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Thermo Gravimetric and Dynamic Mechanical Analysis on Composites of Carbon Fiber, Glass Fiber, Nanoclay and Silicon Carbide

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ABSTRACT: Nowadays, the availability of metals has become less so looking for another resources the availability of fiber materials is immense and low cost we chose natural fiber and composite it in order to improve its properties like strength, stability, and stiffness and easily degradable. We underwent analysis of thermal and dynamic stability of hybrid composite materials like silicon carbide, nano clay, carbon fiber, and glass fiber with various compositions.

I. INTRODUCTION

A composite material is made by combining two or more materials often ones that have very different properties. The two materials work together to give the composite unique properties. However, within the composite you can easily tell the different materials apart as they do not dissolve or blend into each other. The biggest advantage of modern composite materials is that they are light as well as strong. By choosing an appropriate combination of matrix and reinforcement material, a new material can be made that exactly meets the requirements of a particular application. Composites also provide design flexibility because many of them can be moulded into complex shapes. The downside is often the cost. Although the resulting product is more efficient, the raw materials are often expensive.

II. METHODOLOGY

MATERIALS USED

1. Carbon fiber
2. Glass fiber
3. Silicon carbide
4. Nanoclay
5. Epoxy resin

CALCULATION

Glass fiber

Weight of 2 plies of glass fiber = 144 gms

Carbon fiber

Weight of 2 plies of carbon fiber = 134 gms

Volume of specimen

Length * breath * thickness = 300*300*3
= 270000 mm³

No of specimen = 4 no.

Silicon carbide

% added = 5 %

Volume of silicon carbide in specimen = (total volume of specimen * % of silicon carbide)/100

= 270000 * (5/100)

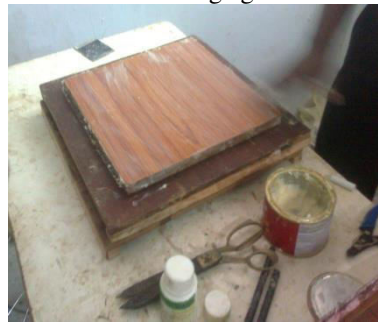
= 13500 mm³

Density of silicon carbide = 3217 kg/m³

Mass of silicon carbide	=	density * volume
	=	(3217E-6) * 13500
	=	43.4295 gms.
Nanoclay		
% added	=	5 %
Volume of Nanoclay in specimen	=	(total volume of specimen * % of Nanoclay)/100
	=	270000 * (5/100)
	=	13500 mm ³
Density of Nanoclay	=	2.35 g/cm ³
Mass of Nanoclay	=	density * volume
	=	(2.35E-3) * 13500
	=	31.725 gms..

PREPARATION OF THE MOULD

The mould used by us here is a flat plate mould. At first, the surface of the mould is cleaned and checked for any voids and blisters. Then the releasing agent is every spread over the mould for easy release of the test specimen after cutting. The gel coats is the first is making the actual mould. The gel cost should be applied in two coats of 0.4mm each, allowing 1-2 hours between coats. The gel coat should de tacky but not wet before proceeding. If any surface pigment is needed, then the colouring agent is mixed with the releasing agent.



Preparation of mould

PREPARATION OF THE REINFORCEMENT

The reinforcement used by us here is bidirectional plain woven GLASS fiber woven mat. This mat is available in rolls with the size of 1m. For the complete fabrication of the specimen of 3 laminae, 1 x 1 m² mat is taken and dimensioned to get 3 piece of 300 x 300 mm. considering the wastage and edge clearance, dimension the layer size by leaving the tolerance of 2mm. Then the mat is cut into 3 pieces of laminate of per- mentioned size using scissors which is used to cut the fabrics. Then the edge of the mats is protected using tapes in order to avoid the unwinding of the mat. The fixture is produce for laminate the composites sizes are the 300x300mm square with different pitch like wise 3, 4, 5, 6, and 7 mm with screw tightened. The material as prepare under different size condition likewise 100x100 each specimen rectangular type from this shape the laminate size 300x300 from the 3mm pitch in between wires are embedded likewise 4,5,6 and 7 pitch are fabricated. The lamination as done ¼ and ¾ condition. The one layer GFRP composites and the four layers and the GFRP in between one and four copper wire embedded according to different pitch.



Preparation of reinforcement



PREPARATION OF RESIN MIXTURES

The resin for sample 1 is epoxy LY556 with hardener XY 54. First the reinforcement used for the fabrication of the sample 1 is weight and the required amount of resin is taken such that the fiber to resin ratio 1:1 in this case, the weight of the reinforcement we get 80gms. Hence we took the resin 240gms of resin beaker. The amount of hardener is taken such that the resin to hardener ratio is 10:1. Hence we took 24gms of hardener and mixed to the resin using stirrer thoroughly.



