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Improvement of Mechanical Properties of Aluminium 6061 based Metal Matrix Composite with Addition of Granite Particulate

Koli Gajanan Chandrashekhar, D.P .Girish, Katkar Ajit Ashok , Raja Yateesh Yadav

Abstract*: *Aluminium is considered as one of the material of future. Aluminium based metal matrix comes with a fascinating set of material properties which combines strength with less weight. Due to this these Al-base metal matrix finds their application in aerospace and automotive sector. Many types of reinforcements are done with Aluminium since last many years to check the improvement in its performance. Therefore many reinforcements are found suitable to form the composite which finds variety of novel applications. In this present investigation MMCs are fabricated with Al 6061 alloy and reinforced with granite particulate of 2-3 microns size in different compositions are used to see their effect on the mechanical properties of Al6061 alloy. The vortex method of stir casting is used to from the metal matrix wherein reinforcements are forced into the vortex created by the molten metal by means of mechanical stirrer. The castings prepared by above method are machined with turning operation on lathe. Improvement in Ultimate tensile strength, Yield strength, % Elongation and Hardness are found with increasing the percentage of granite particulates..

Keywords* : *Aluminium 6061, Composite, Mechanical Properties, Hardness

I. INTRODUCTION AND LITERATURE REVIEW

Conventional materials have limitations to their use in aerospace and advanced automotive applications because of limited set of properties which they posses. Researchers around the world are investigation many materials to suit for different applications. Composites are one group of material which researchers are focusing on recently. Since composite comes with enhanced mechanical, chemical and thermal properties they are replacing conventional materials at many applications. Aluminium based metal matrix comes with a fascinating set of material properties which combines high strength with less weight.

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***** Correspondence Author
Koli Gajanan Chandrashekhar*, Assistant Professor, Department of Mechanical Engineering, Sanjeevan Engineering & Technology Institute, Panhala Kolhapur, Maharashtra India
Dr. D.P .Girish, Professor, Department of Mechanical Engineering, Government Engineering College, Ramanagar, Karnataka India
Katkar Ajit Ashok, Assistant Professor, Department of Mechanical Engineering, Sanjeevan Engineering & Technology Institute, Panhala Kolhapur, Maharashtra India
Dr. Raja Yateesh Yadav Professor, Department of Mechanical Engineering, Shri Madhwa Vadiraja Insitute of Technology & Management, Bantakal- 574115, Udupi, India

Due to this these Al-base metal matrix finds their application in aerospace and automotive sector. Many types of reinforcements are done with Aluminium since last many years to check the improvement in its performance. Therefore many reinforcements are found suitable to form the composite which finds variety of novel applications. Al6061 alloy is one the Al- family alloy which has properties which suits for formation of metal matrix as base material.Kumar et al.[1] conducted experiments on Al6061-SiC and Al7075-Al2O3 to make analysis with respect to density of composites and hardness. They found increase in the density and hardness of the composites compared to the base matrix. Swamy et al.[2] found increase in Hardness of the composite with the increase of reinforcing particulate content while investigating Al6061-Tungsten carbide metal matrix composites. Ramani et al. [3] studied heat treatment aspects of ceramic reinforced aluminum matrix composites. They outlined different heat treatment procedures for aluminum based metal matrix composites with emphasis on the T6 tempers. Shaikshavali et al.[4] found that Al6061-10%, Al2O3 MMC material has good ultimate tensile strength property when compared to other ceramic reinforced MMCs.

II. METHODOLOGY AND EXPERIMENTAL DETAILS

The MMCs are fabricated with Al 6061 alloy and 3µm size granite particulates (GP) (reinforcement). Table 2.1 shows the detailed material composition.

Table 2.1 Details of Material Composition

Sample	%	
	Al6061	Granite
1	100%	0%
2	98%	2%
3	96%	4%
4	94%	6%
5	92%	8%

Tensile tests are as per ASTM E8 standards with samples of diameter 8.9 mm and gauge length 76 mm. The cast complements are machined for above specifications. Brinell hardness test is done as per standard procedure.

