CORROSION PROPERTIES OF ALUMINUM ALLOY PARTICULATE REINFORCED METAL MATRIX COMPOSITE

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ABSTRACT:

This study describes the corrosion characteristics of Al-Cu-Mg alloy-based composites reinforced with various amounts of Titanium reinforced particulates. Corrosion tests were performed on the unreinforced matrix alloy as well as on the various composites in both heat-treated and as-cast conditions. Polarization studies have been carried out in 3.5% NaCl solution using potentiostat model SEP238C. Increased content of reinforcements in the matrix alloy improves the corrosion resistance of the developed composites. Al-Cu-Mg matrix alloy has exhibited a corrosion rate of 2.375472 mpy, whereas Al-Cu-Mg / 8wt % TiO_2 has exhibited corrosion rate of 2.26424 mpy. Solution heat treatment at 525^0C followed by artificial aging at 175^0C was found to improve the corrosion resistance of the specimen tested.

Keywords: Corrosion; Heat treatment; Polarisation; Metal matrix composit.

1. Introduction :

Aluminum Metal matrix composites (AMC) are an important class of materials with the potential to replace a number of conventional materials being used in automotive, aerospace, defense and leisure industries, where the demand for lightweight and high strength components is increasing [1]. Aluminum matrix composites have shown improved mechanical properties such as high strength, high stiffness, wear resistance and high electrical conductivity [2]. The corrosion behavior of the composites in the various environments that the material is likely to encounter is one important consideration when choosing a suitable material for a particular engineering application [3]. The corrosion behavior of metal –matrix composite is determined by several factors such as the composition of the alloy, the matrix microstructure, the reinforcement and the technique adopted in preparing the composite. A very small change in any one of theses factors can seriously affect the corrosion characteristics of the metal matrix composites.

Corrosion is a slow, progressive or rapid deterioration of a metals properties such as its appearances, its surface aspects, or its mechanical properties under the influences of the surrounding environment: atmosphere, water, sea water, various solutions, organic environments, etc.,. Abdul Jameel et. Al., studied the corrosion behavior of Al 6061-Zirconia AMC. Zirconia reinforcement plays a significant role in the corrosion resistance of the material. An increase in the percentage of zircon will be advantageous to reduce the density and increase the strength of the alloy. However, there is a significant reduction in the potential and corrosion rate. The corrosion rate of both the alloy and composite decreased with an increase in exposure time in sea water. The corrosion rate of composites was lesser than that of the corresponding matrix alloy in sea water [4]. Al 6063–alumina reinforced composite exhibited excellent corrosion resistance in NaCl medium than in the NaOH and H_2SO_4 media. The solution heat treatment resulted in improved corrosion resistance for both the composites and the un reinforced alloy while the volume percent of alumina on corrosion resistance did not follow a consistent trend [5]. Geetha mable Pinto et.al., studied the corrosion behavior of 6061 aluminum alloy and its composite Al-15 vol % of SiC composite in different concentrations of 1:1 mixture of HCl and H_2SO_4 at different different temperature by electrochemical methods. The result shows that, the corrosion rate for both the alloy and composite increases with an increase in the concentration of acid mixture. The study reveals that, the corrosion rate increases with temperature for both the base alloy and the composite. [6-7].

2. Experimental procedure:

2.1. Corrosion test

Polarization studies on cast Al2618 matrix alloy and TiO_2 reinforced composites have been carried out in 3.5% NaCl solution using potentiostat model SEP238C. The standard reference was calomel electrode while the working electrode was samples of size 20 mm x 10mm x 1 mm as per ASTM standards. Open circuit potential were measured and the experiments were conducted only after equilibrium was reached i.e. when a steady open circuit potential were observed to record both anodic and cathodic behavior. A scan rate of

0.01mv/sec was adopted. Using the plots of both anodic and cathodic, the corrosion current densities have been evaluated using Tafel slope extrapolation.

Figure 1. Electrochemical test rig SEP 238C model.

3. Result and discussion:

The variation of corrosion rate in 3.5%NaCl of the matrix alloy and TiO_2 reinforced composite materials are studied with increased content of reinforcement as shown in Fig. 2. Increased content of reinforcements in the matrix alloy improves the corrosion resistance of the developed composites. Al 2618 matrix alloy has exhibited a corrosion rate of 2.375472 mpy, where as an Al2618-8wt% TiO_2 has exhibited corrosion rate of 2.26424 mpy. A similar trend is observed by Zuhair M. Gasem [8-9]

The corrosion test data for the heat treatment specimens is shown in the figure 3, which indicates that, heat treatment process shows improvement in the corrosion resistance for both the base alloy and for the composite material. The results are in agreement with the results obtained by K.H.W. Seah et al [8].