	Preparation of resin mixture	=	144 gram.
Weight of the glass fiber		=	144 gram.
Weight of the resin & hardener mixture		=	144 gram.
Matrix mixing Ratio:			
Epoxy: hardener		=	10: 1
Glass fiber: matrix mixture		=	1:1

PROCESS OF HAND LAY-UP

Fabrication of composite material involves several steps, they are,

- Cut 2 plies of Bidirectional E- GLASS fiber woven cloth as per the ASTM code of 300x300mm.
- Weight the 2 plies of Bidirectional E-GLASS Fiber woven cloth in weighting machine. The weight of 2 plies is 144gms.
- Take an empty bowl and weight epoxy resin to 144gms and hardener to 14.4gms, so that epoxy: hardener should be in the ratio of 10:1.
- Mix epoxy resin with the hardener and ceramics of needed amount thoroughly in a bowl.
- Apply releasing agent to lamination sheet, so that the resin should not stick to the lamination sheet.
- Apply epoxy resin over the lamination sheet using brush.
- Place a Bidirectional E-GLASS fiber woven cloth over it.
- Now using the roller squeeze out the air pockets and excess resin.
- In the similar way place all 2 mats at one over the other and apply epoxy resin over it and squeeze out the air pockets and excess resin using roller.
- Now place a lamination sheet coated with releasing agent on top of the materials so that the surface shining will be obtained.
- Apply load of 50Kgs on top of the material.
- Leave it untouched for 24 hrs in room temperature to pre-cure the material.
- Same procedure is followed for carbon fiber.



Preparation of hand lay-up process

SETTING THE COMPRESSION MOLDING

After the completion of hand lay-up, the top plate of the mold that is protected with the releasing wax is kept over prepared and set the hydraulic press. Then the pressure of the press is set to 100 bars and then allowed to cure.

CURING

The process in which the liquid resin becomes a solid and bonds to the fiber. This chemical reaction between either different components of the resin or between the resin and a hardener. The cure can be heat or the addition of a catalyst. The curing time required for this type of resin is to 24 hours and to be kept in room temperature. The laminate is allowed to cure in room temperature for 24 hours in hydraulic press itself, which is set to a presser of 100 bars. Then after the completion of curing process, the fabrication laminate is released the mould.

- Apply epoxy resin over the lamination sheet using brush.
- Then by the help of squeezer, the total area is completely squeezed by manually.
- Entrapped air is escape from the mat as the result of squeezing.
- As the same procedure two layers of glass fiber and epoxy resin and hardener mixture is applied alternatively.
- This is cured at room temperature within 12 hours.
- The procedure is followed for the carbon fiber. A weight press is needed for the Hand lay-up method. The base plate was cleared of rust by scrubbing with an abrasive paper. Then the surface was allowed to dry after cleaning it with thinner solution. After drying, the surface was coated with mansion wax. The surface was given a few minutes to get it set for the mold lay- up. The company codes for the isophthalic semi polymerized resin and the catalyst/Curing agent are Ly 556 and HY 951 respectively. A plate of dimensions 300x300x3 mm was fabricated by this process. First the sponge-epoxy-sponge composite was fabricated.
- The matrix material was poured into the mould slowly in order to avoid air trapping. The mixture was left for 2 minutes so that it becomes a little tacky. After that, the sponge gourd fiber ply was laid unidirectional on the matrix layer, which was covered by another layer of matrix by pouring the mixture slowly onto the surface of the fiber ply. A small pressure was applied using an upper plate to distribute the matrix material and to avoid void formation. Likewise sponge gourd-sponge gourd layer plate was fabricated. The set up was cured under the required pressure of making composite.

IV. LITERATURE SURVEY

This section stresses on the research work that has already been carried out for testing the mechanical properties of the Natural Fiber Reinforced Hybrid composites. Literature review of such work needs to be done in order to understand the background information available, the work already done and also to show the significance of the current project. This chapter presents a general knowledge of the factors which affect the mechanical properties of hybrid fiber reinforced polymer composites.

