Analysis of Mechanical Properties of Glass/Orthophthalic Polyster Resin with Hematite Ore Filled Composites

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Abstract

Composite materials play a vital role in many industrial applications. Research scholars are working on fabrication of new composite materials worldwide to enhance the applicability of these materials. In view of this, the present work is focused on to analyse the effect of hematite ore content on the mechanical behaviour of Bi- directional weaved E-glass fiber, reinforced in Orthophthalic polyster resin matrix with methyl ethyl ketone peroxide catalyst and cobalt octet accelerator were used with hematite ore filler. Three different types of composites are fabricated using 3wt% hematite ore, 6wt% hematite ore and 10 wt% hematite ore with 50% wt fiber, rest matrix material. The Orthophthalic polyster resin and hardener are mixed in 10:2 weight ratio. The result shown that the incorporation of hematite ore has a significant effect on the mechanical behaviour of composites

Keywords:-

GFRP, Mechanical Properties, Orthophthalic polyster resin or General Purpose (G.P) resin, hematite ore filler.

INTRODUCTION

A composite material is considered to be one that contains two or more distinct constituents with significantly different macroscopic behavior and a distinct interface between each constituent. It has characteristics that are not depicted by any of the in isolation.

Fiber reinforced composite found their way in a large number of applications in automotive and aerospace industries by virtue of their lower density. Their light weight makes them suitable for weight sensitive structural applications, where as for commercial applications it is not liable

due to its high cost. Use of low cost easily available fillers may be useful to bring the cost of component down. The effect of such filler addition is necessary to ensure that the mechanical properties are not affected adversely by such an addition, some of the references suggest investigations on a large number of materials to be used as fillers in polymers (Katz and Mileoski 1987) but only a few of them deal with the material system containing fibers and fillers simultaneously (gupta et al 1999)

Zhau bing and Nagbo Ji investigated the use of fillers can be beneficial in laminating or casting of thick components where otherwise considerable exothermic heating can occur. Addition of certain fillers can also enrich to increase the heat resistance of the laminate

Djoković, and Nedeljković has found that increase in hematite filler content lead to increase in elastic moduli and magnitude of stress relaxation of the composites. Enormous work has been carried out on mechanical behaviour of glass/epoxy composites and filled with different fillers such as SiCp, Gr, fly ash and so on. However it can be noted that mechanical properties of glass/epoxy composites filled with hematite filler is not being evaluated sufficiently though it is one of the naturally available types of filler material.

Aramide et al. obtained the results that increase in fiber volume fraction can lead to increase in elastic modulus and extension to break till certain threshold value and further increase in fiber volume implies in decrease in the same properties. However hardness increases with increase in fiber volume but strain decreases.

Hence by this research survey it is motivated to make some experiments to investigate the effect of the varied volume fraction of hematite filler content on glass /unsaturated polyester resin. The objective is to investigate the mechanical properties.

MATERIAL DETAILS

E-glass fabric (300 GSM) of plain weave construction, procured from High tech suppliers of polymers, Bangalore, was used for the study Orthophthalic polyster resin matrix with methyl ethyl ketone peroxide catalyst and cobalt octet accelerator were used. The filler were Hematite is one of the most common minerals. The sandstone is most red and brown in color because of hematite presence. Non-crystalline forms of Hematite may be transformations of the mineral Limonite that lost water, possibly due to heat chemical formula Fe_2O_3. The filler used was hematite passed through 75-150 μm

SPECIMEN PREPARATION AND TEST DETAILS

A hand lay-up method is used to prepare the glass-GP composites with filler. To prepare glass GP with hematite filler composites, filler is mixed with a known amount of GP resin. The laminate was cured at ambient conditions for a period of about 24 hours. The laminate so prepared has a 250mm X 250mm X 3mm.

The composites are fabricated and cured as reported by Suresha et al [9] and basavarajappa et al. [10]. The cured materials are cut to yield test specimens in accordance of ASTM standards. Tensile test has been carried out according to ASTM D 3039, Flexural test has been done according to ASTM D 790, Impact test has been conducted ASTM E23 and Hardness has been measured in terms of B.H.N. value accordance of ASTM E10.

In this present work the two variables are kept changing and making different composites by varying by resin material and the filler material is added by using rule of mixture by its weight ratio as shown in the table 1. The major aim is to know the influence of the hematite ore on

the glass fiber. The following discussion gives the brief idea.

Table1

composites	% of filler	Matrix volume %		Reinforcement volume %	
A	0	Unsaturated polyester	50	Glass fiber	50
B	3	Unsaturated polyester	47	Glass fiber	50
C	6	Unsaturated polyester	44	Glass fiber	50
D	10	Unsaturated polyester	40	Glass fiber	50

ULTIMATE TENSILE STRENGTH

In this test, the tensile behavior of hematite ore reinforced polymer composites in different weight percentages of ore (3%, 6%, 10%) is prepare, the tensile test was carried on UTM, as per the ASTM standards.

