

A Self Sealing Fiber Reinforced Composite

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ABSTRACT

A Self-Sealing Fiber-Reinforced Composite are artificial or synthetically created substance that have constructed in capability to robotically restore harm to themselves without any exterior analysis of the bassle or human intervention. The requirement of self-healing polymers are balance and shelf life, deliverability, reactivity, shrinkage, physical and mechanical, thermal balance and dispersion.

A self-sealing fiber reinforced composite is made by hand lay up technique. In this work carbon fiber is used as a reinforcement, epoxy is used as a healing agent, thermoset phenol formaldehyde is used as a curing agent and thermoplastic polyurethane is used as a self-curing agent.

Five composite sheet are prepared in this technique. A single specimemen is made with the help of A₄ size paper. These sheet are compressed with the help of compression moulding machine at a temperature 180°C, pressure 300 kg/cm². Breathing time also be given in compression moulding machine so that the proper curing is to be done. Five second is the breathing time and this breathing is done three to four times for a single sheet.

The time required for compression is four hours. The sheet are cut by the axe saw and the finishing is done with the help of contour cutter.

The specimen obtained from composite material having different ratio of thermoplastic and thermoset resin content were tested to determine tensile strength, flexural strength, impact strength, differential scanning calorimeter.

KEYWORDS: Carbon fiber, Epoxy resin, Thermoset phenol formaldehyde, Thermoplastic polyurethane.

1. Introduction

Composite is a multiphase material made from a combination of materials differing in composition or form, which remain bounded together, but retain their identities and properties without going to any chemical change. A Self-Sealing Fiber-Reinforced Composite can be achieved by incorporating carbon fiber, epoxy resin, thermoplastic polyurethane resin and thermoset phenol formaldehyde resin.

2. Material and Experimental Procedure

2.1 Materials

Carbon Fiber was provided by Adorn Engineer, Epoxy Resin was provided by Atul Ltd, Thermoplastic Polyurethane Resin was provided by Western Pu Industries and Thermoset Phenol Formaldehyde Resin was provided by Tipco Ltd.

Carbon Fiber	Epoxy Resin	Thermoplastic Polyurethane Resin	Thermoset Phenol Formaldehyde Resin
Source: Adorn Engineer	Source: Atul Ltd Mumbai	Source: Western Pu Industries	Source: Tipco Industries Ltd Valsad
Grade: 12 K twill 400 gsm	Grade: Lapox B-11	Grade: 2710	Grade: Tpf/W/1617

Table No 1: Source and Grade of Material

2.2 Methodology

2.2.1 Hand Lay Up Techniques

The composite sample were made with the help of hand lay up technique. The composition of making the composite sample tabulated in table no 2.

S.No	Carbon Fiber (gm)	Epoxy %	Pu %	Epoxy (gm)	Pu (gm)	Pf (gm)
1)	148	90	10	67.5	7.5	25
2)	148	85	15	63.75	11.25	25
3)	148	80	20	60	15	25
4)	148	75	25	56.25	18.75	25
5)	148	70	30	52.5	22.5	25

Table No 2: Composition

2.2.2 COMPRESSION MOULDING

The curing of the composite sheet were done with the help of compression moulding machine in processing department OLC CIPET Ahmedabad. Five composite sheet is to be carried.

2.2.3 CONTOUR CUTTER

Contour cutter used to finished the composite sample in dumbbell and rectangular shape. The finishing was done in HLC CIPET Ahmedabad.

3 RESULT AND DISCUSSION

3.1 MECHANICAL PROPERTIES

3.1.1 TENSILE STRENGTH

The tensile strength of the material is to be checked by the following formula. The result obtained of the tensile strength is tabulated in table no 3.

Tensile Strength At Break = Load Recorded At Break/ Cross Section Area

S.No	Area (mm ²)	Breaking Load (kn)	Tensile At Break (mpa)
Sample 1	50	1475.96	29.51
Sample 2	50	1477.00	42.14
Sample 3	50	1478.30	56.12
Sample 4	50	1480.20	58.34
Sample 5	50	1496.21	60.03

Table No 3 Tensile at break values at different sample

3.1.2 FLEXURAL STRENGTH

The flexural strength of the material is to be checked and the result obtained is tabulated in table no 4.

S.No	Flexural Strength (mpa)	Flexural modulus (mpa)
Sample 1	335.90	27209.41
Sample 2	344.01	27305.3
Sample 3	350.60	28560.21
Sample 4	378.76	29563.7
Sample 5	383.44	29568.12

Table No 4 Values of Flexural Strength

3.1.3 IMPACT STRENGTH

Izod impact testing of the material is to be checked and it determine the toughness of the material. The result were obtained is tabulated in the table no 5.

