EFFECT OF HEAT TREATMENT ON MECHANICAL PROPERTIES OF ALUMINUM LM13 – MgO_p METAL MATRIX COMPOSITES

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ABSTRACT

Ceramic reinforced aluminum matrix composite materials are gaining wide acceptance in the engineering application because of their low density, high strength and good structural rigidity. Inclusion of MgO particulates as reinforcement in aluminum LM13 alloy material composite improves its hardness. In the present investigation aluminum LM13/MgO composites were developed by vortex method by varying the weight percentage of MgO particulates from 0wt% to 10wt% in the steps of 2wt%. The casted matrix alloy and its composites have been subjected to solutionizing treatment at a temperature of 530° C for 2 hours, followed by quenching in different media such as air, water and ice. The quenched hardness specimens were subjected to artificial aging at 164° C. Microstructural studies were carried out to understand nature of structure. The hardness test was conducted on both aluminum LM13 alloy and aluminum LM13/MgO particulate composite, before and after heat treatment. Aluminum LM13/MgO particulate composites exhibited significant improvement in hardness when compared with aluminum LM13 alloy.

Keywords: *MgO, solutionizing, Artificial Ageing, Hardness.*

1. INTRODUCTION

MMC's are increasing wide prominence in a few segments because of its enhanced mechanical properties. When contrasted with metals, especially when weight is considered as major factor. Aluminum composites are used in different applications few of them are Pistons, brake plate and cylinder and so on [1]. Aluminum composite increases the particulate reinforcement increases the strength by following traditional methods [2, 3]. SiC is most normal molecule utilized in aluminum alloy composites [4, 5] for light weight applications by addition of clay particles in the matrix the strength of the composite increases [6] Al6061 combination is warm treatable and subsequently additionally increment in quality can be normal [7], heat treatment process improves the strength and fit to design the material for industries [8]. Aluminum LM13 compound have various advantages like formability weldability, consumption protection and ease. For generation of Aluminum particulate strengthened composite blend throwing technique gives off an impression of being promising strategy among different regular handling strategies. Warmth Treatment procedure to alter the microstructure of aluminum compound composites with aluminum is the last generation phases of composite [9]. A large portion of the scientists have explored aluminum composites utilizing SiC, Al2O3, MgO, Zircon and so forth., and these composites are industrially accessible in various basic structures [10]. In the present work the maturing conduct of LM13/MgO composites containing MgO particulates is contrasted and warm treated LM13 combination were contemplated.

2. EXPERIMENTAL PROCEDURE

2.1 Development of Composites

LM13 as matrix and MgO as reinforcement the chemical composition are as shown in Tables 1.

Table 1. Chemical Composition of Aluminium LM13 alloy

Si	Mg	Cu	Fe	Ti	Cr	Ni	Mn	Al
12.1	1.2	0.8	0.8	0..02	0.07	0.9	0.2	Bal.

Magnesium oxide used as a reinforcement material. It is white fine powder form & hygroscopic in nature.

Appearance	White Powder
Solubility	Partly soluble in water
Molecular formula	MgO
Molecular weight	40.30
Density	3.70 g/cc
Melting Point	2800°C

In this investigation the matrix Al LM13 addition of particulates MgO with different wt.% (2 wt.% to 10 wt.% in steps of 2). In stir casting process the development of LM13 is heated to a temperature of 700° C to 800° C in a graphite crucible, then particulates MgO is pre heated to the temperature of 400° C and thoroughly stirred at a speed of 550 rpm at a duration of 10 to 15 min. The ready mixed composite is poured to a pre heated cast iron die till it solidifies. The unreinforced and reinforced composite are studied for microstructure analysis and hardness test.

2.2 Heat Treatment

The obtained material is solutionized at 530° C for a period of 2 hours in muffle furnace and quenched in different mediums like air, water and ice and followed by artificial ageing at 164° C at duration 2 to 10 hours in step of 2 hours.

2.3 Hardness Test

The Brinell hardness tests were done according to ASTM-E10-95 standard. The specimen diameter is 20 mm, the testing specimens is cleaned in various emery papers and the tests were conducted in 3 distinct areas on the hardness round specimens both for as cast and heat treated Al LM13/MgO composite material.