III. RESULT AND DISCUSSIONS

The results are discuused in following sub sections

3.1.1 Variations in Ultimate Tensile Strength - σ_{ts} of Al 6061 alloy

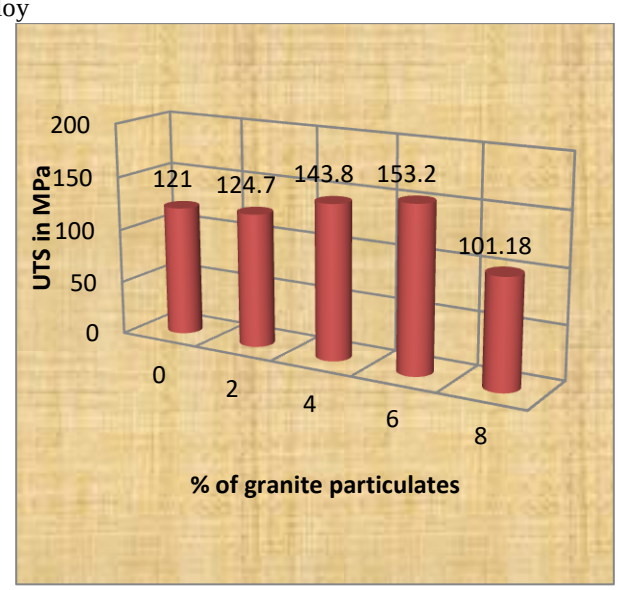

Figure 3.1 Variations in Ultimate Tensile Strength

With respect to above graph of σ_{ts} an average rise of 2.96 % is found in σ_{ts} with increases in GP upto 2%. This rise is more significant with increase in GP from 2 to 4%. Here rise in σ_{ts} is 13.20%. From 4 to 6% of GP very small changes in σ_{ts} found i.e. of only 4.89 % rise. But when GP is between 6 to 8% fall in σ_{ts} is found about 49.43 %. This fall is recorded because of crowding of GP in base matrix.

3.1.2 Variations in Yield Strength -YS of Al 6061 alloy

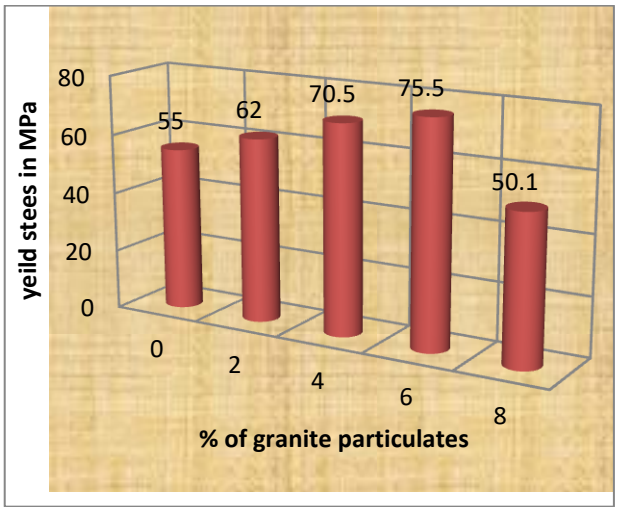

Fig 3.2 Variations in Yield Strength

With respect to above graph of YS an average rise of 12 % is found in YS with increases in GP up to 2%. This rise is more significant with increase in GP from 2 to 4%. Here rise in YS is 14.28 %. From 4 to 6% of GP very moderate changes in YS found i.e. of 9.89 % rise. But when GP is between 6 to 8% drastic fall in YS is found about 55.23 %. This fall is recorded again because of crowding of GP in base matrix.

