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WEAR RESISTANCE OF HYBRID BLEND REINFORCED BY FIBERS WITH DIFFERENT MIXING RATIO.

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ABSTRACT
The research aims to study the mechanical properties (Hardness and Wear Resistance) of composite materials (epoxy resins with phenolic formaldehyde resin) supported by graphite or silica particles or both, and reinforced with carbon fibers of a standard format (-90, 0, +90).easy

INTRODUCTION

The main functions of the fiber in a composite are to carry most of the load applied to composite and provide stiffness. For this reason, fiber materials which have high tensile strength and a high elastic modulus are often used for the fiber in composite [1]. Carbon Fibers (CF) appeared in the market in 1960 and are produced from organic fibers (rayon, acrylics, etc.) or from remaining of petroleum or tar distillation. [2]. Carbon fibers are the strongest and stiffest reinforcing fibers for polymer composites, these fibers are the most commonly used after glass fibers. Carbon fibers can give galvanic corrosion in contact with metals. They're generally used together with epoxy, phenols, polyester, where high stiffness and strength are required, i.e. space and automotive applications [3]. Another mechanical property that may be important to consider is the hardness, it is a measure of a material's resistance to localized plastic deformation . Shore hardness is measured with instrument known as a durometer and is also named durometer hardness [4]. In the current study wear test, this method was adopted because it is easy method and can be inference the wear rate because it gives the amount of wear debris. This method is summarized by weighted of the sample before and after the test, and the difference between the two weights represents the amount of wear debris. [6,5]. Carbon has two natural crystalline allotropic forms: graphite and diamond. Graphite derives its name from the Greek word "graphein" [7]. The water solution which contains a concentration of 40% formaldehyde is called formalin. this is used as a preservative for tissues and in embalming, with a boiling point of 21 ° C, it is used in veterinary and in dentistry as well as in the production of chemicals and polymers and is often used in the manufacture of coatings and explosives [4].In general, phenol-formaldehyde produced by two ways, for manufacture two types of polymers, namely Novolac and Resole [15].
Novolac is a type of polymers produced by mixing formaldehyde (37% water solution) with phenol by added an acidic helper (sulfuric, phosphoric or oxalic acid), and heated to the required degree and then equivalent the reaction mixture, and remove the water by distillation (in its final stages under discharge) to a temperature Estimated 160 ° C . Resole is a type is produced by added basic helper with more formaldehyde relative to phenol. Initially, its consists (Oligomer) is called a resole and it is not needed to a hardener (HMTA) but it need just heat treatment [8, 9]. In (2013), Hamid S., studied the mechanical properties (tensile, bending, and hardness) of unsaturated polyester resin reinforced with silica particles in different weight fractions (10, 20, 30 and 40) %. Results showed decreasing in tensile strength and flexural strength with increasing particle concentration, increasing in hardness, tensile modulus and bending modulus with increasing in particle concentration [10,11]. In (2015), Jweeg et.al. designed a new athletic prosthetic foot. The foot was manufactured by using epoxy reinforced by carbon fibers and that gives good mechanical response. The impact tester was designed and manufactured to perform the test. For the same dropped level, the impact response of the samples with glass fiber and carbon fiber have the same peak load for different drop angle but. In addition, it was clear that the responses of the sample manufactured with carbon fiber were more smoothness than the sample manufactured with the glass fiber [12,13]. In (2016), Jagadale U.S. and Raut L.B., investigated the mechanical properties (tensile strength and shear strength) of glass fibers reinforced polymer matrix with different fibers volume fraction (40, 50 and 60) %, hand lay-up and compression molding were used to prepare the samples. Results showed better mechanical properties at volume fraction (50%), further increase in the fiber content leads to increase in the mechanical properties but the composites start to delaminate [14].

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EXPERIMENTAL PROCEDURE

The practical part includes preparation of raw materials and how to prepare them, as well as mechanical tests conducted on overlapping materials.

The first step:
The epoxy resin was mixed with phenol formaldehyde resin (called resole). Different mixing ratios were used to obtain samples as follows:

Specimen No	Specimen
ER_1	(Epoxy/Resole) (65/35)%
ER_2	(Epoxy/Resole) (75/25)%
ER_3	(Epoxy/Resole) (85/15)%
ER_4	(Epoxy/Resole) (95/5)%

*Material used:

The material used in this work divided to two matrix material:

1- Epoxy resin
2- Phenol formaldehyde (resole) resin

The second step:

After the mechanical tests on the previous samples (different mixing rates), the best case was) Epoxy / Resole) (85/15**%(**

The third step:

The selected samples will then be supported

) : Epoxy / Resole) (80/20**%(**

The composite material (epoxy + resole) was selected by both graphite and silica, as it gave the best mechanical properties.

The fourth step:

The composite material (epoxy + resole), supported by both graphite and silica, is then combined with carbon fiber.

