Effect of Cold Quenching On Mechanical Properties of Al7075-Albite Particulate Composite

Batluri Tilak Chandra[*], Sanjeevamurthy[**], H. S. Shiva Shankar[***]

[*] Research Scholar, Department of Mechanical Engineering, Sri Siddhartha Institute of Technology, Tumkur-572105
[**]Professor, Department of Mechanical Engineering, Sri Siddhartha Institute of Technology, Tumkur-572105
[***]Professor, Department of Mechanical Engineering, Siddaganga Institute of Technology, Tumkur-572103

Abstract-In the present work, an attempt is made to study the mechanical properties of Al7075-Albite particulate composite fabricated by stir casting method by varying the weight percentage of Albite particulates from 0wt%, to 10wt% in steps of 2wt%. The Al7075 alloy and Al7075-albite particulate composites were heat treated at solutionizing temperature of 470° C for 2 hours then quenching in ice media and artificial ageing for 6 hours at 120° C. The specimens were prepared according to ASTM test standards. The microstructure analysis reveals that uniform distribution of Albite particulates in the Al7075 matrix alloy and there was significant improvement in ultimate tensile strength, compressive strength and hardness properties of the composite as compared with Al7075 alloy.

Keywords-Al7075 matrix alloy composite, Heat Treatment, mechanical properties test, stir casting method.

I. INTRODUCTION

The need of best quality materials for industrial application demands to production of composite materials. Aluminum alloy playing a vital role to get better results [1]. From all aluminum alloys 6000 and 7000 series has more benefits such as good formability, weldablity, corrosion resistance and heat treatable [2]. The use of ceramic materials leads to development of light weight composites [3, 4 and 5]. In a matrix alloy the presence of hard ceramic material increases the brittleness with that noticeable amount of increase in strength [6, 7]. By performing the heat treatment on the aluminum alloy there are changes in the microstructure of the composite [8, 9]. The Sic, Al_2O_3, MgO, Zicron etc. are the most commonly used reinforcement in Aluminum composite [10]. The work done by other researchers study says that kim et al [7] reported that hardness strength is increased by performing ageing on Al7075 alloy. Clark et al [8] investigated that pre-aging improves the mechanical properties at retrogation temperature. Komai.k et al [9] says that there is increase in mechanical properties Al7075-SiCw composites. Doel et al [10] concludes that Al7075-Sic increases tensile strength and decreases ductility. Considering the previous studies in this paper an attempt was made to study the mechanical properties of T6 heat treated Al7075-Albite particulate composites.

II. EXPERIMENTAL PROCEDURE

A.Composite preparation

The chemical composition of Al7075 alloy and Albite particulates of diameter 90-150 μm is as shown in the Table 1 and 2.

Table 1: Chemical Composition of Al7075 alloy in 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: Chemical composition of Albite

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

Stir casting method was adopted for the preparation of composite material. The different weight percentages of Albite particulates were chosen from 0wt%, to 10wt% in steps of 2wt%. The Al7075 alloy was melted in an electrical resistance furnace up to 750° C and continuously stirred at 550 rpm. The Albite particulates was preheated at 400° C and added to the melt Al7075 alloy. Finally continuous stirring was done for better wetting between matrix and reinforcement. The T6 Heat treatment was carried out by subjecting to solutionizing temperature at 470° C for 2 hours in muffle furnace followed by quenching in ice and artificial ageing temperature at 120° C for 6 hours.

B. Specimen preparation

The T6 heat treated tensile test specimens were prepared as per ASTM E8-82 standard at room temperature and tested using universal testing machine. Brinell hardness test was conducted according to ASTM-E10-95 standard. The hardness test procedure was carried out as per HB500 tester which is having ball indenter of 10 mm diameter.