Natural fiber reinforced composites have elevated abundant attentions and interests among materials experts and engineers in recent years due to the reflections of developing an environmental friendly material and partly replacing currently used carbon or glass fibers in fiber-reinforced composites. They are high specific strength and modulus materials, recyclable, low cost, easily available in certain countries, etc

NIKARIKA MOHANTA Have investigated at a processing a composite using single, double and triple layer luffa cylindrical fiber mats. The tensile, flexural and inter laminar shear stress of the composites were studied. The fracture surface of the composite were studied using FEM. The networking structure of fiber increase the tensile and flexural strength for double layer composite. The poor wetting of fiber with the matrix material in triple layer decrease. The maximum tensile and flexural strength is obtained for the composite produced with double layer luffa cylindrical fiber. The maximum ILSS is obtained for the composite prepared with triple layer luffa cylindrical fiber.

MARISSA A.PAGLICAWAN Have studied the potential of loofa fiber as reinforcement material for polymer bonded composites. The mechanical properties of the composites have been determined as a function of different method of loofa fiber preparation. The fiber matrix interaction and fiber/matrix volume were also determined using a stereomicroscope. The tensile and flexural modulus varied depending on the sample preparation of composite and the direction of loading. Loofa fiber has three dimensional network and some fibers are naturally arranged in different orientations and has different fiber concentrations. The mechanical properties of the composites are dependent of the properties of loofa and preparation of composites. Treatment of on the surface of the fibers is recommended to obtain good adhesion between the fibers and matrix.

SATYANARAYANA Have studied on lingo celluloses fibers of Brazil. They reported the availability of some of the Brazilian lingo cellulosic fibers, their market, extraction methods, properties and their current applications.

International trends in the study of lingo celluloses fibers tell that, these fibers have latent use in automotive applications; they can be perfect competitors for the non-renewable, costly petroleum-based synthetic fibers in composite materials, mainly in the automotive industry and counting building sectors. A detailed review of the literature survey illustrate that the hybrid composites have a lot of potential as advanced materials in numerous diverse sectors such as automotive, structural, aerospace and marine applications. However owing to their current discovery, not much research has been done on the effects of the fiber parameters such as fiber length and fiber loading on the mechanical performance of the polymer composites. Moreover, there exist very few literatures on the effect of juli flora fiber reinforcement on polymer composites.

V. EXPERIMENTAL TESTS

TEST – 1 THERMOGRAVIMETRIC ANALYSIS

Thermo gravimetric Analysis is a technique in which the mass of a substance is monitored as a function of temperature or time as the sample specimen is subjected to a controlled temperature program in a controlled atmosphere. TGA is a technique in which, upon heating a material, its weight increases or decreases. A Simple TGA Concept to remember: TGA measures a sample's weight as it is heated or cooled in a furnace. A TGA consists of a sample pan that is supported by a precision balance. That pan resides in a furnace and is heated or cooled during the experiment. The mass of the sample is monitored during the experiment. A sample purge gas controls the sample environment. This gas may be inert or a reactive gas that flows over the sample and exits through an exhaust. These instruments can quantify loss of water, loss of solvent, loss of plasticizer, decarboxylation, pyrolysis, oxidation, decomposition, weight % filler, amount of metallic catalytic residue remaining on carbon nanotubes, and weight % ash. All these quantifiable applications are usually done upon heating, but there are some experiments where information may be obtained upon cooling. Both the Pyris 1 TGA and the TGA 4000 are controlled by PerkinElmer's proprietary thermal software, Pyris Software, and have auto sampler accessories for unattended operation.

Operating Procedures for the TGA

Purpose and Scope:

This document describes the procedures and policies for using the MSE-TGA (Thermo gravimetric analysis) the scope of the document are to establish user procedures. Instrument maintenance and repair are outside the scope of this document.

Responsibilities:

This document is maintained by the department Lab manager or Scientific Instructional Technician (SIT). The SIT is responsible for general maintenance and for arranging repair when necessary. If you feel that the instrument is in need of repair or is not operating correctly please notify the SIT immediately. The SIT will operate the instruments according to the procedures set down in this document and will provide instruction and training to users within the department. Users are responsible for using the instrument described according to these procedures. These procedures assume that the user has had at least one training session.

Prerequisites:

All users must read this document and obtain approval and training from the SIT.

Precautions:

1. Check that your sample is compatible with the platinum crucible at temperatures, atmospheres and times you plan to use. Metals will most likely react with the Pt if you get close to their melting temperature. Glassy materials will stick and possibly react at temperatures greater than $\sim 0.8T_g$. For example many polymers use SiO_2 as filler- if you go to a high temperature, the fillers may react with the crucible.
2. Maximum operating temperature is 1200 K, max heat up rate 20 K,
3. Nonreactive balance gas is required.
4. Do not let anything drop in to the furnace tube. If anything does notify the SIT immediately and do not start a run. Place a note on the TGA as well.

