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# Thermal conductivity behavior of epoxy resin reinforced by nanoparticles

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## ABSTRACT

In this research work, a resinous matrix, epoxy with a hardener at a ratio of 1:2 at room temperature, was prepared with nanoparticles (nano-magnesium, nano-zinc and nano-boron) at a ratio of 1% and 2%.
All samples for thermal tests were prepared using the mechanical method.
The method of hand-lay was used to prepare the resinous molds.
Thermal tests were conducted that involved using a Lee's disk to calculate the coefficient of thermal conductivity at room temperature.
The results showed a significant improvement in the properties of the composite material containing nanoparticles due to its properties that led to the improvement of the thermal properties. The positive effects of the dispersion and mixing process in the composite materials was also observed through the results obtained from the composite materials reinforced by nanoparticles and comparing it with the resinous matrix.

## Introduction

The use of composite materials with a resin matrix has been popular in most modern designs due to the superiority of Its thermal properties over the rest of the other materials. There are many applications in which the need for materials with high tolerance to high temperatures to which material can exposed during service has emerged so that it can be used as thermal protectors [1].
The thermal properties of epoxy resin before and after reinforcing with zinc nanoparticles with a volume fraction of 1% and 2% were studied and compared with the same material reinforced by magnesium nanoparticles with a volume fraction of 1% and 2% also compared with the same material reinforced by boron nanoparticles with a volume fraction of 1% and 2%. The effect of the thermal conductivity coefficient on was studied at room temperature and the comparison was made with the aim of obtaining the best properties [2]. The results showed that nanoparticles positively affect the thermal conductivity property. The results also showed that materials reinforced by nanoparticles have a high thermal conductivity coefficient compared with materials that are not reinforced [3].
The aim of this test is to study the thermal conductivity of the polymeric material. Thermal conduction is one of the basic physical phenomena that can be studying and explaining how material effects by heat and most of the applications of composite materials, especially those with a polymer matrix are in the outer periphery, such as building parts, planes, cars, and others. Therefore, studying the properties of these composites has become necessary to measure their tolerance for such conditions [4].

## Materials and Methods

Five samples were prepared from the composite materials (epoxy resin with hardener without reinforcement (E), epoxy resin reinforced with nanomagnesium (E+Mg), epoxy resin reinforced with nanozinc (E+Zn), epoxy resin reinforced with nano boron trioxide (E+B), all samples at 1% and 2% weight fraction. Thermal conductivity test was conducted on all prepared samples at lab temperature and the following figures shows the change in thermal conductivity values with 1% and 2% weight fraction.
The purpose of measuring the thermal conductivity of the samples, a Lee's disc method was used to calculate the thermal conductivity of the insulating materials. The equipment consists of three discs (1,2,3) and an electric heater that connects the equipment to an electrical circuit [5]. We put the sample between the first and second discs, and the heater is between the second and third discs, and it has a power supply unit that starts transfer of heat