3. Results and Discussion

3.1 Microstructure analysis

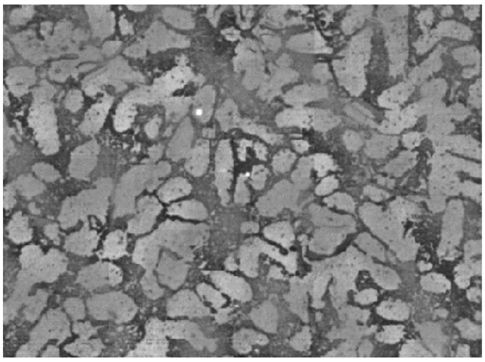

Figure 1. Micrograph of Al (LM13)/0wt% of MgO

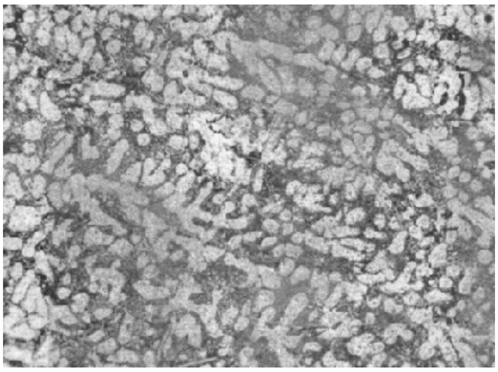

Figure 2. Micrograph of Al (LM13)/ 2wt% of MgO

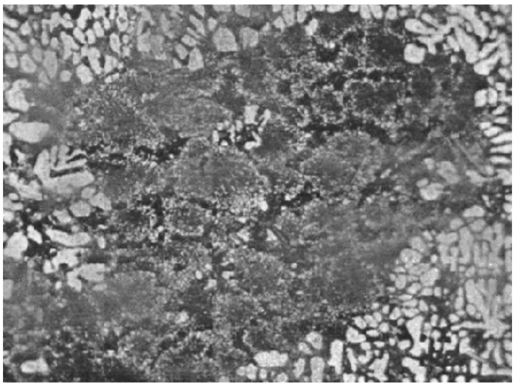

Figure 3. Micrograph of Al (LM13)/ 4wt% of MgO

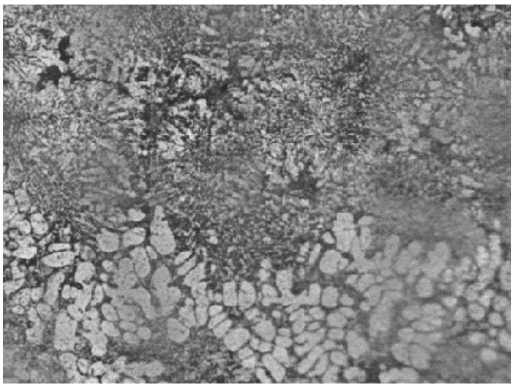

Figure 4. Micrograph of Al (LM13)/ 6wt% of MgO

The specimen for the minute inspection was set up by metallographic methodology scratched in Keller's specialist, analyzed under optical magnifying instrument. The micrographs plainly show the confirmation of negligible porosity in both aluminum LM13 and its aluminum LM13 - MgO particulate composites. Micrograph demonstrates the almost uniform dissemination of the particles in the composite.

