COMPARATIVE STUDY OF TENSILE PROPERTIES OF FORGED HYBRID ALLOYS OF AA6061/SIC/GR/4%& 6%, 8% & 10% FOR VARIES COMPOSITION RATIO OF PARTICLES

S.N. Nataraju[1], A.S. Ravindran[2]

[1]Asst.prof. Department of Mechanical Engineering, SJC Institute of Technology, chickballapura, Bangalore
[2]Prof. Principal, PNS College of Engineering, Bangalore

Abstract

Hybrid materials are important engineering materials due to their outstanding mechanical properties. AA6061 and silicon carbide (SiC) particles and Graphite (Gr) particles were synthesized used stir casting method, which can be used in aircraft and automobile industries to improve the strength and reduce the weight of the components. The major physical parameters like composition ratio, total particle content in%, particle size combination are playing an important role in deciding the mechanical properties. Hot forging involving the shaping of metal to improve strength. Tensile tests were conducted on standard specimens machined from the hot forged sections. The tension test is the most common test for determining the mechanical behavior of materials. The results show that, the reinforcement of the metal matrix with SiC and graphite particulates up to a volume fraction of 10%

Keywords: AA-*Aluminium alloys, SiC-silicon carbide, Gr-Graphite, AMC-Aluminium matrix composite.*

----------***----------

INTRODUCTION

AMC (Aluminium matrix composite) are find application in aerospace and automobile industries because of their properties. The other constituent serves as reinforcements [1-2]. The reinforcement could be in the form of continuous/discontinuous fibers, in addition to four basic types of AMCs [3]. The variant of AMCs known as hybrid. The properties of hybrid AMCs can be tailored by varying the nature of constituents and their weight fraction. There are several companies modified the processes to manufacture the components in commercial scale [4]. The variety of manufacturing processes available for discontinuous metal matrix composites, the current method generally used is stir casting because of its advantages in its simplicity, flexibility and applicability to large quantity production [5-7] .The variables such as holding temperature, size, stirring speed, position of the impeller in the melt are among the important factors to be considered and also speed of solidification of matrix to get better distribution of particles in the production of cast metal matrix composites as these have an impact on mechanical properties.Hybrid composite that is aluminium base metal reinforced with SiC and Al_2O_3 particles have been fabricated by stir casting method. [8-12]

EXPERIMENTAL STUDY

Material

Now a day's Aluminiun alloys is the commonly used material. In the present study the Aluminium alloy6061 is used as the matrix material. In order to increase the strength, Silicon carbide (SiC) and Graphite (Gr) are added as the reinforcement in a proper composition. The materials are purchased and cut in to small pieces as per the requirements for the experiments.

Table- 1. The nominal chemical composition of AA6061 alloy is given in

Elements	**Cu**	**Mg**	**Si**	**Fe**	**Mn**	**Ti**	**Zn**	**Cr**	**Al**
Percentage	**0.259**	**0.827**	**0.461**	**0.358**	**0.050**	**0.120**	**0.006**	**0.179**	Balance

The table-2 below shows the properties of the reinforcement materials.

Reinforcement type	Density (Mg/m^3)	Young's modulus(Gpa)	Co-efficient of thermal Expansion(µm/mk)
AA6061	2.69	72	23.6
SiC	3.21	469	4.3-4.6
Graphite(Gr)	2.25	11.5	1.2-8.2

All the experiments are carried out at M.S.R.I.T Research Centre to produce stir cast hybrid alloy. Some of the figures are

Fig-1. Electric Resistance Furnace

Fig-2. Preheating Furnace

Fig-3. Mould Used For Casting And Pouring

After stir casting the stir cast hybrid AMMC specimens are forged and prepare test specimens carefully based on the ASTM standards.

RESULTS AND DISCUSSION

TENSION TEST

The tension test is the most common test for determining the mechanical properties of materials such as strength, ductility and toughness. The introduction of reinforcement improves the strength of hybrid alloy and decreases its plasticity. The specimens were prepared according to ASTM -E8 standard. A standard tensile Specimen is shown in Figure

