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Moisture Content of Rice Husk Particulated Natural Fiber Polymer Composites

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ABSTRACT: *The composite materials are being developed to replace conventional materials, such as stiffness, high fracture toughness, and ease of fabrication,etc. In the present investigation, the mechanical behaviors of filler-added Coir- Vinyl ester composites were studied. The main objectives of this study is to investigate the water absorption behaviors of rice husk-filler added non woven randomly oriented Coir-Vinyl ester composites for varying fiber length, and filler content. It was inferred that a particulate weight content of 10% and fiber length of 50 mm has restricted the water absorption in a better way. It is observed that the value of moisture absorption increased with increased to particulate content. It is concluded that rice husk particulate filled coir fiber reinforced composite can be used in the low load bearing marine applications.*

Keywords*- Vinyl ester, coir fiber, filler content, moisture absorption.*

I. INTRODUCTION

Composites are multifunctional engineering materials having unprecedented mechanical and physical properties that can be tailored to meet the requirement of a particular application. It can be made from two or more different constituent materials having different physical or chemical properties which do not merge in the finishing structure.

Random oriented coir fiber, polyester composites are low- strength materials, but can be designed to have a set of flexural strengths that enable their use as non-structural building element, the lack of an efficient reinforcement by coir fibers is attributed to their low modulus of elasticity, in comparison with that of the bare polyester resin, with the fabrication rout used , two different products were obtained , namely ,rigid composites , for fiber loading less than 50%wt, and agglomerates, when the fiber loading was higher than 50%wt [Monteiro et al 2008].

Geethamma et al (2005) Chemical treatment of coir fiber on damping of composites was studied and it was found that composite with poor interfacial bonding tent to dissipate more energy than that with good interfacial bonding.Sathiyamurthy et al (2011) investigated the addition calcium carbonate decreases impact properties, but the 2 % additions of calcium carbonate improved other mechanical properties. The fiber diameter of 0.18 mm generally gives better tensile and flexural properties, whereas the maximum fiber diameter 0.25 gives better impact properties. The coir epoxy composites exhibit average values for the tensile strength for the tensile strength, flexural strength and impact strength of 17.86 Mpa, 31.08 Mpa and 11.49 kj/m^2 respectively. These values are significantly lower than those measured for GFRP laminate specimen [Harish et al 2008].The highest value of tensile strength, flextural strength and impact strength were obtained for two layer woven glass and single layer woven coir fiber sequence (GGC and CGG).the mechanical properties of natural fiber woven coir composites were significantly improved by glass hybridization. The coir fiber fail quickly than glass fiber. The two layer of glass plies at front (GGC) opposed applied load greater than the two layers of glass plies at back (CGG) in woven coir glass hybrid composites [Jayabal et al 2010]. Water uptake behaviour is radically altered at elevated temperatures due to significant moisture induced degradation. Exposure to moisture results in significant drops in tensile and flexural properties due to the degradation of the fibre–matrix interface [H.N.Dhakal et al 2007]. The sisal fiber has been treated with different chemicals like silane, permanganate, benzoylchloride, sodium hydroxide and also undergone physical treatment like heating at 100° C to improve the interfacial bonding between fiber and polyester resin. The water absorption studies showed that treatment decreases the water uptake of the composites, which supports the greater fiber matrix interaction. The diffusion, absorption and permeability coefficient also decreased after the treatment [P.A.Srikumar et al 2009].

II. MATERIALS AND PROCESSING

The use of natural fibers, such as oil-palm empty fruit, bunch fiber, jute fiber or bamboo fiber instead of glass and carbon fibers in reinforced composites can reduce the material cost significantly and at the same time yield high strength to weight ratios.

Table 1 chemical composition of Coir fiber

Properties	Value
Water soluble	5.25%
Pectin and related Compounds	3.30%
Hemicelluloses	0.25%
Cellulose	43.44%
Lignin	45.84%
Ash	2.22%

2.1. Materials of composites

The specimen used in this study was made of coir fiber reinforced composite material. The composite was made up of general vinyl ester resin and coir fibers. Accelerator was cobalt octoate and catalyst was methyl ethyl ketone peroxide as shown in the table 2 and rice husk properties are shown in table 3.

