EVALUATON OF MECHANICAL PROPERTIES ON AS – CAST AND HEAT TREATED AL7075 ALLOY REINFORCED WITH ALBITE PARTICULATE COMPOSITES

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ABSTRACT

Aluminium 7075 alloy reinforced with albite particulate composites having 2 wt% to 10 wt% in steps of 2 wt% were developed by stir casting method. The casted composite specimens were heat treated at 470° C solutioninzing temperature with artificial ageing at 120° C. The composite specimens were machined and tested as per ASTM standards. Microstructural analysis clearly reveals that uniform dispersion of albite particulates in the matrix alloy. From mechanical properties test it was observed that increase in hardness, tensile strength and compression strength when compared with As – Cast composites.

Keywords: *Al7075 matrix alloy composite, Albite Particulates, Solutioninzing temperature, Artificial Ageing, Hardness Test.*

INTRODUCTION

Aluminium alloy 7075 has wide demand for the development of high strength and light weight parts and components for industrial application. Al7075 alloy is a good wear resistant with increased mechanical properties [1, 2]. The Aluminium – Zinc alloy develops precipitates of $MgZn_2$ results in embrittlement [2, 3]. The T6 heat treatment was performed with 470° solutioninzing temperature and 120° C artificial ageing [4]. The incorporation of hard ceramic particles into aluminium alloy improves its mechanical properties [5]. From various research work studies it was found that Kim et al [6] the Al7075 alloy ageing increases the hardness. Doel et al [7] studies the Al7075-SiC composite increases mechanical strength and composite becomes brittle in nature. D. Ramesh et al [8] concludes

Al6061-Firt particulate composite after heat treatment increases its mechanical strength. From above literature review the present investigation work carried out on As – Cast and Heat treated Al7075 – Albite particulate metal matrix composite.

PREPARATION OF COMPOSITE MATERIAL

The Al7075 matrix alloy and Albite particulates as reinforcement are used is as shown in the table 1 and 2.

Table 1: Al7075 alloy Chemical Composition (wt%)

Si	Fe	Cu	Mn	Mg	Cr	Zn	Ti	Al
0.4	0.5	1.6	0.3	2.5	0.15	5.5	0.2	Balance

Table 2: Albite Chemical composition

SiO_2	Al_2O_3	Na_2O	K_2O	Fe_2O_3	LOI
70%	18%	10.5%	0.5%	0.06%	0.2%

The Al7075 – Albite having 2 wt%, 4 wt%, 6wt%, 8 wt% and 10 wt% are produced by stir casting method. The Al7075 alloy kept in a crucible and melted using electrical furnace at temperature 650° C to 750° C with simultaneously continuous stirring at 550 rpm. The reinforcement is heated at 400° and added in to the furnace to obtain good bonding and wettability strength between matrix and reinforcement. Further heat treatment is carried out at solutioninzing temperature at 470° C and artificial ageing at 120° C from 2 hours to 10 hours in the increment of 2 hours.

PREPARATION OF SPECIMEN

The tensile test was conducted as per ASTM E8 – 82 standard using universal testing machine. The Brinell hardness was performed as per ASTM E10 – 95 standards with HB 500 tester of 10 mm diameter ball indenter as shown in the figure 1.

Figure 1: Hardness Test specimens before and after Indentation.

