Production and Evaluation of Impact Strength of Snail Shell Reinforced Epoxy Composite

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Abstract: **Particulate-filled polymer composites are becoming quite attractive because of their low cost and wide application. Nowadays shells of arthropods and mollusks are widely used as reinforced materials due to their availability and impact mechanical properties. This study focused on the production and evaluation of impact strength of snail shell reinforced epoxy composite and as well given concrete information and recommendation on usage with respect to appropriate filler concentration and impact strength resistance. Production was carried out according to the percentages of filler which are 0%, 10%, 20%, 30%, 40% and 50% respectively. ASTM standard method forcharpy impact strength tests was used to determine the impact resistance of samples. From the result, the neat epoxy gave 11.344 while 10% and 20% filler concentration gave 7.519 and 7.056 KJ/m² respectively. The results showed that the impact strength of snail shell reinforced epoxy composite, decreases with increase in filler concentration. Composite materials are generally used for building, bridges and structures such as boat, hulls, swimming pool panels and shower stalls.**

Key words: **production, evaluation, impact, strength, snail shell, epoxy, composite.**

I. INTRODUCTION

Modern technologies require materials which have unusual combinations of properties that cannot be provided by any single material.

Composite materials are materials made from two or more constituent materials significantly different physical or chemical properties, that when combined, produce a material with characteristics different from the individual components.[1]

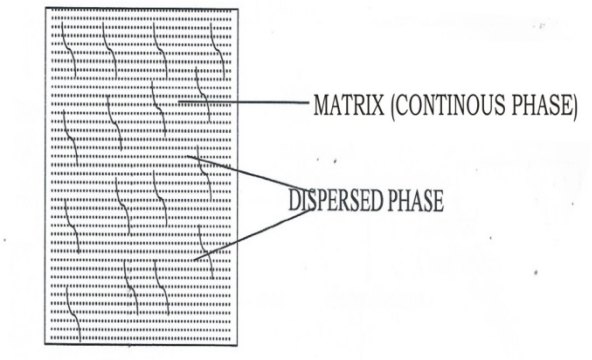

Fig 1.0 REPRESENTATION OF A COMPOSITE MATERIAL

[1] Waterman and Pamela (2007)

The individual components remain separate and distinct within the finished structure.

One of the earliest use of composite materials was by the ancient Mesopotamians around 3400 B.C, when they glued wood strips at different angles to create plywood[2].

The earliest man-made composite materials were straw and mud combined to form bricks for building construction[3]. Ancient brick paint making was documented by Egyptian tomb paintings. Water and daub is one of the oldest man-made composite materials at over 600 years old[4].

In the early 1900's, plastic such as vinyl, polystyrene, phenolic and polyester were developed. As important as these innovations were, reinforcement was needed to provide the strength and rigidity. The first artificial fiber reinforced was Bakelite which dated to 1907[5].

Although other Nigerian researchers have used snail shell and other different materials as filler in polymer composite production, but snail shell of the species[Aspersa] has not been used. One of the major problems associated with snail shell reinforced epoxy composite production and evaluation in many research work done in Nigeria is lack of concrete information on impact resistance or energy absorbing property with reference to appropriate filler concentration and usage. Due to the availability and low cost of snail shell in Nigeria, it is high time we focus on the use of snail shell as a reinforced material in polymer composite production to enable our local industries function to their optimum production.

Therefore, this research seeks to produce and evaluate the impact strength of snail shell reinforced epoxy composite and as well, given concrete information and recommendation on usage, with respect to filler concentration and impact strength resistance.

1.1 Snail shell as a reinforced material

[2] Housecraft and Catherine E (2008). Composite and reinforcement. 2nd edition pp 437-443

[3] John W. Benson (1980). Application of composite materials p.44

[4] Miller and Marvin J. (2007). Classification of plastics and molding techniques. 1st edition. Pp 77-79

[5] May and Clayton A.91987). epoxy resins: chemistry and technology 2nd edition pp 795-797

Fig 1.1 garden/land snail

Below is the taxonomic classification of common garden/land snails in Nigeria[6].

Kingdom: Animalia

Class: Mollusca

Order: Stylommatophora

Family: Helicidae

Genus: Helix

Species: Aspersa

II. MATERIALS AND METHODS

2.1 Apparatus and Material

Mortar and pestle, oven, wire sieve, take away plastic plate, moulds (size: L=17cm. W=13cm), foil [paper, razor blade, hypodermic syringes, spatula, weighing balance [OHAUS], measuring cylinder [50,100(cm^3)], composite cutting machine, impact 15 [DTS-15], filler (grounded sieve snail shell).

