MECHANICAL PROPERTIES ANALYSIS OF TREATED AND UN TREATED NATURAL FILLER REINFORCED EPOXY COMPOSITE

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ABSTRACT

Presently, the awareness of the public along with strict legitimate forces over the use of polymers, the manufacturing and automotive industries started using the renewable materials. Since, natural filler reinforced composites play vital role in developing lightweight structural materials. This study focuses on utilizing saw dust as reinforcement in polyester matrix along with natural filler. Finally, the influence of saw dust a natural filler addition into the $KmNO_4$ chemically treated saw dust composite has been evaluated by mechanical and dynamic mechanical properties. It is found that the addition of natural filler and surface treatment has enhanced the properties of composites due to their synergetic effect. This effect improves the adhesion and uniform stress transfer among the reinforcements. The filler surface morphology was evaluated using micrographs obtained from scanning electron microscope.

KEYWORDS: Saw Dust Filler, Epoxy Resin, Hand Layup Method & $KmNO_4$

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1. INTRODUCTION

In the recent past, attempts have been made to reduce the use of synthetic resin and fiber in fiber reinforced plastics (FRP) by using naturally available materials. The studies were performed in developing reinforcement from various agricultural and natural waste materials due to growing demands for sustainable and recycled materials [1–5]. Due to sustained effort of research, currently, millions of tons of natural filler and fibers are used as reinforcement with polymers for diverse applications, they have many advantages such as better specific strength, low density, ease of availability, low cost and less polluting compared to synthetic materials [6]. Several researchers have shown that synthetic fillers can be substituted by natural fillers in polymer composites for low and medium load structural applications [7–10]. The use of Saw dust filler [11] in FRP composites found that the addition of it has improved the tensile properties of the composite compared to neat polymer. Sarki et al. [12] used coconut shell powder as filler material in epoxy resin and found that the incorporation of coconut shell powder increased the tensile strength and modulus with a slight decrease in impact strength. Chun et al. [13] used coconut shell powder as filler in recycled polypropylene and the results. It revealed that the addition of filler provided an increase in tensile properties, thermal stability, and lower the water absorption compared to treated composites. Toro et al [14] investigated the use of egg shell powder as bio-filler with polypropylene (PP) composite and reported that egg shell powder added composite has better mechanical properties than all types of carbonate fillers. A fully degradable bio composite based on Poly Lactic Acid (PLA) and olive pit powder was fabricated by Koutsomitopoulou et al [15]

and reported that the addition of filler resulted in increase in tensile modulus but decrease in flexural strength. Qingzhao et al [16] fabricated (silk fiber) incorporated PLA composite and found that addition of silk fiber in the PLA matrix increased the dimensional stability and modulus of the composite. The thermal stability was found to be decreased with addition of silk fiber in the matrix. Rajesh and Pitchaimani [17] analysed the influence of weaving architecture on dynamic mechanical and the free vibration behavior of jute polyester composites (plain, basket, stain, twill and huckaback). They found that the weaving architecture influences the storage and loss modulus of composite material. It also reveals that the basket type of weaving carries more load than other weaving pattern. Jandas et al [18] fabricated bio degradable composite using nano clay as filler and banana fiber as reinforcement in PLA matrix. The report indicates that the addition of filler material and natural fiber resulted in reduction of cost of the composite material. The saw dust in the form of hard substance was procured and grinded to a fine powder of 1–2 microns using ball milling process. This fine powder was mixed at different volume proportions of 10, 20, and 30 v/v % in epoxy resin using ultra-sonification technique. The prepared mixtures are then poured into the mould of 300 x 300 x 3 mm³ dimensions. The mould is made of silicon rubber. The powder mixture is then allowed to cure in the room temperature for 6 hrs. Hand layup method had been used to fabricate the composites.

1.1 Raw Materials

Raw materials utilized as a part of this test work are epoxy resin. Saw dust filler (natural filler). The epoxy resin and the hardener are acquired from M/s. Sakthi fiber glass Ltd., Chennai; India. In this present investigation natural filler and synthetic resin are used for fabricating the composite specimen.

