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Research Paper

Absorption of Composite Material Epoxy- Phenol Formaldehyde Hybrid Blend.

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ABSTRACT:*Humidity leads to the breaking of the interface between the base material and the material of the strengthening and thus reduce the bond between them, and the material of the absorption absorbs moisture in larger quantities of the base material, which causes the swelling of the material of the strengthening and thus separation from the base material.*
KEYWORDS: *hybrid blend, Absorption, Phenol formaldehyde resin, epoxy resin.*

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I. INTRODUCTION:

The Composite materials are integrated into multiple applications in large areas of life as they are used in the manufacture of parts of cars, ships, aircraft and other applications. Therefore, the manufacture of any material for a specific application is done only by knowing the effect of the external environment in the manufactured material[1,2]. We observed the negative impact of water on the test of wear and tear, which led us to test the water absorption of samples[3]. Studies indicate that the purpose of immersing the samples in distilled boiling water is to accelerate the absorption process compared to the process of water absorption at room temperature where the samples are immersed for 15 minutes in boiling water, according to each sample and 6 minutes in water at room temperature[4,5]. And then calculate the percentage of absorption of all models immersed in water. The curves that represent the relationship between the percentage of the gain in the mass (Weight Gain%) are plotted with the square root of the time [6]. Mechanical properties are affected by the amount of water circulating throughout the material. Some studies have shown that mechanical properties such as durability and elasticity factors decrease after exposure to moisture or after absorption of water[7,8].This is due to the fact that moisture has a role in breaking the interface between the base material and the reinforcing material by reducing the bond between the base material and the reinforcing material, or that the reinforcing material may absorb larger amounts of the base material, which causes swelling of the reinforcing material and thus its separation from the base material Crash of interconnection between the components of composite material [9]. In terms of the effect of hydrolysis of polymers and their complexities, it is a phenomenon with four mechanisms, the first is the mechanism related to the excess in the permeability of water molecules during the polymer and its overlays, which leads to the phenomenon of swell polymers (Swelling), and the second is the mechanism of not allowing part Of the water entering the polymer body and its overlays due to the filling of micro cavitation and the spaces between the elements of the super molecule structure, which leads to saturation phenomenon, which usually depends on the temperature and type of submerged samples[10,11]. The third mechanism relates to the automatic increase only Char with high temperature to increase the kinetic energy of water molecules This process involves the movement of polymeric chains one after the other after a certain period of time, and is expected to decrease the weight of models and the continuation of this decrease with an increase in immersion time and this process is called polymer desorption. The latter is a mechanism related to negative swelling, which causes the polymer to dissolve in water as a result of a lesion [8]. Some samples have been observed since the first few minutes of immersion in boiling water. This may be due to the polymerization of some chains For some. After a certain time (5-15 minutes), depending on the tolerability of each sample,

there was a decrease in the weight of the models and the continuation of this decrease with the increase in time. This may be due to the fact that the inflated polymer in some cases may cause sufficient pressure to break down the chemical bonds Between the atoms in the polymer chain and thus break down the polymer chain into low molecular weight compounds as a result of polymerization. [5].

II. EXPERIMENTAL PROCEDURE:

Materials: Epoxy resin (LEYCO-POX 103),Phenol formaldehyde (resole) resin

Samples preparation and Calculation of Absorption: epoxy and phenol formaldehyde resin were mixed with different weight fraction as shown in Table.1. When calculating the percentage of the absorption of all models immersed in chemical solutions, the curves that represent the relationship between the percentage of the gain in the mass (Weight Gain%) $\sqrt{Time}$ were plotted with the time root, and then the diffusion coefficient (D) is calculated for all models immersed in chemical solutions.

Sample No.	Composition
E0	(Epoxy/Resole) (65/35)%
E1	(Epoxy/Resole) (75/25)%
E2	(Epoxy/Resole) (85/15)%
E3	(Epoxy/Resole) (95/5)%

Table.: Composition of epoxy-phenol formaldehyde hybrid blend .

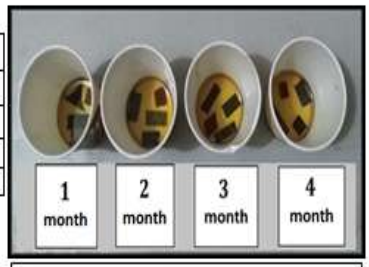


Fig.(1) The samples for Absorption test.

Fig.(2) The Sensitive Balance

To ensure that the hybrid composite is proper in auto application (oil pan) absorptivity should tested with: Immersion of Samples in oil: Owing to the effect of oil on the performance of commercial hybrid composite polymers. The presence of excess oil a polymer may become swollen, exhibiting large changes in mechanical and chemical properties. Oil can reaction with blend and cause it corrosive[11]. The weight of sample was measured before and after immersion in oil to calculate the weight gain.

