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Study of Some Mechanical and Electrical Properties of Epoxy / Carbon / Nano Copper Composite

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ABSTRACT

In this study, the preparation of an overlapping material with a polymer basis in the manner of manual molding or manual casting has been prepared the overlapping material from the compound resin complex as the basis material of the compound and supports the base material with kravit powder and nano-copper and in different weight ratios wt. The results of the research showed that the strength of the overlapping (EB) values decreased with the increase in the weight ratios of nano-powder copper, while the electrical conductivity increased and was higher at 5% nano-copper words.

***Key words**: overlapping material, epoxy resin, tensile test, electrical conduction test*

INTRODUCTION

Developments have witnessed a boom in the industrial and technological field, and this development depends largely on the progress in materials and as a result of these developments in the large industrial field that the world witnessed in various fields, the need to find alternatives to materials with multiple industrial uses has emerged, so these alternatives are of superior quality specifications. This is in terms of cost, light weight and properties in general, according to the various industrial applications such as solar cells and electric cells, including batteries and others. Therefore, what is known as composite materials have been produced [Michael, 1999], as epoxy resins are considered an important type of thermosetting polymers. (Thermal resins), as the epoxy contains one or more groups of epoxide groups, which represent the basic unit of the epoxy resin, and it is worth noting that the resins are characterized by insufficiency or the possibility of reforming them by heat, after converting them to a solid as a result of long polymeric chains intertwined with each other and this The so-called crosslinking is where the epoxy resin contains two or more sets of epoxy groups. Side, which consists of an oxygen atom bonded with two carbon atoms, and the chemical epoxy group is linked with other molecules to form a three-dimensional network with a link that is interlaced in the treatment process [**Liyong, 2002**], the epoxy resin has hardness and chemical resistance in addition to that it possesses a resin that has the ability to adhesion qualitatively High due to the chemical formation to the resin represented in the formation of a group of ethers and hydroxyls in addition to the polar groups that give high strength and adhesion and the material acquires hardness and strength as it is used in applications that require high functional performance, these resins interact with hardeners during processing and the unwanted reaction is by emission of water or Editing, meaning that the products are secondary, which means that the volumetric shrinkage is very small, meaning that the proportion is less than 2%, as the resin acquires high mechanical strength and properties, and the treated epoxy resin possesses high durability as a result of the distance between the cross-link points and the presence of integrated fiber chains [**Michel, 2007**].

1- THE PRACTICAL PART:

In this paper, (mast Quick-52) epoxy resin was used as a base material in the preparation of polymeric composite materials, which is of Chinese origin with a distinction from Fosroc Company. It is in the liquid state and can be polymerized and transformed into a solid state by adding a hardener, where the hardener is distinguished by being a light liquid with low viscosity, low density, and a transparent yellow color, and it is added to the resin in a ratio of (3: 1). It is prepared by mixing it by hand. Black graphite

powder is used as a substance first, and nano copper powder is used as a second material in its chemical formula (to add it to the base material (Matrix) with different weight ratios of graphite wt.% (19,20,21,22,24,25) and for copper wt.% (0,1,3,4,5,6), which is a basic reinforcing material and is known as a compound with good properties.

The up-lay hand molding method was used when preparing the samples, and this method was chosen without the other complicated methods due to its ease, filling and low cost, as a sheet of cap used to encapsulate the external facades of government institutions was adopted with a plastic molding mold with Special treatments for the purpose of non-adherence of the models to the casting plate. This process was recently carried out to pour samples in symmetrical conditions and the mixture was mixed for a period of (60) minutes slowly and then poured into the prepared mold, then these samples were left for (24) hours for the purpose of completing ripening Full) and then leave for a period of (15) days to complete the polymerization process completely before starting to examine the samples, after the previous operations are performed, samples of the composite materials are obtained in the form of plates with a thickness of (3 mm) after which the cleaning process is carried out appropriately, for the purpose of preparing the samples according to Standard specifications where samples were cut using a band saw with fine teeth, and the dimensional control stage is done by using the smoothing device and after that the polishing process is done with zero degree smoothing papers, and six samples were prepared for each of the previously mentioned ratios and You can reduce the percentage of error that you get and get more accurate results with good specifications.

