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Synthesis and Characteristics of Aluminium Metal Matrix Composites Using Al_2O_3 and SiC as Reinforcement Materials

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Abstract— ***Aluminium metal matrix composites have been successfully developed since last forty years. In the e present investigation Al_2O_3 and Sic have been used as reinforcement with aluminium – copper ally as matrix material. The composites were prepared with varying amounts of Al_2O_3 and silica. Corrosion studies were carried out using a standard salt spray fog corrosion testing apparatus confirming to ASTM standard B117 specifications. The results of the investigation are presented and discussed.***

Keywords— Composite, Corrosion, Aluminium – Copper Alloy, ASTM standards.

I. INTRODUCTION

Aluminium – Copper alloys are known for their high strength to weight ratio and finds extensive applications in aerospace industry. The most widely used alloy contains 4% copper which is popularly known as duralumin. Matrix metal composites (MMC) exhibit significant increase in mechanical strength values compared to matrix alloys [1]. Aluminium metal matrix composites were developed about 40 years back and since then various aluminium alloys and reinforcement materials such as graphite, gypsum, Al_2O_3, Sic etc. have been used to produce MMC's as per requirements.

All metals and alloy undergo corrosion Environment by chemicals or electrochemical Processes. The driving force is the free energy of reaction of the metal to generally a metal oxide. Since corrosion reactions generally occur on the metal surface, they are called interfacial processes. A number of different methods to assess corrosion have been developed [3]. In the present investigation a standard salt spray fog type corrosion testing apparatus confirming to ASTM standard B117 specifications has been used.

II. EXPERIMENTAL DETAILS

Liquid metallurgy route using stir casting process was employed for fabrication of the composites [4]. First Al_2O_3 content was kept constant and Sic content was kept constant and Al_2O_3content was varied. The schematic diagram of fog type corrosion testing machine is shown in Fig 1 and the details of the corrosion specimen is shown in Fig 2.

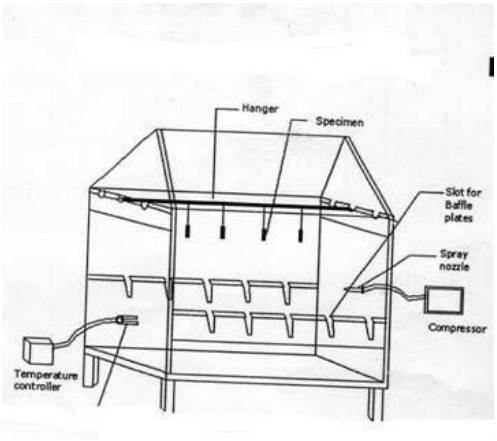

Fig.1 Corrosion testing machine

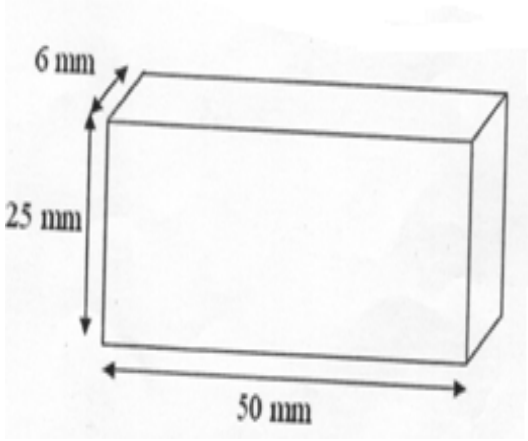

Fig. 2 Details of corrosion specimen

III. EXPERIMENTAL PROCEDURE

1. *Initial weight of the specimens was noted and the specimens were hung from a nylon wire inside the apparatus from the hanger.*
2. *The equipment was cleaned to remove the impurities. Corrosive media consisted of water and sodium chloride 95:5 by weight basis.*
3. *The outlet of the compressor was connected to nozzle inlet using a flexible rubber tube*
4. *The solution was heated by a heating coil arrangement and the temperature was held constant.*
5. *The test was carried out for two temperatures namely 35^0C and 45^0C.*
6. *Compressed air at a pressure of 2 Kg/Cm^2 was passed through the nozzle into the corrosive medium.*
7. *The specimens were exposed to corrosive atmosphere for a total duration of 24 hours. At the end of every 2 hrs., the specimens were removed and cleaned with the solution as per ASTM G1 81 specifications.*

The corrosion rate was calculated using the formula given below

Corrosion rate (mpy) = $\frac{534W}{ATD}$

Where, W = Weight loss of the specimens in milligrams D = Density of the specimen in gram/cc
A = Area in square mm T = Exposure time in hours
Weight loss method was used to assess the corrosion of the specimen.

