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WEIGHT LOSS CORROSION STUDIES OF ALUMINIUM-7075 ALLOY REINFORCED WITH SILICON CARBIDE PARTICULATES COMPOSITES IN ACID CHLORIDE MEDIUM

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ABSTRACT

The aim of the research work to investigate the corrosion behaviour of Silicon Carbide(SiC) reinforced aluminium 7075 metalmatrix composites (MMCs) in acid chloride solution using weight loss method. The composites are manufactured by liquid metallurgy technique using vortex method. Aluminium 7075 / SiC MMCs containing 2, 4 and 6 weight percentage of SiC particulates are casted. The corrosion characteristics of Aluminium 7075 /SiCcomposite and the unreinforced alloy were experimentally assessed. The corrosion test was carried out at different concentrations of 0.025M, 0.05M and 0.1 M solutions for different exposure time. The results indicated that corrosion rate of metal matrix composites was lower than that of matrix material Al 7075 under the corrosive atmosphere irrespective of exposure time and concentration of corrodent. Aluminium 7075 / SiC composite become more corrosion resistant as the SiC content is increased. This is because of the formation of stable oxide layer over the specimens.

KEYWORDS: Aluminium-7075, Metal Matrix Composite (MMCs), Silicon Carbide, LLM, Acid Chloride, corrosion resistance, weight loss.

INTRODUCTION

Metal matrix composites are important class of materials, which contain metal or alloy as matrix and a ceramic particulate or fiber or whiskers as reinforcements. Aluminium based Metal Matrix Composites exhibit enhanced corrosion resistance, wear and mechanical properties. They provide significantly enhanced properties over metals and alloys. They are used for applications in aerospace, power utility, automotive, and military sectors [1- 2]. MMCs reinforced with short fibres offer outstanding specific strength and stiffness along the fiber direction when compared to those with particulate reinforcements that have more isotropic properties. Most research on particulate reinforced MMCs has focused on their manufacturing and mechanical properties[3-4].Relatively little research has been conducted on their corrosion behaviour, and therefore, corrosion mechanisms are not well understood. Conflicting data and interpretations exist regarding fundamental issues, such as corrosion initiation sites and the role of reinforcement in corrosion susceptibility [5-7].Corrosion can affect the metal matrix composite ina variety of ways which depend on its nature and the environmental conditions prevailing. Studying corrosion resistance of Al-based materials is important especially for automotive and aircraft applications. The major advantages of Aluminium 7075 composites compared to unreinforced materials areas follows: greater strength, improved stiffness, reduced density, good corrosion resistance, improved high temperature properties, controlled thermal expansion coefficient, thermal/heat management, improved wear resistance and improved damping capabilities [8-9]. One of the main disadvantages in the use of metal matrix composite is the influence of reinforcement on corrosion rate. This is particularly important in aluminium alloy based composites, where a

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protective oxide film imparts corrosion resistance. The present work is focused on corrosion characteristics of Aluminium 7075/ SiC metalmatrix composites.

MATERIALS AND METHODS

The material selected for the present research work is popularly used Aluminium 7075 alloy which is commercially available. Its composition is given in table 1.

Table 1.Composition of Aluminium 7075 alloy

Element	Cu	Cr	Mn	Mg	Si	Ti	Zn	Fe	Al
Percentage	1.8	0.2	0.4	1.9	0.5	0.15	3.25	0.5	Bal

The reinforcement used in the present research work is 50-80µM size Silicon Carbideparticulates which is commercially available. The mediums used for corrosion testing are 0.025M, 0.05M and 0.1 M The method used for corrosion characterization is static weight loss corrosion method as per ASTM standards G69-80.

A.Composite preparation

The composites are prepared by liquid melt metallurgy technique used by Pruthviraj et al [7]. Pre heated and uncoated Silicon Carbide particulates are added to molten aluminium 7075 alloy. Composites containing 2, 4 and 6 weight percentage of Silicon Carbide particulates are prepared. Aluminium 7075 alloy is also casted in the same way for comparison. Castings are taken in the form of cylindrical bar.

