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(Aluminum – Silicon - Magnesium) Alloy Reinforced by Ceramic Materials

A THESIS

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Abstract

This study is concerned with the effect of adding two kinds of ceramic materials on the mechanical properties of (Al-7%Si- 0.3%Mg) alloy, which are silicon carbide with particle size (25µm > P.S ≥ 0.1µm) and boron carbide with particle size (20µm > P.S ≥ 0.1µm) and adding them to the alloy with weight ratios (0.2, 0.4, 0.6, 0.8, 1%). Stirring casting method has been used to make composite material by using vortex technique which is used to pull the particles to inside the melted metals and distributed them homogenously.

After that solution treatment was done to the samples at (520°C) and artificial ageing at (170°C) in different times. It has been noticed that the values of hardness is increased with aging time of the original alloy and reached its highest value after (8hr).

Mechanical tests were done to the original alloy and the composite material at the maximum hardness value and represented by tensile, hardness, and wear tests. It was found that the hardness value is increased with increment of the amount of added particles; also the increment in the hardness of the alloy which is reinforced with boron carbide is more than that reinforced with silicon carbide.

Regarding the tensile test, results shown that the strength and yield resistance of the composite material are more than that in the original alloy and these values are increased with increasing of the amount added particles and they reached maximum values at (0.6%),

Then they are decreased but these values remain at higher values than that in the original alloy. However the ductility is decreased as compared with the original alloy and this decrement was more obvious with the increasing amount of the added particles. The increment of strength and yield resistance of the alloy reinforced by boron carbide was higher than that reinforced with silicon carbide, while the ductility of the alloy reinforced by silicon carbide was higher than that happened by addition of boron carbide. Also silicon carbide and boron carbide addition to the original alloy is decreased the wear rate, and the decrement would be more with the increased amount of adding particles. In addition the wear resistance of the alloy reinforced with boron carbide was larger than that reinforced with silicon carbide.

X-rays testing proved that secondary phase (AlFeSi) appeared in both original alloy and the composite material. While heat treatment led to the appearance of phases (Mg_2Al) and (Mg_2Si) in original alloy. This was led to obvious improvement in the mechanical properties in addition to appearance ceramic particles in the microstructure on the composite material. This structure which was somewhat homogenous, having fine grains as compared with large grains in the microstructure of the original alloy.