THEORETICAL ESTIMATION TO FLEXURAL STRENGTH OF ARALDITE COMPOSITE USED FOR MANUFACTURING ELECTRICAL CIRCUITS PLATES

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ABSTRACT

In the present research theoretical method was used to calculated flexural strength of composite material consist of araldite resin with different weight percentage (20%,40%,60%) from carbon fibers, where Ansys program version (11) was used to study the effect of different reinforcing under variation loading on flexural strength of composite material. The standard specification (ASTM D790) was used to fabricant the test specimens in Ansys program .The theoretical results shows that high flexural strength value for araldite resin after reinforcing with carbon fibers due to high elastic modulus for these fibers and this strength will increase with increasing percentage of fibers .

Keywords: Flexural strength, Ansys Program, Composite Material.

INTRODUCTION

Composite material is a material consisting of two or more physically and (or) chemically distinct phase, suitably arranged or distributed. A composite material usually has characteristics that are not depicted by any of its components in isolation (Kaw, 2006). Generally, the composite material contains two elements:

1- Matrix material: it is the continuous phase; it may be metal, ceramic or polymer matrix. The polymer matrix is considered the best because of its mechanical and thermal properties, and also it can reinforce by a large fiber volume fraction compared with metal and ceramic matrix. In addition to the low cost and easy fabrication, as example for this materials araldite resin, polyester, and epoxy resin. Araldite resin belong to epoxy group which has excellent thermal and physical properties, and usually used in composite materials for different applications, where it distinct by excellent adhesive capability especially to fibers, also it retain constant dimensions after dryness (Biron, 2007).

2- Reinforcing material: The distributed phase is called reinforcement, many reinforcement materials are available in a variety of forms; continuous fibers; short fibers; whiskers, particles...etc. Reinforcements include organic fibers such as carbon and kevlar fibers, metallic fibers, ceramic fibers, and particles (Biron, 2007).

Morom G. etal studied the effect of hybrid fibers (Carbon/Kevlar) on the impact strength of epoxy resin (Morom *et al.,* 1986). also Ali investigated the effect of changing the reinforcement percentage by fibers on Mechanical properties, for composite material consists of conbextra epoxy (EP-10) resin reinforced by biaxial woven roving kevlar fibers (Al-Mosawi, 2009) . Azhdar studied the impact fracture toughness of fiber reinforced epoxy resin(Azhdar, 1992) .Abbas etal studied effect the change of reinforcement percentage of fibers on the thermal and mechanical properties for polymeric composite material consist of conbextra epoxy (EP-10) resin reinforced by biaxial woven roving S–type glass fibers (Al-Jeebory, Al-Mosawi, 2009).

Flexural Strength

The flexure test method measures behavior of materials subjected to simple beam loading. It is also called a transverse beam test with some materials. Maximum fiber stress and maximum strain are calculated for increments of load. Results are plotted in a stress-strain diagram. Flexural strength is defined as the maximum stress in the outermost fiber. This is calculated at the surface of the specimen on the convex or tension side.

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Flexural modulus is calculated from the slope of the stress vs. deflection curve. If the curve has no linear region, a secant line is fitted to the curve to determine slope. The 3-point flexure test is the most common for polymers. Specimen deflection is usually measured by the crosshead position. Test results include flexural strength and flexural modulus (DeGarmo etal, 2008). Flexural strength can be obtained from the following formula:

$$\sigma = F \times S = \frac{3PS}{2bt^2}$$

Where:

σ = flexural strength (N/m^2)

P = maximum test load (N)

S = dimension between load points (mm)

b= sample width (mm)

t= sample thickness (mm)

Work Procedure

Ansys program version (11) was used to calculate flexural strength value for araldite resin before and after reinforced with different weight percentage from woven roving carbon fibers (20%,40%,60%) . specific Properties for both resin and fibers was input in database of Ansys program , as well as standard shape of specimens , and applied different amount of loads to make a theoretical emulation to experimental flexural test , and then draw the obtained data after applied the loads .Table.1 show the specifications used to draw test specimens . Following a short description to materials used:

1- Araldite resin (AY103) with density of (1.15g/cm^3)

2- Woven roving carbon fibers (0°-45°) with (225 g/m^2). density .

