Research Journal of Chemical Sciences _____ ISSN 2231-606X
Vol. **2(6),** 91-93, June **(2012)** *Res.J.Chem.Sci.*

Short Communication

The Effect of Hybridization on Mechanical Behaviour of Coir/Sisal/Jute Fibres Reinforced Polyester Composite Material

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Available online at: www.isca.in
(Received 19th March 2012, revised 23rd March 2012, accepted 26th March 2012)

Abstract

In the presentinvestigation, the effect of hybridization on mechanical properties on coir and sisal reinforced polyester composite (CSRP), coir and jute reinforced polyester composite (CJRP), jute and sisal reinforced polyester composite (JSRP) were evaluated experimentally. Composites were fabricated using compression moulding technique.The results demonstrate that hybridization play an important role for improving the mechanical properties of composites. The tensile and flexural properties of hybrid composites are markedly improved as compare to unhybrid composites. Water Sorptionbehaviour of composite was also studied. Water absorption behaviour indicated that hybrid composites offer better resistance to water absorption. This work demonstrates the potential of thehybrid natural fibre composite materials for use in a number of consumable goods.

Keywords: Hybridisation, compression moulding, mechanical properties, water sorption.

Introduction

The use of plants fibre reinforced composites has been continuously increased during recent years. Their low density, higher environmental friendliness, and reduced cost proved particularly attractive for low-tech applications e.g., in building, automotive and leisure time industry[1]. Natural fibres have special advantage in comparison to synthetic fibre in that they are abundantly available, form a renewable resource and also biodegradable[2]. Researchers also synthesize nano composites from plant based fibres[3]. The main scope of present work is to demonstrate that hybridisation can be effectively used to obtain higher strength composite materials. Numerous attempts have been already made to study properties of jute and other natural fibres in combination with thermosetting and thermoplastics in a last two decades [4]. Jute and coir based composites have been developed in India as substitutes for plywood and medium density fibre boards, these composite boards especially for low-cost housing needs[5]. From past work a hybrid composite materials using Wood Powder, Groundnut Husk and Cashew nut Husk have been developed[6]. The behaviour of composites and hybrid composites of short bamboo and glass fibres in a polypropylene (PP) matrix under hygrothermal aging and under tensile–tensile cyclic load were studied and this hybrid showed better fatigue resistance [7]. Mechanical and physical properties of oil palm empty fruit bunch/glass hybrid reinforcedpolyester compositeswere studied and showed hybrid composites exhibited good properties [8]. Literature survey tells that the some work have been already done as, Studies on the water absorption properties of short hemp glass fibrehybrid polypropylene composites[9] and studied dynamical mechanical behaviour of sisal/ palm hybrid fibre-reinforced natural rubber composites[10]. In this paper, we were reported a preliminary study to develop natural fibre composite sandwich constructions with the goal of achieving higher modulus and higher strength.

Material and Methods

Materials: Chopped (25 mm) pieces of jute, coir and sisal fibre, polyester resin, cobalt naphthanate (accelerator), methyl ethyl ketoneperoxide (hardener).

Composite Fabrication: Hybrid composite of jute/ coir/ sisal fibre can be fabricated by the hand layup technique using laboratory compression moulding machine. Six trilayered composite samples are fabricated. Trilayeredsandwich (hybrid) constructions were prepared using same fibre prefoam in the skins and different fibre prefoam in the core of composite.

Determination of Mechanical properties of Composite: After fabrication the test specimens were subjected to mechanical testsas per ASTM standards. Tensile properties were determined by subjecting dumb bell shaped specimens to a universal testing machine. The specimen subjected to tensile testing with 100 kg load cell, at a cross head speed of 50 cm/min. Three point bend tests were performed in accordance with ASTM D 790 Method to measure flexural properties. The specimens were 100 mm long, 25 mm wide and 3 mm thick. In three point bending test, the outer rollers were 64 mm apart and samples were tested at a strain rate of 0.2 mm/min. specimen were tested at a cross head speed of 2 mm/min, using an electronic tensometer. Flexural strength in the composite was calculated using the following the following relationships:

$S = \frac{3PL}{2bt}$

Where L is the support span (64mm), b is the width, t is the thickness and P is the maximum load.

Determination of Water Absorption behaviour of Composite: The water absorption characteristics of sisal/jute/coir hybrid fibre reinforced polyester composite were studied by immersion in distilled water at room temperature for 24, 48, 72 hours. The test specimens (25 mmx25 mm) were cut from composite and tested for water absorption as per ASTM D-570. Edges of the sample were sealed with polyester resin. Samples were dried for 24 hours at 50^{o}C. After 24 hourssamples were weighed accurately. Conditioned samples were then immersed in distilled water at room temperature for 24, 48, 72 hours. Samples were taken out of water after appropriate time period and wiped with a tissue paper to remove surface water. They were then weighed. Water absorption can be calculated by following formula : Moisture absorption % = W2-W_1/W_1 *100, W_1=Initial weight of composite, W_2=Final weight of composite

Results and Discussion

Effect of hybridization on Mechanical Properties of composite: The characterization of the composites reveals that the hybridisation is havingsignificant effect on the mechanical properties of composites. The properties of the composites with different hybridisation under this investigation are presentedin figure- 1.Result shows the effect of hybridisation on the tensile properties of natural fibre composites. Among the all composites, the composite having outer layer of jute and core of sisal, had the highest modulus, tensile and flexural strength and composite having skin of coir and core of sisal shows lowest mechanical properties

Effect of hybridization on Water Absorption behaviour of Composite: Water absorption is one of the major concerns in using natural fibre composites in many applications. In this study, 24, 48 and 72 hour water absorption was measured by the weight change method for the coir/sisal/jute hybrid fibre reinforced polyester composites in sandwich constructions. The results are shown in figure- 2. The water absorption in hybrid composites was negligible. In 24 hours, maximum and minimum water uptake was shown by CSRP and JSRP respectively. Water absorption after 24 hrs increases at the rate of 0.7-1.7%.