Figure 1: Brinell hardness test specimens

III. Results and Discussion

C. Microstructure analysis

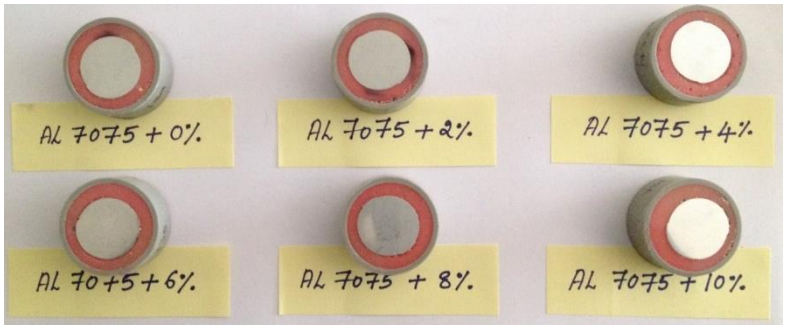
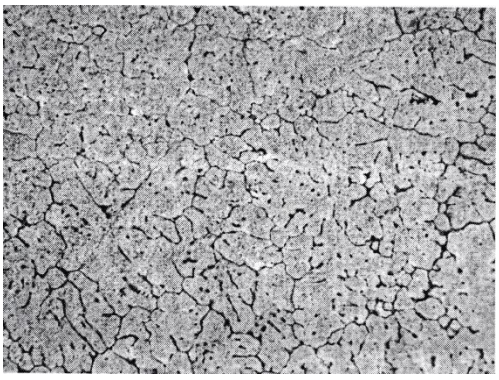
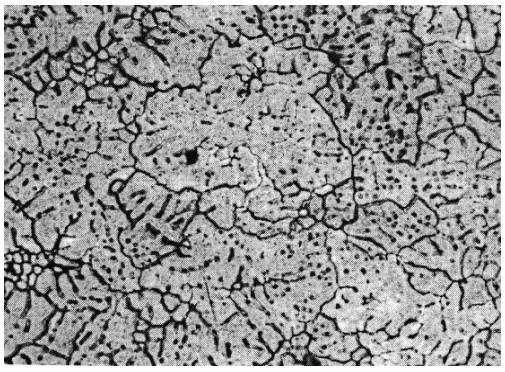
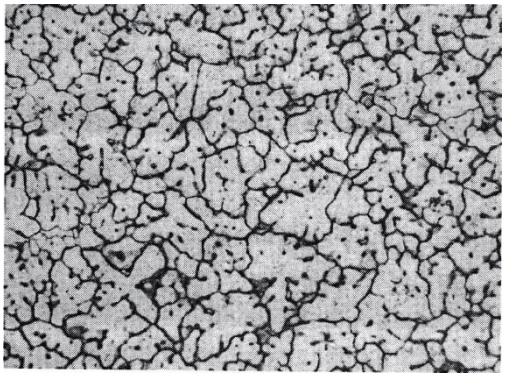
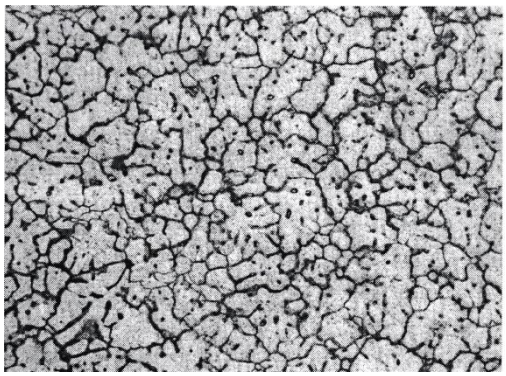


Figure 2: optical Microstructural specimens









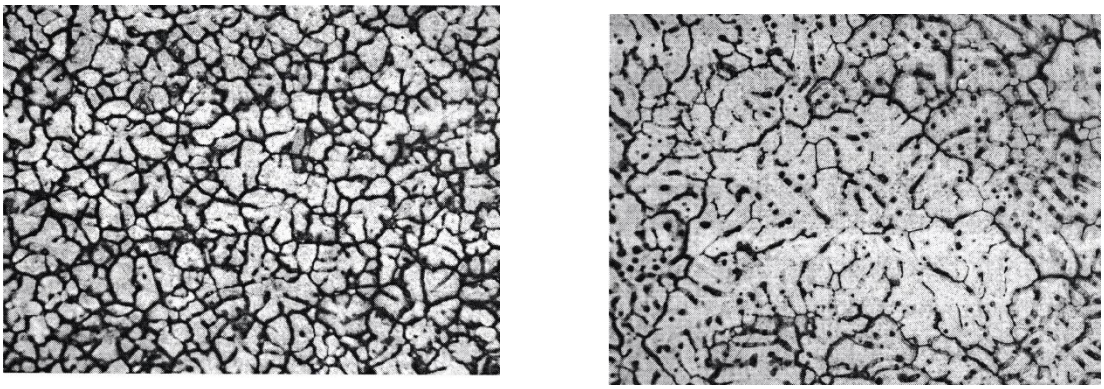


Figure 3: Optical Micrographs of Al7075 alloy, Al7075/2wt%, Al7075/4wt%, Al7075/6wt% Al7075/8wt% and Al7075/10wt% Albite composites at 200X.

