

# Characterisation and Processing of Sago Particle Reinforced Composite.

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**Abstract:** Composite materials are multi-phase materials in which the phase distribution and geometry can be controlled in order to optimize one or more properties depending upon our requirement and application of the composites. The purpose of the paper was to enhance this, as we fabricated the composites using Natural particle reinforced polymer composites. Epoxy resin along with Sago starch particles were used to prepare the specimens in various weight proportions. In order to study the characterization of the composite specimens various test were conducted which include tensile test, Compression test, Flexural test and Water absorption test.. This paper consists of all the literature required, fabrication processes, testing methods and the analysis about the characterization of the fabricated composite

**Keywords:** Natural particle reinforced composite, Epoxy resin, Sago starch particles and characterization.

## I.INTRODUCTION

Composites materials are extending the horizons of designers in all branches of engineering, and yet the degree to which this is happening can easily pass unperceived. In composites, materials are combined in such a way as to enable us to make better use of their virtues while minimizing to some extent the effects of their deficiencies. Use of synthetic polymers in every segment of our life has increased the plastic waste in large quantities, which forms one of the major environmental problems the world is facing today. New environmental regulations and societal concern have triggered the search for new products and processes that are compatible to the environment. Strategies/processes to overcome this environmental problem is the use of bio based polymers, bio composites which are derived from renewable materials, leading to the development of 'green or eco-composite materials' that can be easily degraded or bio assimilated. Natural particles, which were traditionally used as fillers for Thermo sets, are now becoming one of the fastest growing performance additives. Natural particle composites are emerging as a viable alternative in many applications. The general environmental awareness and new rules and regulations will contribute to an increase in the work for more Eco-friendly concept in many applications. These materials are expected to be one of the important materials to realize and recent advances in genetic engineering, natural particle development and composite science offer significant opportunities for improved value-added materials from renewable resources with enhanced support of global sustainability which maintains a sustainable productive society.

## II.LITERATURE REVIEW

J. Olumuyiwa Agunsoye\*, Talabi S. Isaac, Sanni O. Samuel [1] have prepared the composite by using coconut Shell reinforced particulate was prepared by compacting low density polyethylene matrix with 5% - 25% volume fraction coconut shell particles and the effect of the particles on the mechanical properties of the composite produced was investigated.

R.Karthik ,S Sathiyamurthy , S Jayabal and K.Chidambaram [2]have analysed the surface roughness of rice husk and egg shell impregnated coir fiber reinforced polyester composite were evaluated. The short untreated coir fibers with different proportions of fiber length, fiber content and filler content were used as reinforcement in polymer based matrix. The fabricated composites with the different levels of fiber parameters were tested as per ASTM standards.

N. Srivastavaa, V.K. Singhb\*, J. Bhaskar [3] they used walnut particles as reinforcement and an open mould method used to fabricate.Walnut particle reinforced composite was prepared with epoxy matrix with 10 – 40 weight percentage (wt %) of walnut particles and the effect of the reinforcement of particles on the water absorption capacity and compressive strength have been evaluated.

Yan, R.J.T.Lin\*, D.Bhattacharyya [4] investigated the mechanical properties of particulate reinforced polyethylene when using rotational moulding process, different mathematical models are used to predict the tensile properties.

### a)Particle Reinforced Polymer :

Particles used for reinforcing include ceramics and glasses such as small mineral particles, metal particles such as aluminum and amorphous materials, including polymers and carbon black. Particles are used to increase the modulus of the matrix and to decrease the ductility of the matrix. Particles are also used to reduce the cost of the composites. Reinforcements and matrices can be common, inexpensive materials and are easily processed. Some of the useful properties of ceramics and glasses include high melting temp., low density, high strength, stiffness, wear resistance, and corrosion resistance. Many ceramics are good electrical and thermal insulators. Some ceramics have special properties; some ceramics are magnetic materials; some are piezoelectric materials; and a few special ceramics are even superconductors at very low temperatures. Ceramics and glasses have one major drawback: they are brittle. An example of particle reinforced composites is an automobile tire, which has carbon black particles in a matrix of poly-isobutylene elastomeric polymer.

