Effect of T6 heat treatment on Microstructure and Mechanical properties of A356.2 alloy reinforced with RHA composites

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Abstract- The research work mainly deals with the heat treatment process were samples are fabricated by using A356.2 alloy as an Matrix and R.H.A (rice husk ash) Nano particles as reinforcement. The A356.2 composite specimens. are heat treated in a induction furnace at a temp at 300 °C for 30 Min.The specimens were cooled by using different medium (Dry sand ,Oil bath, water Cooling).the micro structure is studied by using optical Microscope. finally the Mechanical properties of the heat treated samples are studied. and results were presented.

Key points:-R.H.A,A356.2 alloy,Tensile strength,Microhardness.

I. INTRODUCTION

Aluminum alloys is most commonly used in automobile industries like automobile, aircraft industries etc.As it has excellent thermal conductivity, better corrosion resistance, less density. Hence an attempt is made to go for A356.2 alloy reinforced with Nano R.H.A (Rice husk ash) particles using stir casting technique. As stir Cast components as excellent mechanical properties fine microstructure and less porosity compare to the other casting process .Gomashchi et al[1]. The industrial importance of aluminum alloys containing silicon as the major alloying element results from their excellent cast ability, good corrosion resistance, and the fact that they can be machined and welded Mulazimoglu et al [2]. the Al Alloy forms a simple eutectic at 577°C and 12.6% Si. It can also be seen that aluminum can dissolve a maximum of 1.62% Si into solid solution. Depending on the amount of silicon, the Al-Si casting alloys are divided into three groups, S.Shivkumar et al [3]. hypoeutectic alloys ,eutectic alloys, and hypereutectic alloys, depending upto the Silicon percentage alloys having silicon percentage between 5% and 10% are called as hypoeutectic alloys, alloys having silicon percentage between 11%-13% are known as eutectic alloys and the alloys with silicon percentage between 14% and 20%.are known as hypereutectic alloys. Generally hypoeutectic alloys have excellent corrosion resistance properties and cast ability as a result it is most widely used in aircraft and automobile industries[4-8].Ezatpour et al [9] the Al-Al2O3 is fabricated by using the stir casting technique and the heat treatment of the samples were performed at various temperatures and the results showed that improved micro hardness, excellent microstructure . Sayed et al [10] showed that increase percentage of Al2O3 increases the tensile strength and yield strength of the composite .Mohsenhagizamani et al [11] proved that the strength and hardness increased by increasing the reinforcement content decreases the yield strength and increases the compressive and tensile strength of the specimens, also the hardness of the specimens is found to be increased when reinforce up to 1% of Al2O3 and found to be decreased up on still increasing the Al2O3 content. To over come these challenges by adding nano particles by stir with Squeeze casting procedure is embraced the literature discuses the mechanical properties in terms of microstructure, hardness and tensile strength. the main aim to the present work is to study the microstructure and mechanical properties of T6 heat treated A356.2 samples reinforced with the R.H.A Nano composites.

II. EXPERIMENTATION PROCEDURE

2.1 *Materials and manufacturing process:*

The reinforcement alloy used in the present study is A356.2 which has the chemical composition in terms of weight percentage listed in the table 1.The matrix Rice husk ash having size of 10μm which is used in the present study also has chemical composition in terms of weight percentage is listed in the table 2.

Constituent	Si	Fe	Cu	Mn	Mg	Zn	Ni	Ti
%	6.5-7.5	0.15	0.03	0.10	0.4	0.07	0.05	0.1

Table 1: Chemical composition of A356.2 Al alloy

Constituent	SIO_2	Graphite	CaO	MgO	K_2O	Fe_2O_3
%	90.23	4.77	1.58	0.53	0.39	0.21

Table 2: Chemical composition of R.H.A

2.2 Optical Emission Spectroscopy:

Its is a chemical micro analysis technique used to find the chemical composition of A356.2 alloy. The test is performed for the conformation of A356.2 alloy in order to perform the research work.fig 1 show the Optical Emission Spectroscopy