Reinforced materials

Carbon Fibers (CF) : is a high-performance fiber that is widely used to support advanced polymer-based composites, because of :

[1] Carbon fiber has the highest value in the coefficient of flexibility and durability compared with the all types of fibers.
[2] Carbon fiber has a variety of physical and chemical properties.
[3] Fabrication of composite and fibers is relatively inexpensive.

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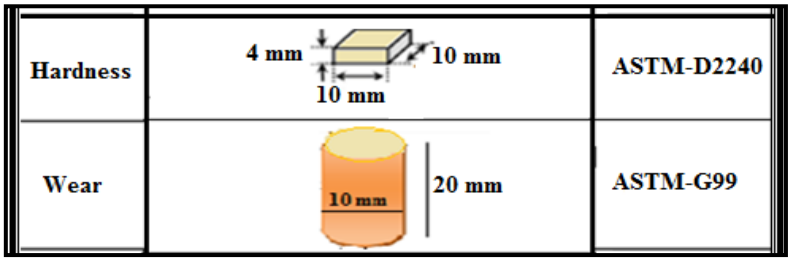
The final case is the composite material (epoxy + resole), supported by both graphite and silica, together with carbon fiber, as the ideal case

Table (1): samples dimensions and standard specifications of the testing specimens[5].



RESULT AND DISUCSSION

Hardness Test : It is known that most tests of hardness depend on the material resistance to penetrate at the outer surface and there are different ways to evaluate the hardness, in the current research has been the hardness test using the hardness (Shore Durometer) type (shore D), and through the results note that the hardness values of samples are increasing with Increase the fractional fraction of the supported particles (graphite, silica), especially if the particle particle size is small, and the homogeneous distribution is distributed within the floor. The studies indicate that the hardness values reached their highest value when increasing the volume fracture to 15% and then decreased to their lowest values at the volumetric fraction (20%). This is due to the high viscosity gained by the prepared material when adding high ratios Of the particles of graphite into the base material, which is in the liquid state, which caused the difficulty of penetration of the base material into the interstitial fissure of the fibers and porous interstices within the overlapping material, resulting in creating a lot of gaps in the prepared material and despite attempts to get rid of gaps and aerobic space I kept some of them p Since the hardness of the surface of the material and the presence of particles of graphite and silica at the surface of the material and the properties of these particles of hardness, the resistance to the force exerted on them are few, so the increase in the values of hardness Be few with increased particle fracture. The effect of particle sizes on hardness values is that hardness values increase with low particle size (graphite or silica) and this is due to the use of particles in small sizes, which facilitates the process of penetration into the base material and into the fiber network interface and into the pores that Which was made during the process of preparing the overlays, all of which helped to increase the area of contact between the components of the overlapping material prepared and then increase the interdependence between them and in an integrated, which gave more positive values when examining the hardness and, conversely, when the presence of large particles will be a barrier either flow of material And the fiber nature has a great role in determining the values of prayer, because the hardness of those fibers vary according to the type of fiber. , Because some of them are made of ceramic materials while other fibers are made of polymeric materials. The hardness test was performed by a regression method with four readings per sample. The most suitable method for measuring the hardness was the hardness values obtained from them, which reflect the condition of the material as a whole and not just the surface state. It is mainly dependent on the amount of energy absorbed by it. Absorbs a greater amount of energy, which leads to the bounce of the ball to a higher altitude than if the material is solid, in which case will return to the rise of the largest result of absorption of less energy and the results obtained confirm this. Fiber orientation has an influential role in hardness values. The calcium-reinforced samples (90o-0) gave the highest values of hardness compared to random-pattern samples. This indicates that the use of standard-size carbon fibers gives more positive results in the reinforcement process , And it is noted that the lattice system in fiber reinforcement increases the hardness values of the samples with the total volume fracture, and these hardness values increase with the number of reinforcing layers, which confirms the positive effect of the arming process with this fiber [8]. The concept of hardness can be counted as a measure of the plastic deformation that the material can suffer under the influence of external stress. Thus, particle reinforcement (silica or graphite) increased the hardness of the material due to increased resistance to plastic deformation. It has been found that the increase in the reinforcement materials and then the carbon fiber armament, led to an increase in the hardness of the material, this may be due to the fact that the hardness is a property of the surface, so this behavior is expected to hardness.

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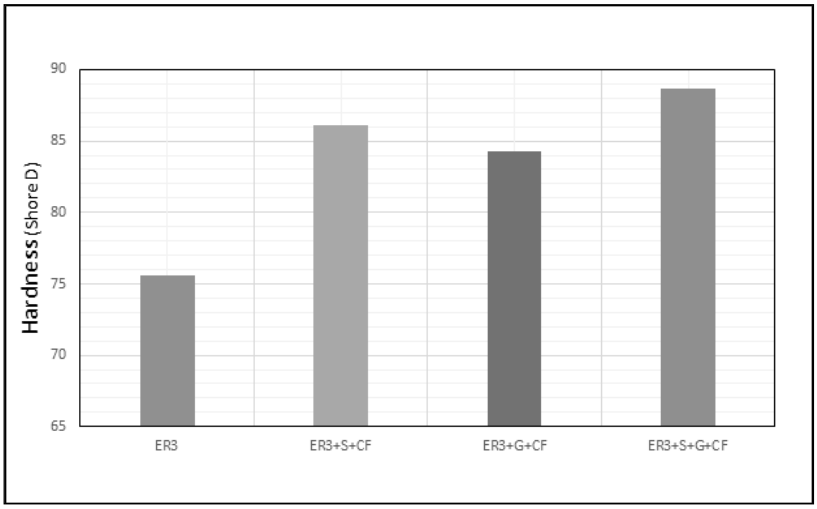