Procedure:

Part 1:

The TGA is part of the MSE cost center. The log MUST be filled out. It is recommended that this be done before

beginning a measurement so as not to forget.

Part 2:

Please remember to check that the nitrogen gas is on and that it is connected to the instrument in the “balance” port. If the tank regulator reads below 400psi, please contact the SIT immediately. Do not attempt to change the tank unless approved to do so.

Part 3:

Open up “Pyris” manager. Select the TGA button at the top of the screen. Click only once. The software is slow and if you double click it will attempt to open twice. When the software is open there will be two dialogs within the application one is the instrument viewer and the other is the method editor. At the right is a column of icons that are used to send direct commands to the instrument. There are diagrams at the end of this document that show the commands. Terms in bold can be found in the diagrams. Select the icon if the furnace is not already in that position.

Part 4:

Using the tweezers supplied with the TGA, load a clean empty crucible with the wire basket onto the hang-down wire. This must be done very carefully. Do not attempt until after a few practice runs with the SIT. The hang down wire is connected to the microbalance at the top of the instrument and is very expensive to fix or replace. Do not pull on the hang down wire as it may be broken off from the arm on the balance mechanism.

After the crucible has been installed, select the icon. The furnace will move into position and rise up over the crucible. When the furnace is in position select the icon. You will need to wait a few minutes to allow the crucible to stabilize and you may zero the balance repeatedly until it stabilizes.

When the balance has been satisfactorily zeroed, select the icon to move the furnace out of the way. Put the sample stage in position under the crucible and hang down wire and carefully remove the crucible by lifting the wire basket from the hang down wire. Put your sample in the crucible and carefully reinstall the crucible and wire basket on the hang-down wire. Select the icon and wait for the crucible with sample to stabilize. This may take up to 10 minutes. Also, if your sample has a lot of moisture it may take more time. While the sample stabilizes go to the method editor and edit as needed.

Part 5:

In Method Editor, input information about your sample. Select browse to name and save your data file. Select the program tab and program as follows:

- Starting temperature
- First temperature scan
- First isothermal
- Second temperature scan
- Repeat as necessary.

Maximum operating temperature is 1200 K, max heat up rate 20 K. The furnace does tend to overheat so this should be taken into consideration. A slower heating rate may be better. When you are satisfied with your method, if you have not done so already, save your method. Please be careful not to overwrite someone else’s method. At this time weigh your sample using the icon. Select the start icon.

Part 6:

When your measurement is complete you may put the furnace in the cool Position and remove your crucible. If you need to run another sample the furnace will cool down faster in the raised position. Please keep your crucibles with you and do not leave crucibles or samples on or around the TGA workspace.

Implementation and Training:

This SOP will be available to all users and must be adhered to. The SIT will train users in the implementation of this document.



TGA Testing Machine

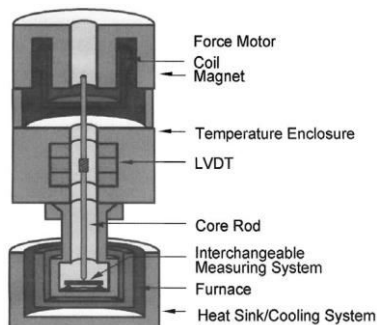
TEST – 2 DYNAMIC MECHANICAL ANALYSES

Dynamic mechanical analysis (DMA) is becoming more and more commonly seen in the analytical laboratory as a tool rather than a research curiosity. This technique is still treated with reluctance and unease, probably due to its importation from the field of rheology. Rheology, the study of the deformation and flow of materials, has a reputation of requiring a fair degree of mathematical sophistication. Although many rheologists may disagree with this assessment, most chemists have neither the time nor the inclination to delve through enough literature to become fluent. Neither do they have an interest in developing the constituent equations that are a large part of the literature. However, DMA is a technique that does not require a lot of specialized training to use for material characterization. It supplies information about major transitions as well as secondary and tertiary transitions not readily identifiable by other methods. It also allows characterization of bulk properties directly affecting material performance.

Depending on whom you talk to, the same technique may be called dynamic mechanical analysis (DMA), forced oscillatory measurements, dynamic mechanical thermal analysis (DMTA), dynamic thermo mechanical analysis, and even dynamic rheology. This is a function of the development of early instruments by different specialties (engineering, chemistry, and polymer physics) and for different markets.