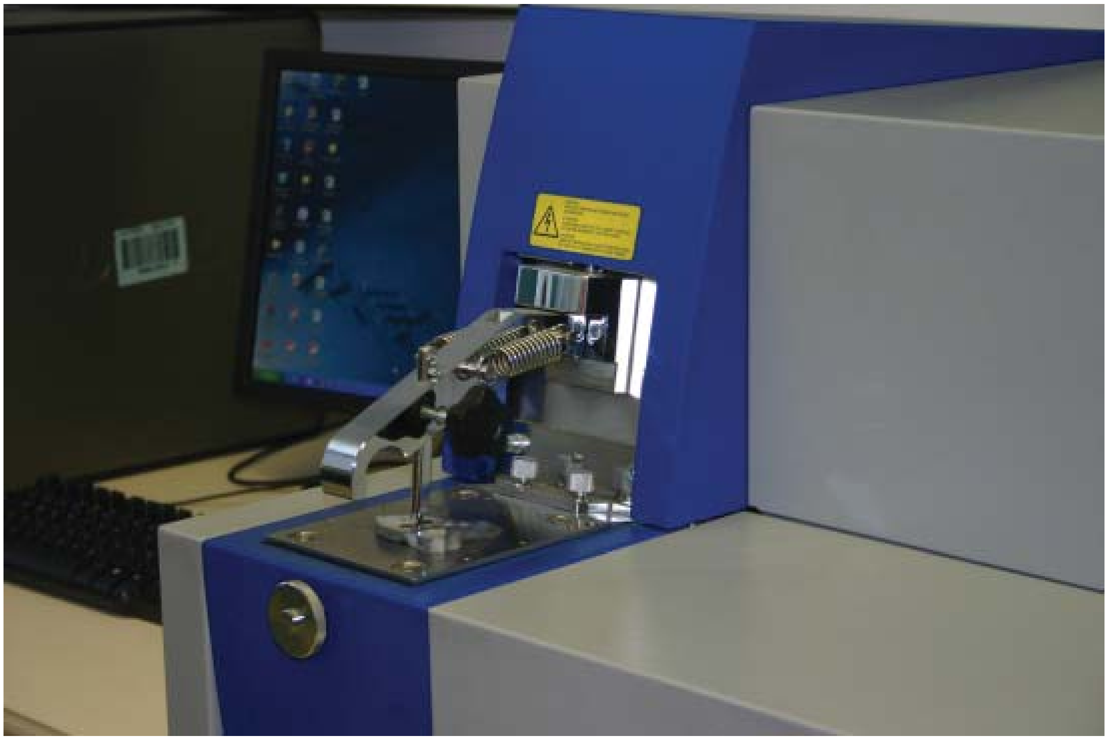

Fig 1:Optical Emission Spectroscopy

2.3 Specimen preparation:

The matrix materials for the preparation of samples is A356.2 and reinforcement as rice husk ash particles. Initially the reinforcement particles was preheated in a crucibles for 30 min to remove the moisture content. The matrix material A356.2 alloy which is used in the preparation of samples is kept in graphite crucible and then heated up to 780^{o}C till the alloy gets melted. Small amounts of Magnesium is added and then the R.H.A particles was Fling out. The Matrix materials is heated in a electric induction furnace which consist of a mechanical stirrer. After melting the matrix the stirring is performed during stirring the preheated R.H.A particles are added along with the small amounts of magnesium. And stirring is performed by using the mechanical stirrer. The stirrer is made up to stainless steel blades a motor is mounted up on it. stirring is done at a speed of 500-700 r.p.m. The stirrer speed can be controlled by the regulator mounted on the motor. the stirring is done for 10 minutes .After completion of stirring the Mixture is poured in the mould to which is also preheated in order to remove obtain the direction solidification. The cast MMC were examined in a non destructive testing for blow holes.

Fig 2: Electric Furnace with Mechanical Stirrer

Fig 3:Final Cast composite blank

III. RESULT AND DISCUSSION

3.1. Microstructure observations on the T6 heat treated samples:

The following fig(3-6) shows the micro structure of heat treated and un heat treated MMC.The white region is due to the present of matrix and the black region is due to presence of eutectic silicon

Fig 4:Microscopic Image Of un-heat treated Sample

Fig 5:Microscopic Image Of Sample cooled in Oil bath

Fig 6:Microscopic Image Of Sample cooled in water bath

Fig 7:Microscopic Image Of Sample cooled in Sand

3.2 Hardness:

The hardness test for the specimen is done by using the Vickers's hardness testing as shown in fig 7 machine. the Vickers's hardness test is also called as the micro hardness testing. The advantages of the Vickers hardness test are that extremely accurate readings can be taken, and just one type of indenter is used for all types of metals and surface treatments. The Vickers method is capable of testing the softest and hardest of materials, under varying loads. With modern advances in technology, PCs and software development, it is now possible to offer automatic indentation measurement. The indentation is done on the surface of the specimen by using the diamond tool. The indentation is done by maintaining load at 150 kgs. Here three trails were conducted on the samples at different places to get the hardness number precisely and their average is considered.

