Experimental Investigation of a Particulate Reinforced Composite

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Abstract- Composite materials are also called composition materials or shortened to composites which are materials made from two or more constituent materials with significantly different physical or chemical properties, that when combined, produce a material with characteristics different from the individual components. The individual components remain separate and distinct within the finished structure. The new material may be preferred for many reasons: common examples include materials which are stronger, lighter or less expensive when compared to traditional materials. Composite materials are generally used for buildings, bridges and structures such as boat hulls, swimming pool panels, race car bodies. In this proposed work attempt has been made to materialize a composite which can be used as reinforcement composite. This composite may be of matrix and dispersed phase, where epoxy resin is a matrix phase and crab shell powder is a reinforcementagent.

Keywords – Composite materials, Crab powder, Mould, Tensile, Compression. Flexural

I. INTRODUCTION

Composite materials are generally used for buildings, bridges and structures such as boat hulls, swimming pool panels, race car bodies, shower stalls, bathtubs, storage tanks, imitation granite and cultured marble sinks and counter tops. The most advanced examples perform routinely on spacecraft and aircraft in demanding environments. Fiber-reinforced composite materials have gained popularity (despite their generally high cost) in high-performance products that need to be lightweight, yet strong enough to take harsh loading conditions such as aerospace components (tails, wings, fuselages, propellers), boat and scull hulls, bicycle frames, swimming pool panels and racing car bodies. Composites are made up of individual materials referred to as constituent materials. There are two main categories of constituent materials: matrix and reinforcement. The matrix material surrounds and supports the reinforcement materials by maintaining their relative positions. The reinforcements impart their special mechanical and physical properties to enhance the matrix properties. A synergism produces material properties unavailable from the individual constituent materials, while the wide variety of matrix and strengthening materials allows the designer of the product or structure to choose an optimum combination. Engineered composite materials must be formed to shape. The matrix material can be introduced to the reinforcement before or after the reinforcement material is placed into the mould cavity or onto the mould surface. The matrix material experiences a melding event, after which the part shape is essentially set. Depending upon the nature of the matrix material, this melding event can occur in various ways such as chemical polymerization or solidification from the melted state.

II. SAMPLE PREPARATION

A. Material Requirement

Fiber-reinforced composite materials can be divided into two main categories normally referred to as short fiber-reinforced materials and continuous fiber-reinforced materials. Continuous reinforced materials will often constitute

a layered or laminated structure. The woven and continuous fibre styles are typically available in a variety of forms, being pre-impregnated with the given matrix (resin), dry, uni-directional tapes of various widths, plain weave, harness satins, braided, and stitched. The short and long fibers are typically employed in compression moulding and sheet moulding operations.

Crab Shell is an excellent dry organic source of nutrients, including Calcium (23%) and Magnesium (1.33%). It retains moisture in the soil and builds the organic matter. It also gives the roots something to grab onto and wrap around, for a food source, creating a deeper root system. Crab Shell should be worked in the soil before planting, or top dressed. It can be applied to lawns with a broadcast spreader. It shows amazing results on lawns and all plants as shown in the figure.1 crab shells have potential important economical and industrial applications due to their chemical composition. They have a high content of protein (34.2%) and essential amino acids; they also have fat (17.1%), with a high proportion of polyunsaturated fatty acids. About 28.5% corresponds to ash (calcium, phosphorous, and magnesium are the major minerals). The mean concentrations of vitamin E, astaxantin, and β-carotene were 23.3, 9.49, and 0.2 mg/100 g, respectively

Figure 1. Crab Powder

Molding or moulding (see spelling differences) is the process of manufacturing by shaping liquid or pliable raw material using a rigid frame called a mold or matrix. This it may have been made using a pattern or model of the final object. A mold or mould is a hollowed-out block that is filled with a liquid or pliable material like plastic, glass, metal, or ceramic raw materials. The liquid hardens or sets inside the mold, adopting its shape. A mold is the counterpart to a cast. The very common bi-valve molding process uses two molds, one for each half of the object. Piece-molding uses a number of different molds, each creating a section of a complicated object. This is generally only used for larger and more valuable objects. Figure. 2 shows the mould can be prepared by wood so that it can easily take of the sample from the wood. The silica wax should be coated before pouring the sample.

Figure 2. Wood mould.

B. Model Preparation

The composite material can be fabricated as in different concentrations such as 60-40 and 70-30. The epoxy resin can be poured in a beaker as per the concentration of 60% ratio and the crab shell powder of 40%. Hardener is to be added on the 5% of epoxy resin. Epoxy material are used as the matrix phase and crab she;; is used as the dispersed phase. The weight of epoxy is used as approximately 55% by weight and composite material is prepared by compression moulding. Compression moulding should be done in the form of wood mould. The composite material

is prepared at 150 C and pressure of 50mpa for a time of one day. 60- 40 concentration of composite material: The 60- 40 concentration of a composite material can be prepared by the 55% of epoxy resin, 5%of hardener and 40% of crab powder. The following figure shows the 60-40 concentration of composite material.

