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PHYSICALAND THERMAL PROPERTIES OF FIBER(S-TYPE)-REINFORCED COMPOSITEARALDITE RESIN (GY 260)

Mahmoud A. Hassan
Al-Qadisiya University
Assist Lecturer

ABSTRACT

This study aims to investigate: first, study the effect of changing the reinforcement percentage by fibers on mechanical properties (Impact, tensile, and compressive strength) for composite material consist of Araldite resin reinforced by chopped glass fibers with density ($2.6 g/cm^3$) .glass fibers was mixed with araldite resin in different weight reinforcement percentage (20%, 40%, 60%) . the best results was obtained with large reinforcement percentage (60%). Second, study the effect ofthe same above reinforcement percentage on thermal conducting of composite material, where the result show increased thermal conducting with increasing percentage of reinforcement. Fourier equation was used to calculate the changing in thermal conductivity coefficient (k) for composite material.

KEYWORDS: Composite Material, Thermal Properties, Mechanical Properties .

INTRODUCTION

A composite is commonly defined as a combination of two or more distinct materials, each of which retains its own distinctive properties, to create a new material with properties that cannot be achieved by any of the components acting alone. Using this definition, it can be determined that a wide range of engineering materials fall into this category. For example, concrete is a composite because it is a mixture of Portland cement and aggregate. Fiberglass sheet is a composite since it is made of glass fibers imbedded in a polymer. Composite materials are said to have two phases. The reinforcing phase is the fibers, sheets, or particles that are embedded in the matrix phase. The reinforcing material and the matrix material can be metal, ceramic, or polymer. Typically, reinforcing materials are strong with low densities while the matrix is usually a ductile, or tough, material [**Rao and Rodrigues, 2012**].

The thermal conductivity of a material is equivalent to the quantity of heat that passes in unit time through unit area of a plate, when its opposite faces are subject to unit temperature gradient (e.g. one degree temperature difference across a thickness of one unit). For non-metallic solids like composites, the heat transfer is view as being transferred via lattice vibrations, as atoms vibrating more energetically at one part of a solid transfer that energy to less energetic neighboring atoms. This can be enhanced by cooperative motion in the form of propagating lattice waves, which in the quantum limit are quantized as phonons. Practically, there is so much variability for non-metallic solids that we normally just characterize the substance with a measured thermal conductivity when doing ordinary calculations [**Incropera, 1996**].

Aralditeresin belong to epoxy group which have excellent thermal and physical properties, and usually used in composite materials for different application, where it distinct by excellent adhesive capability especially to fibers, also it retain constant dimension after dryness [**Ali et. al., 2011**].

G.Morom, E.Drukkler, A. Weinberg, and J. Banbaji studied the effect of hybrid fibers (Carbon /Kevlar) on the impact strength of epoxy resin [**Morom, 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 kevlarfibers [**Ali,2009**]. Azhdar studied the impact fracture toughness of fiber reinforced epoxy resin [**Azhdar, 1992**]. Abbas , Ali , and Sajed studied effect the change of reinforcement percentage of fibers on the thermal conductivity for polymeric composite material consist of conbextra epoxy (EP-10)resin reinforced by biaxial woven roving S–type glass fibers [**Abbas and Ali, 2009**]. Kahtan and Ali studied the behavior for composite material consisted from unsaturated polyester resin reinforced by palms fibers is studied and compared it with another material reinforced by glass fibers and then these two types of fibers combined together to make a hybrid composite material and also calculated the range of it's thermal conductivity [**Kahtan and Ali, 2004**].

MATERIALS AND METHOD .

Materials: There are two types of materials employed in this study:

1- Araldite resin (GY 260) with density of (1.15-1.2 g/cm^3) .This resin supplied from Huntsman Corporation.
2- Glass fibers S-type with density (2.6g/cm^3) .

