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Study of Mechanical Properties of Carbon Fiber by Influence of Filler Materials

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ABSTRACT - *The desertion work describes the mechanical properties of new polymer composites consists of carbon fiber reinforcement, epoxy resin and filler materials like ZrO_2 and Sic. Experiments like tensile test, bending test, impact test are conducted to find the significant influence of filler material on mechanical properties of carbon fiber reinforcement plastics composites, The test result have shown that higher the filler material volume percentage greater the strength for both ZrO_2 and Sic filled carbon epoxy composites, Sic filled composites show more sustaining values than ZrO_2.*

Key words: Carbon fiber reinforcement, Epoxy resin, Filler materials.

1 INTRODUCTION

Composite materials can be well defined as an amalgamation of two or more than two materials [Reinforce, Fillers and Binders] different in composition on a very small scale. Composite material are made from two or more than two constituents with considerably differ in physical and chemical properties .when the compositions get mixture the material with appearance different from the individual components. We can say that do not lose their properties to the product causing from their mixture.

The core benefits of composite materials have their great strength and stiffness, for example Carbon fibers have great specific strength, high modulus, good in fatigue resistance and dimensional stability and lower density fibers composite materials have their high strength and stiffness. If it combined with low density, when compared with bulk materials, allows for a weight reduction in the finished part.

1.1 SPECIMEN PREPARATION

The method that is used for manufacturing the laminated composite plates is HAND LAY UP technique as shown in Fig.1below, it is the oldest method used to get the composite materials. The type of carbon fiber mat selected to make specimens is, Mat-GSM.

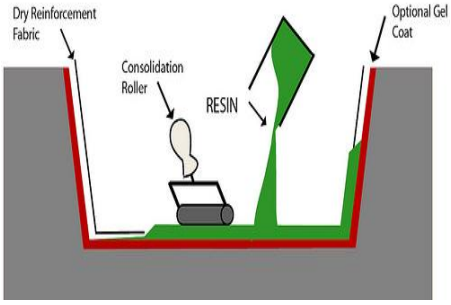


Fig.1 Hand Lay Up Technique
(source;www.netcomposites.com)

The matrix material used was a medium of viscosity is epoxy resin [Lapoxy T-22] and a room temperature curing polyamine hardener [K-6], both the matrix and hardener are manufactured by ATUL India Ltd. Gujarath, India. This matrix was chosen because it provides good resistance to alkalis and has good adhesive properties. Based on volume fraction the calculations were made for 60-40 [60% Carbon fiber and 40% Epoxy resin] combination May shows better results. There are two filler materials ZrO_2 and Sic were added to carbon fiber mat 60-40 combination by keeping epoxy resin percent constant [40%]. The amount of filler materials added is 4%, 8% and 12% of ZrO_2 and 4%, 8% and 12% of Sic, the complete details shown in Tab.1 below. The specimens are prepared as per the ASTM [American Society for Testing and Materials] standards for each test with different dimensions, the details given below in Tab.2.

Sl no.	Carbon Fiber [Mat-GSM]	Epoxy [Lapoxy T-22]	`Filler material percent	
			ZrO2	SiC
01	60	40	-	-
02	60	30	10	10
03	60	20	20	20
04	60	20	10+10	10+10

Tab.1 Filler Material Composition

Tests	ASTM Standards	Dimensions (mm)
Tensile	D-3039	250×25×4
Impact	D-256	55×10×10
Bending	D-790	110×25×6

Tab.2 Test specimen dimensions

1.2 EXPERIMENTAL SETUP

The following tests were conducted in desertion work;

- Tensile test,
- Bending test,
- Impact test,

The tests were conducted using calibrated Universal Testing Machine [UTM] as shown in fig.2 below

