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Effect of Alkaline Treatment on Mechanical and Thermal Properties Oftypha Angustifolia Fiber Reinforced Composites

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Abstract - Sustainable development is increasingly becoming a priority of governments and businered which is driven by growing environmental awareness. Much academic research explores new ways to create greener and environmentally friendlier materials for variety of aplications ranging from aeronautic, automotive and construction industry. The natural fibre reinforced composite has the advantage of being light weight, availability, strong, cheap, safe, ease of recycling, sustainability, renewability hermal and acoustic insulation, saving of fabrication energy and carbon dioxide neutrality.

The composites are molded with unsaturated polyester resin matrix and reinforced with natural fibre. Five identical specimens are prepared for each fibre content. In this study, mechanical properties of composite such as tensile strength, tensile modulus were measured using universal testing machine. Guarded hot plate apparatus was used to measure the thermal conductivity of natural fibre typha angustifolia reinforced composite.. The results shows that mechanical properties, increased as fiber content increased. Thermal conductivity of composite is in the range of 0.168 w/m k to 0.187 w/m k and thermal conductivity decreased about 11.3% as fiber content increased. The newly developed composite material has lower thermal conductivity and is used as an insulating material to save energy.

Keywords - *Natural composites,Typha angustifolia fiber,Reinforced composites,Effect of Alkaline Treatment..*

I. INTRODUCTION

The use of natural fibers has been documented since their use by the Egyptians 3,000 years ago but since the 1970s a number of high tech synthetic fibers such as glass, aramid and carbon have entered and dominated the composite market because of their superior mechanical and thermal properties. With increasing environmental concerns, natural fibers are once again being considered as reinforcements for polymer composites. The development and application of natural fiber polymer composites have been extensively reviewed .Unsaturated polyester matrix has been used for many years in broad technology fields such as naval construction, offshore applications, waterlines and building construction . The reinforcement of polyester with various cellulosic fibers has been widely reported. Rajulu et al. used bamboo fibers as reinforcement with epoxy/unsaturated polyester blend and studied the tensile properties and chemical resistance of the resulting composites. The growing interest in using natural vegetable fibers as a reinforcement of polymeric based composites is mainly due to their renewable origin, relative high specific strength and modulus, lightweight and low price. Recent developments in natural fibers such as jute, sisal, coir, flax, banana, etc, have shown that it is possible to obtain well performing materials, using environment friendly reinforcements.

The overall objective of this work is to investigate the fiber extraction from Typha angustifolia by retting method and the use of these fibers as reinforcement in polester matrix.Typha angustifolia fiber reinforced composites at various percentage volume of fiber were fabricated, tested and characterized to evaluate their thermal conductivity and, mechanical properties.

II. EXPERIMENTALSECTION MATERIALS & METHODS

Unsaturated polyester resin of grade ECMALON 4411 was purchased from Ecmass resin pvt, Ltd, Hyderabad, India. The resin has a density of 1242 kg/m^3, young's modulus of 615 M Pa, Tensile strength of 29.2 M Pa and elongation at break of 4.5%.

III. EXTRACTION OF FIBRES

The extraction of fibers involves retting process followed by decorticating. The stems of Typha angustifolia were cut at their base and immersed in a water- retting tank for two weeks. Later, they are removed; the fibers were stripped from the stalks by hand, washed and dried in the sun. After drying, any extraneous matter that may still be adhering to them was removed. The extracted fibers were used for composite making. Some quantity of fibers was treated with5% aqueous NaOH solution.

IV. FABRICATION AND TESTING OF COMPOSITE FABRICATION OF COMPOSITES

Unidirectional composites were prepared, using polyester matrix to asses the reinforcing capacity of Typha angustifolia fibers. The quantity of accelerator and catalyst added to resin at room temperature for curing was1.5% by volume of resin each. Hand lay up method was adopted to fill up the prepared mould with an appropriate amount of polyster resin mixture and unidirectional Typha angustifolia fiber, starting and ending with layers of resin. Fiber deformation and movement should be minimized to yield good quality, unidirectional fiber composites. Therefore at the time of curing, a compressive pressure of 0.05MPa was applied on the mould and the composite specimens were cured for 24 hours. The specimens were also post cured at 70° C for 2 hrs after removing from the mould. Composite samples were prepared with five different percentage volume of Typha angustifolia fibers. The picnometric procedure was adopted for measuring the density of the composite.

