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# Behavior of Natural Fiber-Polymer Composites using Compression Moulding Process

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***Abstract:*** **The main objective of the experiment is to find the mechanical behaviour of fillers added polymer based composites by comparing the experimental results. In the present investigation, the mechanical behaviours of filler-added Coir- Vinyl ester composites were made by using compression moulding process. However, only when the composite phase materials have notably different physical properties it is recognized as being a composite material. Fillers offer a variety of benefits that is increased strength and stiffness, heat resistant. Fillers namely termite mound and egg shell particulate are used to make the samples. The experimental results were compared with the fillers of egg shell particulate samples without termite mound.**

***Keywords: Compression moulding, Egg Shell, Termite mound***

## INTRODUCTION

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. The constituents of the composites retain their individual, physical and chemical properties depending upon the fabrication process. Fillers offer a variety of benefits that is increased strength and stiffness, heat resistance, heat conductivity, stability, wet strength, fabrication mobility, viscosity, abrasion resistance and impact strength, reduce cost, shrinkage, exothermic heat, thermal expansion coefficient, porosity, crazing and improved surface appearance. Plants, such as flax, cotton, hemp, jute, sisal, kenaf, pineapple, ramie, bamboo, banana, etc., as well as wood, used from time immemorial as a source of lignocelluloses fibres, are more and more often applied as the reinforcement of composites.

## EGG SHELL

An eggshell is the outer covering of a hard-shelled egg and of some forms of eggs with soft outer coats. Bird eggshells contain calcium carbonate and dissolve in various acids, including the vinegar used in cooking. While dissolving, the calcium carbonate in an egg shell reacts with the acid to form carbon dioxide. The albumen in turn is surrounded by two shell membranes (inner and outer membranes) and then the eggshell. The chicken eggshell is 95-97%calcium carbonate crystals, which are stabilized by a protein.

*Material Preparation*

The compression moulding machine is used to fabricate the plates of 300mm*300mm*3mm.

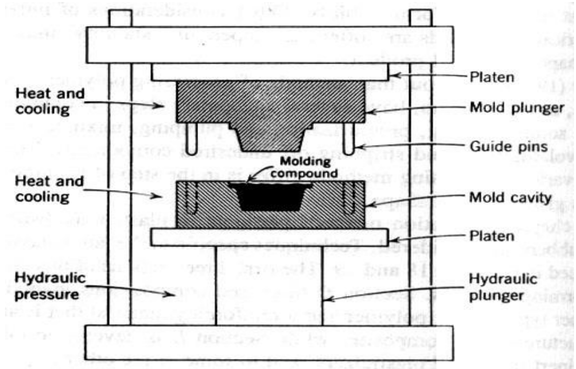


Fig 2.1 Compression Moulding Machine

Then the fabricated plate is left in room temperature for 8 hours for curing process.

Fig 2.2 & Fig 2.3 Compression moulding Die & Fabricated composite plate

## EXPRIMENTAL ANALYSIS
## EXPRIMENTAL EVALUATION

Poly Vinyl Acetate (PVA) release agent was applied to the surface before the fabrication. The coir fibres were pre-impregnated with the matrix material consisting of unsaturated Polyester resin, Termite mound soil and Egg Shell filler. Cobalt Octoate accelerator and MEKP catalyst in the ratio of 1:0.015: 0.015A stainless steel mould having dimensions of 300 × 300 × 3 mm3 is used for composite fabrication. The Rice husk and egg shell particulates are mixed with polyester resin by the simple mechanical stirring and the mixture is poured into Moulds in the

Compression Moulding machine conforming to the requirements of various testing conditions and characterization standards.

Tensile test has been carried out by universal testing machine. The fractured sample of tensile test is shown in Fig 3.1

Fig 3.1Tensile tested specimen

Flexural testing has been carried out in instron flexural testing machine. The specimen was prepared as a beam and the load applied in the middle of the specimen. Three point flexural test was conducted.

Fig 3.2 shows the fractured specimen.

Fig 3.2Flexural tested specimen

Sample was incised into the shape (65×12.7×3) mm, The Impact strength test was conducted using a Tinius Olsen impact test machine. Fig 3.3 shows the fractured specimen.

Fig 3.3Impact testing machine

RESULTS AND DISCUSSIONS

The fabricated composite material is cut by ASTM standards for testing. Impact, Flexural and Tensile testing has been carried out.

