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Evaluated the Properties of a Composite Material Which Reinforced by Fiber Glass

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Abstract: In this research, a polymer composite material was prepared from two polymers (Epoxy resin- Resole resin) and reinforced by fiber glass, The phenol formaldehyde resin was used with different weight ratio (10% , 20% , 30% , 40%) , with epoxy resins of varying proportions (90% , 80% , 70% , 60%) at 20C° (included: shock resistance, tensile strength, and bending resistance), analysis and comparison with the mechanical properties of the alloy, including the part chosen for the purpose of replace the alloy with compound material for weight loss and improve mechanical properties.

Keywords: Epoxy resin, Resole resin, Glass fiber, Polymer composite material, Mechanical properties.

Introduction:

The solid matter is made up of free electrons and atomic bonds in a cyclic order called splicing. Accordingly, the transfer of thermal energy results from two effects: the free electron migration and the vibrational waves of the chain[1,2]. This means that the thermal conductivity is the sum of the electronic compound, Thermal properties on the frequency of reciprocal interactions between the splicing atoms and the surface radiation properties of the solids, the spherical size of the air or vacuum space and the nature of the solid bond between them[3,4]. The previous studies indicate an increase in the values of the thermal conductivity of the combined hybrid spectra with the increase of the fraction of the particles of the graphite[5]. This is because the graphite particles have a high thermal conductivity, and the presence of the graphite particles reduces the percentage of air bubbles formed in the hybrid, Heat transfer[6]. The rate of increase in the values of the thermal conductivity of samples prepared from polystyrene, glass fibers and graphite minutes is higher than in the samples supported by kefler fiber rather than glass, because the kefler fiber is more isolated Of glass fiber, because the kefler fibers have a decrease in thermal conductivity values of 0.04w / m.k compared to the thermal conductivity of E-glass fibers of w / m.k (1.3) [7,8]. The effect of the particle size of the graphite particles with the 10% volumetric fraction on the thermal conductivity coefficient of the hybrid composite material prepared in this research indicates that the values of the thermal conductivity coefficient increase with increasing the particle size of the graphite particles, because the presence of minutes in small granular sizes mixed with the base material facilitates From the process of flowing liquid material to the inside of the fence located within the fiber network as well as filling the air freshener and gaps within the base material, which helps to increase the area of the petition and create large areas rich in basic material and the basic material has a recommendation The thermal conductivity increases with the increase in the particle size of the graphite particles[9,10]. This is similar to the results obtained by Zhang and his colleagues when studying the effect of the particle size of the graphite particles on the conductivity Thermocouples for carbon electrodes prepared from polymeric-based overlays [11,12]. Composite materials in this regard represent nothing but a giant step in the ever-constant endeavor of optimization in materials. Strictly speaking, the idea of composite materials is not a new or recent one. Nature is full of examples wherein the idea of composite materials is used[13]. In the 20th century, modern composites were used in the 1930s when glass fibers reinforced resins. Boats and aircraft were built out of these glass composites, commonly called fiberglass . Since the 1970s, application of composites has widely increased due to development of new fibers such as carbon, boron, and aramids, and new composite systems with matrices made of metals and ceramics[14].

Fig.1: Types of composites [11]

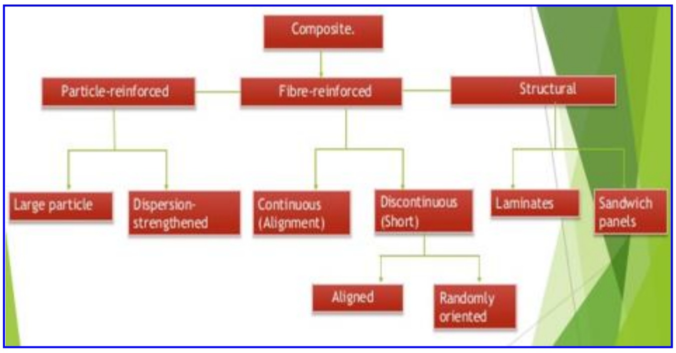

Fig. (1): A classification scheme for the various composite types [1].