Composite samples Fabrication: Hybrid composite Araldite resin reinforced by chopped glass fibers can be fabricated by the hand lay up technique using laboratory compression molding machine. Three types of samples were manufactured as follows : Impact samples : The impact strength was determined using Charby Impact Instrument conforming to (ASTM-E23) specification suitable to Notch depth is (0.5mm) and notch base radius is (0.25mm). Tensile strength samples: The standard dumb bell samples are cast according to (ISO-R-527). Compressive Strength Samples: these samples fabricated according to (ASTM-D790) standard as a rectangular shape(10mm×135mm) .
Thermal Conductivity Samples: These samples have a disc shape with (25 mm) diameter and (3 mm) thickness.

Determination of Mechanical properties of Composite: Charpy Impact Instrument was used to evaluated the impact strength of composite material .The universal test instrument manufactured by (ZheJinangTuGong Instrument Co., Ltd) was used to measure tensile strength with a (20KN) load . Compressive strength can be measured by three point test by using universal hydraulic press (Leybold Harris No.36110) to calculate the maximum load exposed on middle of the Sample .

Thermal Conductivity Test . Heat Conduction Unit Manufactured P.A. Hilton Ltd England was used in this test ,and Fourier equation applied to calculate thermal conductivity coefficient (k).

$$Q = -k \times A \times \left(\frac{\Delta T}{\Delta X} \right)$$

Where:
Q = heat passed per time (W).
k = thermal conductivity coefficient (W/m.ºC) .
A = area (m^2) .
$\frac{\Delta T}{\Delta X}$ = temperature gradient (ºC/m).

RESULTS & DISCUSSION

Figure1 shows the value of impact strength with fibers reinforcing percentage .Generally ,the impact resistance considered low to the resins due to brittleness of these materials ,but after reinforcing it by fibers the impact resistance will be increased because the fibers will carry the maximum part of the impact energy which exposition on the composite material .All this will raise and improved this resistance .The impact resistance will continue to increase with increased of the fibers reinforcing percentage .

The resin considered as brittle materials where its tensile strength is very low as shown in **Figure 2**, but after reinforcing by fibers this property will be improved greatly ,where the fibers will withstand the maximum part of loads and by consequence will raise the strength of composite material .The tensile strength will be increased as the fibers percentage addition increased ,where these fibers will be distributed on large area in the resin as mentioned above ,the resin is brittle ,therefore its compressive strength will be low before reinforcement as shown in **Figure 3** .But after added the fibers to this resin the compressive strength will be raise to the producing material because the high modulus of elasticity of these fibers will helps to carry a large amount of loads and raise this strength. From **Figure 4** which represents the thermal conductivity with (80%) resin and (20%) glass fibers , we observed that increasing of (k) value when temperature increased due to good conducting ability of glass fibers compared with resins. **Figure 5** represents the thermal conductivity with (60%) resin and (40%) glass fibers ,thermal coefficient still increased with raising temperature, and we expect this increment because the high thermal coefficient of fibers . this behavior of increment will continue with (40%) resin and (60%) glass fibers as shown in **Figure 6**.

CONCLUSIONS

From the obtained results we get:

Low mechanical properties (Impact, Tensile, Compressive Strength) of the araldite resin .enhancement of mechanical properties after reinforcement by glass fibers .Improvement of thermal coefficient when reinforcing by fibers .Increasing thermal coefficient values with increased reinforcing percentage.

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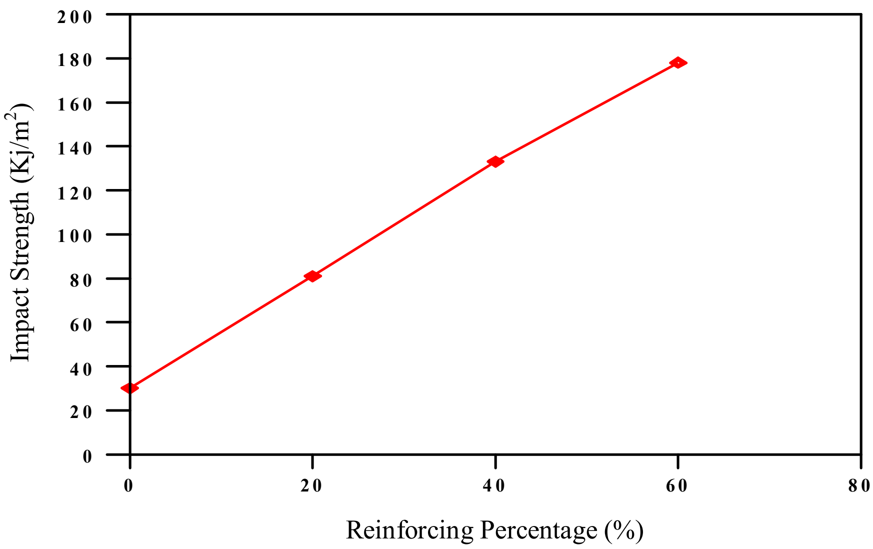