### b)Epoxy Resin:

Epoxy resins have a well-established record in a wide range of composite parts, structures and concrete repair. The structure of the resin can be engineered to yield a number of different products with varying levels of performance. A major benefit of epoxy resins over unsaturated polyester resins is their lower shrinkage. Epoxy resins can also be formulated with different materials or blended with other epoxy resins to achieve specific performance features. Cure rates can be controlled to match process requirements through the proper selection of hardeners and/or catalyst systems. Generally, epoxies are cured by addition of an anhydride or an amine hardener as a 2-part system. Different hardeners, as well as quantity of a hardener produce a different cure profile and give different properties to the finished composite.

Epoxies are used primarily for fabricating high performance composites with superior mechanical properties, resistance to corrosive liquids and environments, superior electrical properties, good performance at elevated temperatures, good adhesion to a substrate, or a combination of these benefits. Epoxy resins do not however, have particularly good UV resistance. Since the viscosity of epoxy is much higher than most polyester resin, requires a post-cure (elevated heat) to obtain ultimate mechanical properties making epoxies more difficult to use. However, epoxies emit little odor as compared to polyesters. In this work epoxy resin was chosen for matrix phase.

#### c) Reinforcement particles :

For the present work the sago particles were chosen as reinforced phase the chemical name was 'Metroxyl n sago' which when undergone through wetting process acquires stickiness it helps in better bonding in the composites. These when mixed with epoxy resin show a very good bonding with the resins, increasing the hardness of the composites. In this paper the starch particles are varied in the proportions of 10%, 20%, 30% and 40% on weight proportions. The various characteristic properties of the laminates prepared are analyzed by conducting several tests.

### III. FABRICATION OF COMPOSITE.

#### a) Preparation of moulds:

The various steps involved in preparing the mould

frames that are used for laminates preparation are shown in Figure 1.

- Procurement of the various materials for the preparation of frame like the metal rods, cutting tools etc.
- Preparing a rough draft of exact dimensions of the mould frame.
- Cutting the individual rods or sheets.
- Setting the individual parts of the frames together and checking for any errors.
- Welding all the parts together for a permanent joint of the parts of frame so that there won't be any problems while fabricating the composites.

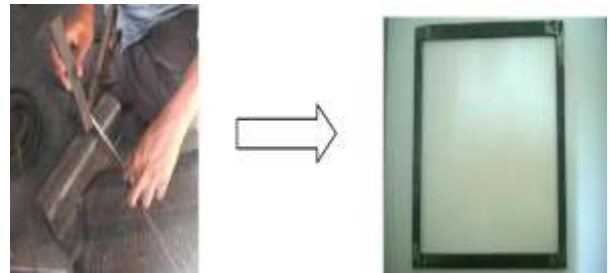


Fig.1. Mould Frame Preparation

#### b) Preparation Of Laminates-Hand Lay Up Process:

The laminates are prepared using the Hand Lay-up technique shown in the Figure 2. Preparing mould set-up placing the frame and the tiles under the frame without any movements.

- Sealing the edges and sides of the mould set-up with wax coating and adhesive to make sure that there are no leakages.
- Firstly the epoxy resin and the Sago Starch particles are mixed depending up on the respective proportions.
- The mixture is then thoroughly stirred using a stirrer for about one hour and then the hardener is mixed about 5-10%.
- Then the mixture is poured into the mould set up layer by layer until the mixture exactly fills in the mould.
- It is left to cure itself for about 3-4 days.
- The finished laminates are carefully removed from the mould set up.

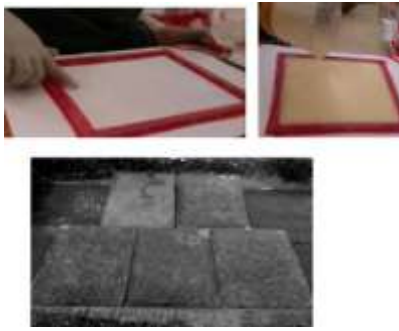


Fig2: Laminates Preparation

#### c)Preparation Of Test Specimens:

The finished laminates are marked accurately according to the specified ASTM-Standards and carefully cut on a Jig Saw machine which was Shown in Fig3.1 and Fig3.2. The finishing is done to obtain a smooth surface finish on the edges.