3.2 Hardness

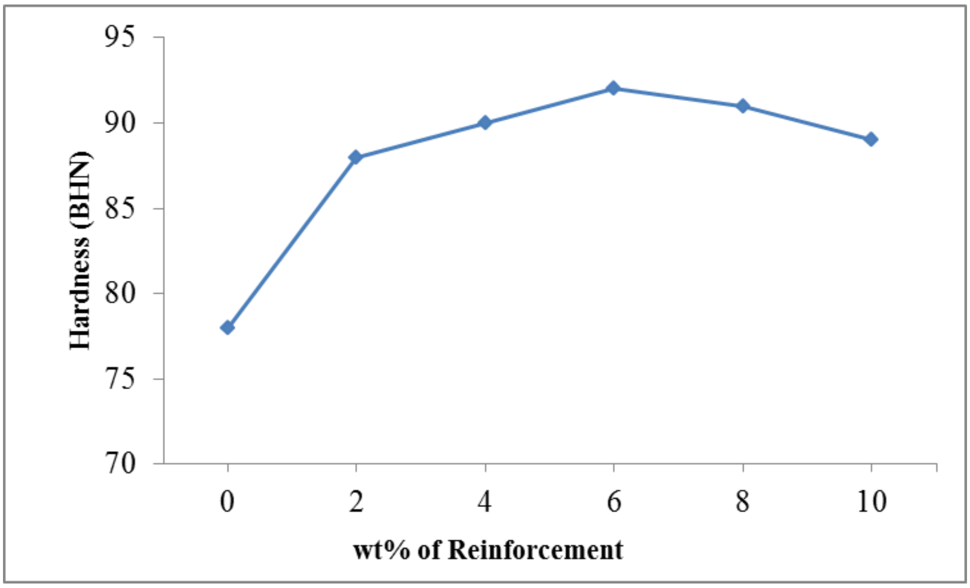

Figure 5. Variation of hardness with increase in wt% of reinforcement for aluminium LM13 matrix alloy and its aluminium LM13 -MgO particulate composites.

In the figure 5 shows that the increase in the weight percentage of MgO particulate it is found that significant improvement in hardness, it is due to presence of hard ceramic MgO particulate improves the hardness and wear resistance of AlLM13/MgO composite material [11-15].

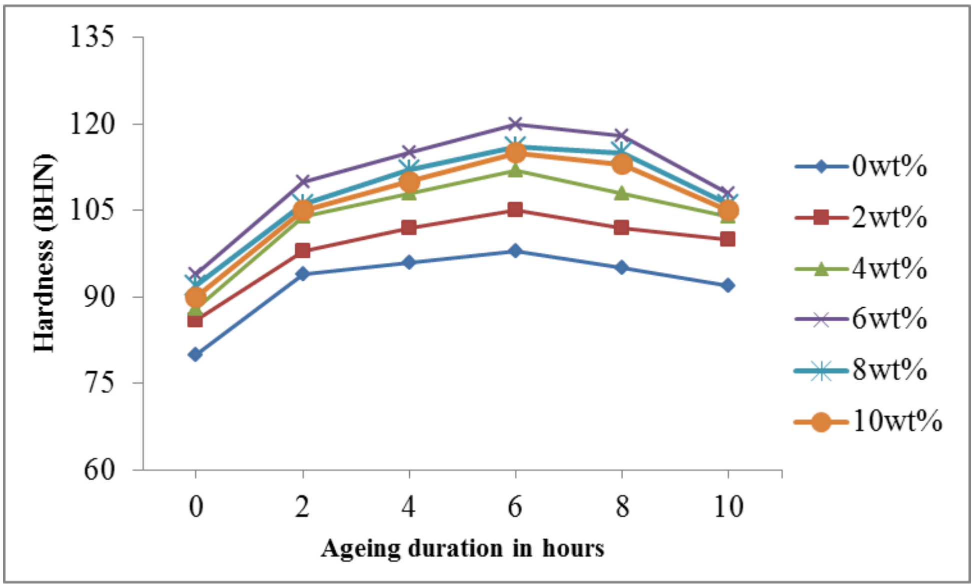

Figure 6. Variation of hardness with increase in ageing time for aluminium LM13 matrix alloy and its aluminium LM13 -MgO particulate composites for Air quenched under different heat treatment conditions