Fig 8: Vickers Hardness Testing machine   Fig 9: Specimens with Indentation

Table 3: Summary of Hardness of treated and untreated A356.2/R.H.A samples:

Heat treatment process	Trail 1	Trial 2	Trial 3	Average
Untreated	63.81	59.2	61.5	61.5
Oil cooled	81.39	83.45	80.13	81.65
Water cooled	76.84	74.69	78.43	76.65
Sand Cooled	71.26	72.57	72.48	72.10

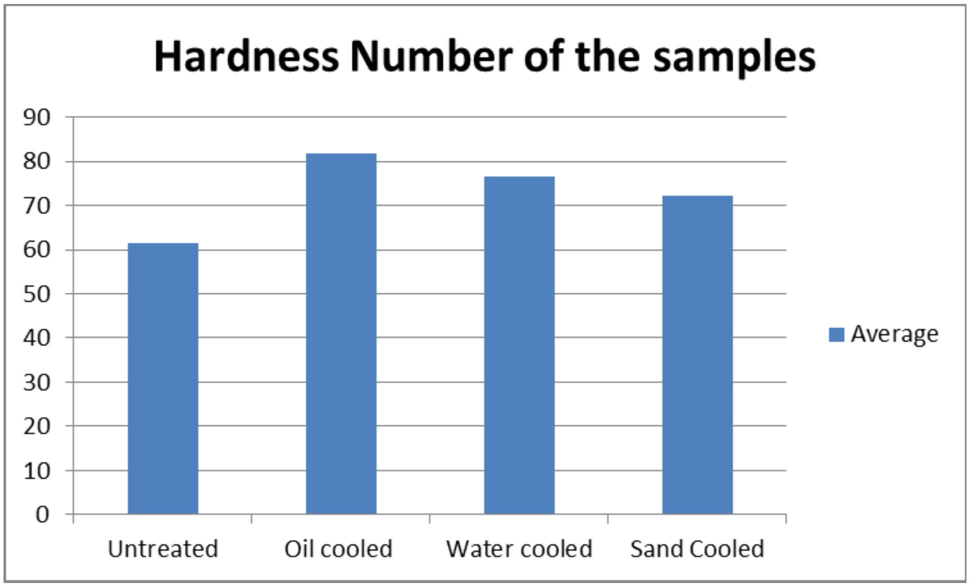

Fig 10: Hardness results of untreated and heat treated Samples

3.3 Tensile Test:

The tensile test of the specimens is performed on the universal testing machine. The tensile properties, such as, tensile strength, yield strength and % elongation are represented in Table 3.2. from the below table it is clear that samples which had undergone heat treatment exhibit high tensile strength compare to to the samples which are untreated.

Table 4: Summary of Tensile Strength of treated and untreated A356.2/R.H.A samples:

SL.No	Heat treatment process	Yield stress(MPa)	Ultimate Tensile strength(MPa)	%Elongation
1	Untreated	135.67	147.43	3.86
2	Oil cooled	148	169.57	2.72
3	Water cooled	140	147.43	3.86
4	Sand cooled	138	140	2.72