BASIC PRINCIPLES

DMA can be simply described as applying an oscillating force to a sample and analyzing the material’s response to that force. The applied force is called stress and is denoted by the Greek letter, σ . When subjected to a stress, a material will exhibit a deformation or strain, ϵ . Most of us working with materials are used to seeing stress–strain curves



Section view of DMA testing machine

Operating Procedure for DMA

Purpose and Scope:

This describes the procedures and policies for using the MSE Department Perkin-Elmer Dynamic Mechanical Analyzer. The scope is to establish user procedures. Instrument maintenance and repair are outside the scope. This includes the Thermolyne and the Moldatherm furnaces. This SOP does not cover the high temperature furnaces or any

of the furnaces that use molybdisilicide elements. Please refer to the High Temperature Furnaces SOP for those procedures.

Responsibilities:

The department Lab manager or Scientific Instructional Technician (SIT) maintains this document. The SIT is responsible for general maintenance and for arranging repair when necessary. If you feel that the instrument is in need of repair or is not operating correctly please notify the SIT immediately. The SIT will operate the instruments according to the procedures set down in this document and will provide instruction and training to users within the department. Users are responsible for using the instrument described according to these procedures. These procedures assume that the user has had at least one training session.

Definitions:

The Dynamic Mechanical Analyzer (DMA) measures the changes in mechanical behavior such as modulus and damping as a function of temperature, time, frequency, stress or a combination. Measurements modes are: Temperature scan, time scan, modulus, tangent delta, mechanical analysis, characterization of temperature and time dependencies, frequency scan mode and creep recover mode. Prerequisites: All users must read this document and obtain approval and training from the SIT. Precautions: The DMA is a sensitive electronic device and great care should be used when handling any of the fixtures. Users should be aware that the chamber furnace could reach temperatures as high as 500 Celsius. Heat sink temperature must not raise above 45 Celsius thus the need for the chiller. The DMA shares resources with the TGA and the TMA. It is very important that the N₂ gas line is connected to the TGA when it is in operation. If the TGA is not in operation and N₂ is desired for the DMA measurement, you may move the line from the TGA to the DMA gas port, but you must leave a note on the TGA that includes your contact information. All three instruments can be operated at the same time. If you are using the computer for anything other than setting up a run or extracting data and someone else needs to set up a run on another instrument, please surrender the computer.

Procedure:

Part 1: TA User Log

The DMA is part of the MSE cost center. The log MUST be filled out. It is recommended that this be done before beginning a measurement as not to forget. The Log is an Excel file located on the desktop. It should open automatically when the user first logs in.

Part 2: Operation:

Before you start, please observe the following: Read through this procedure before starting. Check that the right gas lines are connected and that there is enough pressure in the cylinders. If not contact Tuesday Kuykendall immediately. Fill out the DMA log spreadsheet on desktop. Turn on the chiller. On the chiller is a breaker switch that must be turned on first, next switch to 'on' and press the start button. Do not begin any measurements until this is done.

Sample Preparation:

Most measurements are addressed in an ASTM standard and it is strongly recommended that the user consult the appropriate standard to gain information about specific sample prep for the DMA. For the purposes of this procedure, the 3pt bend test with a 15mm expanse will be assumed. Samples can be as thin as 1mm and as thick as 5mm. The default fixture is 15mm and the ratios can be 1:5:20 or 1:10:50 according to ASTM standard E- 1640-04.

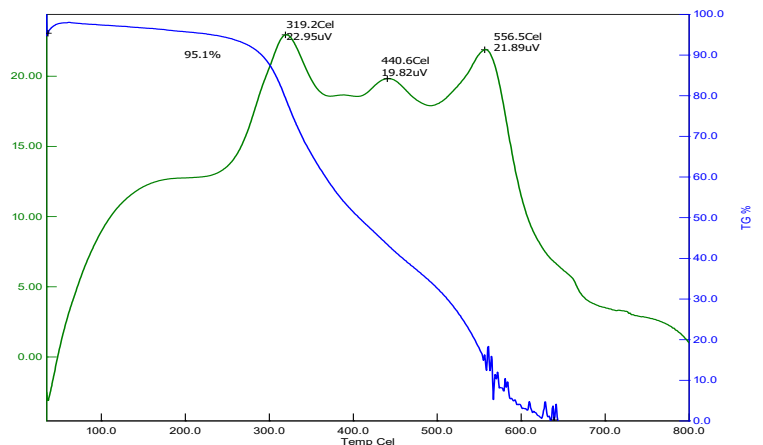
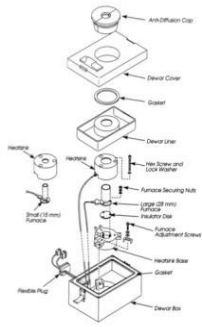
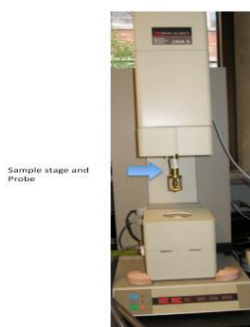
1. Load your sample:

- a. Lower the furnace if it isn't lowered yet and place a cover over the top.
- b. If necessary, install the correct fixture for your measurement as trained.
- c. The probe should sit on the expanse in the middle, if it doesn't the probe will need to be adjusted. Adjust probe as trained.
- d. Place the prepared sample across the expanse.
- e. Lower the probe and verify that it is sitting on the top of the sample; this will be the zero height.
- f. Remove the covering and raise the furnace.
- g. Place the collar over the furnace mouth.