The specimens were prepared for the microscopic examination by using standard metallographic procedure etched with killer's agent. The optical micrograph of Al7075-Albite particulates of different weight percentage shows the minimum porosity and clearly indicates the uniform distribution of Albite particulates in the composite.

D. Hardness

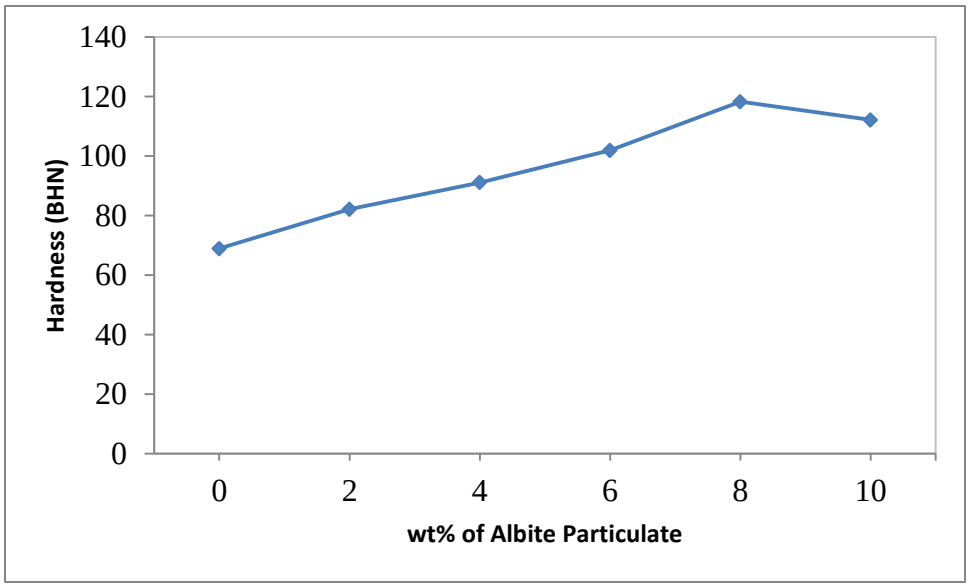


Figure 4: Heat treated Albite wt% on hardness of the composite

The hardness denotes that surface indentation made on the material to check the resistance. From the figure 4 it shows that increase in the Albite particulates in terms of weight percentage in the Al7075 matrix alloy it was found that significant improvement in hardness up to 8wt% and further decreases in the hardness this is due to the poor wettability between reinforcement and matrix. Similar types of results are obtained from various researchers the presence of hard ceramic particles [15, 16].

E.Tensile Strength

Tensile strength results as shown in the figure 5 there is an increase in the ultimate tensile strength of the composite due to the addition of Albite particulates at different weight percentages when ceramic particulates added in to ductile matrix the composite becomes brittle in nature this shows improvement in strength beyond 8wt% there is decrease in strength due to poor bonding between reinforcement and matrix. [17].

