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A Review Paper on Tensile Properties of Natural Fiber Polymer Matrix Composites

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Abstract: *Environmental awareness today motivates the researchers, worldwide on the studies of natural fiber reinforced polymer composite and cost effective option to synthetic fiber reinforced composites. In the present work different natural fiber based polymer matrix composites are prepared by using natural fibers Coir, Saw Dust, Rice husk and their tensile properties are studied. Usual hand- lay-up technique has been adopted for manufacturing the composite. To have a good compatibility between the fiber and matrix, chemical modification of fibers has been carried out. The study confirms that the tensile strength of the composites are varies with the volume fraction of the fibers.*

I. Introduction

The advantage of composite materials over conventional materials stem largely from their higher specific strength, stiffness and fatigue characteristics, which enables structural design to be more versatile. By definition, composite materials consist of two or more constituents with physically separable phases. However, only when the composite phase materials have notably different physical properties it is recognized as being a composite material.[2]

In recent years, there has been an increasing environmental consciousness and awareness of the need for sustainable development, which has raised interest in using natural fibres as reinforcements in polymer composites to replace synthetic fibres such as glass. [2] Natural fibers, as reinforcement, have recently attracted the attention of researchers because of their advantages over other established materials. They are environmentally friendly, fully biodegradable, abundantly available, renewable, cheap and have low density. Plant fibers are light compared to glass, carbon and aramid fibers. The biodegradability of plant fibers can contribute to a healthy ecosystem while their low cost and high performance fulfills the economic interest of industry. When natural fiber-reinforced plastics are subjected, at the end of their life cycle, to combustion process or landfill, the released amount of CO_2 of the fibers is neutral with respect to the assimilated amount during their growth. [1]

Polymeric materials reinforced with synthetic fibers such as glass, carbon and aramid provide advantages of high stiffness and strength to weight ratio as compared to conventional construction materials, i.e. wood, concrete and steel. In spite of these advantages, the widespread use of synthetic fiber-reinforced polymer composite has a tendency to decline because of their high-initial costs and also production of synthetic composites requires a large quantum of energy and quality of environment suffered because of the pollution generated during the production and recycling of these synthetic materials.

In recent time plant fibers have been receiving considerable attention as substitutes for synthetic fiber reinforcements. Unlike the traditional synthetic fibers like glass and carbon these lignocellulosic fibers are able to impart certain benefits to the composites such as low density, high stiffness, low cost, renewability, biodegradability and high degree of flexibility during processing. Cellulosic fibers like sisal, coconut (coir) and bamboo in their natural form as well as several waste cellulosic products such as shell flour, wood flour and pulp have been used as reinforcing agents of different thermosetting and thermoplastic composites. [1]

II. Literature Review

Paul Wambua et.al [3] In this work the investigator explained about how the natural fibres (sisal, kenaf, hemp, jute and coir) reinforced polypropylene composites were processed by compression moulding using a film stacking method. The mechanical properties of the different natural fibre composites were tested and compared. Hoi-yan Cheung et.al [4] In this paper, the author explained comprehensive review on different kinds of natural fibre composites and their potential in future development of different kinds of engineering and domestic products. K.L. Fung et.al [5]

In this paper, a pre-impregnation technique has been introduced for the injection moulding of sisal fibre reinforced polypropylene (PP/SF) composites. S. Harish et.al [6] investigated the use of coir, a natural fiber abundantly available in India. Natural fibers are not only strong and lightweight but also relatively very cheap.

M. Ashok Kumar et.al [7] investigated the tensile, flexural and dielectric properties of composites made by reinforcing Sansevieria cylindrica as a new natural fibre into a rubber based polyester matrix. J.L.Thomason [8] in this paper the poor performance of natural fibres as composite reinforcements where the focus on chemical aspects has not yet delivered the "holy grail" of glass fibre replacement in volume applications is discussed.

III. Fabrication of Composites

The natural fibers are thoroughly washed with distilled water in order to remove dirt, sediments and other contaminations like light and soft fiber. Then the fiber is dried to remove the moisture until it gains constant weight then Alkali treatment has been done to improve the dispersion of the particles, reducing agglomeration by reducing the hydrogen bonding that holds them together. The UP resin and hardeners are mixed in the ratio, (MEKP) catalyst1.5 gm & (1%Cobalt) accelerator 3.0 gm, as recommended by the resin manufacturer. The dried & chopped fibers are then added in to the UP resin as per the required ratio and well blended until the constituent mixes uniformly. Then the mixture is transferred into the mould and allowed to remain in the mould for 24hrs under load of 100kg. The molded composite is removed from the mould after 24hrs. Then the composite material is cured in the furnace at 100^0C for 2hrs. This eliminates moisture from the material. Specimens of suitable dimension as per ASTM-D638 standard are cut using a diamond cutter for tensile testing.