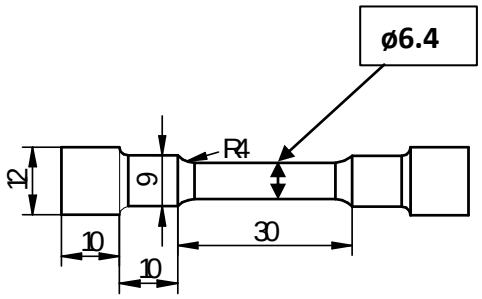
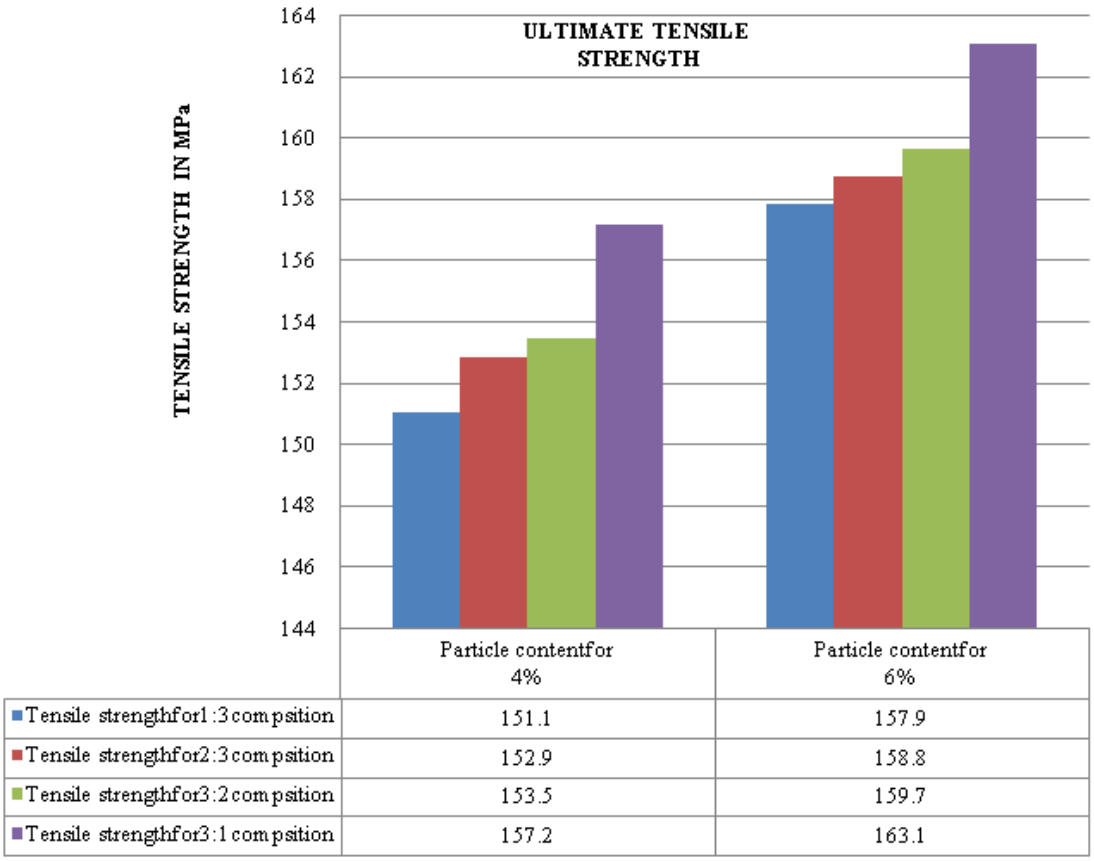


Fig 4. Ultimate Tensile Strength of Forged Hybrid Alloy.

The measured values of ultimate tensile strength for 8 specimens (8 experiments) and tabulated as shown in table.

Table-1: For Tensile Strength (Forged Hybrid Alloy For 4%And 6%)

Experiment No.	processes parameters level				Tensile strength (MPa)
	Composition ratio SiC :Gr	Total Particle content in%	Silicon carbide Particle size in(micron)	graphite Particle size in(micron)	
1	1:3	4	25	25	151.1
2	2:3	4	53	53	152.9
3	3:2	4	75	75	153.5
4	3:1	4	103	103	157.2
5	1:3	6	53	75	157.9
6	2:3	6	25	103	158.8
7	3:2	6	103	25	159.7
8	3:1	6	75	53	163.1



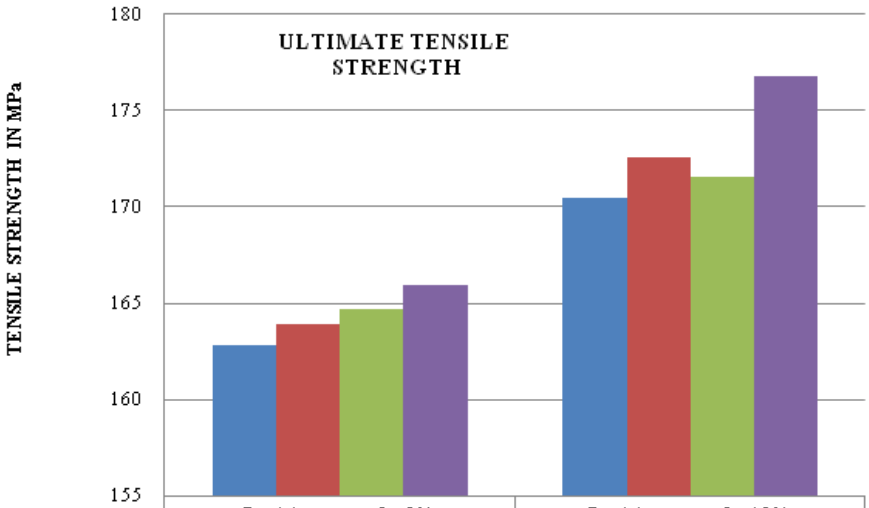
Graph No1

Ultimate tensile strength of forged hybrid alloy.