B. Specimen preparation

The specimen are prepared from the bar castings. Cylindrical specimen of size 20 mm x 20mm are machined from the bar castings of the composites and the matrix alloy. All the specimens are subjected to standard metallographic techniques as done by S. EzhilVannan and Paul Vizhian Simson[8] before subjecting them to static weight loss corrosion tests.

RESULTS AND DISCUSSION

The results of weight loss corrosion tests in different concentrated solution HCL are given in the figures 1-3.

Figures 1-3 show the results obtained for the static weight loss corrosion test of Aluminium 7075 / Silicon Carbide composites and the matrix alloy in 0.025M, 0.05M and 0.1M HCL respectively for different times of exposure. The results can be discussed under the topic effect of time of exposure and effect of Silicon Carbide content.

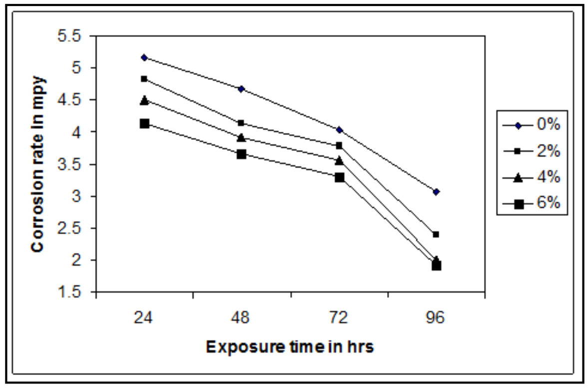

Fig 1: Results of the test in 0.025M HCL

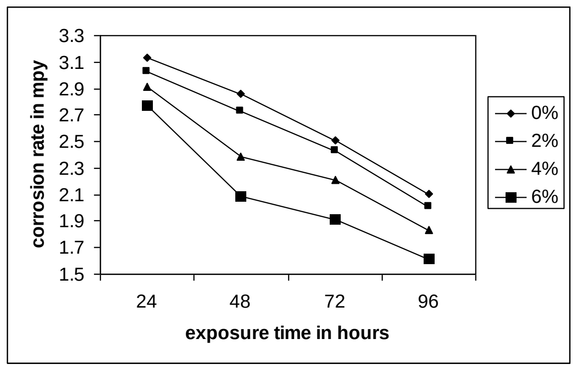

Fig 2: Results of the test in 0.05M HCL

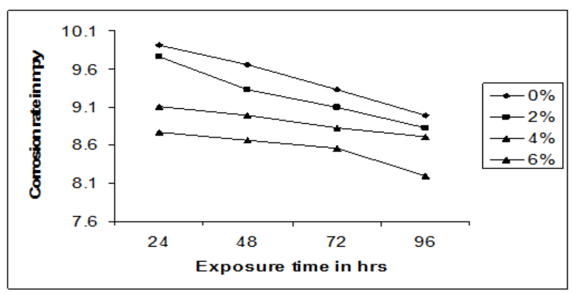

Fig 3: Results of the test in 0.1M HCL

Figures 1-3 show the results obtained for the static weight loss corrosion test of Aluminium 7075 / Silicon Carbide composites and the matrix alloy in 0.025M, 0.05M and 0.1M HCL respectively for different times of exposure. The results can be discussed under the topic effect of time of exposure and effect of Silicon Carbide content.

Effect of Time o Exposure

The trend observed in all the cases show decrease in corrosion with increase in test duration. It is clear from the graphs that the resistance of the composite to corrosion increases as the exposure time increases. This eliminates the possibility of hydrogen bubbles clinging on to the surface of the specimen and forming a permanent layer affecting the corrosion process. The phenomenon of gradually decreasing corrosion rate indicates the possible passivation of the matrix alloy. De Salazar [9] explained that the protective black film consists of hydrogen hydroxy chloride, which retards the forward reaction. Castle et. al.[10]pointed out that the black film consists of aluminium hydroxide compound. This layer protects further corrosion in acid media. But exact chemical nature of such protective film still is not determined.

From the Fig 1 to 3 it can be clearly observed that for both as cast and composite, corrosion rate decreases monotonically with increase in Silicon Carbide content. In the present case, the corrosion rate of the composites as well as the matrix alloy is predominantly due to the formation of pits and cracks on the surface. In the case of base alloy, the strength of the corrosion medium used induces crack formation on the surface, which eventually lead to the formation of pits, thereby causing the loss of material. The presence of cracks and pits on the base alloy surface was observed clearly. Since there is no reinforcement provided in any form the base alloy fails to provide any sort of resistance to the acidic medium. Hence the weight loss in case of unreinforced alloy is higher than in the case of composites.

