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Effect of Granite particulate on Tensile Properties & Hardness of Aluminium 6061 based Metal Matrix Composite

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Abstract

Aluminum 6061 alloys have been proposed for extensive use in automotive engine applications and there have been discrete cases of experimental implementation. In order to enhance the usability of this material, it has been investigated in composite forms with various ceramic reinforcements. Viability of the different constituents depends on the compatibility of their physical and chemical properties.

In this present investigation efforts are made to study the mechanical properties of Al6061 alloy reinforced with granite particulate of 2-3 microns size in different compositions. The vortex method of stir casting was employed, in which the reinforcements were introduced into the vortex created by the molten metal by means of mechanical stirrer. Castings were machined to the ASTM standards on a highly sophisticated lathe. An improved mechanical properties are occurs on reinforced compared to unreinforced Metal Matrix Composites (MMCs).

Key Words: *Metal Matrix composite, Aluminium 6061, Granite particulates, gravity die Casting.*

1 INTRODUCTION

Composite materials have successfully substituted the traditional materials in several light weight and high strength applications. The reasons why composites are selected for such applications are mainly their high strength-to-weight ratio, high tensile strength at elevated temperatures, high creep resistance and high toughness. Typically, in a composite, the reinforcing materials are strong with low densities while the matrix is usually a ductile or tough material. If the composite is designed and fabricated correctly it combines the strength of the reinforcement with the toughness of the matrix to achieve a combination of desirable properties not available in any single conventional material. The strength of the composites depends primarily on the amount, arrangement and type of reinforcement in the resin.

It is possible to develop new material with a unique combination of properties previously unattainable with conventional materials. This ability to engineering materials with specific properties for specific applications represents a great potential advantage of composites. It is also possible to selectively reinforce particular areas of components, thus providing development of materials properties only in an area, which is truly necessary.

2. OBJECTIVES OF PRESENT WORK

In the present investigation, a study had been conducted to evaluate the various properties such as tensile and hardness of aluminium 6061alloy with granite particulate.

The equipment has been planned as follows:

- Production of composite casting of different dimension by liquid metallurgy process.
- Preparation of specimen of required dimensions for various tests
- The microstructure observation to evaluate the quality of castings.
- Different tests are conducted to evaluate the hardness property and various tensile properties like UTS, YS and ductility.

3. EXPERIMENTAL DETAILS

3.1 Material selection

The Al 6061 alloy (matrix material), 3µm size granite particles (reinforcement) are used for fabrication of MMCs.

3.2 Composite preparation

The dies are prepared by spraying the mold cavity with lubricant. The lubricant both helps control the temperature of the die and it also assists in the removal of the casting. The dies are then closed and molten metal is injected into the dies under high pressure; between 10 and 175 Mpa (1,500 and 25,400 psi). Once the mold cavity is filled, the pressure is maintained until the casting solidifies.

Table 3.1 shows the different compositions considered for casting of selected material

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

3.3 Tensile test

Tensile tests were conducted at room temperature using universal testing machine (UTM) in accordance with ASTM E8. The tensile specimens of diameter 8.9 mm and gauge length 76 mm were machined from the cast composites with the gauge length of the specimen parallel to the longitudinal axis of the castings.

3.4 Hardness test

Brinell hardness is determined by forcing a hard steel or carbide sphere of a specified diameter under a specified load into the surface of a material and measuring the diameter of the indentation left after the test. The Brinell hardness number, or simply the Brinell number, is obtained by dividing the load used, in kilograms, by the actual surface area of the indentation, in square millimeters. The result is a pressure measurement, but the units are rarely stated.

4. RESULTS AND DISCUSSION

4.1 Tensile properties

The results of the mechanical tests such as ultimate tensile strength, yield strength, ductility and hardness of as cast Al6061 MMCs are given in the Figure 4.1, Figure 4.2, Figure 4.3 and Figure 4.4 respectively.