The measured values of ultimate tensile strength for another 8specimens (8experiments) and tabulated as shown in table.

Table2: For tensile strength (forged hybrid alloy for 8% & 10%)

Experiment No.	processes parameters level				Tensile strength (MPa)
	Composition ratio SiC :Gr	Total Particle content in%	Silicon carbide Particle size in(micron)	graphite Particle size in(micron)	
1	1:3	8	25	25	162.8
2	2:3	8	53	53	163.9
3	3:2	8	75	75	164.7
4	3:1	8	103	103	165.9
5	1:3	10	53	75	170.5
6	2:3	10	25	103	172.6
7	3:2	10	103	25	171.6
8	3:1	10	75	53	176.8



	Particle content for 8%	Particle content for 10%
Tensile strength for 1:3 composition	162.8	170.5
Tensile strength for 2:3 composition	163.9	172.6
Tensile strength for 3:2 composition	164.7	171.6
Tensile strength for 3:1 composition	165.9	176.8

Graph No-2

CONCLUSION

- Total weight fraction % of reinforcement is the most significant factor in determining the UTS of hybrid composite.
- The particle composition ratio SiC: Gr is the most significant factor in determining the strength of hybrid composite.
- Experimental result showsUTS for 3:1 for particle content of 4% &6% is 157.2 MPa &163.1MPa which increased by 5.9 MPa and also observed that UTS for 3:1 for particle content of 8% &10 % is 165.9 MPa&176.8MPa which increased by 10.9Mpa.
- Weconclude that by comparing as % reinforcement increases tensile strengthincreases by 45.87% by reducing the porosity by thermo mechanical treatment.

REFERENCES

[1] A.S.M Hand book, vol.21 composites, Material Park, Ohio (2002).

[2] Surappa M K, Rohatgi P K 1981 Preparation and properties of aluminium alloy ceramic particle composites. J. Mater. Sci. 16: 983–9933)

[3] Aluminium matrix composites: Challenges and Opportunities M K Surappa Sadhana Vol. 28, Parts 1 & 2, February/April 2003, pp. 319–334

[4] Development of Aluminium Based Silicon Carbide Particulate Journal of Minerals & Materials Characterization & Engineering Manoj Singla1, D. Deepak Dwivedi, Lakhvir Singh, Vikas Chawla, Vol. 8, No.6, pp 455-467, 2009

[5] Hashim j., Looney L. and Hashmi M.S.J., Metal matrix composites: production by the stir casting method, J.Master.process.technol, 123 (2002) 251-257.

[6] Casting of SiC Reinforced Metal Matrix Composites W. Zhou, Z.M. Xu / Journal of Materials Processing Technology 63 (1997) 358-363 , 358

[7] Studies on Al6061-SiC and Al7075-Al2O3 Metal Matrix Composites by G. B. Veeresh Kumar1*, C. S. P. Rao, N. Selvaraj, M. S. Bhagyashekar Journal of Minerals & Materials Characterization & Engineering, Vol. 9, No.1, pp.43-55, 2010

[8] Hashim j., Looney L. and Hashmi M.S.J., Metal matrix composites: production by the stir casting method, J.Master.process.technol. 92-93(199) 1-7

[9] Brabazon D.,Browne D.J.,Carr A.j., Mechanical stir casting of aluminium alloys from the Mushy state :process, microstructure and mechanical properties, Master.Sci .Engg.,A326 (2002) 370-381.

[10] D. Ramesh, R. P. Swamy and T. K. Chandrasekhar Effect of weight percentage on mechanical properties of frit particulate reinforced Al6061 composite vol. 5, no. 1, January 2010 issn 1819-6608 ARPN Journal of Engineering and Applied Sciences ©2006-2010 Asian Research Publishing Network (ARPN).

[11] Rohatgi P.K., "Material Matrix composite", DefenceSci .J. 43(1993) 323-343.

[12] Hashim, J., Looney L, and Hashmi M. S.J., "The wettability of SiC Particles by Molten aluminium alloy",J. Material Process Techno., 119 (2001) 329 - 335

ACKNOWLEDGEMENTS

I am thankful to **Dr.R.Chandrashekar**, ProfessorAcharaya Institute of Technology and also thankful to **Dr.P.G.Mukanda**. Professor andMetallurgist IIT Karagpur help me in carrying out R&D work. Iam thankful to MSRIT research Centre to carry out my experimentation work and also to Raghavendra spectro metallurgical laboratory peenya industrial area Bangalore fortesting.