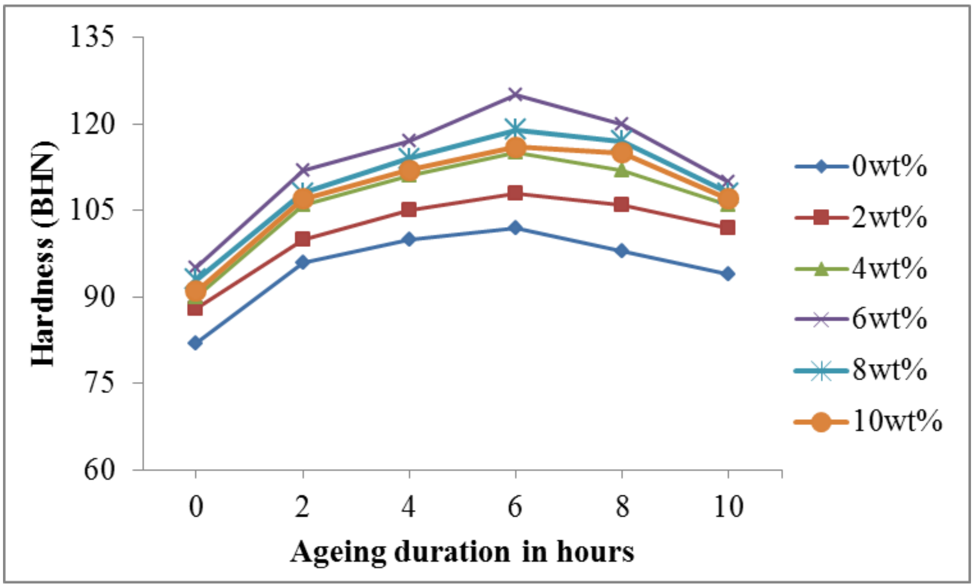

Figure 7. Variation of hardness with increase in ageing time for aluminium LM13 matrix alloy and its aluminium LM13 -MgO particulate composites for Water quenched under different heat treatment conditions

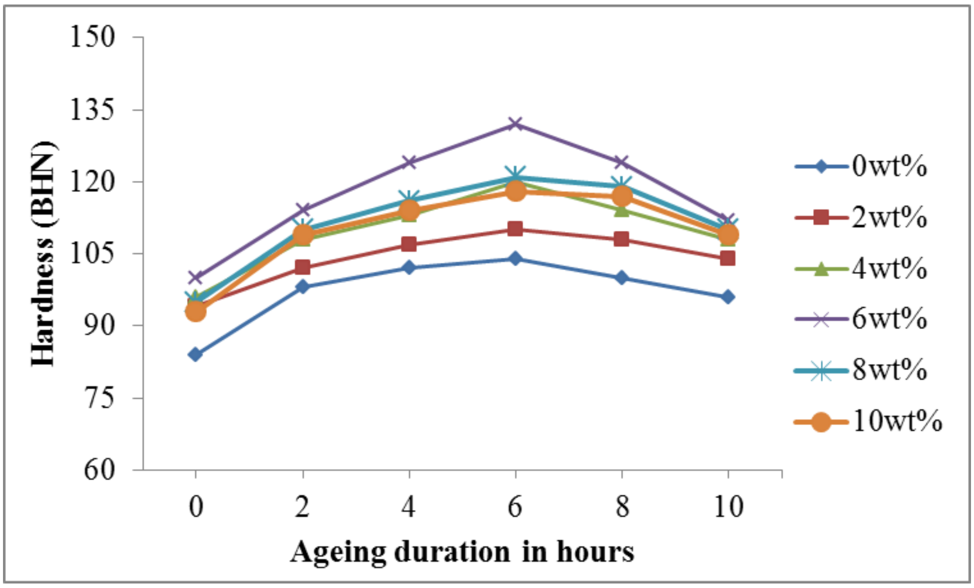

Figure 8. Variation of hardness with increase in ageing time for aluminium LM13 matrix alloy and its aluminium LM13 -MgO particulate composites for Water quenched under different heat treatment conditions

Figure 6, 7 and 8 shows that, in all the quenching medias and under each developing time composites shows higher hardness when equated with matrix Al LM13 alloy. After solutionized with air quenching and developed for period of 6 hrs the aluminum LM13/MgO at 6wt% indicated most noteworthy change in hardness around 33%, on water and developing for 6 hrs the aluminum LM13/MgO at 6wt% demonstrated most extraordinary change hardness around 35%, and in Ice, developing for 6hrs at aluminum LM13/MgO at 6wt% demonstrated most prominent difference in hardness of around 38%.

4. Conclusions

1. Aluminium LM13 composites have been effectively created with genuinely uniform scattering of MgO particles utilizing vortex strategy.

2. The microstructural examine unmistakably uncovers the about uniform circulation of support particulates in the Aluminum LM13.

3. The hardness of the composites expanded altogether with expanded substance of MgO particles. Warmth treatment significantly affects Brinell hardness of Aluminum LM13 alloy and its composites. Ice extinguishing took after by simulated maturing for 6 hrs brought about greatest hardness of matrix alloy and its composites.

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