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Fabrication of Corrosion Cum UV Resistant Carbon/Glass Fiber Reinforced Polymer Composite with Epoxy Phenol Novolac Resin

S.Karthik[1],
[1]Assistant Professor, Department of Textile Technology Jaya Engineering College Chennai

C.S.Gopika[2]
[2]Student of M. Tech, II[nd] year, Department of Textile Technology, Jaya Engineering College, Chennai

L.Nagarajan[3]
[3]Associate Professor, Department of Textile Technology, Jaya Engineering College, Chennai

***Abstract* - Corrosion is a natural phenomenon that deteriorates the material property due to chemical or environmental attacks. Thus in order to avoid corrosion, Carbon/ glass fabric composites are used along with different resins. Here carbon glass combined fabric with Epoxy Phenol Novolac (EPN) resin is selected instead of normal epoxy resin to produce the composite and fabricate by hand lay method and made the uniform spreading with the help of a padding machine. The composite will be tested for tensile strength, salt spray corrosion test and UV resistance test and is expected to give better tensile strength, corrosion resistance and UV resistance properties.**

Keywords* - *Composite, carbon fiber, glass fiber, Epoxy Phenol Novolac, tensile strength, corrosion resistance, UV resistance

I. INTRODUCTION

Carbon fibers are lightweight, have high strength, and high stiffness properties which withstand up to 3000^0c [1]. They have high chemical resistance, low thermal expansion, fatigue resistance, corrosion resistance, etc. They are manufactured mainly using the precursor Polyacrylonitrile(PAN), as the PAN fiber is produced and is fully stretched, and heated at high temperature in the absence of oxygen by carbonization process where all the other elements except the carbon get eliminated and form the fiber thus it contains 90% carbon so-called carbon fiber. Thus they are used in different fields i3ncluding aerospace, automobiles, wind blades, etc. as reinforcement material for composites. But the carbon fibers are costly compared to other fibers, Glass fibers can be used along with carbon fiber which have comparable properties. Glass fibers are also lightweight, low cost and durability [2]. They are manufactured from silica (SiO_2) sand, SiO_2 is heated to 1720°C/3128°F then cooled quickly and the process yields the amorphous or randomly ordered atomic structure as glass. So in order to produce the composite is matrix is needed along with the reinforcement and normally used matrix is epoxy resins. Here Epoxy Phenol Novolac is used instead of normal epoxy. An Epoxy Phenol Novolac (EPN) is an epoxy resin where the epoxide functional group is attached to the phenolic oxygen of a phenolic novolac. They have better corrosion resistance than normal epoxy as corrosion resistance which is required in many fields as it will affect the durability and the efficiency of the material.As the composite is exposed to the sunlight the UV resistance is also important as the long exposure to sunlight will break down the chemical bond within the resin and lead to cracking. Ultraviolet radiation lies between wavelengths of about 400 nanometers (1 nanometer [nm] is 10^{-9} meters) on the visible-light side and about 10 nm on the X-ray side, though some authorities extend the short-wavelength limit to 4 nm. Based on the interaction of wavelengths of ultraviolet radiation with biological materials, three divisions have been designated: UVA (400–315 nm), also called black light; UVB (315–280 nm), responsible for the radiation's best-known effects on organisms; and UVC (280–100 nm), which does not reach Earth's surface. Here UVA is checked for the carbon composites. Thus composite with better strength, good corrosion, and UV resistance need to be produced. Thus the composite needs to be produced with carbon glass fabric along with Epoxy Phenol Novolac resin and tested for tensile strength, corrosion resistance and UV resistance test.

II. MATERIAL AND METHODOLOGY

A. *Material*

1) Carbon glass blended fabric:
Carbon glass blended fabric which is having both carbon and glass fiber in a single fabric in different orientations with 750×84mm size. Here the carbon yarn is placed in one of the sides in a unidirectional weave where the fibers are placed in respective position using stitching thread and there will be no glass fiber over the side. On the other side, glass fiber is placed at $-45/+45^0$ along with carbon fiber at 90^0 and -45^0angle. Thus the use of different ply of fabric is avoided by using a single fabric with different yarn orientations.

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2) Epoxy Phenol Novolac:

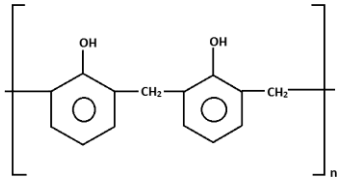

Fig 2.1 EPN structure

EPN is the resin which is having better corrosion resistance properties along with mechanical property is used here along with the hardener which has good compatibility with carbon and glass fiber. They are having a high degree of cross-linking, leading to high resistances.

B. Methodology:

The glass plate is taken as the mold and apply the releasing agent over the plate uniformly. Take the fabric, weight and mix the resin and hardener as per the recipe at 2:1 ratio and place the fabric over the glass plate as such that the glass fiber side comes at the top and the carbon fiber side at the bottom side. Apply the resin over the top of the fabric uniformly using the roller to avoid air bubbles and pass the composite through the padding machine for uniform application of resin throughout the fabric. Keep the sample for 24 hours for a complete cure at room temperature.

Table 1.1 composite making recipe

MATERIALS	QUANTITY
Fabric weight	56gm
Resin	36ml
Hardener	18ml
Curing temperature	Room temperature
Curing time	24 hours

III. RESULT AND DISCUSSION

The tensile strength of the fabric and composite have been tested by UTM and fig 3 shows that the plain fabric gives the peak value as 0.88 KN whereas the composite sample with EPN give 7.25KN which shows that there is an increase of 3723.86% in the peak load after applying the resin over the fabric and the composite shows 3.57% increase in the peak load withstand capacity as compared to 60%glass fabric.

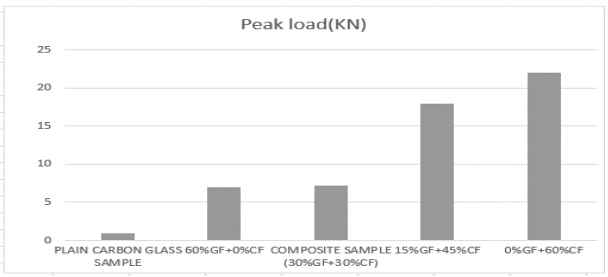

Fig 3:Peak load of different composites

Fig 4: sample before and after corrosion test

Fig 5:Sample before and after UV resistance test

As per the test result, the corrosion test shows no noticeable change in the sample after 24 hours and thus shows that the material have good corrosion resistance.The UV resistance test gives light discoloration after 24 hours. Thus the result shows that UV has affected the sample and thus the epoxy need to be replaced by a more UV- resistant resin for making the composite to be suitable for outdoor application.

CONCLUSION

The development of carbon composite in different field is one of the future for the technical textile and the study about its different property is an inevitable requirement for its different application. The tensile strength of the fabric and the composite is compared which respect to the peak load which shows an increase in strength after the application of resin and the produced composite shows better strength compared to 60%glass fabric+40%resin composite. Here in order to study the corrosion and UV resistance property of the carbon glass composite, developed the carbon glass composite using Epoxy Phenol Novolac resin and corrosion test along with UV resistance is conducted .The result shows that the composite give good corrosion resistance property but it is lagging in UV resistance thus the material can be used in different application in order to avoid the corrosion and need to develop the composite with better UV resistance by using UV inhibitor along with the resin to improve UV resistance.

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