A. Microstructural analysis

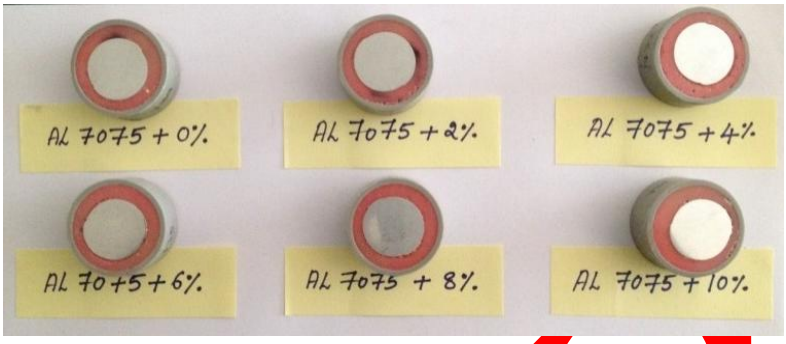

Figure 2: Optical Microscopic examination specimens

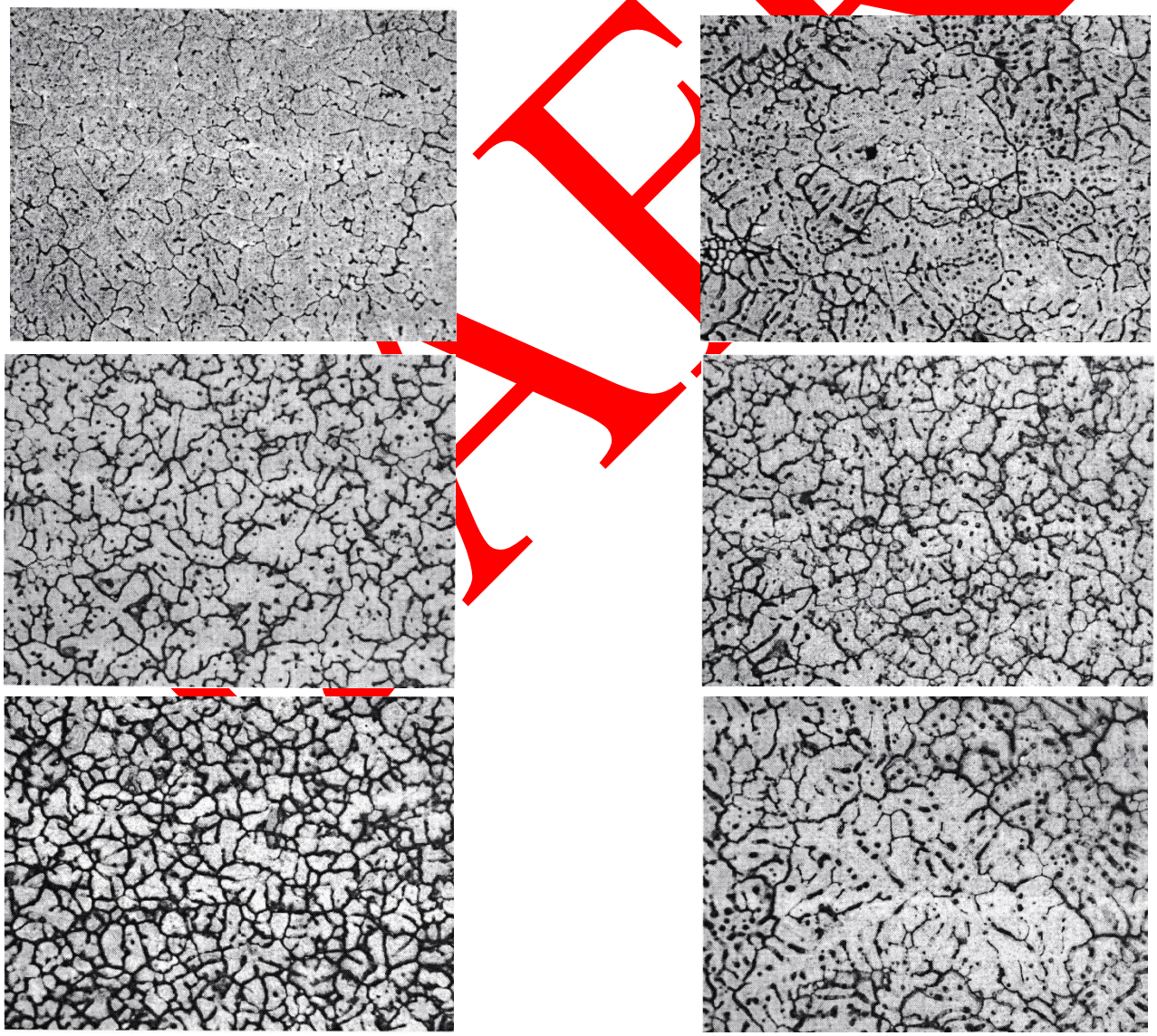

Figure 3: Optical Micrographs of Al7075 alloy, Al7075/2wt%, Al7075/4wt%, Al7075/6wt% Al7075/8wt% and Al7075/10wt% Albite composites at 200X.

The figure 3 shows the micrographs are obtained from optical microscope etched with killer's agent. The results clearly shows minimum porosity and good bonding between matrix and reinforcement with uniform distribution of albite particulate in Al7075 matrix alloy.