3- Test specimens: standard specification (ASTM D790) used to fabricant the test specimens with rectangular section (135×10×10mm).

Table 1. Specifications used to draw test specimens

No. of Nodes	No. of Element	Type of Element	Model
10290	5145	Solid 185 Geometry , 8 Nods ,3-D Modeling	Linear

RESULTS AND DISCUSSION

Fig.1 represent the flexural strength to araldite resin AY103 before reinforcement , where observed that , low flexural strength for this resin when exposed to loads ,because of in general the resins considered a brittle materials , which accepted with experimental results obtained (Al-Mosawi, 2009).

Fig.2 represent the flexural strength to araldite resin AY103 after reinforcing with (20%) carbon fibers , where the strength of resin will increased due to the fibers will withstand the maximum part of loads and by consequence will raise the strength of composite material and this also accepted with experimental results obtained (Al-Jeebory, Al-Mosawi, 2009).

The flexural strength will be increased as the fibers percentage addition increased as illustrated in **Fig.3** and **Fig.4** which represent flexural strength to araldite resin AY103 after reinforcing with (40%) and (60%) from carbon fibers respectively . These fibers will be distributed on large area in the resin which will be improved flexural strength greatly which also accepted with experimental results obtained (Kiichi *et al.,* 2009).

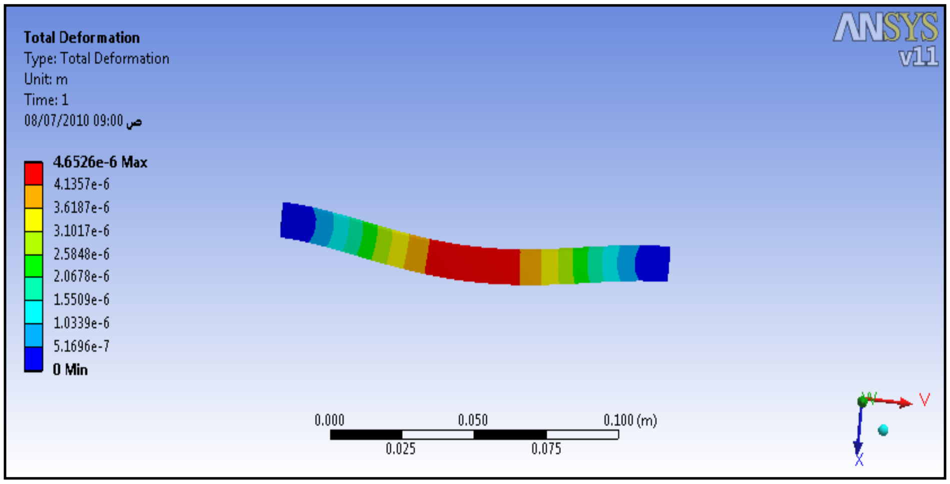

Figure 1. Flexural strength to araldite resin before reinforcement

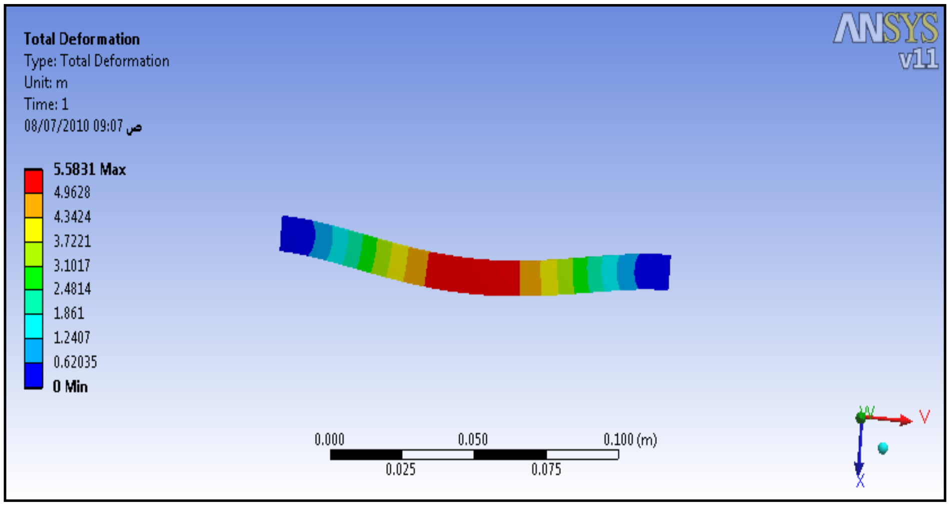

Figure 2. Flexural strength to araldite resin after reinforcing with (20%) carbon fibers