Effect of oil absorption on blend:

The weight of the samples was measured before immersion using a four digit sensitive electronic balance. These samples were immersed in oil. After (7) days, the samples were taken out. The samples were weighted after being dried. This process was repeated every week for one month.

The percentage of the change in mass for the samples placed in the oil was calculated as follows[2]:

$$\text{Weight gain \%} = \frac{M2 - M1}{M1} * 100$$

Where:

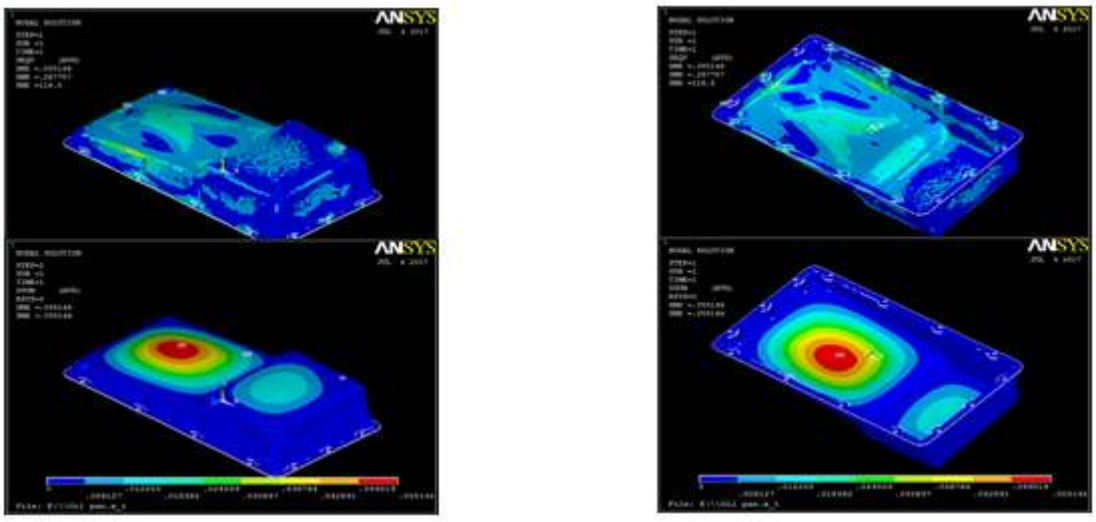
M1: mass of the sample before immersion in (g)

M2: mass of the sample after immersion in (g).

The curves of the absorption percentage with the square root of time were plotted for all prepared samples.

ANSYS models:

The oil pan was selected in the engine as part of the study, and a simulation program was used as shown in the figure below, where the composite material used in the research is tested and compared to the alloy material from which the part was originally manufactured (see Fig.3). The element type of SOLID 45 was used in the ANSYS program for modeling because it appropriate for modeling of three dimensional solid structures, this element has 8 nodes with 3 degrees of freedom at the directions of x, y and z at each node. In modeling this element, the linear isotropic model was used for simulating the stress and deformation in oil pan of four blends. Modeling is done by using three dimensional program (SOLIDWORK 2016) which contains 3D drawing tools then the model was imported to ANSYS program. The model was drawn as shown in figure (3). show solid work steps to draw the model.



Fig(3)The oil basin model (Oil Pan) in the car engine, as a model for comparison in the simulation program used.

Scanning Electron Microscopy (SEM):

The scanning electron microscope (SEM) is one of the most versatile instruments available for the examination and analysis of the microstructure morphology. Electron microscopy has been developed by replacing the light source with the high energy electron beam[9]. The SEM permits the observation and characterization of heterogeneous organic and inorganic materials on a nanometer (nm) to micrometer (µm) scale. The popularity of the SEM stems from its capability of obtaining three –dimensional –like images of the surfaces of a very wide range of materials, although the major use of the SEM is to obtain topographic images in the magnification range 10-10,000 X. The types of signals produced from the interaction of the electron beam with the samples include secondary electrons, backscattered electrons, characteristic x-ray, and other photons of various energies. These signals are obtained from specific emission volumes within the samples and can be used to examine many characteristics of the sample (surface topography, crystallography, composition, etc.)[4].

III. RESULTS AND DISCUSSIONS

The properties of the composite material are affected by the amount of oil spread throughout the material. The mechanical properties of the material such as toughness and modules of elasticity decrease after being exposed to moisture or after absorbing a quantity of oils. This is because moisture has a role in breaking the interface between the base material and the reinforcing material By reducing the bond between the base material and the material of strengthening, or that the material of the strengthening may absorb larger amounts of the base material, which causes the swelling of the material of the strengthening and thus separation from the base material, ie, the breakdown of the interconnect and the interconnect between the components of the composite material. The majority of polymers are resistant to acids and weak bases. However, strong and oxidizing acids are caused by polymer degradation. Strong bases and organic solvents attack polymers and damage the material [1,2]. The resistance of the plastics to both the chemically effective medium and the physiologically effective medium depends on the chemical composition, the polymer structure, and the temperature. High bonding polymers are not affected by solvents and cannot be dissolved unless the chemical bonding between the polymer chains is broken. Polymers are chemically inactive, as the use of solutions with them does not lead to interaction between them (ie, polymers and solvents). The Optical Microscopy was used in the study of the morphology of Polymer Blends. Photographs of the mixture surface were taken before and after immersion in oil. Figure (4) show oil absorption of composite blends. It can be seen that there is a very small weight gain in the blends, which means that this blends is not sensitive to change with the environmental conditions. That's could be due to highly bonded molecular between matrix and reinforcement that resist penetration and inclusion of other particles like oils.