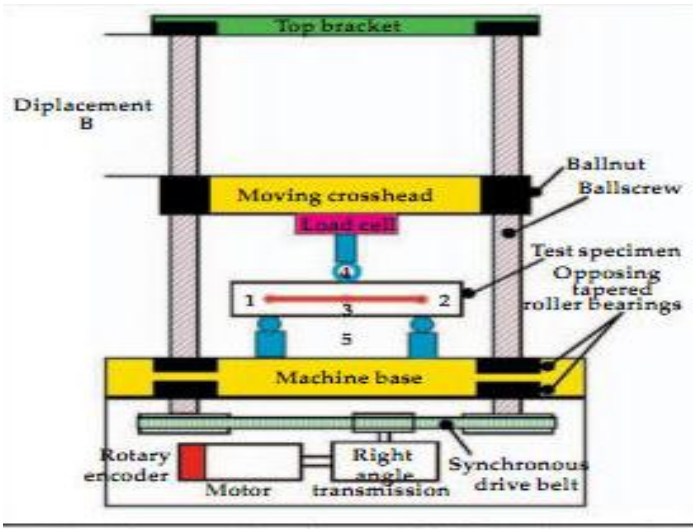
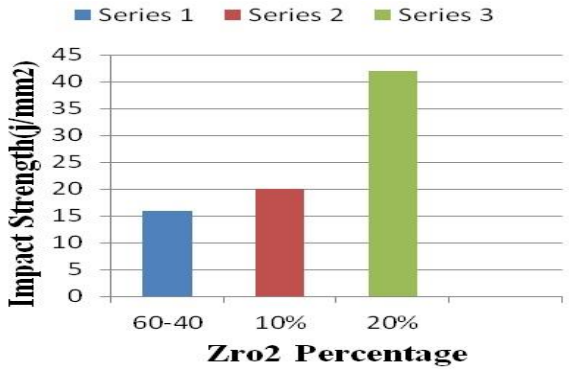


Fig.2 Universal Testing Machine (source;www.admet.com)

2 RESULTS AND DISCUSSION

2.1 Effect of filler on tensile characteristics



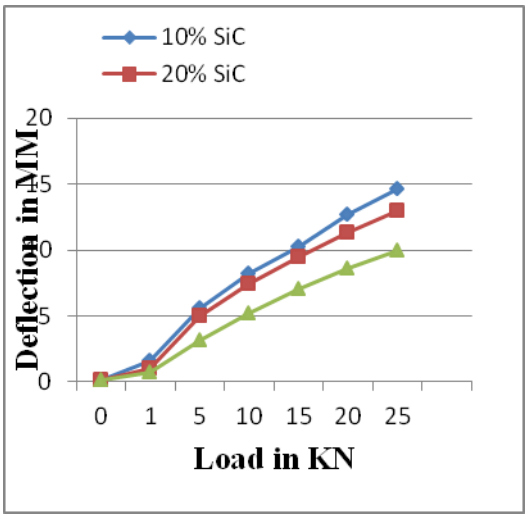
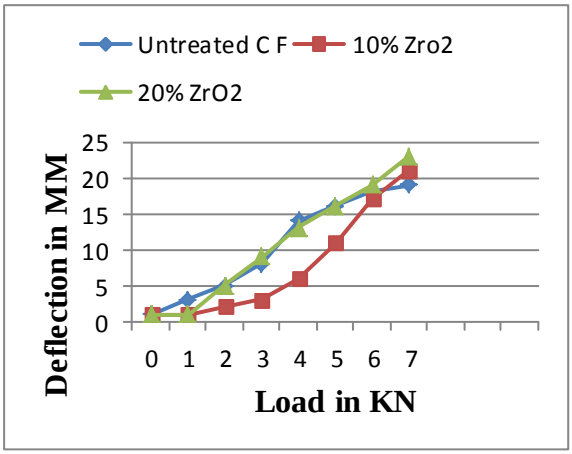


Fig. 3 Load-Displacement for Sic and ZrO_2

Comparison of the Load and Deformation relation is shown in Fig.3. From graph it can be observed that filled composites bear more load than unfilled carbon epoxy composites, damage mechanism in composite materials during tension involves various combinations of damage modes are matrix cracking, deboning and fiber breakage occurs during testing. As seen in graph, untreated carbon fiber composite bear less load than 10% volume fraction filler, maximum load is for 20% volume fraction filler, where as 10% Sic and 10% ZrO_2 volume filler is moderately high comparatively others.