Table 2 Materials of fabrication composites

Material	Type
Matrix	Vinylester resin
Catalyst	Methyl Ethyl Ketone Peroxide
Accelerator	Cobalt Octoate
Promotor	Di Methyl Aniline (DMA)
Particulate	Rice husk
Reinforcement	Coir fiber
Releasing agent	Acetone

Table 3 Properties of rice husk

S.No	Property	Range
1	Bulk density (kg/m^3)	96-160
2	Length of husk (mm)	2.0-5.0
3	Harness (Mohr's scale)	5.0-6.0
4	Ash (%)	22.0-29.0
5	Carbon (%)	35.0
6	Hydrogen (%)	4.0-5.0
7	Oxygen (%)	31.0-37.0
8	Nitrogen (%)	0.23-0.32
9	Sulphur (%)	.04-.08
10	Moisture (%)	8.0-9.0

2.2 Planning of experiments

The natural coir fiber was selected as reinforcement material in this investigation. The matrix material of unsaturated vinyl ester resin and the particulate material of rice husk were used. The Compression Moulding process technique was used for fabricating particulate impregnated Coir Vinylester composites. Poly Vinyl Acetate release agent was applied to the surface before the fabrication. The coir fibers were pre-impregnated with the matrix material consisting of unsaturated Vinylester resin-Rice husk particulate, Cobalt Octoate accelerator and MEKP catalyst in the ratio of 1:0.015:0.015.The impregnated layers were placed in the resin matrix (300 mm × 300 mm × 3mm) and pressed heavily before removal. After 1hour, the composites were removed from the mould and cured at room temperature (28^0 C) for 24 hrs.

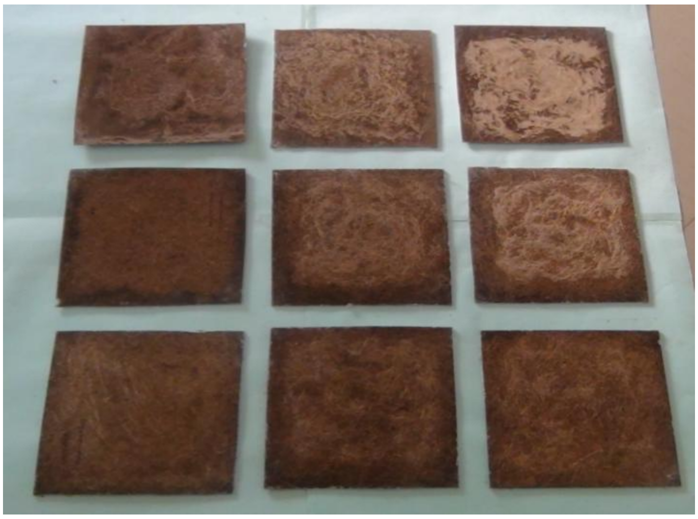

Figure 1 Photographic image of fabricated Composite sheets

2.3. Water absorption test

Water absorption study was performed following the ASTM D 570-98 method. Water absorption of the composite specimen (10 x 10 x 3 mm) was determined after 2 days (48 hours) immersion in distilled water at room temperature at 24° C conditions. The various parameters are fiber length and particulate content of nine specimens of each formulation were dried in an oven for 24 hours at 80 ±2°C. The dried specimens were weighed with a precision of 0.001 gm. All specimens were immersed in distilled water and seawater. At the end of the immersion periods, the specimens were removed from the waters, the surface water was wiped off using tissue, and wet weight values were determined.

Water absorption percent was calculated using the following formula:

$$\mathbf{W = (m_t - m_o)/m_o \times 100} \ \ldots\ldots\ldots\ldots (1)$$

Where

W Moisture content
$\mathbf{m_o}$ Dry weight
$\mathbf{m_t}$ weight after time *t*

III. RESULT AND DISCUSSION

Moisture absorption observations were determined by the weight gain relative to the dry weight of the samples. The moisture content of a sample the effects of fiber length and particulate content on the water absorption behavior of the composite specimens are given in Figure 2.The moisture absorption increased with increasing of fiber length and particulate content in all the cases. This behavior has been explained on maximum immersion on the distilled water absorption are 18.69 % of weight, then the composition of the fiber length 30 mm and particulate content 30% of the composites. The minimum immersion on the distilled water absorption are 8.74 % of weight, then the composition of the fiber length 50 mm and particulate content 10% of the composites. The water absorption testing result of composites specimens are given in shown Table 5.