CONCLUSION

The Silicon Carbide content in Aluminium 7075 alloys plays a significant role in the corrosion resistance of the material. Increase in the percentage of Silicon Carbide will be advantageous to reduce the density and increase in the strength of the alloy, but the corrosion resistance is thereby significantly increased.Aluminium 7075 MMCs when reinforced with Silicon Carbide of weight percentage from 0 to 6 percent could be successfully produced by liquid melt metallurgy technique (LMM). The rate of corrosion of both the alloy and composite decreased with increase in time duration in all concentrations of Acid chloride solutions. The corrosion rate of the composites was lower than that of the corresponding matrix alloy in concentrations of acid chloride solution.

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REFERENCES

1. H.E. Deve, C. McCullough, Continuous-fiber reinforced Al composites: A new generation, JOM vol 47, pp 33-37, 1995J. D. Poston and W. D. Horne, “Discontiguous OFDM considerations for dynamic spectrum access in idel TV channels,” in Proc. IEEE DySPAN, 2005.
2. V.V. Vikulin, I.Y. Kelina, A.S. Shatalin, L.N. Rusanova, Advanced ceramic structural materials, Refract. Ind.Ceram. Vol 45, pp 383-386, 2004.
3. R. Asthana, M. Singh, N. Sobczak, The role of wetting and reactivity in infiltration of ceramic-metal composites, Ceram. Eng. Sci. Proc. Vol 26, pp 249-261, 2005.
4. A. Vassel, Continuous fibre reinforced titanium and aluminium composites: A comparison, Mater. Sci. Eng. A Vol 263, pp 305-313, 1999.
5. S. EzhilVannan and Paul Vizhian Simson, Corrosion Behaviour of Short Basalt Fiber Reinforced with Al7075 Metal Matrix Composites in Sodium Chloride Alkaline Medium, J. Chem. Eng. Chem. Res. Vol 1(2), pp122-131, 2014.
6. J.M.G.DeSalazar, A.Urefia, S.Mazanedo and M.Barrens, Corrosion behaviour of AA6061 and AA7075 reinforced with Al2O3 particulates in aerated 3.5%chloride solution potentiodynamic measurements and microstructure evaluation, Corrosion Science, Vol 41, pp529-545,1999.
7. J.E.Castle, L.Sun and H.Yan,The use of scanning auger microscopy to locate cathodiccenters in SiC/Al6061 MMC And to determine the current density at which they operate, Corrosion Science, Vol 36(6), pp1093-1110, 1994.
8. T.P.D. Rajan, R.M. Pillai, B.C. Pai, Reinforcement coatings and interfaces in aluminium metal matrix composites, J. Mater. Sci. Vol 33, pp 3491-3503, 1998.
9. J. Rodel, H. Prielipp, M. Knechtel, N. Claussen, Better ceramics through metal

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modification, Trans. Mater. Res. Soc. Jpn. Vol 19B, pp 763-776, 1994.
10. R. D. Pruthviraj, P.V.Krupakara, B.S.Parashuram, Effect of reinforcement content on the corrosion properties of ALUMINIUM 7075/SiC composites in equimolar solution of sodium hydroxide and sodium chloride solution, Bulletin of Electrochemistry, Vol 22(6), pp 281-284, 2006.
11. P.V.Krupakara, Corrosion Characterization of Al6061/Red Mud Metal Matrix Composites, Portugaliae Electro chimicaActa Vol 31(3), pp157- 164, 2013.
12. Wu.Jianxin, Liu Wei LiPeng Xing & Wurenjie, “Effect of matrix alloying elements on the corrosion resistance of C /Al composites materials, Jr.of.Mat.Sci. lett. Vol.12, pp1500-1501, 1993.
13. J.F.Mclyntyre, R.K.Conrad&S.L.GoHedge, "Technical note: The effect of heat treatment on the pitting behavior of SiC / AA2124", Corrosion, vol 46,190-192.

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