S.no	Thickness (mm)	Scale Reading	Scale/ Thickness
Sample 1	3.64	7.49	2057 J/M
Sample 2	3.49	7.45	21346.70 J/M
Sample 3	3.40	7.48	2200 J/M
Sample 4	3.15	7.49	2385 J/M
Sample 5	3.18	7.52	2364 J/M

Table No 5 Values of Impact Strength

3.1.4 DSC ANALYSIS

Perkin Elmer, diamond DSC was used to observe the effect of high molecular weight epoxy resin in the polyurethane resin and phenol formaldehyde resin to get the information of curing of the resin. Temperature upto 400 °c and rate of rise is 20 °c/ min is used

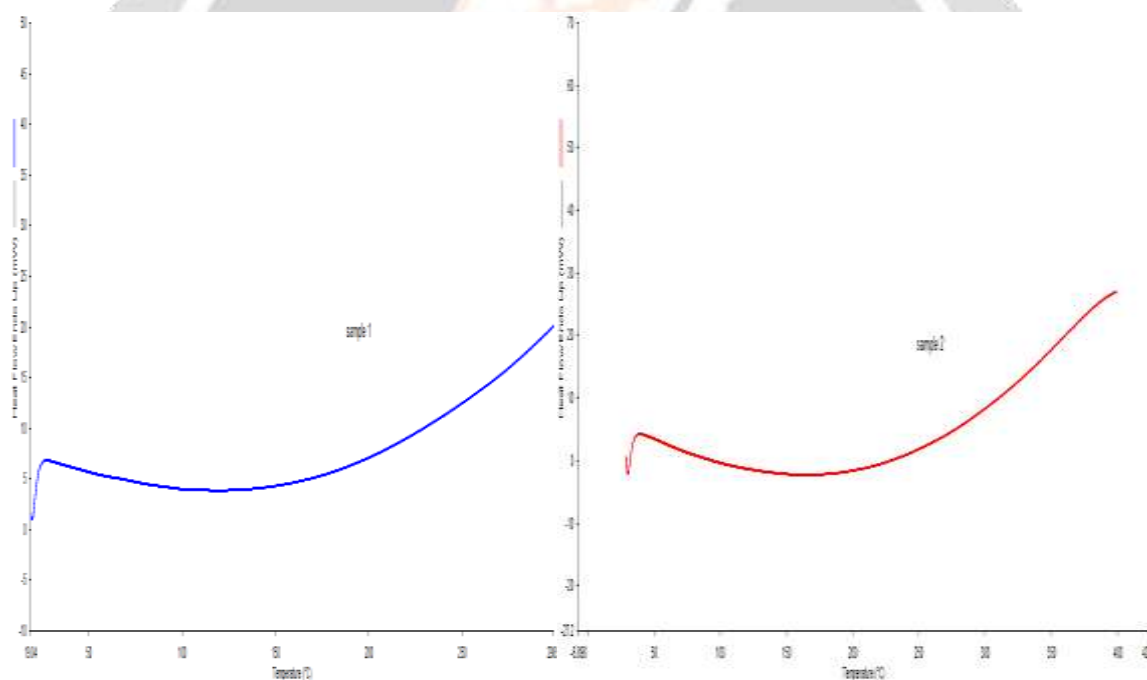


Figure 1 Dsc Sample 1

Figure 2 Dsc Sample 2

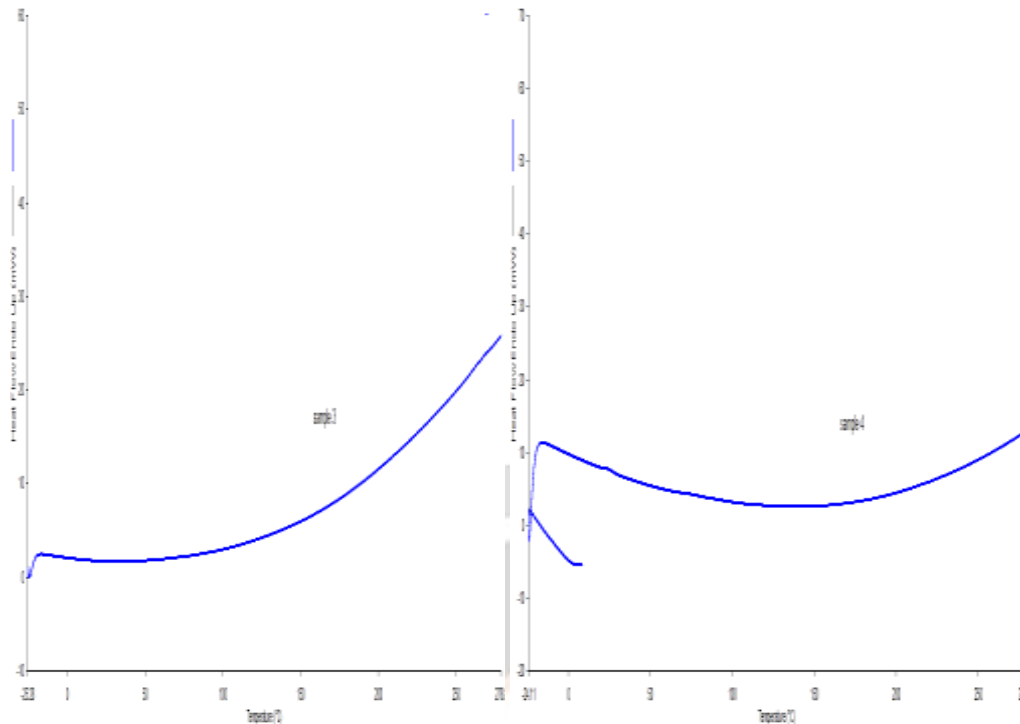


Figure 3 Dsc Sample 3

Figure 4 Dsc Sample 4

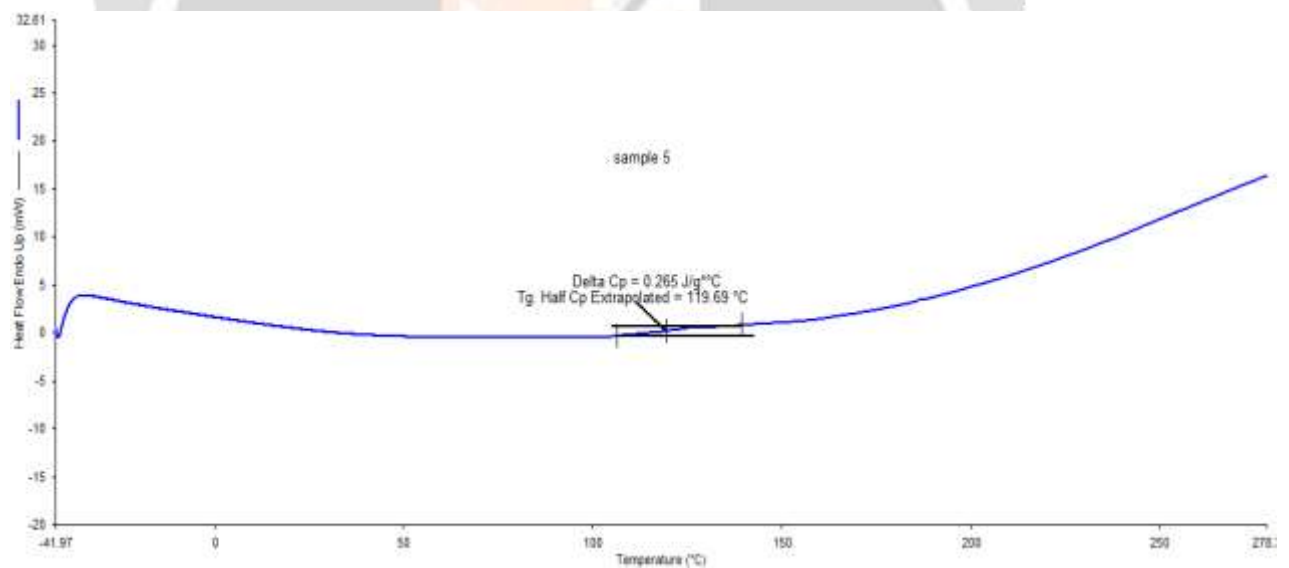


Figure 5 Dsc Sample 5

CONCLUSION

In tensile strength thermoset epoxy resin percent decrease and thermoplastic polyurethane resin percent increases. It was observed that the sample 5 had higher breaking and higher tensile strength.

In flexural strength the similar condition applied. It was observed that the sample 5 had higher flexural strength and higher flexural modulus.

In impact strength the same procedure is applied. It was observed that the sample 5 had higher scale reading and higher scale/ thickness.

In differential scanning calorimeter the same thing is done. It was observed that the sample 5 had delta cp = 0.2665 J/g °c and Tg half cp extrapolated = 119.69 °c.

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