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Exploration of Tensile, Flexural and Chemical Inertness Properties of Sisal Fibre Reinforced Polymer Composites-Surface Analysis

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ABSTRACT

Our Experimentation finds, reaction of fibre external analysis on tensile, flexural and chemical resistance properties were studied for sisal fibre reinforced composites.

Fibre surface analysis has done to produce link between fibre and the matrix to improve the mechanical properties. Fibre surface analysis were done by boiled the sisal fibres in different % of NaOH and treated the fibres in different % of NaOH, treated in acetic acid and methanol.

Polyester resin have used as the matrix for preparing the composites and these properties for Natural sisal fibre reinforced composites were also studied. From the results it was observed that 25% NaOH boiled sisal fibre reinforced composites have higher tensile, flexural properties than other composites. Natural sisal fibre composites show fewer properties than treated composites. Chemical inertness properties indicate that all sisal fibre reinforced composites are resistance to all chemical agents except carbon tetra chloride.

Keywords : Sisal fibre, Surface treatment, tensile properties, Flexural properties, Chemical resistance properties.

I. INTRODUCTION

A polymer matrix composite is a composite material composed of a variety of short or continuous fibers bound together by an organic polymer matrix. PMCs are designed to transfer loads between fibers of a matrix. Some of the advantages with PMCs include their lightweight, high stiffness and their high strength along the direction of their reinforcements. Other advantages are good abrasion resistance and good corrosion resistance.

Fiber-reinforced PMCs contain about 60 % reinforcing fiber by volume. The fibers that are commonly found and used within PMCs include fiberglass, graphite. Fiberglass has a relatively low stiffness at the same time exhibits a competitive tensile strength compared to other fibers. The cost of fiberglass is also dramatically lower than the other fiber which is why fiberglass is one of the most widely used fiber. The reinforcing fibers have their highest mechanical properties along their lengths rather than their widths. Thus, the reinforcing fibers

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maybe arranged and oriented in different forms and directions to provide different physical properties and advantages based on the application.

The effect of surface modification of sisal fibres on the mechanical properties like tensile and flexural properties of sisal fibre reinforced composites. The tests are carried out as per the ASTM standards. This paper consists of Natural and different treated sisal fibre reinforced composites. Chemical inertness tests are carried out to find the ability of a composite to withstand exposure to acids, alkalis, solvents and other chemicals.

Sisal fibres obtained from local sources and resin supplied by Allied marketing Ltd, Hyderabad was used as a matrix, methyl ethyl ketone peroxide as a catalyst and cobalt naphtanate as an accelerator supplied by M/S/ Bakelite Hylam, Hyderabad. The styrene monomer is used as linking agent and PVA used as mould releasing agent. NaOH was used for external analysis of sisal fibres.

II. METHODS

External Modification of Sisal Fibres by Boiled and Treated with 5, 10, 15 and 20% wetting thoroughly in NaOH.

To make use of sisal fibre reinforcement in composites, fibre external analysis must be done to obtain an enhanced interface between the hydrophilic sisal fibre and the hydrophobic polymer matrices. Natural fibres are chemically treated to remove lignin, waxy substances, and natural oils covering the external surface of the fibre. Sodium Hydroxide (NaOH) is the chemical for bleaching and/or cleaning the surface of plant fibres. During alkalization,

Here sisal fibres has boiled in the different concentrations (5, 10,15 and 20%) of NaOH solution for 45 mins to remove the soluble greasy material in order to enhance the adhesion characteristics between the fibre and the matrix.

For Sodium Hydroxide analysis, the sisal fibers were dipped into different concentrations (5, 10, 15 and 20 %) of the NaOH solution and 25% acetic acid and methanol for 3 h. The boiled and treated fibers were washed with water to remove the excess of NaOH sticking to the fibres. The fibres are cut into 2.5 cm length for molding the composites.

PRODUCTION OF COMPOSITES

Polyester and styrene were mixed in the ratio of 80:15 parts by weight respectively. Later, 2 wt% methyl ketone peroxide and 2 wt% cobalt napthenate have added and mixed deeply. Diced 2.5 cm length of sisal fibres with different analysis have used to prepare the composites.