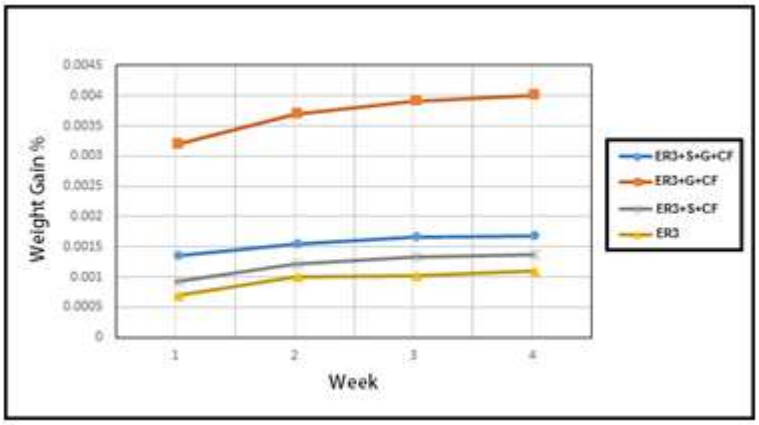


Fig.4: show oil absorption of composite blends.

Figure (5) show the composite blends (Epoxy, Resole and carbon fibers) added silica (ER3+S+CF) and with graphite (ER3+G+CF), the test show a well distribution and good compatibility of the powder in the matrix and that can give improvement in the strength of the composite.

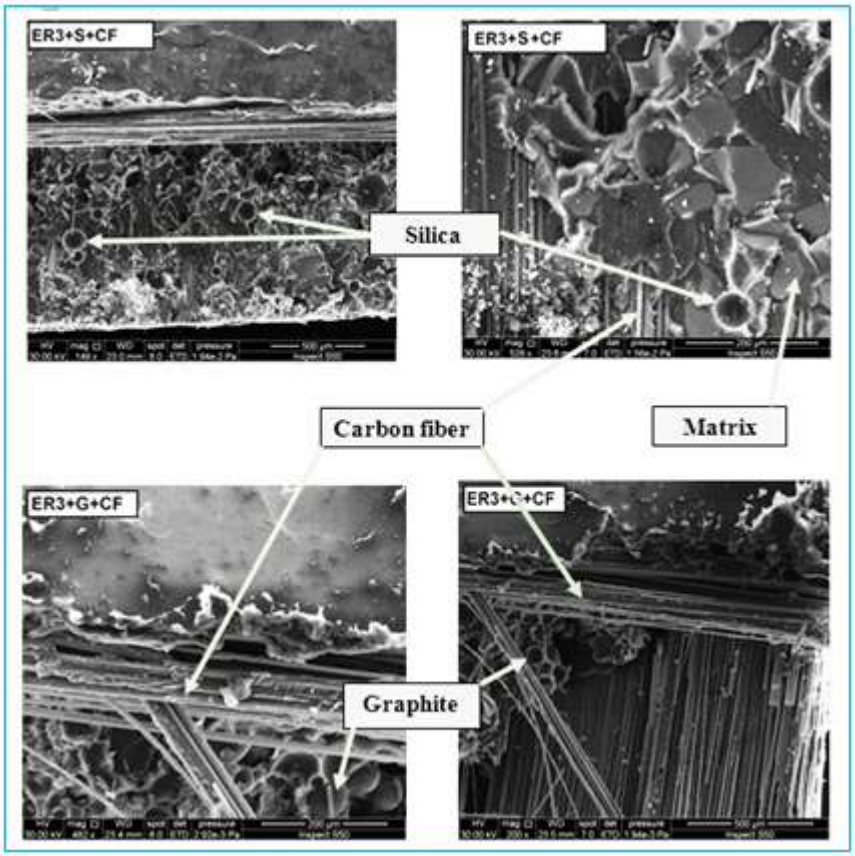


Fig. (5): surface morphology of the composite blends.

IV. CONCLUSIONS

1- strong and oxidizing acids, polymer decay is due to the strong rules and organic solvents, they attack the polymers and lead to damage to the material.

2- the material of the reinforcement may absorb larger amounts of the base material, which causes the swelling of the material of the strengthening and thus separation from the base material, the breakdown of the bonding and contiguity between the components of the composite material.

3 - Aggression solution has an effect on polymers as they attack polymers and lead to polymer clay softening and reduce the chemical family.

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