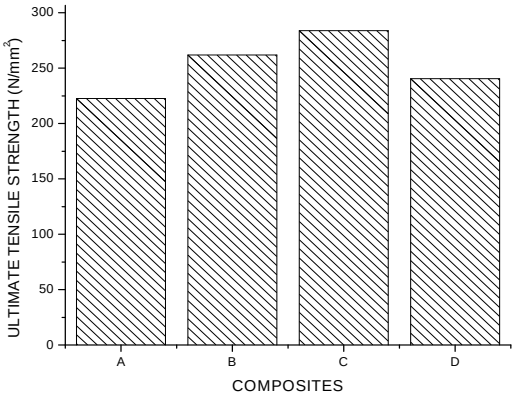

Fig: 1 The comparison of UTS of varying filler material

The test specimens are prepared as per ASTM 3039. The three specimens of each sample of composite were subjected to tensile test and mean value is considered for comparison. The result gives a brief outline on ultimate tensile strength that is as the percentage of filler added to the resin material and Glass fiber there is increase in tensile strength of the composite as further increase of percentage of filler show the decrease in tensile strength due to weak bonding between the filler and the resin material the figure 1 show the overview of test.

FLEXURAL STRENGTH

The major aim to conduct this test is two know the combined stress induced by the flexural loading this test helps designer to know the ability of the material that withstand bending forces applied perpendicular to its longitudinal axis (flexural strength).

In this test, the flexural behavior of hematite ore reinforced polymer composites in different weight percentages of ore (3%,6%,10%) is prepare, the flexural test was carried on UTM, as per the ASTM standards.

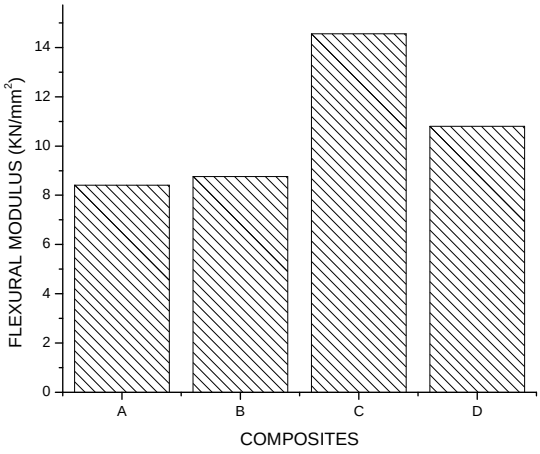

Fig: 2 The comparison of Flexural Strength of varying filler material

The test specimens are prepared as per ASTM 790. The three specimens of each sample of composite were subjected to tensile test and mean value is considered for comparison. The result gives a brief outline on ultimate flexural strength that is as the percentage of filler added to the resin material and Glass fiber there is increase in flexural strength of the composite as further increase of percentage of filler show the decrease in flexural strength due to weak bonding between the filler and the resin material the figure 2 show the overview of test.

HARDNESS TEST

Hardness is resistance of material to plastic deformation caused by indentation. Sometimes hardness refers to resistance of material to scratching or abrasion. Hardness may be measured from a small sample of material without destroying it. Hardness is not fundamental property and its value depends on the combination of yield strength, tensile strength and modulus of elasticity.

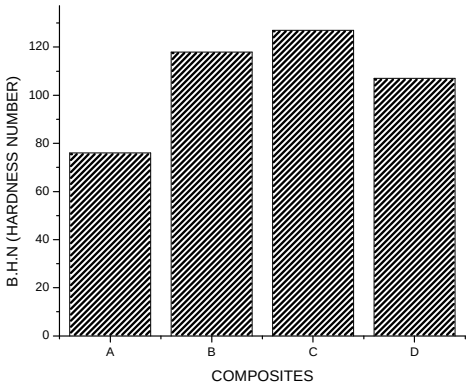

Fig:3 The comparison of B.H.N of varying filler material

The test conducted on Brinell hardness machine, as per the ASTM standards the specimen prepared as per ASTM E10, the figure 3 shows the comparison with unfilled glass GP composite and filled glass GP composite. The hardness is increased by increasing the hard reinforcement weight percentages in the composites.

IMPACT STRENGTH

Impact tests are designed to measure the resistance to failure of a material to a suddenly applied force. The test measures the impact energy, or the energy absorbed prior to fracture. Impact energy is a measure of the work done to fracture a test specimen.

The impact strength is defined as the resistance of the materials to shock. The impact testing is to find out the energy absorbed by a specimen with brought to fracture by hammer blow and gives a quality of the material.Toughness measurement of hematite ore reinforced polymer matrix composites through impact testing is discussed in this section. The specimens prepared as per ASTM D256 three trials conducted on each composite materials and the mean value is considered for the comparison due addition of the filler into the matrix material increase the resistance to propagate the crack growth in the laminates, The figure 4 shows influence of filler material on the matrix material as fiber is kept constant percentages in the composites.

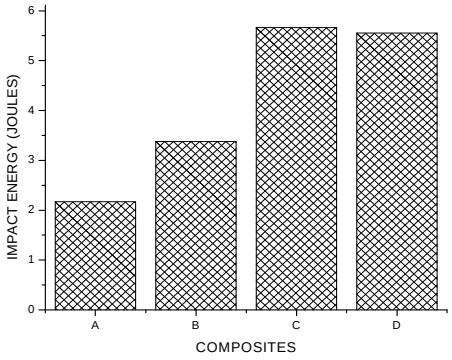

Fig: 4 The comparison of Impact Strength of varying filler material

CONCLUSION

The fabrication hybrid reinforced polymer composites were carried out by hand layup method. The experimental investigations on the composite specimens were carried out to determine the tensile strength, impact strength, hardness and flexural strength. It was observed that the inclusion of hematite ore in composites with increased tensile strength, impact strength, hardness and flexural strength. Increase filler percentage till 6% weight fraction in composites got beneficial mechanical properties, further increase of filler material with matrix material improper bonding, interface and embrittlement of the composites causes detrimentaleffect.

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