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Analysis Of Glass Fibre Reinforced Polymer Composite Material With Different Orientation And Additives

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***ABSTRACT**:- In Composites, Polyesters Are Basically The Most Significant Resin Where The Glass Fibre Is Used As Reinforcement. Strength Of The Material Which Is Prepared Using Polyester Resin And Fibre Glass Is Largely Depends On Glass Content In The Resin And On Orientation Of Glass Fibres.The Motivation Behind This Evaluation Is To Assessment Of The Mechanical Characterisation, For Example, Tensile Test And Modal Analysis Of Prepared Specimen. This Study Focus On Preparationand Testing Of Polyester Sap Utilizing Glass Fiber For Various Orientation Upon Added Substances $Casio_3$ And Sic. The Mechanical Properties Of The Polyester Changes Gradually By Changing The Layers Of Fibres And For Different Orientation Of Glass Fibre And By Adding Additives The Property Differs. The Laminate Is Prepared According To Rule Of Mixture And Specimens Are Prepared As Per Astm Standard, Different Layers Of Glass Fibres Are One, Two, Three And Four Layers And The Orientation Of Glass Fibre Is 0^o, 30^o, 60^o, And 90^o. The Glass Fibre Used Is In Fabric Form. The Modal Analysis For Prepared Specimen Was Carried Out To Find First Five Natural Frequencies And Corresponding Mode Shapes, For Both The Composites Plate With Additives Calcium Silicate And Silicon Carbide.*

I. Introduction

Composite Materials Are The New Generation Materials. It Is Developed To Meet The Request Of Fast evelopment Of Technological, Changes Of The Industry. Composite Materials Or Composites Are Engineering Materials Produced Using Two Or More Constituent's Materials That Remain Separate And Distincton Macroscopic Level Whereas Forming A Single Component.Physical Characteristics Requirements: Strength, Toughness, Elasticity, Corrosion-Resistance, Wear Resistance, Long Term Dependability Natural Fibers Are A Renewable Resource Material All Through The World Particularly In The Tropics. Glass Fiber Reinforced Polymer Matrix Composites Are The Most Prominent Reinforced Plastic Material Which Are Utilized As A Part Of Numerous Industry. [1].

II. Methdology

Fabrication Of Composite Laminate

Preparation Of Mould.Preparation Of Composite Laminates For Different Orientations Of Glass Fibre.Cutting The Laminates As Per ASTM Standards.Tests Are Conducted To Evaluate Mechanical Properties Of Prepared Laminates.Comparing The Mechanical Properties Of Prepared Laminates.Conduct Modal Analysis Test For Prepared Specimen. The Hand Layup Method Is One Of The Efficient Processes For Developing Of PMC's Products. In This Method, An Operator Places Resin And Reinforcement In Or On The Mould By Using Hand Layup Equipment.

Laminate And Specimen Preparation.

The Steps To Fabricate The Laminates Are As Follows:
Step1: Calculations(According To The Rule Of Mixture)
Step2: Selection Of Mould.
Step3: Preparation Of Matrix Material.
Step4: Preparation Of Reinforcement.
Step5: Preparation Of Laminates.

Analytical Calculation

The Principal Step Is To Ascertain The Amount Of Material Required For Fabrication. Calculations Of rameters And Measuring The Materials Are Finished By Method For Electronic Weighing Machine. According To ASTM Standard, For The Preparation Of Laminate, The Density Of The Laminate Should Be Known. Hence We Know That Density Is Given By The Ratio Of Mass To Volume. The Composite Specimen Can Be Fabricated ccording To The ASTM Standards. For The Fabrication Hand Layup Method Can Be Done. Different Ply Construction Can Be Done As Shown In The Table.1 As We Know The Density And Volume Of The Laminate, Therefore The Mass Of The Laminate Can Be Calculated.

Table2.1: Composition Of Composite Material To Prepare Laminate

S.No	Matrix	Reinforcement Fiber	Additive	Method Of Fabrication
1	Polyester Resin(60%)	Glass Fibre (36%)	Calcium Silicate(4%)	Hand Layup Process
2	Polyester Resin (60%)	Glass Fibre (36%)	Silicon Carbide(4%)	

III. Experimenation

3.1 TENSILE TEST

Table 3.1: Requirement For Tensile Test Specimen For Additive Silicate Carbide

Raw Material	Quantity
Polyester Resin	19.937grams
Glass Fibre	11.937grams
Sic	1.326grams

Dimensions: 228mm*25mm*4mm

The Cutting Of The Specimen For Different Layers And Orientation Of Glass Fibres For Tensile Testing Specimen Is Shown Below.

Figure 3.1: Tensile Test Specimen With Additives Calcium Silicate Or Silicon Carbide.

3.2 MODAL ANALYSIS

Dimension 300*300*5mm

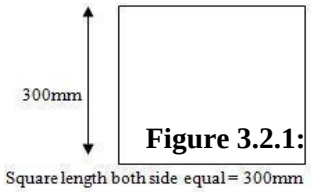


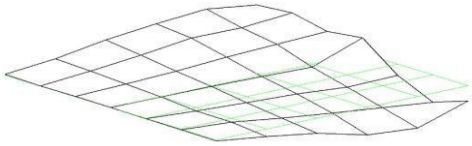
Figure 3.2.1: Specimen For Modal Analysis

A Cantilevered Rectangular Symmetric Plate Polyester Resin Reinforced With Glass Fibre Having Different Orientation Along With The Additive Calcium Silicate And Silicon Carbide Having Measurements 300x300x5mm Is As Appeared In Figure3.2.1