Figure1 Impact strength

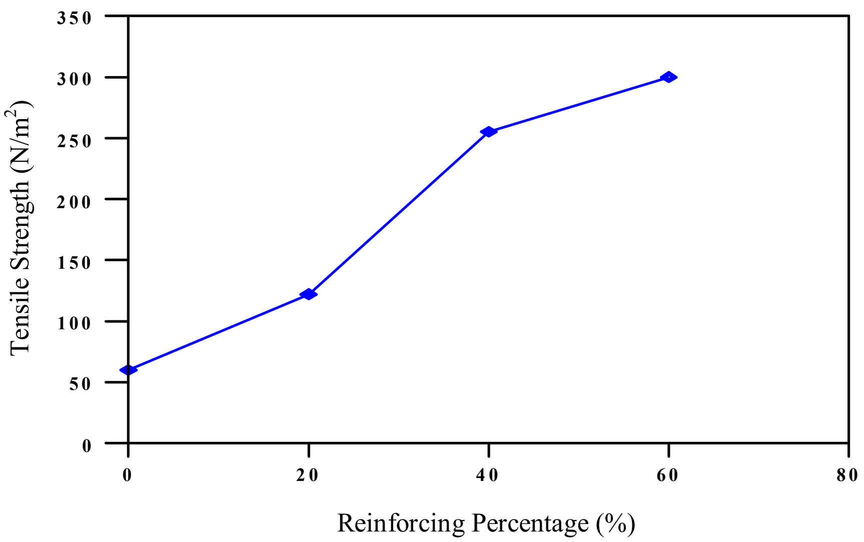

Figure 2 Tensile strength

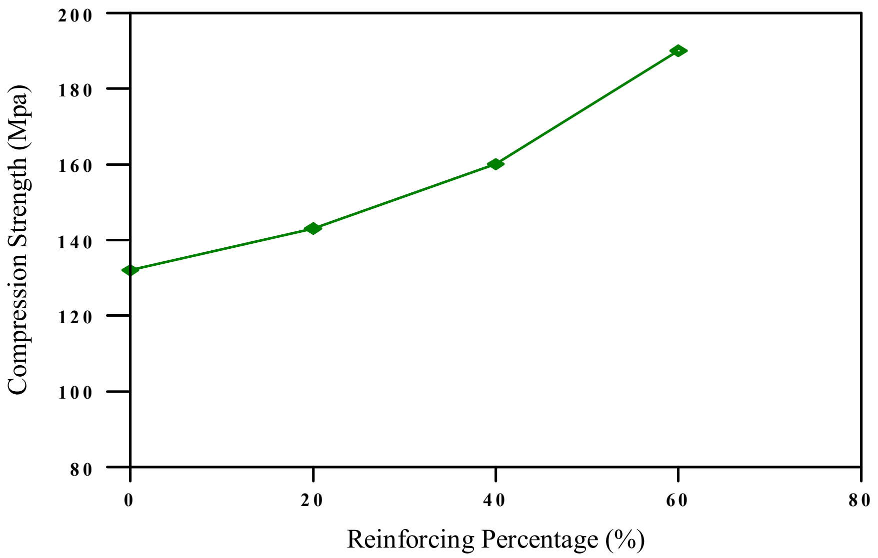

Figure 3 Compressive strength

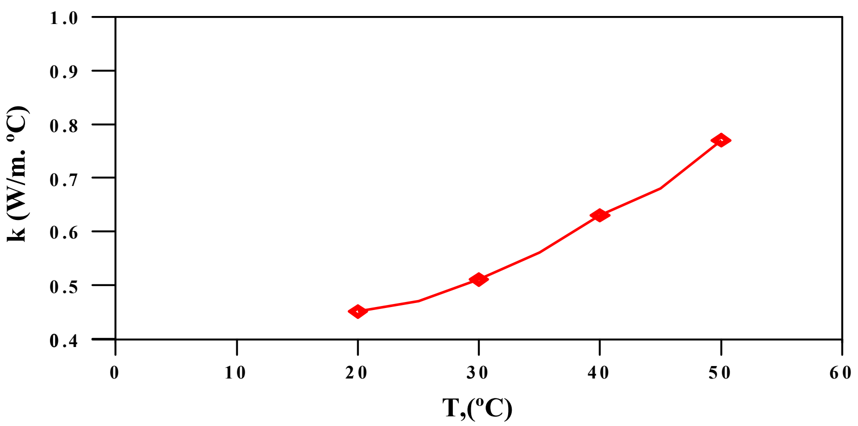