2. Open the software:

- a. Double click on 'Pyris Manager' from the desktop
- b. When the three applications are displayed on the top of the screen select DMA, press only once.
- c. Two dialogs will open, the "method editor" and the "instrument viewer". At the right of the screen is a column of icons that are used to send direct commands to the DMA (see diagrams).
- d. If one has already been prepared, open the method editor for the particular measurement.
- e. Zero probe force

- f. Zero probe height
- g. Check that chiller is on
- h. Select start.
3. To create a Method:
 - a. A method can be created during the driver's test portion of the training.
 - b. Enter sample information.
 - c. Select browse to name your file and assign file path.
 - d. Select the program tab and program your scan.
 - e. What value you are measuring will determine which scan to choose for example:
 - Temperature Scan
 - Frequency Scan
 - Stress/Strain Scan
4. Note the time the scan will take to be sure the sample can be removed for other users.
5. The second dialog on the screen is the Instrument viewer. This is a live update of the force, frequency, amplitude, temperature, and time. When the scan is started, the Instrument viewer will continue to update.
6. When the scan is completed, a third dialog will be displayed, this is the data analysis graph.
7. To save the data as a .txt file, select the data analysis window, select file, select export data, and select ASCII. A dialog will open; check the box next to include data points. Your file will be saved in a folder on the desktop.



DMA Testing Machine

VI. EXPERIMENTAL TESTING RESULTS

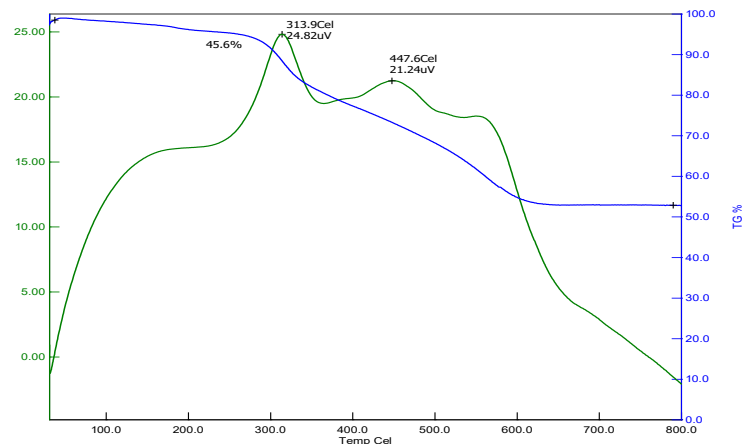
THEMOGRAVIMETRIC ANALYSIS

Carbon + silicon carbide

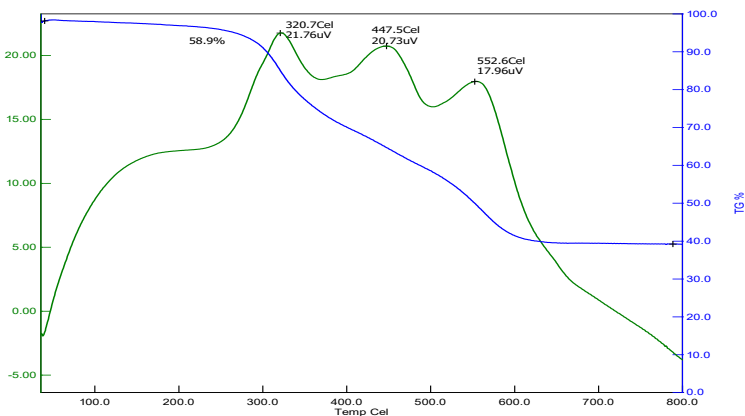
- Module: TG/DTA
- Data Name: C + Sic
- Measurement Date: 3/17/2015
- Sample Name: C + Sic
- Sample Weight: 2.485 mg
- Reference Name: Empty
- Reference Weight: 0.000 mg
- Temperature Program:
- CelCelCel/min min s
- 1* 30 800 20 0 0.5
- Comment:
- Operator: Inkarp
- Gas1: N2