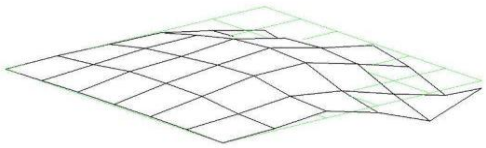
Figure 3.2.1: Modal Analysis Specimen Placed Testing

MODAL ANALYSIS FOR COMPOSITE PLATE WITH ADDITIVE $CaSiO_3$
1st Mode Shape: Bending Nature
1st Natural Freq: 22.983 Hz

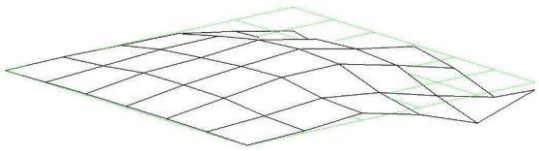
2nd Mode Shape:Twisting Nature
2nd Natural Freq:50.602 Hz



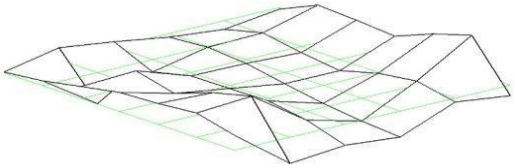
3nd Mode Shape:Double Bending Nature
3rd Natural Freq:123.176 Hz



4th Mode Shape:Combination of bending twisting
4th Natural Freq:150.241 Hz



5th Mode Shape:Complex mode
5th Natural Freq: 253.373Hz



MODAL ANALYSIS FOR COMPOSITE PLATE WITH ADDITIVE SiC
1st Mode Shape: Bending Nature
1st Natural Freq: 29.63 Hz
2nd Mode Shape:Twisting Nature

2nd Natural Freq: 63.23 Hz
3nd Mode Shape:Double Bending Nature
3rd Natural Freq:104.98 Hz
4th Mode Shape:Combination of bending twisting Nature
4th Natural Freq: 197.39 Hz
5th Mode Shape:Complex Nature
5th Natural Freq: 247.4Hz

IV. RESULT AND DISCUSSION

1.1 Tensile Test Results

The Tensile Test Is Directed For The Specimen Of Polyester Matrix Composite For Various Layers Of Glass Fiber And For The Diverse Introduction Of The Glass Fiber With The Test Speed 5.00mm/Min And The Outcomes Is Noted Down. The Diagram Is Created For The Tested Qualities As Shown In Figure

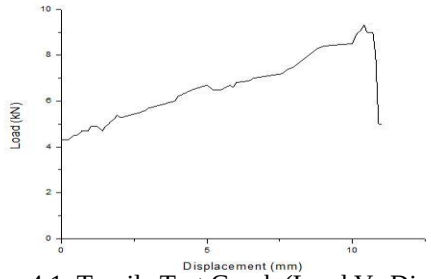


Figure:4.1: Tensile Test Graph (Load Vs Displacement)For Composite Along With Additive Casio3.

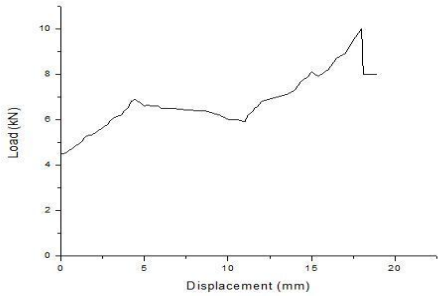


Figure 13 : Tensile Test Graph (Load Vs Displacement)For Composite Along With Additive Sic

Modal Analysis Results

Table : Obtained Natural Frequencies For Composite Plate With Additives Casio3 And Sic

	Natural	Natural
	Frequency ($Casio_3$)	Frequency(Sic)
Mode1: Bending	22.983 Hz	29.63 Hz
Nature		
Mode2: Twisting	50.602 Hz	63.23 Hz
Nature		
Mode3: Double	123.176 Hz	104.98 Hz
Bending Nature		
Mode4:Combination	150.241 Hz	197.39 Hz
Of Bending And		
Twisting		
Mode5: Complex	253.373Hz	247.4Hz
Nature		

V. CONCLUSION

Laminate For Different Orientation Of Glass Fibre With Different Layers Of Glass Fibre Reinforced Polyester Matrix Composite Is Prepared. The Composite Laminate Is Prepared For Glass Fibre For 00 300, 600 And 900 Orientation With Additive Calcium Silicate And Silicon Carbide. The Specimens Are Prepared According To ASTM Standards Values For Tensile, Compression And Bending Test And For Modal Analysis Test. The Mechanical Characterisation Like Tensile, Compression And Bending Test Was Conducted And Modal Analysis For Prepared Specimen Was Also Conducted. From The Results Obtained It Can Be Concluded That,

- For Tensile Test, The Results Shows That The Peak Load Maximum For Composite Having Additive Silicon Carbide.
- The Modal Analysis For Prepared Specimen Was Carried Out To Find First Five Natural Frequencies And Corresponding Mode Shapes, For Both The Composites Plate With Additives Calcium Silicate And Silicon Carbide.
- The Natural Frequency Of The Composites Is Found To Improve The Vibrational Nature Of Prepared Specimen. The Natural Frequency Is High For The Composite Plate Which Has Additive Silicon Carbide And Can Be Employed For Low Frequency Range Applications.
- The Natural Frequency Found Higher For Calcium Silicate Additive And Can Be Employed For High Frequency Range.
- It Can Be Concluded That For Low Operating Frequency Applications, Sic Is Better Since Its Natural Frequencies Are Higher.
- It Can Also Be Concluded That For High Operating Frequency Applications, $Casio_3$ Is Better Since Its Natural Frequencies Are Higher In That Range.

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