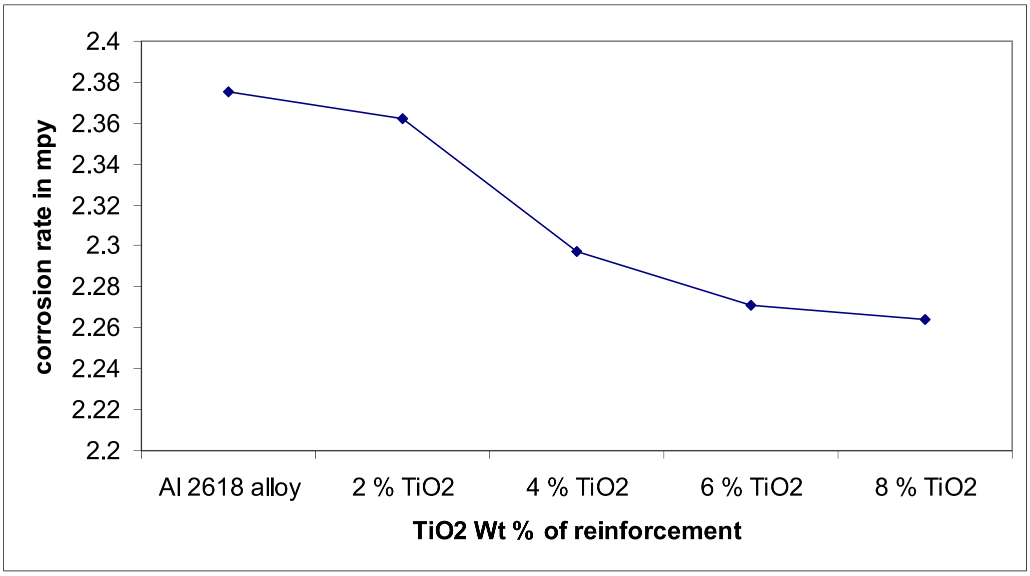

Figure 2. Effect of reinforcement on corrosion rate of composites.

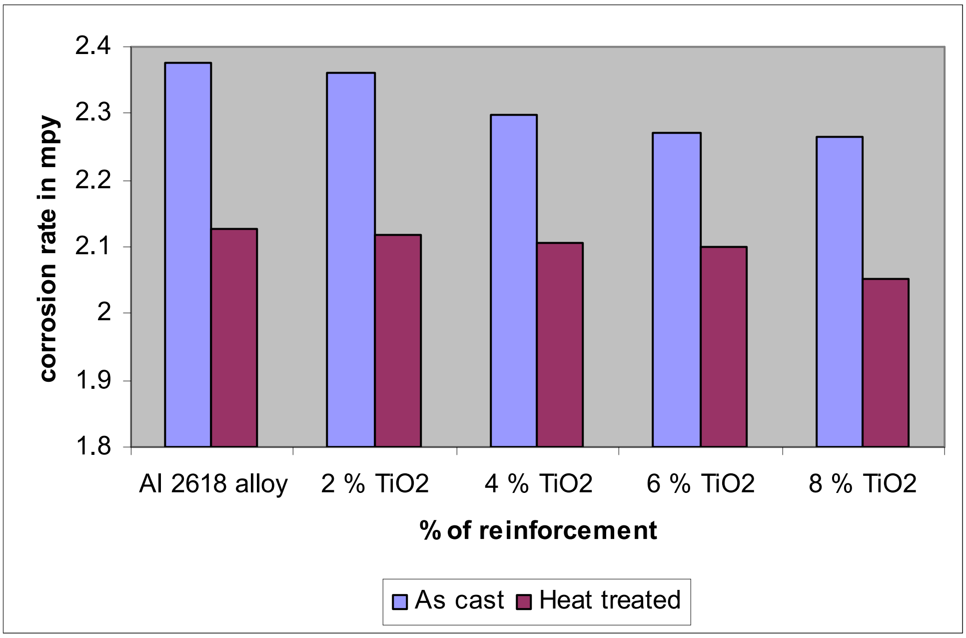

Figure3. Effect of heat treatment on corrosion rate.

4. References:

1. Aluminum metal composites: Challenges & opportunities, by M.K. Surappa. Sadhana. Vol.28. Part 1 Feb/Apr. 2003. PP 319-334.

2. M.D. Huda, M.S. J. Hashmi and M.A. El-Bardie, MMCs: Materials, manufacturing and mechanical properties, Key engineering materials, Trans Technical publications Ltd., 1995, pp. 37-64.

3. El-sayed M. Sherif, A.A. almajid, Fahamsyah hamdan latif and Harri Junaedi. Effects of graphite on the corrosion behavior of aluminum-graphite composite in sodium chloride solutions. Int.J. Electrochem. Sci., 6 (2011) 1085 – 1099.

4. A. Abdul jameel, H.P. Nagaswarupa, P.V. Krupakara and T.R. Shashi Shekar. Evaluation of corrosion rate of Al 6061 – Zirconia metal matrix composites in sea water. Int. J . of ocean and oceanography, Volume 3, no. 1 (2009) pp. 37-42.

5. K.K. Alaneme and M.O. Bodunrin. Corrosion behavior of alumina reinforced metal matrix composites. JMMCE, Vol 10. No.12. PP.1153 -1165.

6. Geetha Mable Pinto, Jagannath Nayak, A Nityananda shetty, Corrosion behavior of 6061 Al-15 % SiC composite and its base alloy in a mixture of 1:1 HCl and H_2SO_4 media, Int.J. Electrochem. Sci, 4 (2009) 1452-1468.

7. U.Achutha Kini, Prakash Shetty, S.Divakara Shetty and M.Arun Isloor, Corrosion inhibition of 6061 aluminum alloy /SiC composite in HCl acid medium using 3 – Chloro-I-Benzothiophene -2- carbohydrazide, Indian journal of chemical technology, Vol. 18.Nov. 2011, 439-445.

8. K.H.W. Seah, M.Krishna, V. T. Vijayalakshmi and J.Uchil. Corrosion behavior of garnet particulate reinforced LM 13 alloy MMCs. Corrosion Science 44 (2002) 917 -925.

9. Zuhair M. Gasem and Amro M. Al-qutub, Corrosion behavior of powder metallurgy aluminum alloy 6061 /Al2O3 metal matrix composites. The 6th Saudi Engg conference, Dec-2002, Vol 5. 271 – 281.