3.1.3 Variation in % Elongation of Al 6061 alloy

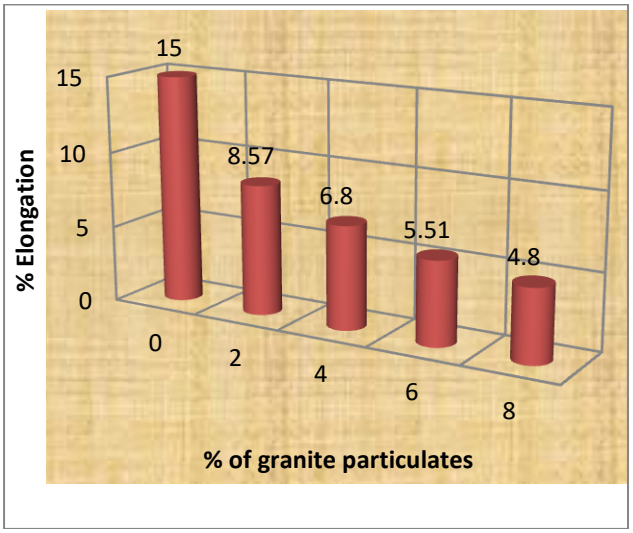

Figure 3.3 variation of % Elongation

With respect to above graph of variation in % Elongation it is observed that % Elongation comes down upto 55 % with changes in GP from 0% to 2%. It indicates that GP % has a significant effect on % Elongation initially. Because further increase in GP from 2% to 4% a fall of only 16% is found in % Elongation. Same trend is visible with further increase in GP from 4% to 6% of here on % Elongation drops up to 19.41%. % Elongation decreases up to 11.5% when GP increases from 6 to 8%. This decrease is basically found due to hardness effect imparted by GP.

3.1.4 Variation in Hardness-BHN of Al 6061 alloy

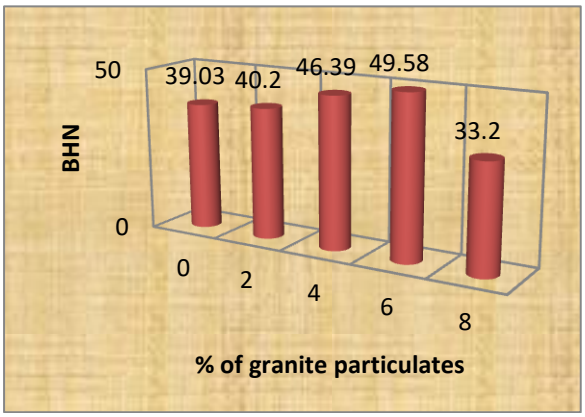

Fig 3.4 Variation in Hardness (BHN)

With respect to above graph of BHN an average rise of 3.5 % is found in BHN with increases in GP up to 2%. This rise is more significant with increase in GP from 2 to 4%. Here rise in BHN is 12.34 %. From 4 to 6% of GP very moderate changes in BHN found i.e. of 7.39 % rise. But when GP is between 6 to 8% drastic fall in BHN is found about 45.13 %. This fall is recorded again because of crowding of GP in base matrix.

IV. CONCLUSION

Following are some of important features of above study

Upto 0-2 %,2-4% and 4-6% of GP reinforcements all i.e Ultimate tensile strength ,yield strength and hardness incrseses but they show sudden fall with 6- 8 % of GP.

This is found due to crowding of GP in base matrix. % Elongation drops maximum up to 19.41%. with increase in GP upto 8% due to hardness effect imparted by GP.

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AUTHORS PROFILE

Koli Gajanan Chandrashekhar working as an assistant professor in Sanjeevan Engineering Technological University, Panhala. I have 13 years teaching and 02 years industrial experience. Also I am Pursuing Ph.D. in Mechanical Engineering from Visvesvaraya Technological University, Belagavi in the Area of Composite Material.

Dr. Girish D.P., Professor at Government Engineering College, Ramanagara, Karnataka My area of research is Composite Material. I am having Teaching Experience of 25 years and published 29 Research papers. Also I presented 11 International and 07 National conference Papers. Under my guidance 09 students have been awarded Ph.D.

Katkar Ajit Ashok currently working as an assistant professor in Sanjeevan Engineering Technological University, Panhala. I have Teaching Experience of 11 yrs and Industrial Experience of 05 yrs. Also I am Pursuing Ph.D. in Mechanical Engineering from Visvesvaraya Technological University, Belagavi in the area of composite material.

Dr. Raja Yateesh Yadav currently working as an Assistant Professor (Senior) in Department of Mechanical Engineering at Shri Madhwa Vadiraja Institute of Technology & Management, Vishwothama Nagar, Bantakal. I have completed Ph.D. in mechanical Engineering.I have published 05 international level journal papers. Also I have 10 years teaching experience.