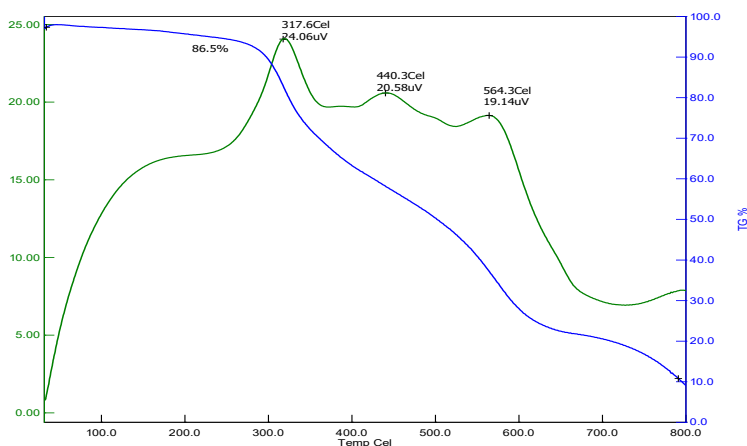
- Pan: empty
- Carbon + nano clay**
- Module: TG/DTA
- Data Name: C-NC
- Measurement Date: 3/14/2015
- Sample Name: C-NC
- Sample Weight: 2.251 mg
- Reference Name: Empty
- Reference Weight: 0.000 mg
- Temperature Program:
- CelCelCel/min min s
- 1* 30 800 20 0 0.5
- Comment:
- Operator: Inkar
- Gas1: N2
- Pan: empty



- Glass + nano clay**
- Module: TG/DTA
- Data Name: G + NC
- Measurement Date: 3/16/2015
- Sample Name: G + NC
- Sample Weight: 3.865 mg
- Reference Name: Empty
- Reference Weight: 0.000 mg
- Temperature Program:
- CelCelCel/min min s
- 1* 30 800 20 0 0.5
- Comment:
- Operator: Inkar
- Gas1: N2
- Pan: empty



- Glass +Silicon Carbide**
- Module: TG/DTA
- Data Name: G-SiC
- Measurement Date: 3/14/2015
- Sample Name: G-SiC
- Sample Weight: 3.126 mg
- Reference Name: Empty
- Reference Weight: 0.000 mg
- Temperature Program:
- CelCelCel/min min s
- 1* 30 800 20 0 0.5
- Comment:
- Operator: Inkar
- Gas1: N2
- Pan: empty

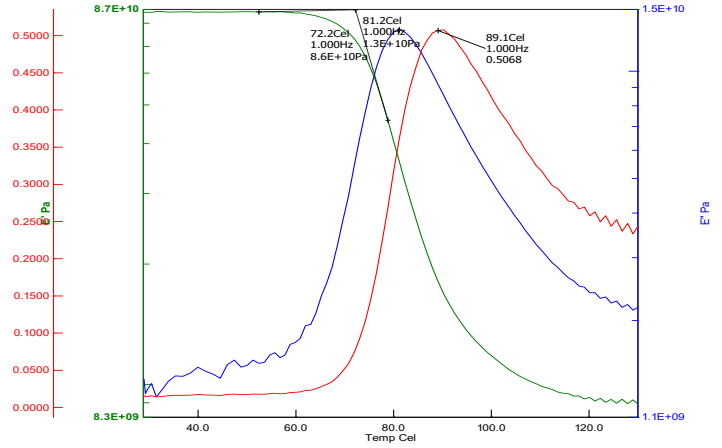




DYNAMIC MECHANICAL ANALYSES

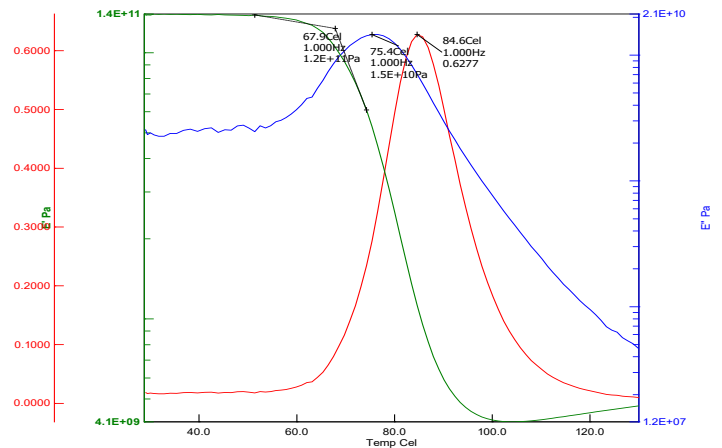
Carbon + nano clay

- Geometry Factor: 3.313E-005 m
- Length: 50.000 mm
- Width: 10.000 mm
- Thickness: 3.000 mm
- Module: DMS
- Data Name: C +NC
- Measurement Date: 3/11/2015
- Sample Name: C +NC
- Temperature Program:
- CelCelCel/min min
- 1 25 200 2 0
- Sampling: 3.0 s