IV. RESULTS AND DISCUSSION

1. Composites containing 8% Sic and varying amounts of Al_2O_3

a. The results of the experiments are summarized below. Fig 3 shows variation of weight loss with time of testing (in hours) and fig 4 shows the variation of weight loss with Al_2O_3 content. A study of these figures indicate the following

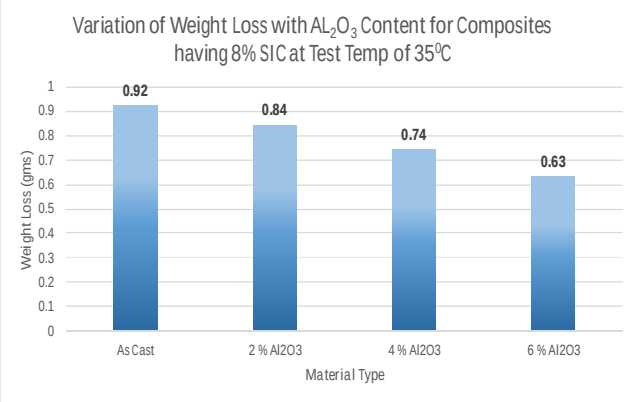

Fig.3 Weight Loss with Time of Testing

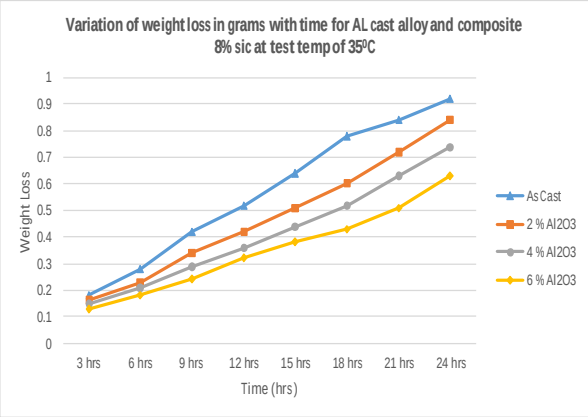

Fig. 4 Variation of weight loss with Al_2O_3 content.

b. Weight loss of the specimen increases steadily with increase in duration of testing.
c. Compared to as cast Al-Cu alloy, composite shows less weight loss due to corrosion.
d. Weight loss decreases with increase in Al_2O_3 content indicating as improved corrosion resistance of composites with Al_2O_3 content.
e. A minimum weight loss of .63 gm was noticed with composites containing 6% Al_2O_3.

Fig 5 shows variation of corrosion rate with time of testing and Fig 6 shows the variation of corrosion rate with Al_2O_3 content. A study of these figures indicate the following

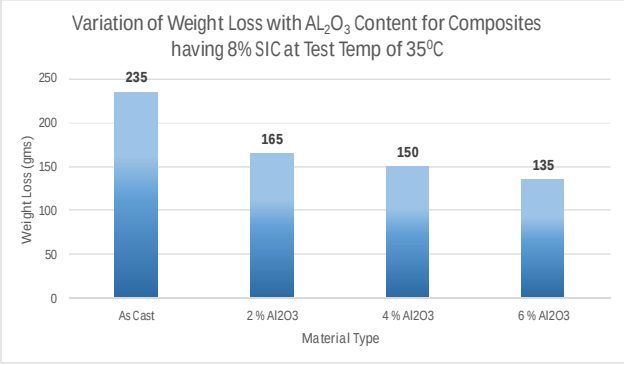

Fig. 5 Variation of corrosion rate with time of testing.