B. Hardness

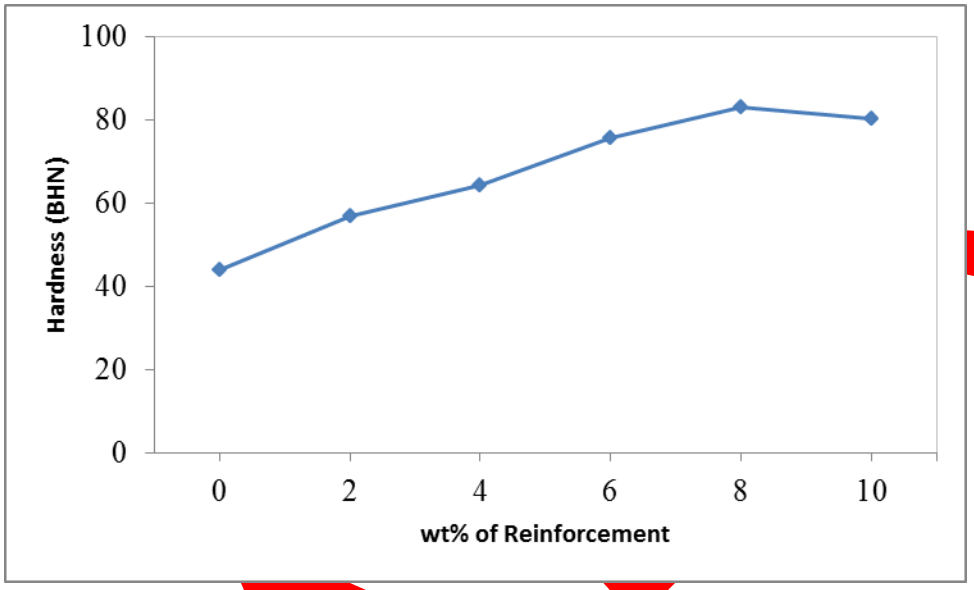

Figure 4: Effect of hardness by varying Albite wt% in Al7075 alloy without heat treatment.

Resistance offered by a material is known as hardness. Figure 4 clearly indicate that when different weight percentages of albite particulate is incorporated in to Al7075 matrix alloy it was showed increase in the hardness up to 8wt%. Further there was decrease in hardness due to poor bonding and wettability between reinforcement and matrix [9].

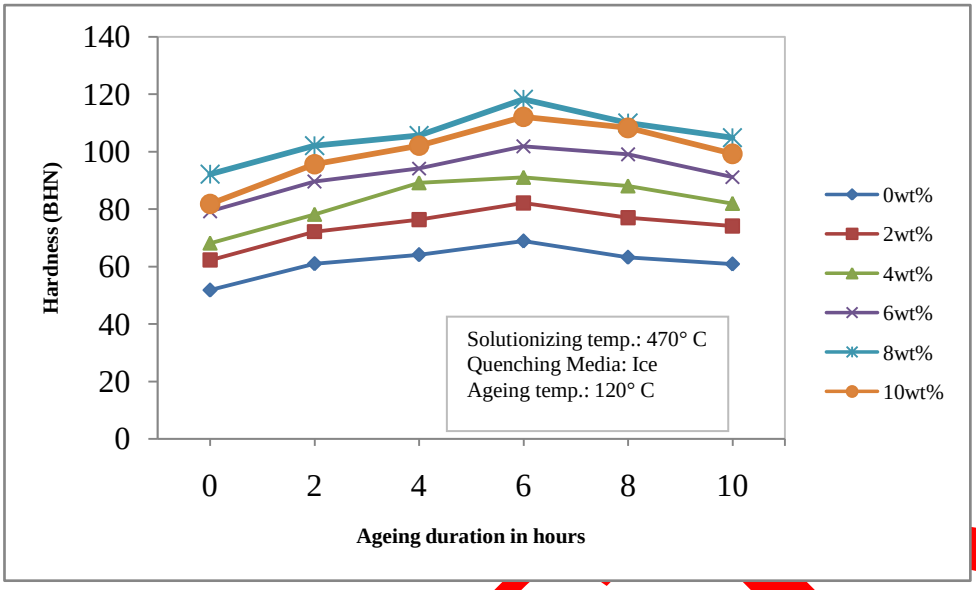

Figure 5: Effect of hardness by varying Albite wt% in Al7075 alloy, ice quenched and increasing in ageing period with heat treatment.

Figure 5 shows that heat treatment carried out on both Al7075 matrix alloy and its respective composites which is solutioninzed at temperature at 470° C ice quenched, artificially aged at 120° C. with different aging time duration from 2 hours to 10 hours in steps of 2 hours. The maximum increase in the hardness was found at 6 hours aging duration with 44% improvement in hardness compared to Al7075 matrix alloy. Similar type of research work carried out by other researchers also [9, 10].