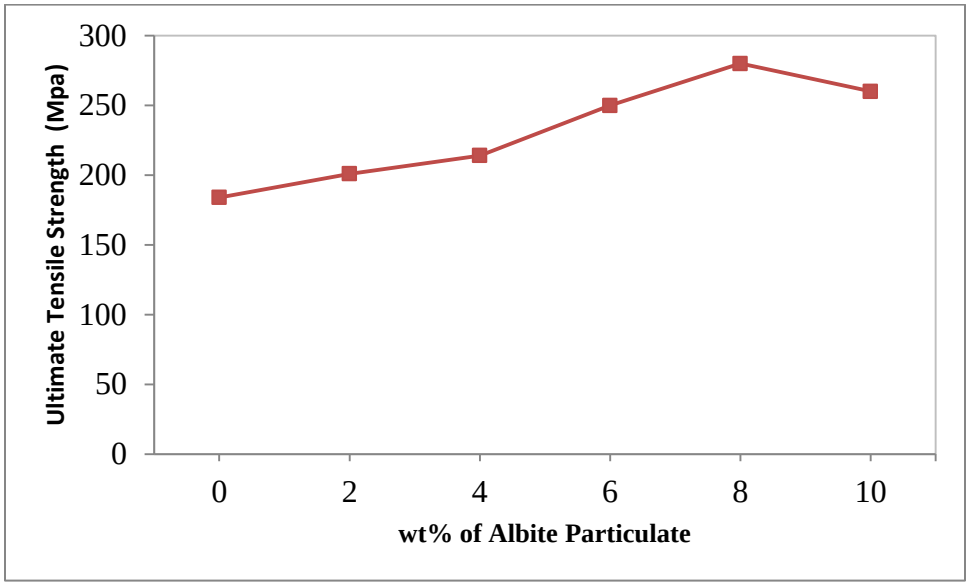


Figure 5: Heat treated Albite wt% on Tensile Test of composite

F.Compressive Strength

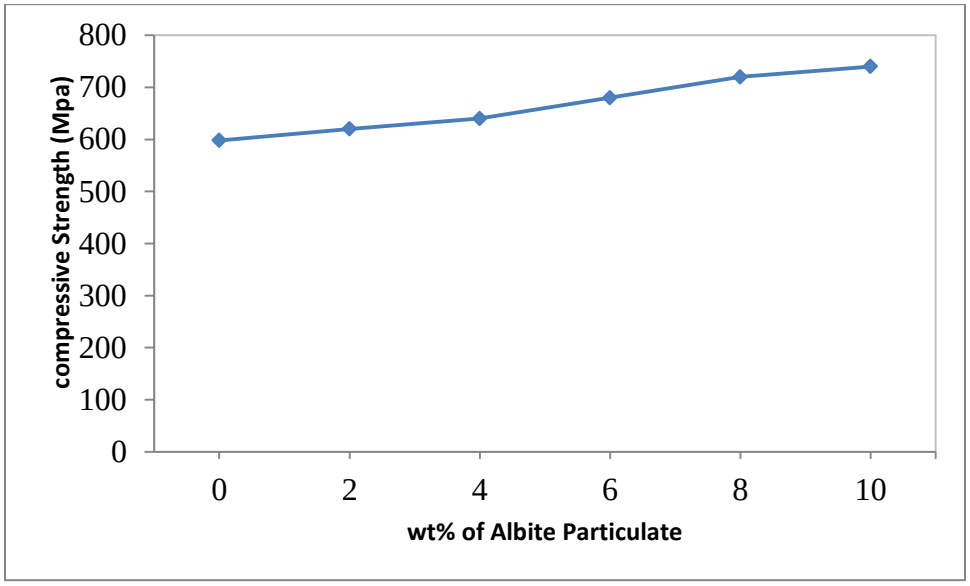


Figure 6: Heat treated Albite wt% on Compressive Strength of composite

Figure 6 shows the addition of Albite particulates in to Al7075 matrix alloy there is increase in compressive strength. This is due to the interface and effective transfer of applied compressive load to the uniformly distributed well bonded reinforcement. [7].

IV. Conclusions

1) Using stir casting technique, Albite particulates are introduced into the Al7075 alloy to prepare composite material was successfully implemented.
2) The microstructural analysis clearly shows that uniform distribution of Albite particulates in the Al7075 alloy.
3) The hardness strength of the Al7075 – Albite particulate composite was increased up to 8wt%, further there was decrease in hardness strength.
4) The ultimate tensile strength was increased by varying weight percentage of Albite particulates into Al7075 matrix alloy. Above 8wt% there was decrease in strength due to poor ductility due to addition of Albite particulates which is highly brittle in nature.
5) Addition of Albite particulates into the Al7075 alloy improves compression strength.

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AUTHORS

First Author – Mr. Batluri Tilak Chandra, M. Tech, Sri Siddhartha Institute of Technology and btilakchandra@gmail.com
Second Author – Dr. Sanjeevamurthy, Ph. D, Sri Siddhartha Institute of Technology and hodmechssit@gmail.com
Third Author – Dr. H. S. Shiva Shankar, Ph. D,Siddaganga Institute of Technologyandhssmed_sit@yahoo.co.in

Correspondence Author – BatluriTilakChandra,Author name, btilakchandra@gmail.com, +91 9449949753.