In the table 4.1 shows the values of the three parameters for the fabricated plates of egg shell with termite mound. The tabulation shows the low and high values obtained from the testing taken. The filler added makes the vital difference in the values of mechanical behaviour of the fabricated plates.

| Sample No. | Fiber length (mm) | Vinyl Ester Wt% | Fiber content (wt %) | Filler content (wt %) | | Tensile Strength (MPa) | Impact Strength (kJ/m²) | Flexurer Strength (MPa) |
|---|---|---|---|---|---|---|---|---|
| | | | | eggshell | Termite mound | | | |
| S1 | 10 | 60 | 30 | 5 | 5 | 21.5 | 28.4. | 23.1 |
| S2 | 10 | 60 | 20 | 10 | 10 | 24.35 | 42.5 | 20.16 |
| S3 | 10 | 60 | 10 | 15 | 15 | 20.1 | 30.15 | 21.3 |
| S4 | 30 | 60 | 30 | 5 | 5 | 24.72 | 37.4 | 25.4 |
| S5 | 30 | 60 | 20 | 10 | 10 | 30.43 | 48.45 | 22.5 |
| S6 | 30 | 60 | 10 | 15 | 15 | 23.4 | 41.58 | 21.4 |
| S7 | 50 | 60 | 30 | 5 | 5 | 23.21 | 32.25 | 33.73 |
| S8 | 50 | 60 | 20 | 10 | 10 | 26.9 | 40.42 | 27.6 |
| S9 | 50 | 60 | 10 | 15 | 15 | 22.6 | 28.5 | 26.15 |

Table4.1 Values of Egg Shell Termite Mound

| Sample No. | Fiber length (mm) | Vinyl Ester Wt% | Fiber content (wt %) | Filler content (wt %) eggshell | Tensile Strength (MPa) | Impact Strength (kJ/m²) | Flexurer Strength (MPa) |
|---|---|---|---|---|---|---|---|
| S1 | 10 | 60 | 30 | 10 | 17.6 | 27 | 21 |
| S2 | 10 | 60 | 20 | 20 | 20.22 | 33.5 | 22 |
| S3 | 10 | 60 | 10 | 30 | 16.41 | 29 | 20 |
| S4 | 30 | 60 | 30 | 10 | 22.32 | 32.3 | 24 |
| S5 | 30 | 60 | 20 | 20 | 25.12 | 37.1 | 28 |
| S6 | 30 | 60 | 10 | 30 | 20.2 | 31.1 | 26 |
| S7 | 50 | 60 | 30 | 10 | 23.1 | 32 | 21 |
| S8 | 50 | 60 | 20 | 20 | 20.4 | 37.3 | 24 |
| S9 | 50 | 60 | 10 | 30 | 16.3 | 30.9 | 23 |

Fig 4.2 Values of onlyEgg shell

In the table 4.1 shows the values of the three parameters for the fabricated plates of only egg shell as filler material. The tabulation shows the low and high values obtained from the testing taken. The filler added makes the vital difference in the values of mechanical behaviour of the fabricated plates.

| Sample no | Fiber length (mm) | Vinylester%(Wt) | Fiber content(Wt) | Filler content (eggshell + termite mound) | Tensile strength(MPa) | Impact strength(kj/m²) | Flexural Strength(MPa) | Filler content (eggshell) | Tensile strength(MPa) | Impact strength(kj/m²) | Flexural Strength(MPa) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S1 | 10 | 60 | 30 | 5+5 | 21.5 | 28.4. | 23.1 | 10 | 17.6 | 27 | 21 |
| S2 | 10 | 60 | 20 | 10+10 | 24.35 | 42.5 | 20.16 | 20 | 20.22 | 33.5 | 22 |
| S3 | 10 | 60 | 10 | 15+15 | 20.1 | 30.15 | 21.3 | 30 | 16.41 | 29 | 20 |
| S4 | 30 | 60 | 30 | 5+5 | 24.72 | 37.4 | 25.4 | 10 | 22.32 | 32.3 | 24 |
| S5 | 30 | 60 | 20 | 10+10 | 30.43 | 48.45 | 22.5 | 20 | 25.12 | 37.1 | 28 |
| S6 | 30 | 60 | 10 | 15+15 | 23.4 | 41.58 | 21.4 | 30 | 20.2 | 31.1 | 26 |
| S7 | 50 | 60 | 30 | 5+5 | 23.21 | 32.25 | 33.73 | 10 | 23.1 | 32 | 21 |
| S8 | 50 | 60 | 20 | 10+10 | 26.9 | 40.42 | 27.6 | 20 | 20.4 | 37.3 | 24 |
| S9 | 50 | 60 | 10 | 15+15 | 22.6 | 28.5 | 26.15 | 30 | 16.3 | 30.9 | 23 |

Fig 4.3Comparison Table

Fig 4.3 shows the detailed values of the three mechanical behaviour's values. The tabulated values shows lower values and higher values of compared values.

## CONCLUSIONS

By carrying out present study, following points are ascertained and may conclude based on results obtained and discussed.

1. Termite mound and eggshell particulate coir fibre reinforced composites exhibited maximum value of tensile strength 30.43MPa was obtained 30mm fibre. It was 5.31MPa higher than the eggshell particulate coir fibre reinforced composites
2. The maximum value of impact strength 48.45kJ/m2 was obtained 30mm fibre length and The maximum value of flexural strength 33.73MPa was obtained 50mm fibre length
3. It was clearly observed that the inclusion of termite mound and egg shell particulate in natural fibres improves tensile, impact and flexural strength

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