Previous studies [11] indicate that the increase in the percentage of reinforced materials (70-90%) also led to a decline in the hardness values of the prepared models due to a decrease in the ratio of the base material. This means a weakness in the cohesion of prepared compositions,]. However, the above figure indicates a rise in hardness values with increasing carbon fiber ratio, especially to 3%, which confirms the positive effect of the process of strengthening this type of fiber because it possesses characteristic. The two surfaces are composed of protrusions and grooves and the beginning of contact between the two surfaces occurs at the sharp protrusions, and under the impact of pregnancy, the stress is concentrated on the sharp protrusions, which leads to a deformation of these stenosis and increase the pregnancy lead to increased deformation at the tops of protrusions and the region near The surface is drilled as a result of the impact of the minutes resulting from the surface crust crash. The small cracks accumulate together, leading to the removal of the surface layers of the debris formed in the form of thin minutes. This increases the plastic deformation with the increase of the load. That the sliding surfaces at low loads leads to the formation of a protective surface membrane reduces the contact between the two surfaces and therefore the force required to cut the bond between the protrusions less than the force required to cut the molecular bonding of the chains of the mixture and thus less wear rate, but increase the load is getting cracking surface membranes and adhesion Is strong between the two surfaces and therefore the force required to cut the connected protrusions is higher than the force required to cut the molecular bonding of the mixture chains so the wear rate increases. And the strength of friction between the two surfaces affect the rate of wear and tear by getting emotions as a result of the generation of pressure stress resulting from the shedding of pregnancy and these emotions cause the transfer of part of the surface of the sample contact the surface of the disk and therefore the contact area will increase continuously, leading to increased wear and tear [3]. Moreover, the temperature has an effect on the rate of wear and tear and the increase in temperature increases the softness of the material and this leads to increased adhesion between the protrusions of the two surfaces and thus increase the rate of wear and tear. There may be a decrease in the rate of wear and tear as a result of the stress on the model works on the surface of sharp protrusions, which reduces the rate of wear and tear, but increase the burden of pregnancy leads to the formation of sharp bumps again and increase the rate of wear and tear [5]. It is noted that all of the above-mentioned machineries have obtained the models used and the transition from wear transition to severe wear, indicating that wear and tear increased with increased load, or transition from transition Wear) to moderate wear (Mild wear), is due to the phenomenon of emotional dependence and the transition of wear and tear from one stage to another depends on the test conditions and chemical composition of the mixture. This is what the researcher (Hallel) found that the rate of wear and tear of pure epoxy increases with the increase of the load [10].

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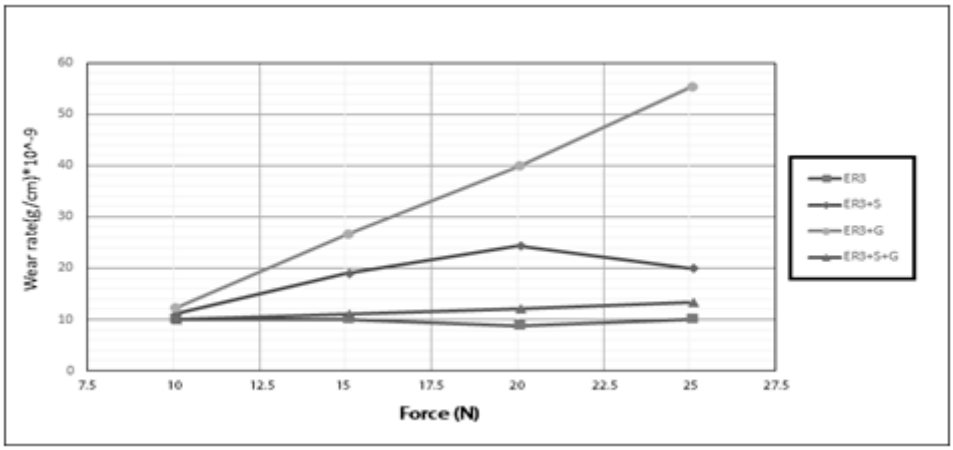

CONCLUSION

[1] The rate of wear and tear in the dry state is less than in the case of immersion in chemical solutions and for the same reasons mentioned earlier.
[2] Note that the rate of wear and tear when immersed in chemical solutions was the effect of acid solution less than in the base solution.
[3] The rate of wear and tear of the iron disc is less than the wear rate of the copper disc and for the same reasons described previously.

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