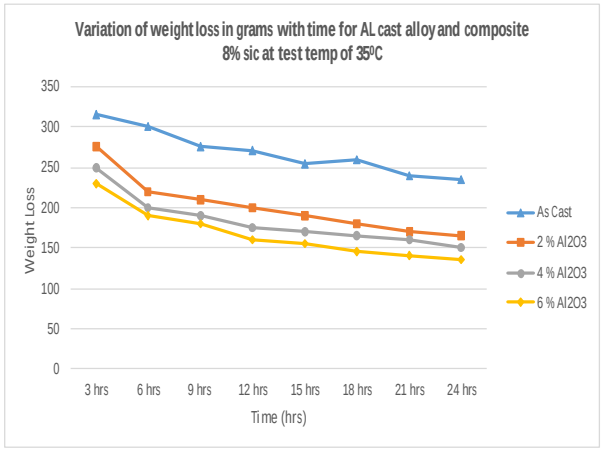

Fig. 6 Variation of corrosion rate with Al2O3 content.

- Corrosion rate decreases steadily with increase in duration of testing
- Compared to as cast Al-Cu alloy, composite shows less rate of corrosion
- Corrosion rate decreases with increase in Al_2O_3 which is 135 mpy.

2. **Composites containing 6% Al_2O_3 and varying amounts of SiC**.

Fig 7 shows variation of weight loss with time of testing and fig 8 shows the variation of weight loss with sic content. A study of these figures indicate the following

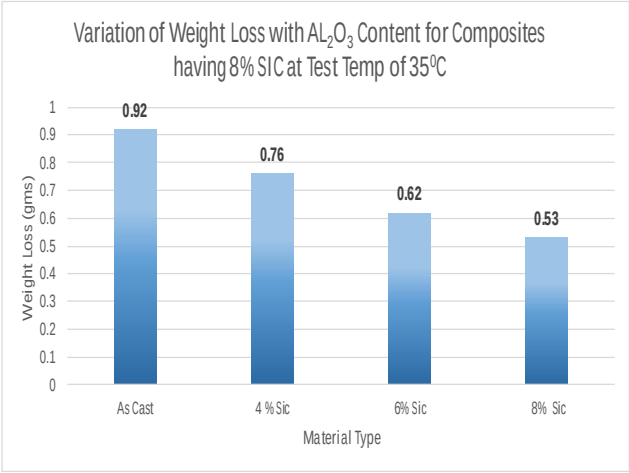

Fig. 7 Variation of weight loss with time of testing.

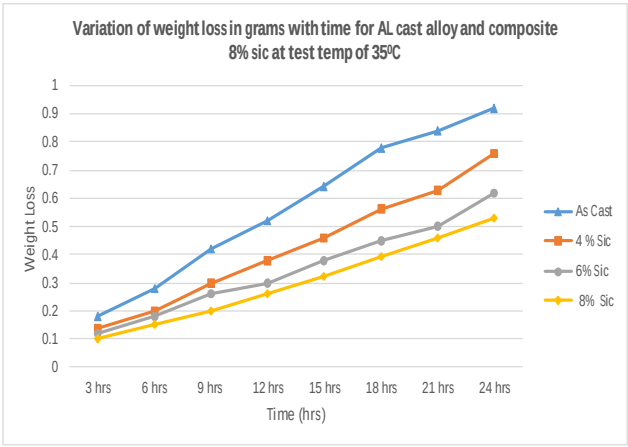

Fig. 8 Variation of weight loss with SiC content.

Weight loss of the specimen increases steadily with increase in duration of testing

- *Compared to as cast Al-cu alloy, composite shows less weight loss due to corrosion as all times of testing*
- *A decrease in weight loss of specimens with increase in Sic content was observed*
- *Composite containing 8% Sic exhibited minimum weight loss of .63 gms*

Fig 9 shows variations of corrosion rate with time of testing and Fig 10 shows variation of corrosion rate with sic content. A study of these figures indicates the following.