4.1.1 Effect of Granite particulate on UTS of Al 6061 alloy

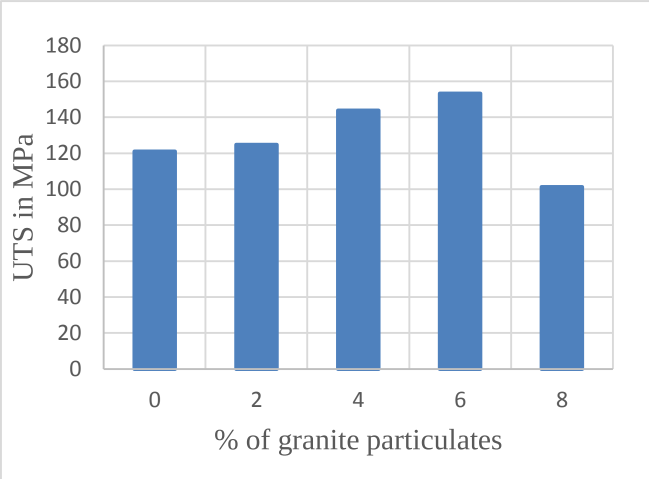

Figure 4.1 Variation of UTS in as cast condition

Figure 4.1 shows the variation of UTS for different composition of composites. From this graph we observe that, UTS increases, as the percentage of granite particulates is increases in base matrix. From 0% to 2% granite particulates increase in the base matrix will increase UTS about 2.96%. Further increase in 2% to 4% granite particulates in base matrix will increases the UTS in average about 13.28%. For increase in reinforcement from 4% to 6% of granite particulates in the base matrix will increase UTS about 4.89%, due to uniform distribution of granite particulate in base matrix. Further increase in 6% to 8% granite particulates in base matrix will decreases the UTS about 49.43%, due to cluster of granite particulate in base matrix.

4.1.2 Effect of Granite particulate on yield strength of Al 6061 alloy

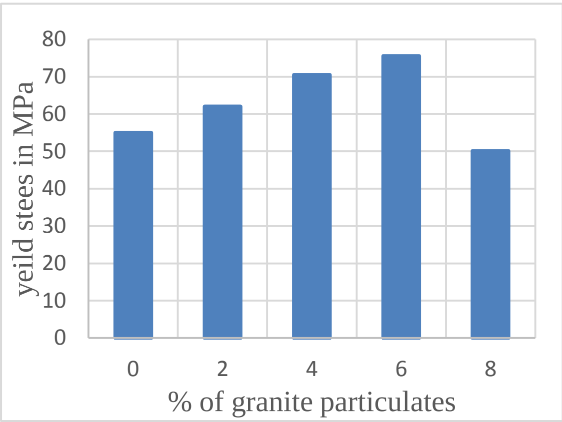

Figure 4.2 Variation of YS with respect to granite variation in as cast condition

Figure 4.2 shows the variation of yield stress for different composition of composites. From this graph we observe that the YS increase as the percentage of granite particulates is increase, it is also clear that, it follow the same trend as that of UTS. From 0% to 2% granite particulates increase in the base matrix will increase YS about 12%. Further increase in 2% to 4% granite particulates in base matrix will increases the YS about 14.28%. For increase in reinforcement from 4% to 6% of granite particulates in the base matrix will increase YS about 9.89%. Further increase in 6% to 8% granite particulates in base matrix will decreases the YS in average about 55.23%, due to cluster of granite particulate in base matrix.

4.1.3 Effect of Granite particulate on Percentage Elongation of Al 6061 alloy

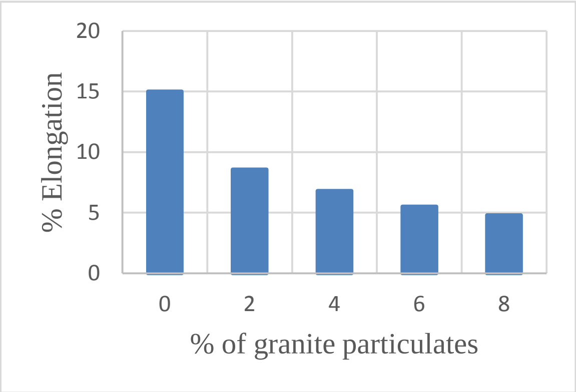

Figure 4.3 variation of % Elongation in as cast condition

Figure 6.4 shows the variation of percentage elongation for different composition of composites. From this graph we observe that the percentage elongation decreases as the percentage of granite particulates is increase. For increase in reinforcement from 0% to 2% granite particulates in the base matrix will decreases percentage elongation about 55%. Further increase in 2% to 4% granite particulates in base matrix will decreases the percentage elongation about 16%. For increase in reinforcement from 4% to 6% of granite particulates in the base matrix will decreases percentage elongation about 19.41%. Further increase in 6% to 8% reinforcement in base matrix will decreases the percentage elongation in an average about 11.5%. This decreases of ductility is due to granite particle imparts hardness to base material, which breaks the ductility barrier.

4.1.4 Effect of Granite particulate on Hardness of Al 6061 alloy

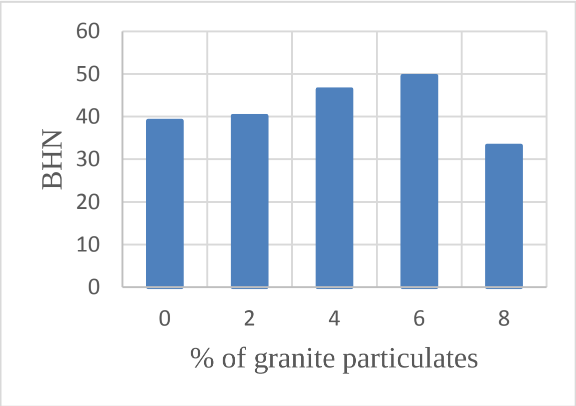

Figure 4.4 Variation of Hardness with respect to granite variation in as cast condition

Fig.4.4 shows the variation of hardness for different composition of composites. From this graph we observe that the hardness increase as the hardness of granite particulates is increase, it is also clear that, it follow the same trend as that of UTS. From 0% to 2% granite particulates increase in the base matrix will increase hardness in average about 3.5%. Further increase in 2% to 4% granite particulates in base matrix will increases the hardness in average about 12.34%. For increase in reinforcement from 4% to 6% of granite particulates in the base matrix will increase hardness in average about 7.39%. Further increase in 6% to 8% granite particulates in base matrix will decreases the hardness in average about 45.13%, due to cluster of granite particulate in base matrix.