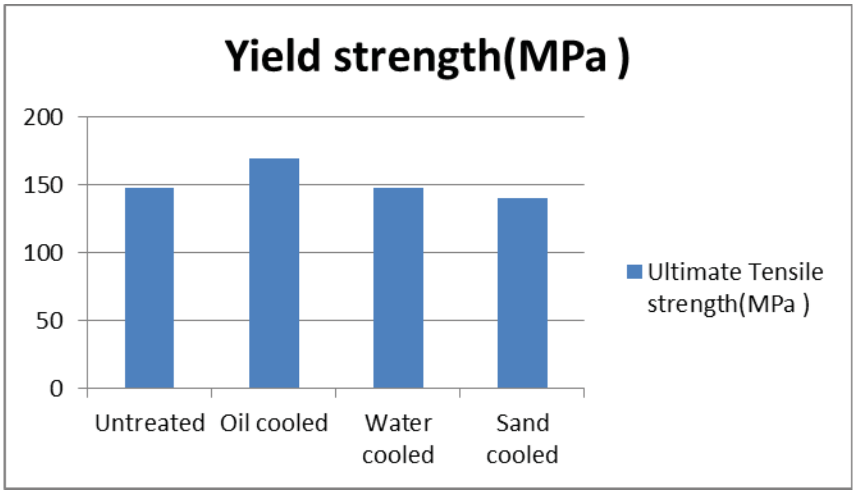

Fig 11: Graph showing Yield stress of untreated and heat treated Sample

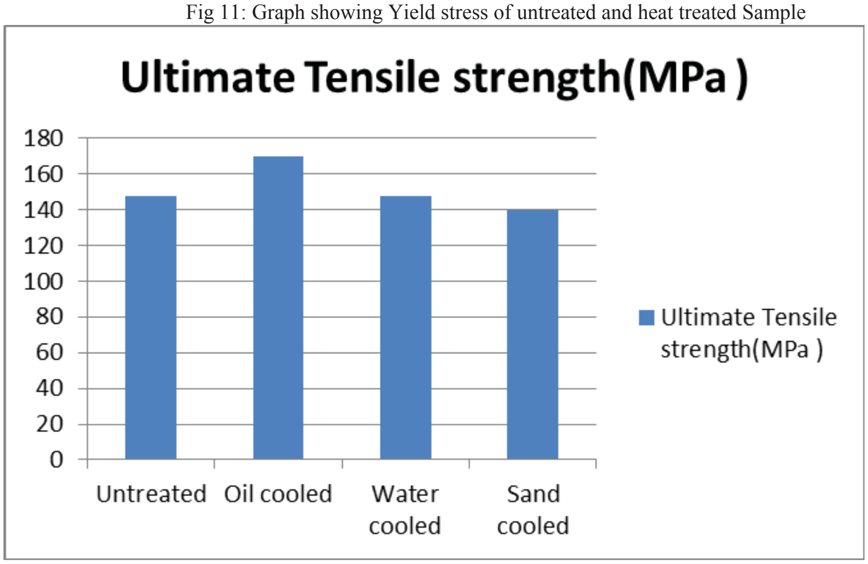

Fig 12: Graph showing Yield stress of untreated and heat treated Samples

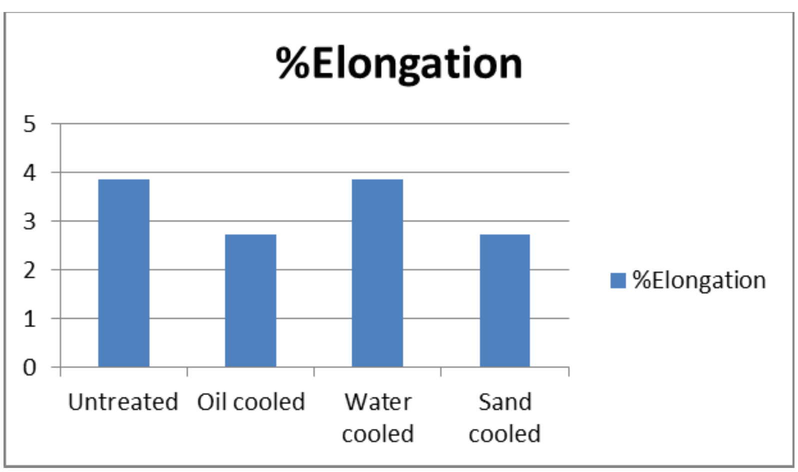

Fig 13: Graph showing % Elongation of untreated and heat treated Samples

IV. CONCLUSIONS

From the above results we found that

1. The hardness of the sample which is treated with the oil bath has increase hardness because the heat dissipation capacity in oil bath is lesser and due to the formation of more amount of eutectic silicon in the structure .
2. The tensile strength of the specimen is increased for the samples which are heat treated under water bath
3. The hardness of the samples is found to be decrease in the specimens which are cooled in sand because of silicon content present in sand. As the silicon content in the sand increases the heat dissipation capacity of the sample increases hence it restricts the formations of new grains.

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