact strength of composite. The work of chemical test is carried out to evaluate the property of reacting with composite which might enhance or reduce the composite. The chemical resistance of *hardwickia binata* reinforced polyester composites to acetic acid, Nitric acid, Hydrochloric acid, Sodium hydroxide, Sodium carbonate, Benzene, Toluene, Carbon tetrachloride and Water was studied. By this alkali treatment the Mechanical properties are clearly studied, some alkalies may reduce and some alkalies might enhance the properties.

KEYWORDS: *Hardwickia Binata*, *Caesal Pinceae*, Reinforcing, Polyester, Izod Impact Tester .

I. INTRODUCTION

In making composites there requires a reinforcement phase and strong matrix phase. In making Fiber reinforced plastics (FRP) are made by different reinforcements. Several studies are made on fiber reinforced glass fibers such as chopped glass, rovings, woven rovings etc. And different experiments are carried out natural fiber composites also such as sisal, bamboo, banana, roselle, hemp, jute etc. In every Automobile and Aircraft accessories manufacturing industries, the fibers like glass and natural fibers are adopted due to their withstand nature to different conditions and exhibit desirable properties when combined with some other materials. Now the usage of FRP products came into existence which possess desirable properties such as less weight, high strength, low cost etc. Due to the light weight high durable nature and corrosion resistant nature the parts and hull of ferri and ship hull are made by glass fiber reinforced plastics. In this work the natural fiber Indian black wood (*Hardwickia Binata*) is reinforced with polyester matrix. By the alkali treatment of *Hardwickia Binata* the amorphous hemi cellulose eliminated from the fiber this leads to higher crystallinity nature. And in preparing the test specimens the fiber volumes are considered as (5,10,15,20)gms of *hardwickia binata*.

II. MATERIAL

The high performance polyester resin LY 556 with catalyst and accelerator are mixed in a proportion of 10:1 as matrix. The fibers *hardwickia binata* are collected from birluty check post of Nallamala forest, Andhra Pradesh. These fibers are soaked in 1 % of NaOH solution for about 30 min to remove the hemi cellulose and greasy material and then wash with distilled water and dried under the sun for one week.

III. EXPERIMENTAL SET UP

Dimensions of Mould

For making the composites, a Moulding box was prepared with glass with 200mmx200mmx3mm mould (lengthx width x thickness) is shown in Fig 1.

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Fig 1. Model of Glass Mould

Preparation Of Mould

The mould cavity was coated with a thin layer of aqueous solution of Poly Vinyl Alcohol (PVA) which acts as a good releasing agent. Further a thin coating of hard wax was laid over it and finally another thin layer of PVA was coated. Each coat was allowed to dry for 20 min at room temperature. A 3mm thick plate was made from the polyester and hardener taken in the ratio of 100 and 10 parts by weight respectively. The samples of araldite and hard wax are shown in Fig.2.



Fig 2. Araldite and Hard wax

Impact Test Using Izod Impact Tester

A. Testing of Specimen by using izod Impact Tester

Impact test was performed to evaluate the impact strength. A specimen of rectangular shape with standard specification was cut from the composite plate ready made. The load at break was noted from the scale after failure. The same procedure was repeated for other specimens cut from the same composite plate. Later, the average load at the break was noted and impact strength. 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.

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Chemical Testing

The chemical resistance of the composites was studied as per ASTM D 543-87 method.

$$W = \frac{w_2 - w_1}{w_1}$$

W-weight of final sample.

w₂-weight of treated sample.

w₁- weight of untreated sample.

IV. EXPERIMENTAL RESULTS

Impact Testing

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. The specimens are shown in Fig.3.



Fig 3. Samples of impact testing

The IZOD Impact tester consists of a pendulum of known mass and length that is dropped from a known height to impact a notched specimen of a material. For this test a notched specimen is fixed between supports. The machine with following specifications is shown in Fig.4.

Display	:	Digital Indicating Unit.
Scale range	:	2,4,7.5,15,25 Joules.
Hammers	:	Two.
Power supply	:	230V AC, 50Hz, Single Phase.

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Fig 4. Izod Impact Tester

Table 1
Impact Testing Values Of Hardwickia Binata

% of Volume Fraction of Fiber Composite	Impact Strength	
	Kgcm/cm(ASTM)	Joule/m(SI)
0(pure polyester)	0.15	50
5gms	0.54	180.52
10gms	1.24	400.06
15gms	0.95	316.68
20gms	1.94	646.66

The values are impact testing values of specimens. The volume fraction of fiber are taken as 5,10,15,20 gms. First the pure polyester is tested and then the fiber reinforced composites are test at different fiber volume fraction. And by the reinforcement of natural fiber Hardwickia Binata the values of impact strenth are increased are shown in Table 1.

Chemical Testing

The chemical resistance of the composites was studied as perASTM 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-eighted 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. The weights of treated, untreated and final weights are represented in Table 2.

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Table2
Values Of Chemical Testing Of Hardwickia Binata

Chemicals	W ₁	W ₂	$W = \frac{w_2 - w_1}{w_1}$
40% nitric acid	0.28	0.21	-0.2550
10% Hydrochloric acid	0.16	0.18	+0.1250
8% Acetic acid	0.17	0.20	+0.1764
10% sodium hydroxide	0.17	0.22	+0.2941
20% sodium carbonate	0.19	0.22	+0.1578
10% Ammonium Hydroxide	0.26	0.20	-0.2307
Benzene	0.16	0.23	+0.4375
Toluene	0.16	0.20	+0.2505
Carbon tetrachloride	0.17	0.23	+0.3529
Water	0.20	0.21	+0.0500

W-weight of final sample.

w₁- weight of untreated sample.

w₂-weight of treated sample.

V. CONCLUSION

The Impact Strength of fiber is more at 20% volume fraction of fiber when compared to 5,10,15% fiber volume fractions. The effect of alkali treatment of harwickia binata properties were studied. These composites were found to exhibit good impact and chemical resistance properties. The composites with alkali treated fibers were found to possess higher 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 fibers on alkali treatment may be responsible for this behavior.

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