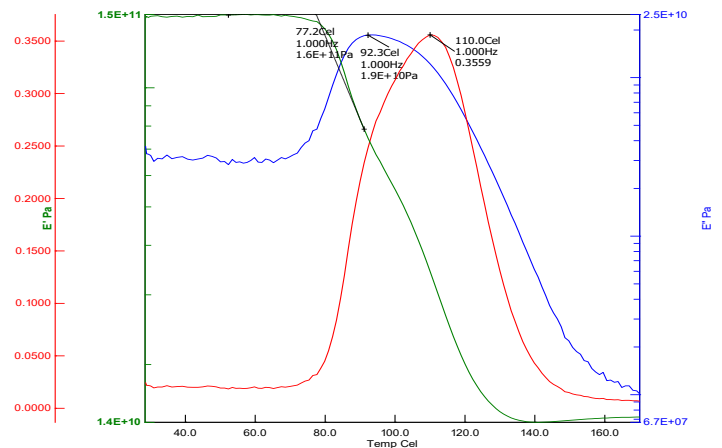
Carbon +silicon carbide

- Module: DMS
- Data Name: C+ SiC
- Measurement Date: 3/10/2015
- Sample Name: C+ SiC
- Sample Shape:
- Geometry Factor: 3.313E-005 m
- Length: 50.000 mm
- Width: 10.000 mm
- Thickness: 3.000 mm
- Temperature Program:
- CelCelCel/min min
- 1 25 200 2 0
- Sampling: 3.0 s



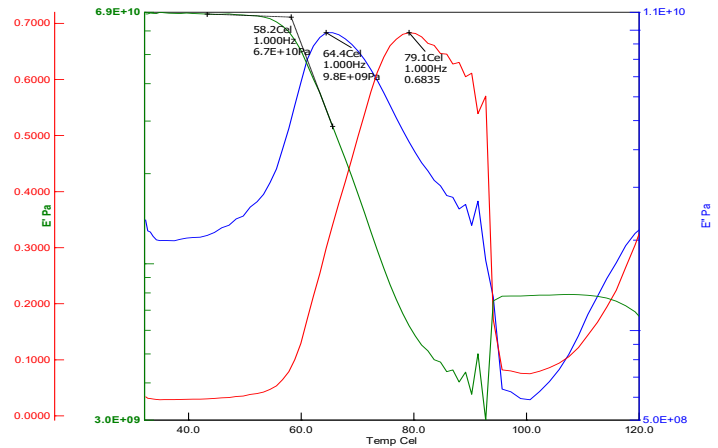
Glass + nano clay

- Module: DMS
- Data Name: g+ NC
- Measurement Date: 3/10/2015
- Sample Name: g + NC
- Sample Shape:
- Geometry Factor: 3.313E-005 m
- Length: 50.000 mm
- Width: 10.000 mm
- Thickness: 3.000 mm
- Temperature Program:
- CelCelCel/min min
- 1 25 200 2 0
- Sampling: 3.0 s



Glass + silicon carbide

- Module: DMS
- Data Name: g + SiC
- Measurement Date: 3/11/2015
- Sample Name: g + SiC
- Sample Shape:
- Geometry Factor: 3.313E-005 m
- Length: 50.000 mm
- Width: 10.000 mm
- Thickness: 3.000 mm
- Temperature Program:
- CelCelCel/min min
- 1 25 200 2 0
- Sampling: 3.0 s

**VII. CONCLUSION**

Comparing the results of thermo gravimetric analysis the composite of carbon fiber + Nanoclay can withstand high temperature than carbon fiber +silicon carbide. Same sort of result is obtained for glass fiber. It is more thermally stable when composite with Nanoclay than silicon carbide.

The dynamic mechanical analysis is mainly done to find the damping ratio. The minimum value of damping ratio is required for the selection of the composite material. On this fact the carbon fiber with Nanoclay possess less damping ratio than silicon carbide. Glass fiber also possesses similar results. The Nanoclay is thermally stable and its mechanical stability is more than silicon carbide on composite with fibers. Hence Nanoclay can be preferred instead of silicon carbide when composite with carbon fiber and glass fiber for the application requires thermal and mechanical stability.

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