Conclusion

This work being an experimental study on untreated (coir/ sisal/ jute) fibre-reinforced polyester composites. It has been shown in this study the tensile properties of natural fibre composites can be significantly improved by natural fibres in a sandwich construction. Significant reduction in water absorption of natural fibre composites is also obtained with the sandwich construction. This work also demonstrates the potential of these hybrid natural fibre composite materials for use in a number of consumable goods.

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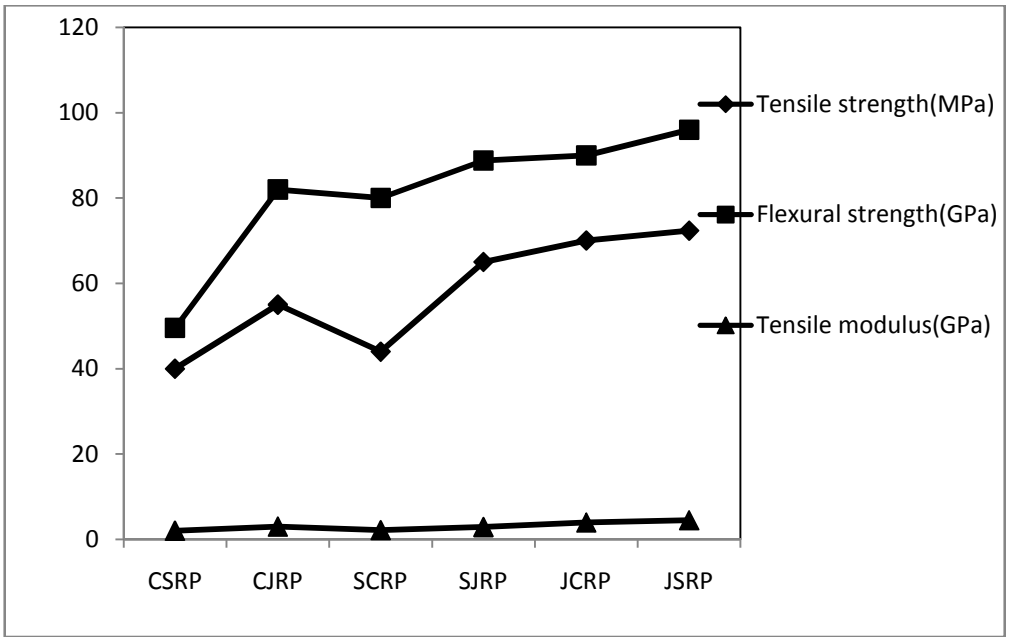
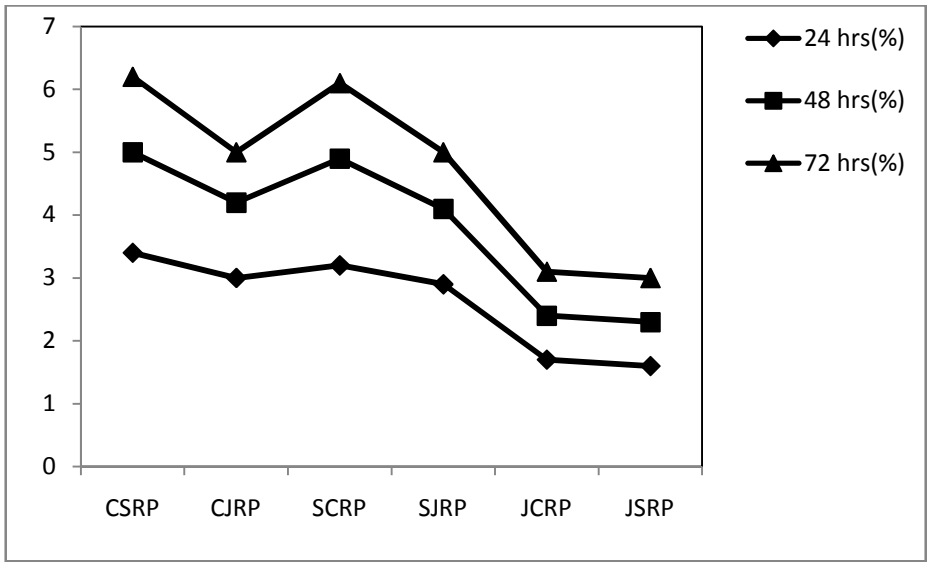


CSRP-coir-sisal(core) reinforced polyester composite, CJRP- coir-jute(core) reinforced polyester composite, SCRP-sisal-coir(core) reinforced polyester composite, SJRP-sisal-jute(core) reinforced polyester composite, JCRP-jute-coir(core) reinforced polyester composite, JSRP-jute-sisal(core) reinforced polyester composite

Figure-1
Mechanical properties of various combinations of natural fibre reinforced hybrid polyester composite



CSRP-coir-sisal(core) reinforced polyester composite, CJRP- coir-jute(core) reinforced polyester composite, SCRP-sisal-coir(core) reinforced polyester composite, SJRP-sisal-jute(core) reinforced polyester composite, JCRP-jute-coir(core) reinforced polyester composite, JSRP-jute-sisal(core) reinforced polyester composite

Figure-2
Water absorption behaviour of various combinations of natural fibre reinforced hybrid polyester composite