- ***Samples***

From Figure (2-4) (stress and strain curves) for epoxy-graphite samples with weight ratios (0,1,3,4,5,6wt%), the highest value was taken for the sample's endurance of tensile strength (kilo-Newton) and as shown when increasing the ratio The gravity of the nano-copper elemental tensile strength begins to decrease and from the third chapter (preparing samples) it is noticeable that adding nano-copper material to the compound and increasing its weight ratio leads to a decrease in the value of the tensile strength of the sample, where the values were respectively with the weight ratios 0.685,0.52,0.472,0.41 , 0.385,0.345)) kilo-Newton, the increase in the weight ratio of nano-copper means an increase in stress concentration regions or areas of weak molecular bonds. The figure below shows the shape of the samples.

2- MECHANICAL EXAMINATIONS

1-2 Tensile Tests:

As the tensile test is one of the most common and most commonly measured mechanical tests in materials, it is a very important test as it is possible through this test to obtain sufficient information that is a basis for determining the mechanical behavior of the material, most notably the yield stress, the percentage of elongation in the material as well as the elastic modulus of the material and other important factors in this test [Sim, 2011], where the results of this mechanical examination are used when testing materials with engineering applications. The tensile test ears have broad properties that are included with high-performance specifications in order to ensure quality in the development of materials where those tensile properties are measured when The existence of a development of the material in order to compare it with other materials different from it [Hai, 2013], and from the information that the tensile test gives is the ductility of the material and the resistance of the material, where the resistance of the material is characterized by having engineering applications according to the design within two criteria, the first of which is the presence of the required stress when a quantity of plastic deformation occurs In terms of yield strength (the highest value of stress that the material can withstand) and the second is represented by the presence of tensile strength. The ductility of the

material can be defined as a measure of the amount of deformation occurring to the material when it bears such strength before the fracture process occurs. Ductility is also used specifically in engineering design to remember the standard specifications of materials through good qualities and durability. Flexibility properties can also be measured through a tensile test [**Xiujuan, 2012**].

Figure (1-2) illustrates the tensile test apparatus for the specimen

RESULTS AND DISCUSSION OF A TENSILE TEST

This test is one of the important mechanical tests in examining materials, as this test is considered a measure of the material's ability to resist the load to which it is exposed and leads to pulling the material and thus breaking it. When the tensile test of the polymeric models was taken before and after adding the minutes to it, special curves between stress and strain were drawn for all samples. Which was prepared for the purpose of the study, through Figure (1) it is evident that the behavior of the stress and strain curve for all samples of the polymeric mixing supported with black graphite powder and reddish-yellow nano-copper powder and that the behavior of these curves is related to the nature of the relationship that connects the substrate with the support material in addition to The presence of adhesion strength between the base material and the support material.