2.2 Effect of Filler on Bending Characteristics



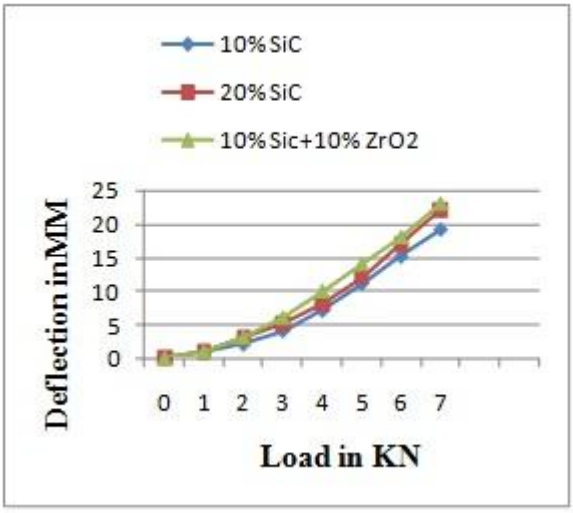
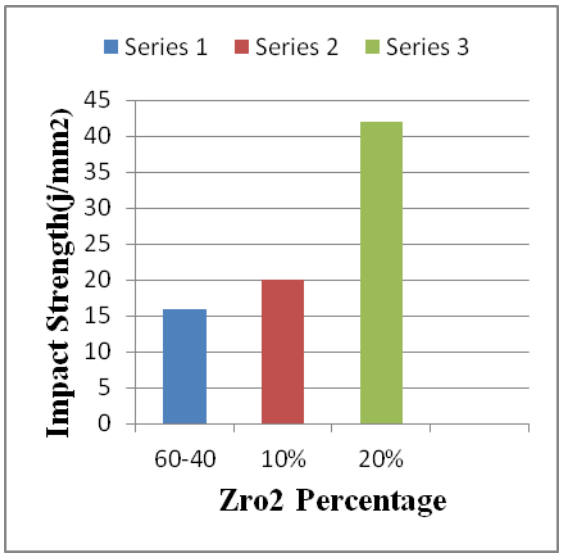


Fig.4 Load- Displacement for Sic and Zro_2

It can be observed that the bending load bearing strength of composite increases with the addition of filler. The addition of Zro_2 as the filler material to carbon epoxy composite makes the material harder than untreated carbon epoxy composite, this leads to bear more bending load than the untreated carbon fiber composite material. The bending strength increased with addition of filler content. Also it can be observed that there is a sharp yield in case of ZrO_2 filled composite.

The addition of Sic leads to increase in the bending strength compared to normal carbon epoxy composites. As from the graph, there is no sharp yield in the case of Sic filled composites. Since Sic is a ductile material, the addition of filler had enhanced the bending strength of composites.

2.3 Effect of Filler on Impact Strength



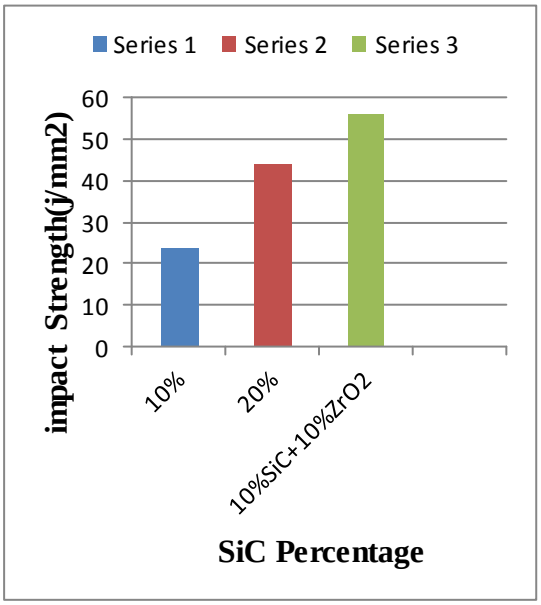


Fig 5 comparison of Impact strength of Filler materials

It is observed that increase in the impact strength with increased percentage content of filler. It is also very clear that the impact strength of the test specimen with the V notch grooved across the laminates is higher than that of specimens with the V notch along the laminates irrespective of percentage of content.

3. Conclusions

- Tensile, Bending and Impact strength increases with addition of filler material.
- Sic filled composite shows significantly good results than ZrO_2 filled composites.
- 10% Sic & 10% ZrO_2 filled composite shows more tensile load in comparisons with unfilled and ZrO_2 filled composites.
- Impact toughness value for 10% Sic & 10% ZrO_2 composite is more than filled composites.
- Sic and ZrO_2 filler material makes material harder and brittle which is the reason for reduction in impact toughness value
- Sic filled composite shows significantly higher values than ZrO_2 filled composites

REFERENCES

[1] Patil Deogonda, Vijaykumar N Chalwa, Mechanical properties of glass fiber reinforcement epoxy composites, SMSMPITR, Akluj, India.

[2] Sumin Zhu, William G, Influence of silicon carbide particle size on the microstructure and mechanical properties of zirconium diboride–silicon carbide ceramics, University of Missouri-Rolla, USA.

[3] D.D.L. Chung, Comparison of submicron-diameter carbon filaments and conventional carbon fibers as fillers in composite materials, State University of New York.

[4]W.kowbel, C H Shan, Mechanical behavior of carbon composites made with cold plasma treated carbon fibers, Auburn University, AL.

[5] Soo-Jin Park et al, Studies on the mechanical interfacial properties of carbon–carbon composites impregnated with an oxidation inhibitor, Chonbuk National University, Chonju, South Koria.

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