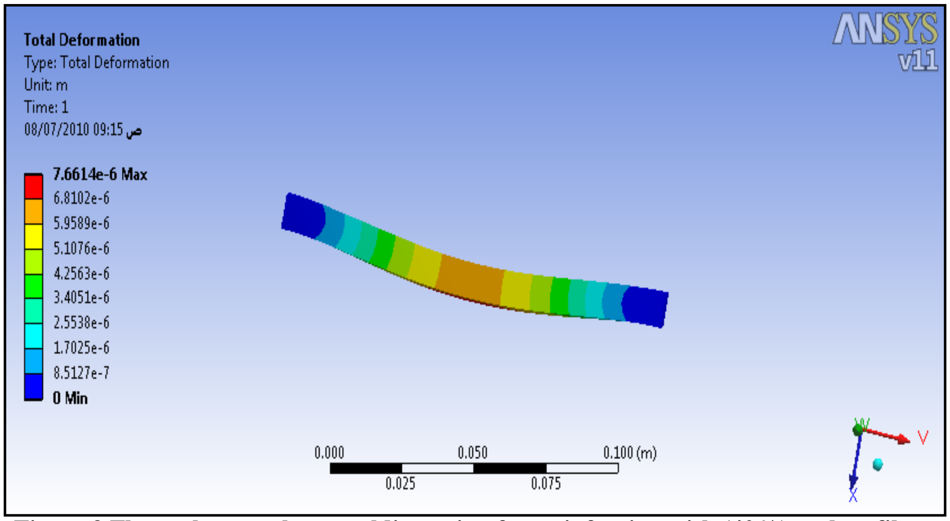

Figure 3.Flexural strength to araldite resin after reinforcing with (40%) carbon fibers

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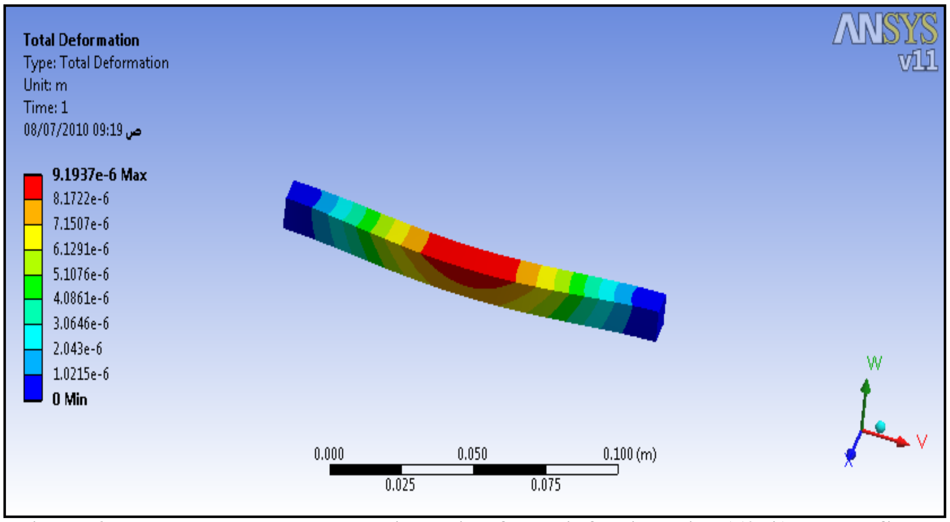

Figure 4.Flexural strength to araldite resin after reinforcing with (60%) carbon fibers

CONCLUSIONS

From this study we concluded that:

1. Low flexural strength of araldite resin .
2. Improvement of mechanical properties after reinforcement by carbon fibers.
3. The mixing ratio of 6:4 (carbon fibers: araldite resin) is the optimum mixing ratio which is obtaining the best result.

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