2.2 Regent

Epoxy resin, and hardener

III. METHODOLOGY

3.1 Sample collection

The snail shells were obtained from Gwagwalada market while the epoxy resin and hardeners were purchased from a chemical shop in Lagos, Lagos State.

3.2 Sample preparation

The snail shells were thoroughly cleaned, washed and dried in an oven temperature to remove water. Furthermore, they were pounded using mortar and pestle to powder form. Wire sieve was used to sieve the sample. The collected sample was stored in two cleaned, dried takeaway plastic plates tightly covered and was finally used for composite production.

3.3 Method of production

Open molding method was adopted.

Appropriate measured amount of both resin and the reinforced material was mixed completely and placed in an open mould of the sizes, L, 17cm and W 13cm covered at the bottom with aluminum foil which was allowed to cure or harden while exposed to air.

Below are the photographs of the produced polymer composite at various filler level i.e. 0, 10, 20, 30, 40 & 50%.

Fig 3.1: standard: At Zero filler level (100% EP)

Fig 3.2: composite produced at 10% Filler

Fig 3.3: Composite produced at 20% filler

Fig 3.4: composite produced at 30% filler

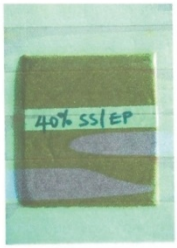

Fig 3.5: Composite produced at 40% filler

Fig 3.6: Composite produced at 50% filler

Figure 3.1 - 6 showing composite produced at various filler level or concentration

Note: SS=> Snailshell[filler]

EP => Epoxy

Fig 3.4 showing impact 15 [DTS-15] Used for impact strength Determination
NOTE: (SS) represent snail shell (filler)

(EP) Represent Epoxy Resin

3.4 Charpy Impact Strength Test Procedures

Charpy impact test is an ATSM standard method of determining the impact resistance of materials. A hammer-like

[6] Peter H. Raven, George B. Johnson (2002). The diversity of mollusks and Athropods. 3rd edition .

pendulum with a massive striking edge was allowed to hit the sample. From the travel of the pendulum after breaking the specimen, the energy absorbed by the sample was determined [7]. Values for the energy (KJ/m^2) required to break each of the samples was calculated by the machine [impact-15] as shown on the result sheet, the testing temperature was maintained at 22.

IV. RESULT, DISCUSSION, CONCLUSION AND RECOMMENDATION

4.1 Result

The results are presented in table 4.1 and figure 4.1. Table 4.1shows the values of energy in KJ/m^2 required to break the various samples produced at zero filler level [100%EP] to 50 filler level [50% SS/EP] in percentages and figure 4.1 presented the result in bar chart.

Table 4.1: showing the result of the impact test of snail shell epoxy composite

S/N	FILLER LEVEL (%)	IMPACT ENERGY (KJ/m^2)
1	0	11.344
2	10	7.519
3	20	7.056
4	30	6.737
5	40	5.107
6	50	3.613

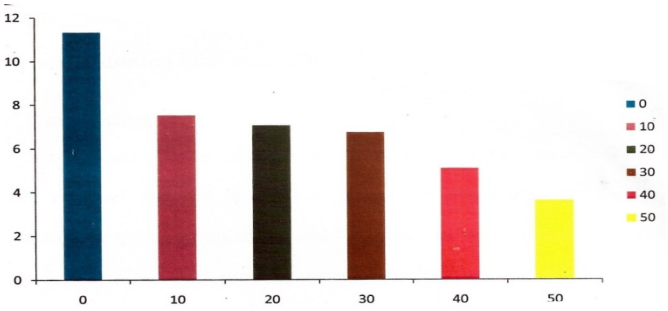

Figure 4.1: the interpretation of results in bar chart

4.2 Discussion

It is obvious from figure 4.1 that the impact strength of snail shell reinforced epoxy composite decreases with increase in filler concentration. The decreased observed between 30 - 50 percentages is significant compared to decrease observed between 10 - 20 percentages.

4.3 Conclusion

Snail shell contains calcium carbonate and can be considered as a good source of filler material in polymer composite production due to its impact mechanical properties, availability and low cost. The impact strength of snail shell reinforced epoxy composite decreases with increase in filler concentration.Information obtained from impact test can be used to determine whether a given composite has sufficient energy – absorbing properties to be used for a particular application.

4.4 Recommendation

Since the impact strength of snail shell reinforced epoxy composite decreases with increase in filler concentration, it is recommendable that, snail shell polymer composite which usage demanded high impact strength should be produced at low filler concentration while those which usage demanded low impact strength should be produced at high filler concentration.

REFERENCE

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