5. CONCLUSIONS

The present investigation on the effect of granite particulates reinforcements with Al-6061 metal matrix composites are led to the following conclusions.

i. Ultimate tensile stress increases with increasing percentage of granite particulates in MMCs.
ii. Yield stress increases with increasing percentage of granite particulates in MMCs.
iii. % Elongation decreases with increasing percentage of granite particulates reinforcement.
iv. Hardness increases with increasing the percentage of granite particulates

3. REFERENCES

1. [1] H. Akbulut, M. Durman and F. Yilmaz, "Dry Wear And Friction Properties of δ-Al2O3 Short Fiber Reinforced Al-Si (LM 13) Alloy Metal Matrix Composites", Wear, Vol. 215, No.1-2, 1998, pp.170-179.
2. [2] Hans Berns, "Comparison of wear resistant MMC and white cast iron", Wear, Vol.254, No.1-2, 2003, pp.47-54.
3. [3] H. Z. Wang, S. Q. Wu and S. C. Tjong, "Mechanical and Wear Behavior of An Al/Si Alloy Metal-Matrix Composite Reinforced With Aluminosilicate Fiber", Composites Science and Technology, Vol.56, No. 11, 1996, pp.1261-1270.
4. [4]G. B. Veeresh Kumar, C. S. P. Rao , N. Selvaraj, "Study of Mechanical and Tribological Behavior of Particulate Reinforced Aluminum Metal Matrix Composites" , Journal of Minerals & Materials Characterization & Engineering , Vol. 10, No.1, pp.59-91, 2011
5. [5]A.R.K. Swamy, A. Ramesha, J.N.Prakash and G.B.Veeresh Kumar, "Effect of Particulate Reinforcements on the Mechanical Properties of Al6061-WC and Al6061-Gr MMCs" , Journal of Minerals & Materials Characterization & Engineering, Vol. 10, No.12, pp.1141-1152, 2011
6. [6] SwapnilRamani, Dr. P.L. Srinivasa Murthy, B.N. Sarada, "Heat Treatment of Ceramic Reinforced Aluminum Matrix Composites ", International Journal of Advances in Engineering Research ,Vol. No. 11(1), 2016
7. [7] G.J.Naveen, C.Siddaraju, L.H.Manjunatha, "Study On Microstructure and Mechanical Properties of Al6061-Cenosphere-Tin Based Mmc's" International Journal of Science, Technology & Management, vol no 4, may 2015 , pp 228-234
8. [8] Sivarao, NurIzanT.J.S.Anand, FairuzDimin, "Investigation of Chemical Composition on Widely Used Al 6061-T6511 Engineered Material: An XRD Analysis toward Improvement of Mechanical Properties" International Journal of Basic & Applied Sciences IJBAS-IJENS,Vol:10, No:04
9. [9] Dr. G. Mallesh, Manjunatha H. S, Pradeep Kumar V. G, Rakesh D. R, "Mechanical and Tribological Properties of Aluminum Al6061alloy Reinforced with SiC", International Journal of Emerging Technology and Advanced Engineering, Volume 5, March 2015, pp111-117
10. [10] Saravanan, C., Subramanian, K., Ananda K., V. and Sankara N. R, "Effect of Particulate Reinforced Aluminium Metal Matrix Composite", Mechanics and Mechanical Engineering, Vol. 19, No. 1 (2015),pp23–30
11. [11] Prashant Sharma (2012), " Determination of Mechanical Properties of Aluminium Based composite", International Journal on Emerging Techologies, Vol.3, issue 1, 2012, pp 157-159
12. [12]Rama Durai K, Chanakyan C, Janet A & Bharathikanna R, "Effect of Tib2p Particulate Addition in Aluminium 6061 Through Stir Casting Technique" International Journal of Multidisciplinary Research and Modern Education (IJMRME), Volume II, Issue I, 2016

13. [13] P.k. rohatgi , J.K.Kim, N.gupta, Simonalaraj, A.Daoud, "Compressive Characteristics of A356/Fly Ash Cenospehere Composites Synthesized By Pressure Infiltration Technique", Science Direct 37(2006) 430-437
14. [14] N.Radhia, r. Subramanian, Sivenkat Prasat, "Tribological Behaviour Of Aluminium/Alumina/Graphite Hybrid Metal Matrix Composite Using Taguchi's Techniques", Journal Of Minerals And Materials Characterization And Engineering 10(2011) 427-443