- *Corrosion rate decreases steadily with increase in duration of testing for as cast Al-cu alloy as well as composites.*
- *A lesser rate of corrosion is noticed in composites when compared to as cast Al-Si alloy.*
- *Corrosion rate decreases with increase in Al_2O_3 content.*
- *A minimum rate of corrosion of 125 mpy was noticed in the case of composite containing 8% Sic.*

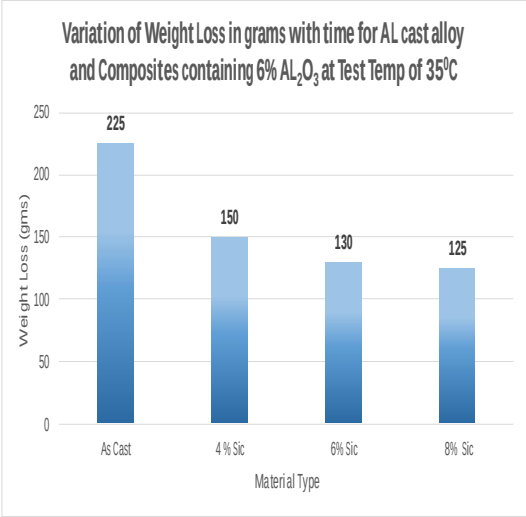

Fig. 9 Variations of corrosion rate with time of testing.

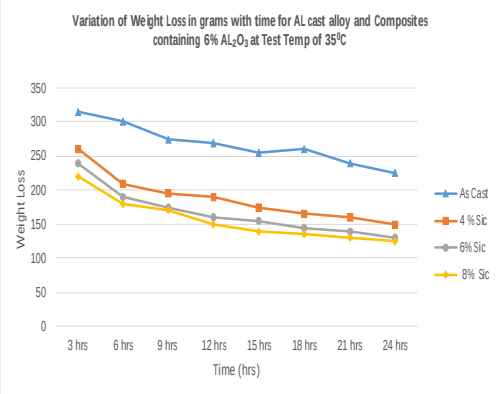

Fig. 10 Variation of corrosion rate with SiC content.

V. CONCLUSION

From the experimental study conducted on Al-Cu alloy composites containing Sic and Al_2O_3 the following conclusions can be made

- *Weight loss due to corrosion decreases with increase in both Al_2O_3 and Sic content. Further composites exhibit much greater resistance to corrosion compared to as Al-Cu alloy*
- *Corrosion rate of composites is much lower than the corrosion rate observed in as cast Al-Cu alloy. Further, the corrosion rate decreases with increase in both SiC and Al_2O_3 contents.*
- *Thus composites fabricated using Al-Cu apply as matrix and Sic&Al_2O_3 as reinforcements exhibit excellent resistance to corrosion and hence depending on the application and need composite can be fabricated with desired amounts of matrix and reinforcement materials.*

VI. REFERENCES

[1]. A Ibrahim: F.A. Mohammad and E.J. Lanernia – "*Particulate Reinforcement Metal Matrix composites – A review*" – J. Material Science Vol. 26 (1991), 1137 – 1156.
[2]. V.B. Velidandla –et al – " *P/M Processing of A1 – Sic Composites*", J. Powder Metal. Vol 27 (1991), 227-235.
[3]. Y.B. Liu T.K.M. Kwok SC Lim, L.Lu & M.O.Lai "Fabrication *of A1-4.5cu/15SicComposites: I processing using mechanical alloying*" J. Material Proc Technology. Vol 37 (1993) 441-451.
[4] Isaac M. Daniel and ori Ishai, *Engineering Mechanics of composites Material*, oxford University Press, New York, 1994.
[5]. Laws. N and Dvorak, G.J., J. Composite Material V – 22, 1988, pp900.
[6]. Lu. T.J and Hutchinson J.W. Composite Material V – 26, 195, pp403-404.
[7]. Hutchinson J.W and Jensen. H.M Mech Mater. V-9, 1990, pp139 – 163.
[8]. David Weiss, Barri Chamberlain, and Rick Bruski, " Justifying Aluminum Metal Matrix Composites in an Era of cost Reduction" Modern casting / February 2000pp 58 to 60.
[9]. R. Dasagupta, H.Meenai, "*Sliding wear properties of A -Cu Based alloys with Sic particle reinforced composites under varying experimental conditions*" Kluwer Academic