Table 5 Distilled water absorption wt % of coir fiber filled vinyl ester Composites

Specimen Number	Fiber length (mm)	Particulate content (%)	Fiber content (%)	Wt before immersion gm (10^{-3})	Wt after immersion gm (10^{-3})	Water absorption (Wt %)
1	10	10	30	3.05	3.3	11.48
2	30	10	30	3.00	3.44	14.67
3	50	10	30	3.09	3.36	8.74
4	10	20	20	3.11	3.49	12.22
5	30	20	20	3.17	3.62	14.20
6	50	20	20	3.19	3.66	14.73
7	10	30	10	3.18	3.61	13.52
8	30	30	10	3.21	3.81	18.69
9	50	30	10	3.23	3.94	15.79

The comparison of weight values in composites and water absorption for different combinations of particulate-coir-polymer composites are shown in Figure 2 and 3 respectively.

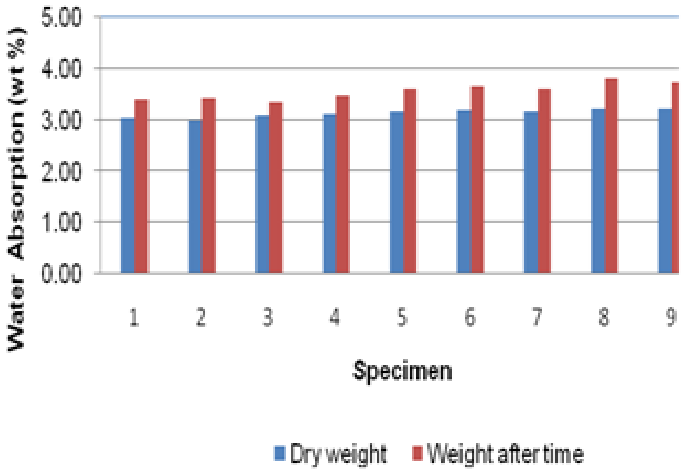

Figure 2 Comparison of weight values in composition

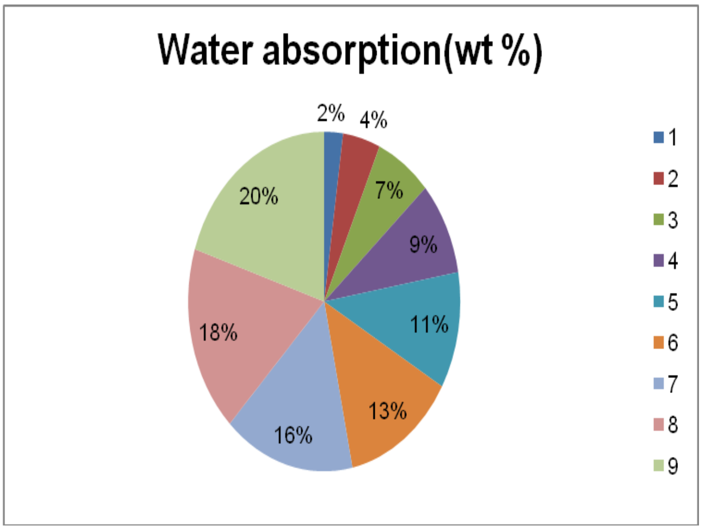

Figure 3 Water absorption for different combinations of Particulate – coir - polymer composites

IV. CONCLUSION

The rice husk particulate filled coir fiber reinforced composites were fabricated using compression molding technique for varying fiber length and particulate content. The fabricated composite subjected to water absorption test as per ASTM standard. The effect of particulate weight content and fiber length on the water absorption ability of the rice husk particulate filled coir fiber reinforced composite was studied.

It was inferred that a particulate weight content of 10% and fiber length of 50 mm has restricted the water absorption in a better way. It is observed that the value of particulate content increased more which results more water absorption in composites. The mechanical and thermal properties of particulate filled coir fiber vinyl ester composites have to be studied in the future circumstances. It is concluded that rice husk particulate filled coir fiber reinforced composite can be used in the low load bearing marine applications.

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