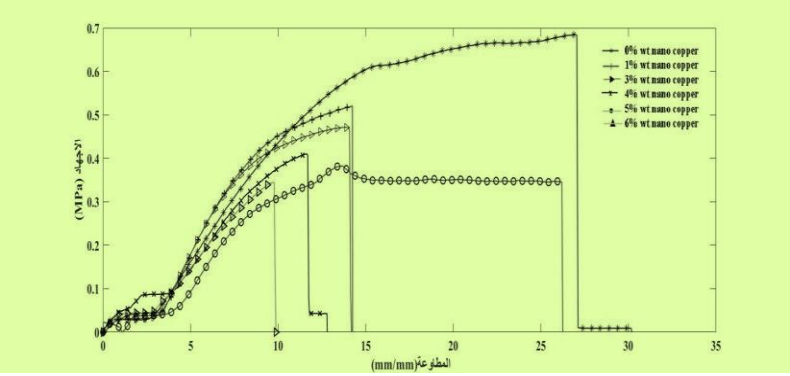


Figure (4-1) shows the stress and strain curves of the polymeric materials

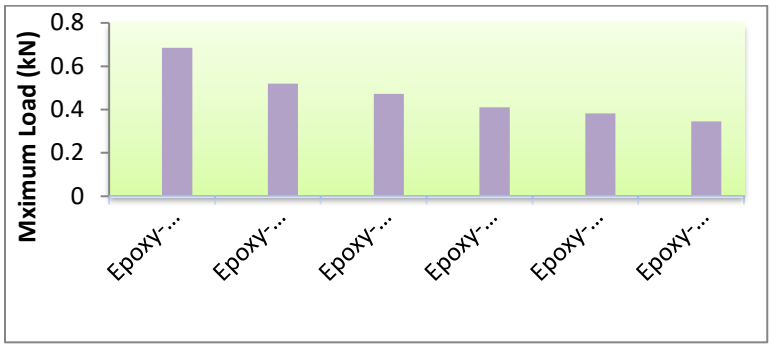
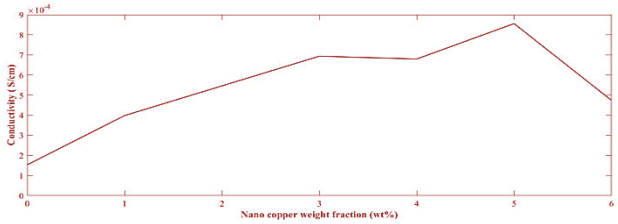


Figure (2-4): The highest value of tensile strength (kilo-Newton) before fracturing for all types

Electrical conductivity test results

The four point-probe for resistivity measurement is referred to as the four point-probe for resistivity measurement as in the figure below, where it was found that the electrical conductivity.



From the above figure, the electrical conductivity value (s / cm) increases as the weight ratio of nanoparticles increases, as the highest value of the electrical conductivity becomes in the ratio of 5% of nano copper, while we find the lowest electrical conductivity value at 0% and that increasing the copper ratios improves the electrical conductivity values For the composite, and when the size of the nanoparticle granule becomes, these grains are distributed uniformly within the compound material (epoxy - graphite) and the reason for this is to block the free spaces and this causes the flow of electrical charges inside the conductive material, and we find the increase in the increase due to the absence of clumping in the material.

In Table (4-1) below, an explanation of the electrical conductivity values of the six prepared samples

Sample number	**Sample1 (%)**	**Sample2 (%)**	**Sample3 (%)**	**Sample4 (%)**	**Sample5 (%)**	**Sample6 (%)**
Electrical resistance (mΩ/cm)	0153256	0398297	0693752	0679788	0855943	0474118

Electrical Resistivity Test Results:

The four point-probe test for resistivity measurement is indicated. The four point test for resistivity measurement is indicated in the figure

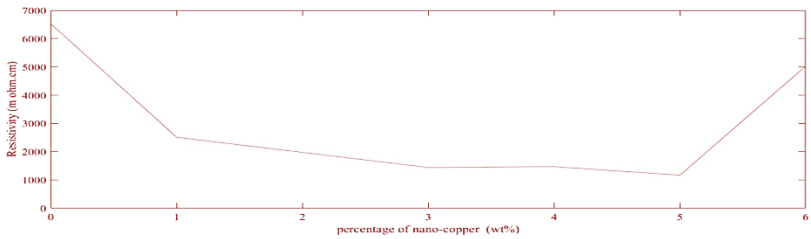


Figure (4-3) shows the relationship between electrical resistivity and gravitational ratios

From the above figure, the resistivity value (mΩ.cm) decreases as the weight ratio of nano-copper increases, so that it becomes less value in 5% nano copper, as the lowest value for resistivity is when the sample is 5% epoxy-graphite (mΩ.cm). Thus, it is

the highest value of Conductivity, and we conclude that increasing the weight ratio of nano-copper improves the conductivity values of the compound (epoxy - graphite - nano copper) and when the size of the copper grain is the nano-scale, these grains will be distributed uniformly within the epoxy - graphite material by filling in the voids. The free-volume hole causes a greater passage of electric charges and the free volume is a characteristic feature of the polymer matrix and this arises from the free spaces between the polymeric chains and is within the molecular scale, and the weight ratio of nano-copper 6% begins to increase resistivity again. This is due to the agglomeration process.

CONCLUSIONS

Adding the ratio of nano-copper particles to the polymeric material (epoxy resin) leads to giving good properties of mechanical and physical properties in general as well as having an effect on electrical properties.

1. An increase in the tensile strength of the composite material of epoxy resin reinforced with nanoparticles of nanoparticles occurs with an increase in the weight fraction.
2. The addition of nanoparticles of copper nanoparticles to the polymeric material increases the modulus of elasticity (E), shock resistance and fracture strength Kc. with an increase in the weight fracture.
3. The hardness of the combined material increases with the increase in the weight fraction of the nanoparticles of copper nanoparticles.

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