The application of polymeric materials in automobiles is constantly increasing and this trend is expected to continue. The key factors in selecting the polymeric materials in relation to other materials applied in automobiles are the today's appearance of automobiles, their functionality and more economic manufacture, as well as reduced fuel consumption. Although the reduction of the mass of parts is the main reason of choosing polymeric materials, the future growth of their usage will result in new applications in automobiles related to comfort, safety and possibility of parts integration. The application of polymeric materials allows more freedom in design, and in many cases only these materials can allow safe geometrical or economic solution for the construction of parts. The automobile parts which are made of polymeric materials are divided into four categories: internal parts, external parts, parts in the engine compartment, and bodywork and engine parts[9]. A composite material is defined as a combination of two or more different materials which are indissoluble in each other and differ in form or chemical composition, the properties result better than those of the individual components used alone [10]. The composite consist from two type are reinforcement and a matrix, the main advantages of composite materials are high strength and stiffness, with low density, compared with metal and ceramic materials, allowing for a weight reduction in the part. The reinforcing phase gives the strength and stiffness, in most cases, the reinforcement is harder, stronger, and stiffer than the matrix [11].

Experimental Procedure

Materials used: The materials used in this work are: **(1) Epoxy resin** supplied by (Sikadur®-52 Injection Type N), the base used to mix is mixed 3 gm of resin with every 1 gm of the hardener. Table (1) shows the properties of the epoxy resin.

Table (1) the properties of epoxy resin used in this research [23].

Properties	Values
Tensile Strength	39Mpa (at 23℃)
Flexural Strength	60Mpa (at23℃)
Compressive Strength	54Mpa (at23℃)
Density	1.3Mpa (at20℃)
viscosity	441mPa.s (at20℃)

2. Resole resin: Is consists of one part only**.** Resole resin was the first wholly synthetic polymer to be commercialized [8]. It has become one of the most widely utilized synthetic polymers since Baekeland developed a commercial manufacturing process in [5]. Resole is synthesized under basic conditions with the formaldehyde (F) and phenol (p) molar (F/p>1) [7].

3. Glass fiber: The type of glass fiber used in this work as reinforced materials are woven E- glass fiber from the Tenax Company, England, made as reinforcement.

Table (2) the properties of glass fiber used in this research [26] [27].

Properties	Values
Compressive strength	1077Mpa
Tensile strength	3521Mpa
Young modulus	69.8Gpa
Poisson’s ratio	0.23
Density	2.6g/cm³

The practical part includes the preparation of the raw materials and how to prepare them in addition to the mechanical tests carried out on the overlapping material. These materials were mixed with different weight. At first, the substance was mixed with phenol formaldehyde resin, called resole. Different mixing ratios were used to obtain the samples . For the purpose of making samples for the necessary tests to obtain the mechanical properties and analysis and compare them with the mechanical properties of the alloy, which is the part of the original, which was chosen for the purpose of replacement of the alloy composite material used in the search for weight loss and improve mechanical properties. The oil tank 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.

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

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

Phenol-formaldehyde (PF) resole resin was the first wholly synthetic polymer to be commercialized [2]. It has become one of the most widely utilized synthetic polymers since Baekeland developed a commercial manufacturing process in 1907 [3]. Resoles are synthesized under basic conditions with the formaldehyde (F) and phenol (P) molar ratio (F/P>1) [2]. Resole was curing by heated it.

Results and Discussions

Tensile strength: Tensile resistance is a measure of the material's ability to resist static forces that try to pull and break the material. Fibrous composite materials consist of strong, fragile fibers immersed in the matrix material that is more metallic [8]. **Figure (2)** shows the values of ultimate tensile strength before and after reinforcement by fibers, where the blend before reinforcement has low tensile strength but when reinforced with fibers the tensile strength become higher where addition of fibers to resins improves their resistance to tensile strength significantly where the fibers bears a large part of the load which increases the tensile strength of the composite material because the fibers are characterized by their low ductility [2].