Figure 4 Reinforcing Percentage ((80%) Resin + (20%) Fibers)

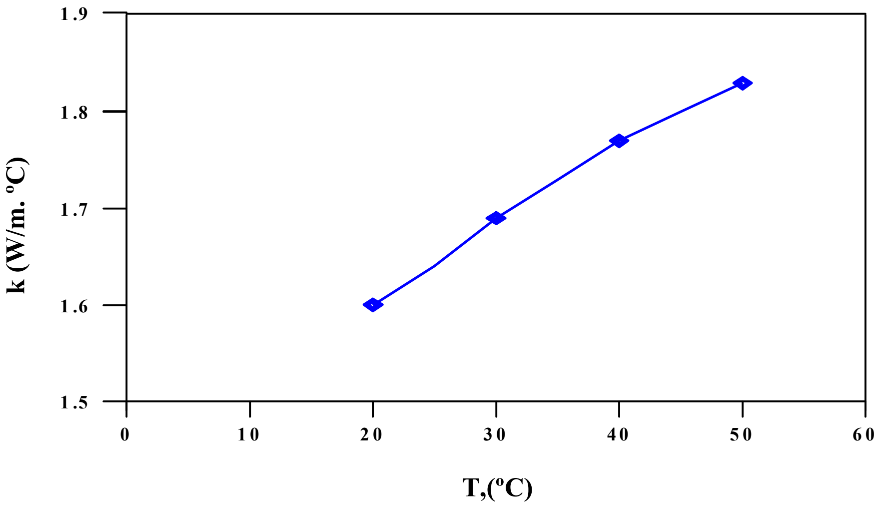

Figure 5 Reinforcing Percentage ((60%) Resin + (40%) Fibers)

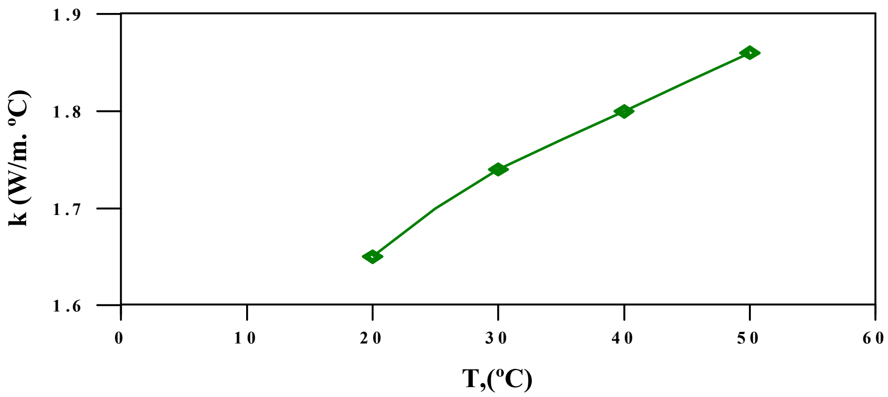

Figure 6 Reinforcing Percentage ((40%) Resin + (60%) Fibers)