Fig1: Tensile Test Specimen Before Test

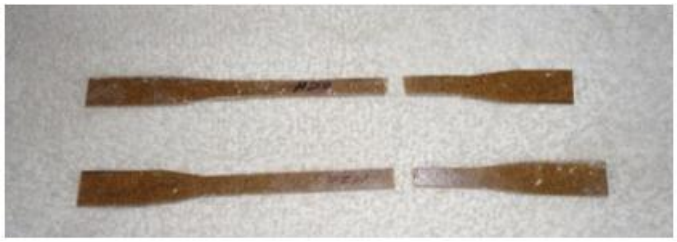

Fig 2: Tensile Test Specimen After Test

Table 1: Details of Composites Prepared C-Coir, H-Rice Husk, S-Saw Dust

Sl. No.	Specimen Designation	% of Coir	% of Rice Husk	% of Saw Dust	% of USP
1	C5	5	-	-	95
2	C10	10	-	-	90
3	C15	15	-	-	85
4	C20	20	-	-	80
5	H5	-	5	-	95
6	H10	-	10	-	90
7	H15	-	15	-	85
8	H20	-	20	-	80
9	S5	-	-	5	95
10	S10	-	-	10	90
11	S15	-	-	15	85
12	S20	-	-	20	80
13	C10H10	10	10	-	80
14	C10S10	10	-	10	80
15	C10S10H10	10	10	10	70

IV. Results and Discussions

The results of characterization test are reported here. The evaluation of tensile strength has been studied and discussed. The interpretation of the results and the comparison among various composite samples are also presented(Fig 3 and Fig 4).

Tensile Test Results

Table 2: Tensile Strength of Composites

Specimen	Tensile Strength (MPa)
C5	10.3
C10	14.5
C15	21.79
C20	17.02
H5	9.2
H10	11.8
H15	14.96
H20	16.98
S5	12.6
S10	16.16
S15	18.06
S20	19.06
C10H10	29.09
C10S10	31.17
C10H10S10	34.53

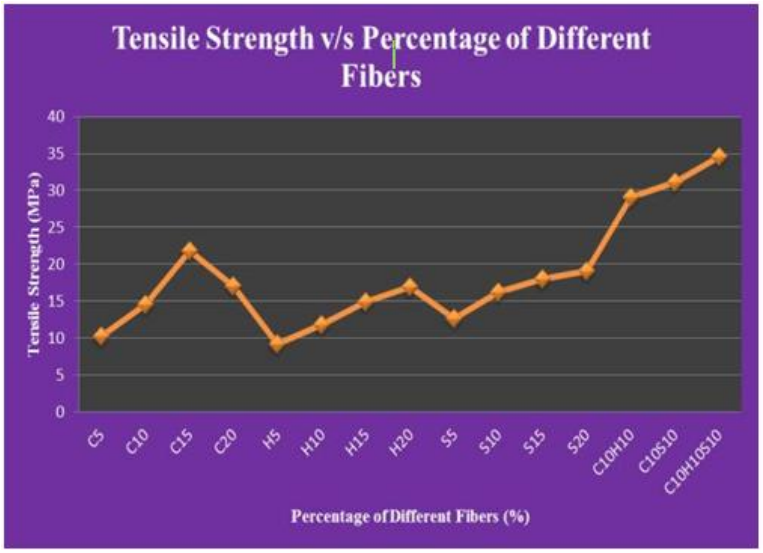

Fig 3: Comparative Line Chart of Tensile Strength of Various Composites

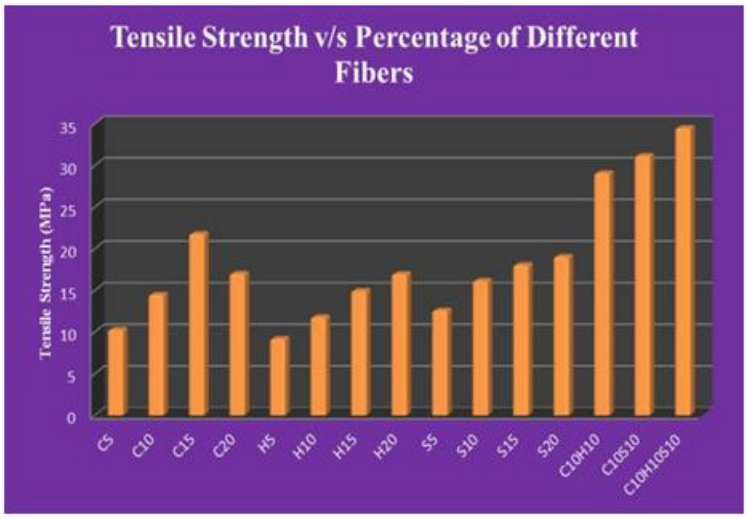

Fig 4: Comparative Bar Chart of Tensile Strength of Various Composites

From the Tensile Test Results it is evident that all the specimens show appreciable improvement of mechanical properties. Addition of fibers , up to 20%, in to the composites improves tensile strength, strain rate , percentage of Elongation, Young's Modulus. In case of coir composites beyond 15% of coir tensile properties

decreases due to poor bonding of resin over the reinforcement. Hence decrease in properties of the specimen occurs. From above graph it can easily indentify that the hybrid composites exhibits the good tensile strength as compared to other composites this may because of increased in the reinforcement.

V. Conclusions

From Result and discussion it is found that the Natural Fiber Hybrid Composite, made out of Coir fiber+ Rice Husk + Saw Dust + Unsaturated Polyester resin combination showed better result of tensile strength. The strength of the Composite material increases as the Percentage of reinforcements increases. This is due to the Strong bonding of the Matrix with the Reinforcement (Fiber) and the load is carried by them.

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