The fiber is added to matrix mixture, which is poured in the mould and air bubbles are removing with a roller. The castings were allowed to cure for 24to 48 hrs.' at room temperature, and cured at 90 ℃ for 2 h. Hand lay-up method is used to making the composites.

TESTING

TENSILE AND FLEXURAL PROPERTIES

The tensile and flexural strength, tensile and flexural modulus of the matrix as well as sisal fibre reinforced composites has found by using an UTM Machine. The tensile test has conducted as per ASTM standards specification and flexural test also as per ASTM standards.

CHEMICAL INERTNESS PROPERTIES

Here ASTM G 548–93 used to find the chemical inertness of the composites. The effect of chemical agents, alkalies and solvents like acetic acid, nitric acid, Hcl, ammonium hydroxide, NaoH, aqueous sodium hydroxide, carbon tetra chloride are used on the matrix and hybrid composites.

In all tests, the samples were pre-weighed in a precision electrical balance and soaked in the respective chemical agents for 48 hrs and suddenly washed in distilled water and dried room temperature. The tested samples are re-weighted and % of loss/gain has found.

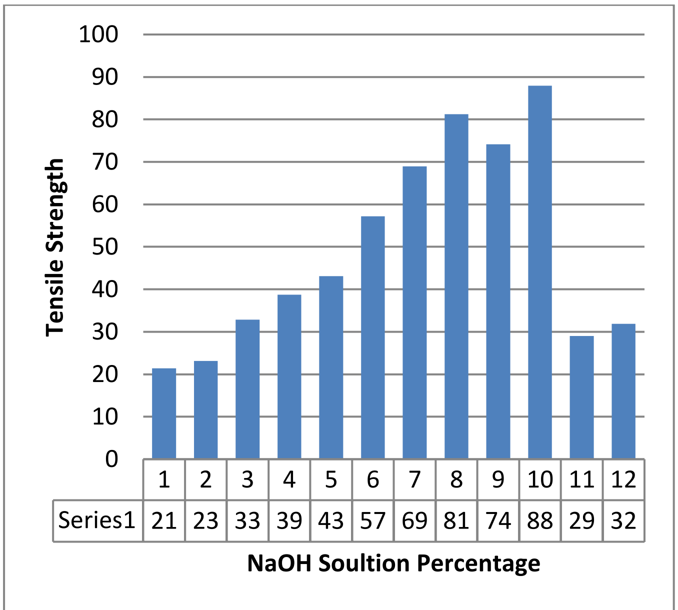
III. RESULTS AND DISCUSSIONS

TENSILE AND FLEXURAL PROPERTIES

The end result of surface analysis on tensile, flexural and chemical inertness have studied for sisal fibre composites and compared with Natural fibre composites. The tensile and flexural strength, tensile and flexural modulus sisal fibre composites with different treatments illustrated in Table No i.

The effect of different treatments (5, 10, 15 and 20% NaOH boiled and treated, acetic acid treated, and methanol) of sisal fibre on the tensile and flexural strength of sisal fibre composites in Graphs. 1 and 2. From these table and graphs, it has found that tensile, flexural properties are more when the fibre was boiled with 20% of NaOH and matrix shows low properties than other composites.

Natural composites show lower properties than other treated composites. In graph shows that the tensile and flexural strength increases with increasing the NaOH solution



Graph(i): Tensile Strength vs NaOH Solution

Samples	Tensile strength (MPa)	Tensile modulus (GPa)	Flexural strength (MPa)	Flexural modulus (GPa)
Matrix	21.42	0.98	56.11	1.00
Natural	23.16	1.87	65.87	3.85
5% NaOH treated	32.84	1.53	76.33	4.12
5% NaOH boiled	38.75	1.78	84.18	4.53
10% NaOH treated	43.12	1.75	90.11	4.78
10% NaOH boiled	57.16	1.84	106.61	4.97
15% NaOH treated	68.93	1.90	113.64	4.64
15% NaOH boiled	81.22	1.93	137.78	6.12
20% NaOH boiled	74.13	1.95	118.92	4.85
20% NaOH treated	87.91	1.98	139.75	6.87
25% Acetic acid treated	28.98	1.46	63.13	3.55
Methanol treated	31.89	1.57	69.41	4.31

Table (i) Tensile and flexural strength of sisal fibre reinforced composites.