1.2 Fabrication of Composite

A polyester sheet is taken and with the assistance of silicon rubber mould with dimension 300 x 300 x 3 is prepared. For various volume fraction to deliberate saw dust filler, synthetic resin. Care was taken to keep away from the air bubbles. In this procedure the accompanying composite was readied. The composite materials are fabricated by hand layup process. As a matter of first importance, a discharge gel is splashed on the form surface to stay away from the adhering of polymer to the surface. Thin plastic sheets are utilized at the top and base of the mould plate to get great surface complete of the composite. At that point thermosetting polymer in fluid shape is blended completely in appropriate extent with an endorsed impetus (curing operator) and poured onto the surface effectively placed in the mould. The polymer is consistently spread with the assistance of brush. In the wake of setting the plastic sheet, discharge gel is splashed on the inward surface of the mould plate which is then kept on the stacked layers and the weight is applied. In the wake of curing either at room temperature or at some particular temperature, mould is opened or the created composite part is taken out and additionally handled. At that point the work piece is taken from the mould and they are cut according to ASTM measurement and methods

1.3 Composition of Composite

Table 1: Composition of Composite

S. No	% of Saw Dust	% OF Epoxy
Treated filler 1	10	90
2	20	80
3	30	70
Un treated filler 4	10	90
5	20	80
6	30	70

1.4 Astm Dimensions

According to ASTM (American society for testing materials) international standards the specimen is cut for testing mechanical properties. For the tensile testing the ASTM D 638 is prepared with (160×20×3)mm dimensions as a double dumbbell shape, ASTM D 790 with rectangular cross section of (100×12.5×3)mm is used for flexural testing, ASTM D 256 rectangular cross section with (64×12.7×3.2)mm is used for impact testing.

2. RESULTS AND GRAPHS

Figure 1: Tensile Strength.

Figure 2: Flexural Strength.

Table 2: Impact Strength

S. NO	Impact strength (J)
Treated saw dust filler	
10	1
20	1
30	1
Un treated saw dust filler	
10	1
20	1.2
30	1.1

3. RESULTS AND DISCUSSIONS

The tensile, flexural, and impact strength of epoxy composites with different vol % of treated and untreated saw dust filler are shown in The figures show that the incorporation of KMnO_4 treated filler material improves the mechanical properties of composite material to certain extent. The addition of filler material up to 20 vol% increases the tensile property of composite. From the further addition of filler material reduces the tensile strength of the composite material. This is due to uniform distribution of saw dust in the epoxy matrix. Due to uniform dispersion, stress is created because of applied load is disseminated equally. It also indicates that bonding between filler and matrix is better when compared to the composite with 30 vol % of filler materials. Agglomeration of filler material results in amorphous nature of the composite. The influence of treated saw dust filler reinforcement on flexural characteristics of the composite is shown in graph 2. A trend similar to the tensile properties was observed in the flexural property also. It shows that the addition of treated filler material up to 20 vol % increases the flexural strength of the composite material. Addition of saw dust by more than 20 vol % decreases the flexural properties of the composite material. The decrease in flexural properties at higher vol % is due to the agglomeration and weak interface between the filler and the matrix. The influence of saw dust on impact properties of epoxy is shown in table 2. Provides an interesting observation that the addition of filler up to 10 vol % does not improve the impact strength of composite material. However, further addition of filler increases the impact strength of composite material moderately. It is due to brittleness of the composite material. Further addition of algae decreases the impact strength of the composite material; however, the value is still higher than neat resin.

4. CONCLUSIONS

- The influence of different vol % of saw dust filler addition of the epoxy resin with mechanical properties were analyzed.
- The mechanical test results revealed that the inclusion of KMnO_4 treated 20 vol % filler in the epoxy matrix increases the mechanical properties such as tensile, flexural, and impact strength of the composite.

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