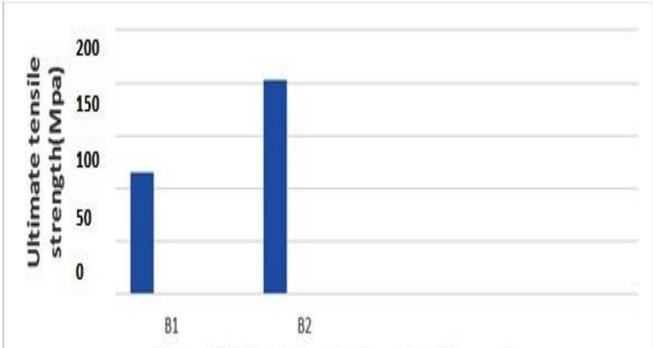

Figure (2) Ultimate tensile strength of the samples.

Impact resistance: The impact resistance expresses the material's ability to resist the fracture under the effect of a sudden load, it is also a measure of the durability of the material, where the most durable materials are the ones that exhibit the highest resistance to impact [3]. **Figure (3)** shows the values of impact strength before and after reinforcement by fibers, where the impact strength is generally low for resins because of its brittle but when reinforced by fiber, the value of the impact resistance increases, this is because the fibers will bear the bulk of the impact energy on the composite material where the fiber works to distribute stress on a larger volume, which improves this resistance [4].

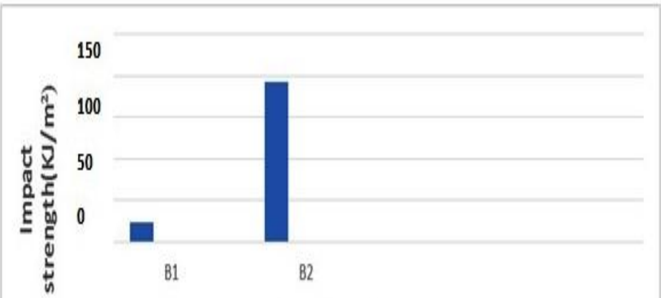

Figure (3) Impact strength of the samples.

Flexural strength: This property is a measure of resistance to bending, and can be defined as the maximum carrying load that can be cast on the test model before it is broken and measured in units (Mpa) [32]. **Figure (4)** Shows the flexural strength before and after reinforcement by fibers. Polymers have low flexural strength and this is due to their brittleness, where the flexural resistance is low before reinforcement by fibers, but this resistance begins to rise after fiber reinforcement due to the high coefficient of elasticity of these fibers, which leads to the carrying of the bulk of the load on the composite material, which in turn increases the flexural resistance of this material supported by fibers [33].

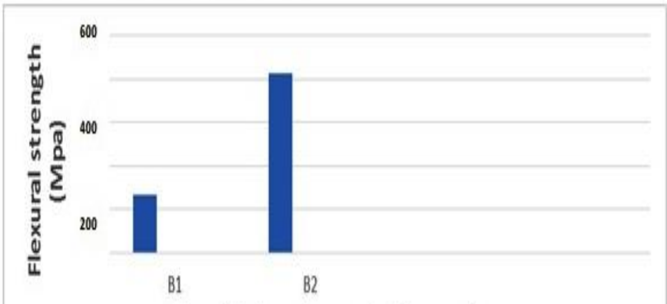

Figure (4) Flexural strength of the samples

Conclusions

1- The values of tensile strength, impact strength and flexural strength for the blend (epoxy-resole) were improved when reinforced with fibers because the larger load on the resulting composite material will endured by fibers.
2- Good transfer of loads from the matrix material to the fibers due to strong bonding between the matrix and fibers.
3- Low tensile strength, impact strength and flexural strength for the blend (epoxy – resole).

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