Chemical Resistance Properties

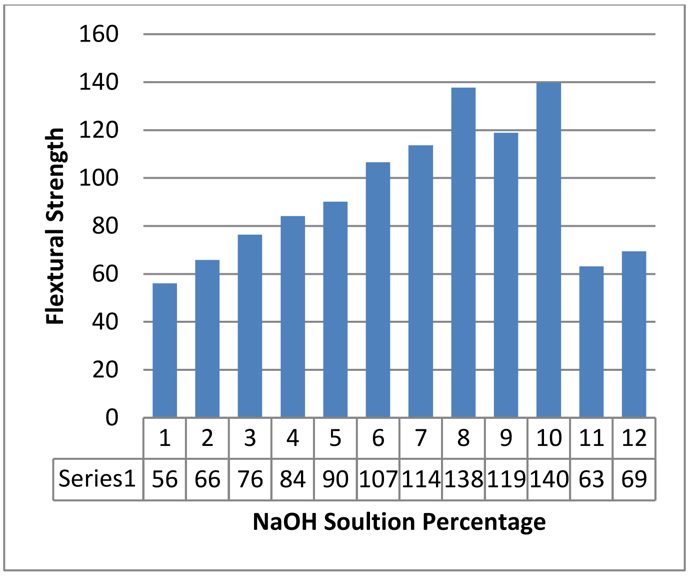
Table (ii) shows the % wt gain/weight loss of the matrix for Natural and different treated sisal fibre composites.

This deeply shows that the matrix composites have not loss the weight and the weight increment shows that swelling of the composite by the adding of the chemicals is taking place, instead of erosion, In General weight increase larger due to the hydrophobicity of fibre for the water or other solutions.

In all tests, the % of weight gain is more when the fibre was treated with alkali. It is visible data from the table that all composites are resistant to water and all the chemical agents except carbon chloride. The back end is attack of chlorinated hydro carbons linking by polyesters. In these navigations composite can thought for making water and chemical agent reservoirs.

INFERENCE

Here, unsaturated polyester based sisal fibre reinforced composites have made by hand lay-up experimentation. The end result of surface analysis of sisal fibre on tensile, flexural and chemical inertness properties of sisal fibre reinforced composites have found. 20% NaOH boiled sisal fibre reinforced composites keep more tensile and flexural strength, and more temperature generates a more rough surface landscape. This landscape gives good fibre–matrix boundary adhesion and an increase in mechanical assets of the composites. From the chemical inertness test, it has inferred that all composites have resistance to all chemicals except carbon tetra chloride.



Graph(ii): Flextural Strength vs NaOH Solution

Table (ii) Chemical inertness properties of sisal fibre reinforced polymer composites

Chemicals	Weight gain (+)/loss (-)									
	Matrix	Natural	5% NaoH Treated	5% NaoH Boiled	10% NaoH Treated	10% NaoH Boiled	10% NaoH Treated	10% NaoH Boiled	CH3COCH 25%	Methyl
C6 H5 Cl	0.742	0.234	0.255	0.659	0.445	0.723	0.220	0.294	0.553	0.385
Sodium hydroxide	0.625	0.172	0.541	0.979	0.924	1.125	1.594	0.414	0.745	0.741
CCl_4	−0.652	−0.218	−0.790	−0.540	−0.211	– 1.223	– 0.114	– 0.363	−0.331	−0.442
H_2O	0.641	0.982	0.490	0.919	0.554	0.774	0.35	1.628	4.205	2.021
CH3 COCH (10%)	0.513	0.112	0.660	0.796	0.878	1.552	0.353	0.335	2.100	1.256
HCL (10%)	0.222	0.543	0.644	0.734	0.823	1.063	0.759	0.543	1.480	1.554
HNO3 + HCl (45%)	0.326	0.312	0.560	0.573	0.414	0.424	0.539	0.726	0.620	0.921
NaOH (10%)	0.512	0.735	0.850	0.581	0.357	0.522	0.290	1.935	1.153	2.923
HCON(CH3) (5%)	0.001	0.314	0.852	1.028	1.054	0.625	0.719	0.312	2.183	0.356
CH3 CH2 OH (10%)	0.642	0.754	1.391	1.330	1.614	1.613	0.816	0.898	1.887	0.912

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