C. Tensile Strength

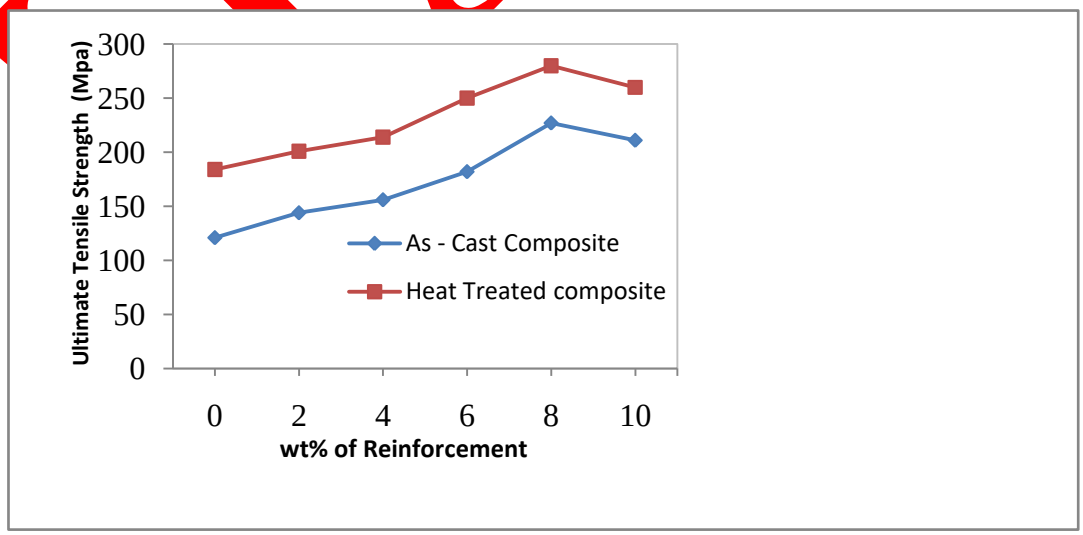

Figure 6: Effect of Tensile strength by varying Albite wt% in Al7075 alloy with heat treatment and without heat treatment.

Figure 6 indicates addition of hard ceramic particulates in to Al7075 matrix alloy increases its ultimate tensile strength due to agglomeration of albite particulates in the matrix alloy while the heat treated composite showed improved ultimate tensile strength compared to As – Cast composite this is due to formation of precipitation hardening results in stain hardening in the composite [9, 10].

D. Compressive Strength

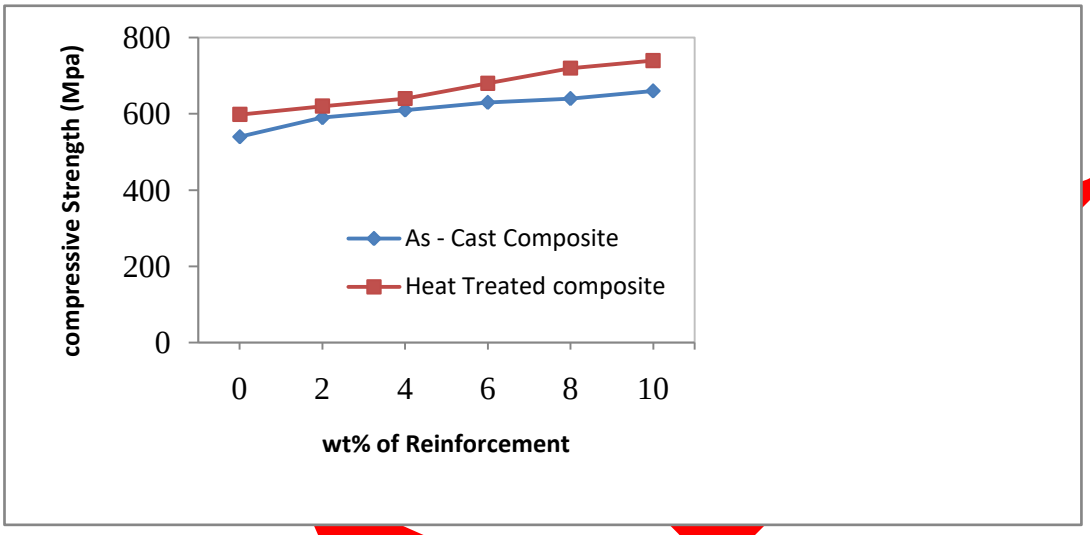

Figure 7: Effect of Compressive strength by varying Albite wt% in Al7075 alloy with heat treatment and without heat treatment.

Figure 7 shows the increase in the compressive strength of the Al7075 – Albite particulate composites. This is due to the interface and effective transfer of applied compressive load to the uniformly distributed well bonded reinforcement.

CONCLUSIONS

1. The Al7075 – albite particulate composite were successfully manufactured by stir casting method.
2. The distribution of albite particulates in the Al7075 matrix alloy was uniform which is obtained microstructure analysis.
3. The hardness of Al7075 – albite particulate composite was found to be increased at 6 hours ageing time duration.
4. The tensile and compressive strength was increased in heat treated composite compared to as – composite.

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