Fig.3.1 Marking



Fig.3.2Cutting the sample



3.3 Tensile Test sample



3.4 Water Absorption Test Specimens

## IV.RESULTS AND DISCUSSIONS:

### Compression test:

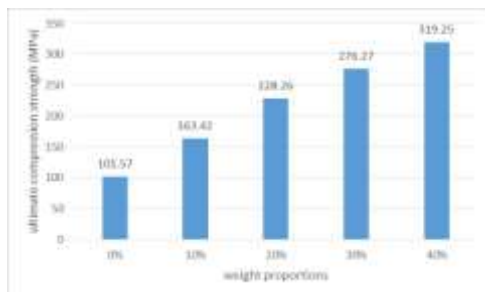


Fig .4.1: Ultimate Compression strength Vs Weight proportions

After the series of tests conducted on all the specimens as per the results to study their characterization graphs are drawn as Shown in Figure.4.1. It can be clearly seen that the compressive strength of the specimens gradually increased as the weight proportions of the particles was increased. From the graph, the 0% weight proportion specimen has 101.57 Mpa compressive strength and it increased for the 10% by 63.42 Mpa. Therefore there is an increase in the compressive strength of the composites as the weight proportions of the reinforcement increased. The specimen with 40% reinforcement has the highest compressive strength among all the specimens. The compressive strength is increasing may be because of the arrangement of particles in the matrix phase. The particles are able to bear the load due to the bonding with the matrix phases.

### TENSILE TEST:

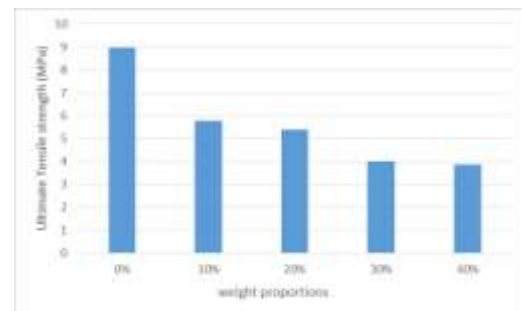
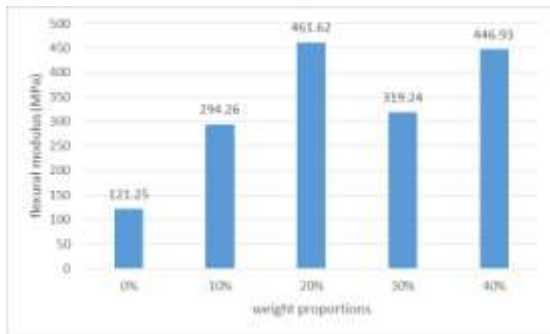


Fig.4.2.Ultimate Tensile strength Vs Weight proportions

After conducting the tests on the UTM machine the tensile strengths of specimens are observed to decrease gradually. As Shown in Figure.4.2 the specimen containing the least reinforcement (0%) has the highest tensile strength because there is no presence of particle reinforcement. The next specimen containing the 10% weight proportion specimen has the second highest tensile strength and this phenomena continues till the last specimen.

The least tensile strength is observed in the specimen that has the highest proportion of reinforcement (40%) This may be due to the addition of particles made the composite brittle. As in case of fiber composites the continuous phase is present which makes the composites excellent in tension strength , whereas the particulate reinforcement is not a continuous phase that makes the composite very weak in tensile strength.

## FLEXURAL TEST:



**Fig4.3:** Flexural Modulus Vs Weight proportions.

After Flexural test was conducted on the load frame varying the deflections the amount of load the specimen is able to withstand is calculated.

The flexural modulus is calculated using mathematical formulae. It can be observed from the Figure.4.3. that the flexural modulus increased as the weight proportions of the reinforcement increased. From the graph there is an increase till the 20% proportion and then it slightly decreased in the next proportion. The bending ability of the fabricated composites is then studied as per the results obtained

## V. Conclusion

From the observations of all the tests conducted it is observed that the prepared composite materials are good in compressive

strength. The specimens are also good in sustaining the loads which cause bending. So we conclude that these composite materials made by epoxy resins and starch particles can be used for constructional applications. From flexural bending test It is observe that the strength of composite is reduced for the specimen having 30% wt .this is may be because of improper arrangement of particals.so the proper care should be taken to get accurate results.

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