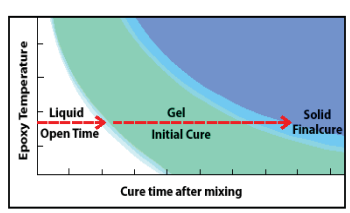
Figure 3. Sample Preparation

III. EXPERIMENT AND RESULT

The tensile test should be done first according to the ASTM standards. Specimens are placed in the grips of a Universal Test Machine at a specified grip separation and pulled until failure. For ASTM D3039 the test speed can be determined by the material specification or time to failure (1 to 10 minutes). A typical test speed for standard test specimens is 2 mm/min (0.05 in/min). An extensometer or strain gauge is used to determine elongation and tensile modulus. Depending upon the reinforcement and type, testing in more than one orientation may be necessary. After the tensile testing, impact testing should be done. This test method covers the determination of the temperature at which plastics and elastomers (as defined by Terminology D883) exhibit brittle failure under specified impact conditions. Two routine inspection and acceptance procedures are also provided. The testing figure can be shown in figure. The material should be cutted as per the ASTM standards.

Figure 4. Preapred Specimen

Curing may be achieved by reacting an epoxy with itself (homopolymerisation) or by forming a copolymer with polyfunctional curatives or hardeners. In principle, any molecule containing reactive hydrogen may react with the epoxide groups of the epoxy resin. So it requires one for sample preparation.



As it cures, mixed epxoy pass from a liquid state, through a gel state, to a solid state. (figure 1)

IV. RESULTS AND DISCUSSION

The composite material can be tested for its tensile strength, compression load, flexural load, impact load and water absorption

Tensile test of concentration 60 – 40:
Thickness: 11.50mm Width : 13.30mm Area : 152.95mm^2
Gauge length: 100mm

Flexural test: Thickness -10.30mm Width -35.20mm Area-362.56mm^2 Gauge length-100m
F= 3PL/2bd^2
F= 3*0.45*1000*1000/2*35.20*10.30^2 =180.75N

Compression test:
Specification of compression test:
Thickness-12.20mm
Width-32.30mm Area-394.06mm^2
Gauge length-100mm

Test	**60 : 40**	**70 : 30**
Tensile strength in MPa	**10.73**	**13.14**
Flexural load	**0.45**	**0.63**
Compression load	**20.37**	**7.85**
Impact values in joules	**2**	**2**
Water absorption	**0.07**	**0.07**

Table 1. Results of crab shell composite material

The composite material can be tested and their results can be evaluated and it should be compared with the glass fiber and a bamboo natural fiber as follows. The specifications of crab composite material as are listed.

Tests	Values
Cylinder size	150mm
Cylinder length	500mm
Courser abrasive sheet	60 grade
Equivalent resolution	84 times
Rotational frequency	40 rpm
Load applied	1kg
Area	22500mm^2

Table 2.Specification of crab composite material

Sample ID	Initial weight(g)	Final weight(g)	Abrasion loss(g)	%	Kg applied
60:40	2.0526	1.8348	0.2178	10.61	1
70:30	2.1920	1.9237	0.2683	12.24	1

Table 3. observation

Tests	Crab composite	Glass fibre	Bamboo fibre
Tension test	13.14	23.08	8.25
compression	7.85	15.02	2.86
Flexural load	0.45	7.58	0.22
Impact load	2	18	2
Water absorption	0.07	Nil	0.01
Load applied	1kg	1kg	1kg

Table.4 Comparison of crab composite with bamboo and glass fibre:

From the above table, it should be noted that the glass fiber's tension , compression and impact test values should be higher than the crab composite and lower than the bamboo fibre. The composite mixed with the powder can be effectively used as a very good alternative for most of the weight carrying structural elements and their results should be verified and values should be evaluated. Results of testing are attached below**.**

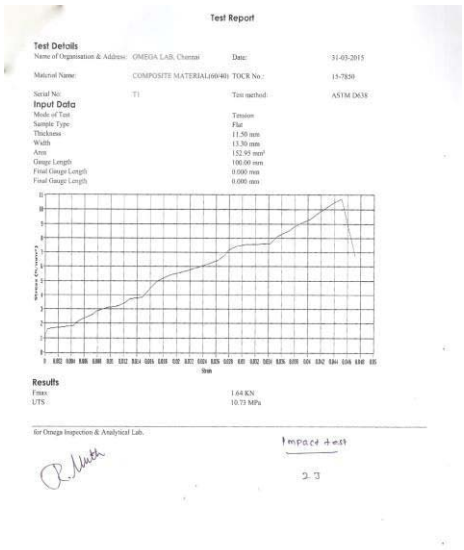


Fig.6 Tension test result for concentration 60-40:

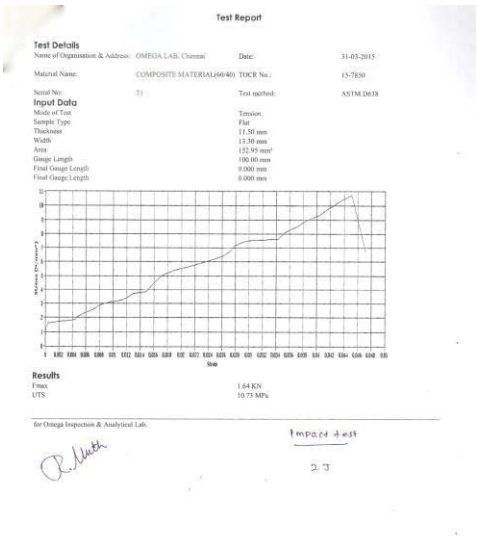


Fig.7 Compression test result for concentration 60-40:

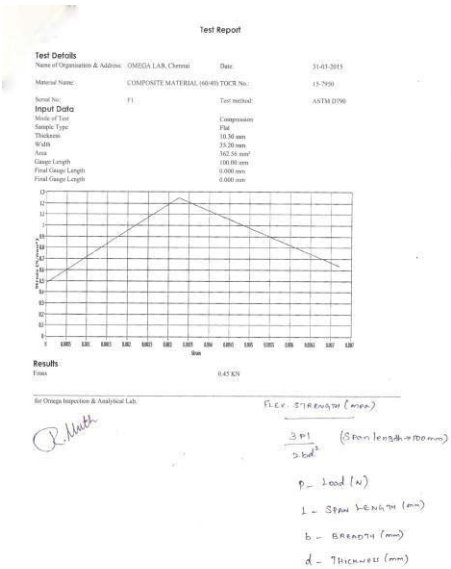


Fig 8. Flexural test result for concentration 60-40:

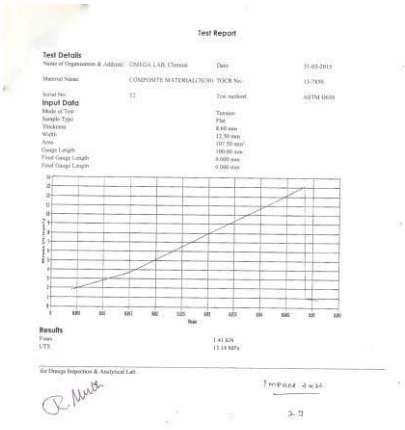


Fig 9 Tension test result for concentration 70-30:

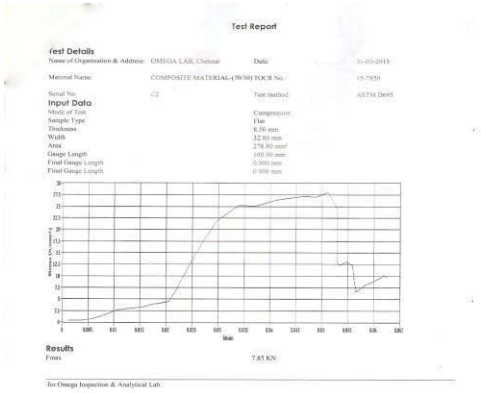


Fig 10. Compression test result for concentration 70-30:

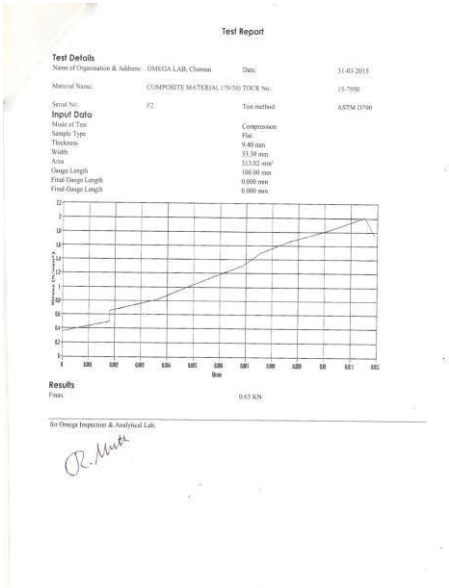


Fig 11. Flexural test result for concentration 70-30:

IV. CONCLUSION

Particulate reinforced composites are at a relatively early stage of development. With a range of constituent material options available to optimize performance, vinyl ester/ crab shell composite may offer considerable flexibility in design and application to mechanical engineering structures.

In this course of study, the following details were observed by doing the tests like tensile, flexural and impact

- Vinyl ester had very good compatibility with the crab shell material. This was proved while examine the tensile test by ranging the crab shell material, the elongation at the break were slightly got reduced, simultaneously strengths were improved. The reinforcement of this as well proved very good compatibility with the vinyl ester resin. While doing the test the remarkable change was identified in the impact strength, impact strength values are shown rapid increase by adding the proportionate of powder.
- In our observation over this study, the composite mixed with the powder can be effectively used as a very good alternative for most of the weight carrying structural elements

REFERENCES

[1] R.J. Bishop, "Modern Physical Metallurgy and Materials Engineering: Metals and Materials "
[2] Prof H.Thomas Hahn**."** Journal of Composite Materials"
[3] Beebe, E., and England, J, "Lead concentrations in processed C&D wood" 1998
[4] Dr. Donald Adams, "Testing Composite Material "