V. MECHANICAL PROPERTIES:

The tensile properties of the composites were measured as per the standard test method ASTM D 638 M. The test specimens with 160mm long, 12.5 mm wide and 3mm thick were prepared. Five identical specimens were tested for each percentage volume of fiber. Overlapping aluminum tabs were glued to the ends of the specimen with epoxy resin filling the space at the tab overlap to prevent compression of the sample and also for effective gripping in the jaws of the chuck. The specimens were tested at a cross head speed of 2mm/min, using an electronic tensometer (METM 2000 ER-1), model supplied by M/s Mikrotech, Pune. India

VI. THERMAL CONDUCTIVITY TEST.

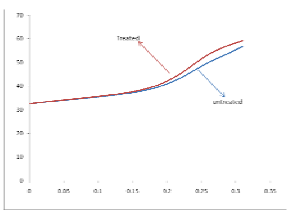
Guarded heat flow meter test method was used to measure the thermal conductivity of Typha angustifolia fiber reinforced polyester composites using an instrument Unitherm^{TM} Model 2022 in accordance with ASTM-E1530. The sample of size 50 mm in diameter and 10 mm in thickness is placed in between two polished surfaces and a pneumatic pressure of 70 kPa were applied on the top portion of the stack.

VII. RESULT & DISCUSSION TENSILE PROPERTIES

The results of tensile tests for the composites under study for different fiber content are given in Table I. The variation of mean tensile strength with varying fiber content is presented in Figure 1. It was clearly evident that with increasing the fiber content in the polyester matrix, the tensile strength is also increasing. This is due to the fact that the polyester resin transmits and distributes the applied stress to the Typha angustifolia fibers resulting in higher strength. Therefore, the composite can sustain higher load before failure compared to the unreinforced polyester. The percentage increment in tensile strength of the treated fiber composites over the pure polyester at the maximum fiber content (31.4) is found to be 82.9.. The tensile modulus also increases as the volume fraction of fibre increases It is observed that treated fiber composites showed better tensile properties than untreated composites due to enhancement in bonding between fiber and matrix

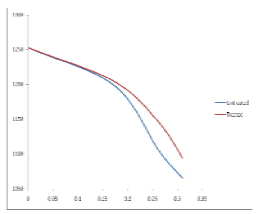
Volume fraction raction	Ten Tensile strength		Tensile Modulus (mpa)	
	untreated	treated	Untreated	Treated
0	32.4	32.4	615.32	615.32
0.174	38.54	39.21	646.56	784.63
0.263	50.42	53.97	906.83	947.97
0.31	56.72	59.26	1178.92	1207.65

Tensile strength



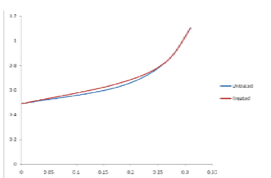
Volume fraction of fiber

Density



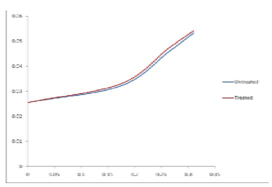
Volume fraction of fiber

Specific tensile modulus



Volume fraction of fiber

Specific tensile strength

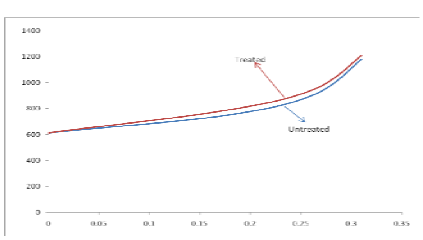


Volume fraction of fiber

VIII. THERMAL CONDUCTIVITY:

The variation of thermal conductivity of untreated and treated fiber composite with respect to fiber content is shown in Figure 3. It is clearly evident that the thermal conductivity of the composites is found to decrease with increase in fiber content. This behavior of composite seems to be justified because the fiber loaded in the matrix has a lower thermal conductivity. It is found that the thermal conductivity of treated fiber composite is more than the untreated fiber composite. This observation indicates that the composites under study have good insulating properties.

Tensile modulus



Volume fraction of fiber

IX. CONCLUSIONS:

In this work, Typha angustifolia fiber reinforced Polyester composites were prepared. The Typha angustifolia is available abundantly in nature and has lower density. The tensile properties of the composites with these fibers was found to be higher than those of the matrix and increased with fiber content.The density and the thermal conductivity of these composites were found to decrease with fiber content. Thus the composites of Typha angustifolia fiber-polyester composites were found to be light in weight, possessed better mechanical and insulating properties. Hence the newly developed composite material can be used for applications such as electronic packages, insulation board, automobile parts, building construction etc.

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