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Effect of Titanium Di Borate Nano Particles on Al 8081 Alloy in Acid Chloride and Neutral Chloride Mediums at Laboratory Temperature

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ABSTRACT

This paper evaluates corrosion properties of TiB2/Al 8081 alloy directly purchased from the industry. The corrodent used for the test is different concentration of acid chloride & Neutral Chloride mediums that is 0.1N 0.05N 0.075N 0.025N of HCl & 3.5%,0.35%,0.035% NaCl respectively .As a concentration of acid chloride & Neutral Chloride medium increases the corrosion rate is also increases .All the test are conducted at laboratory temp.The weight loss potentiodynamic and EIS was studies in all the cases the corrosion rate is decreases an attempt is made in the paper to provide explanation for these phenomena

Keywords: *AA 8081, HCL, NaCl, Immersion Test, TiB2.*

INTRODUCTION

Al 8081 is an aluminum-based alloy in the "commercially pure" wrought family (1000 or 1xxx series). With a minimum of 99.0% aluminum, it is the most heavily alloyed of the 1000 series. It is also the mechanically strongest alloy in the series, and is the only 1000-series alloy commonly used in rivets. At the same time, it keeps the benefits of being relatively lightly alloyed (compared to other series), such as high electrical conductivity, thermal conductivity, corrosion resistance, and workability. It can be strengthened by cold working, but not by heat treatment Aluminum / Aluminum alloys have strong corrosion resistance. They are sensitive to high temperatures ranging between 200 and 250°C (392 and 482°F) and might lose some of their strength. However, the strength of the aluminum alloys can be increased at subzero temperatures, making them ideal low-temperature alloys. The aluminum 1100 alloy is a pure aluminum alloy with excellent forming characteristics. The following datasheet will provide more details about Aluminium / Aluminum 1100 alloy. Advanced material currently being developed to an increasing extent today there are more than 80000 engineering materials are available in market and the figure is increasing rapidly among these advances materials are finds Al 8081. Al 8081 alloy have been used extensively in industry this is attributed to their excellent castability good mechanical property and chemical properties among the Al alloys Al 8081 alloy has been widely used during the past few years in this paper an attempt is made to evaluated corrosion behavior of Al 8081alloy in different concentration of HCl solution a corrodent commonly used for corrosion resting since its provided a high concentration of chlorides as ions which acts as passive film be stabilizers 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. Aluminum 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 fibers 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 in a 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 Aluminium1100 composites compared to unreinforced materials are as 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].

MATERIALS AND METHODS

The following table shows the chemical composition of Aluminum 1100 alloy. Corrosion involves both chemical and electrochemical reaction of a metal with its environment. This means that corrosion process requires at least two reactions namely anodic and cathodic reactions to form a current flow. The metal transfers electrons to the electrolyte and give the anodic reaction which is a chemical or electrochemical oxidation process. The various mechanisms involved in these processes have been reported by many researchers

Composition of Al 8081 alloy in wt% (ASTM B669-82)

The material selected for the present research work is popularly used Aluminum 1100 alloy which is commercially available. Its composition is given in table 1.

Table1. *Composition of Aluminium 1100 Alloy*

Cu	Si	Fe	Mg	Others	Al
0.10%	0.5%	0.6%	0.1%	0.1%	Balance

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 Simson8 before subjecting them to static weight loss corrosion tests. Specimen will be prepared as [ASTM] Standard 20mmx20mm which is used for immersion test method and similarly for potentiodynamic and ocpt test should be conducted and as per ASTM standard specimen such as 2cmx1cm can be prepared.

EXPERIMENTAL PROCEDURE

Weight Loss Corrosion Test

The corrosion behavior of AL 8081 alloy was studied by immersion test. The static immersion corrosion method was adopted to measure the corrosion loss. 0.1N, 0.075N, 0.05N, 0.025N hydrochloric acid & 0.035%, 0.35% and 3.5% solutions of sodium chloride.200 ml of the prepared solution were taken in a beaker. Samples were suspended in the corrosive medium for different time intervals up to 96 hours in the steps of 24 hrs. To minimize the contamination of the aqueous solution and loss due to evaporation, the beakers were covered with paraffin paper during the entire test period. After the specified time the samples were cleaned mechanically by using a brush in order to remove the heavy corrosion deposits on the surface. The corresponding changes in the weights noted. At least three samples were tested and average value was taken. Corrosion rates were computed using the equation

Corrosion rate: 534 **W/DAT mpy**

Where W is the weight loss in gms, D is density of the specimen gm/cc, A is the area of the specimen (cm^2) and T is the exposure time in hours.

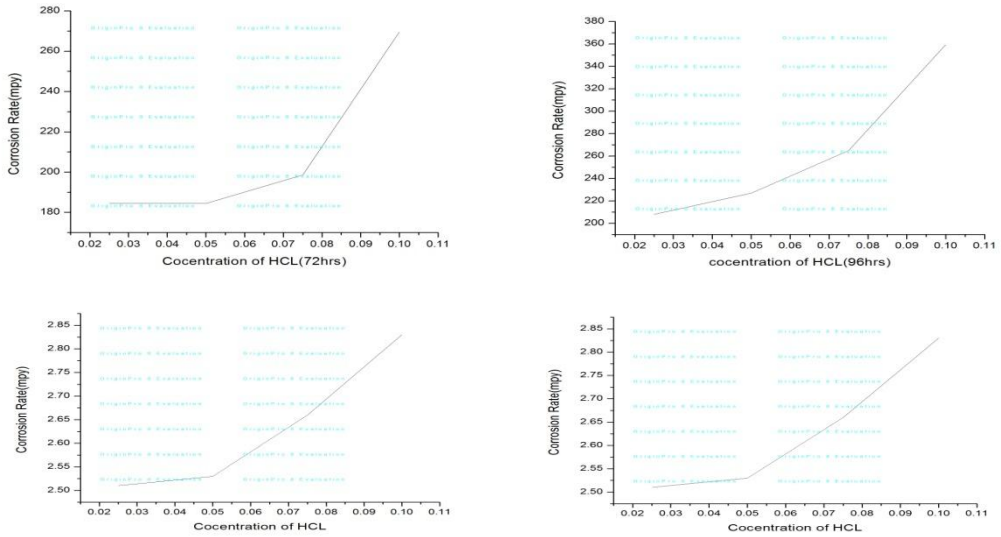

Fig.1 *Weight Loss Corrosion Test of Al 8081 in Different Concentration of HCl Solution at 250C*

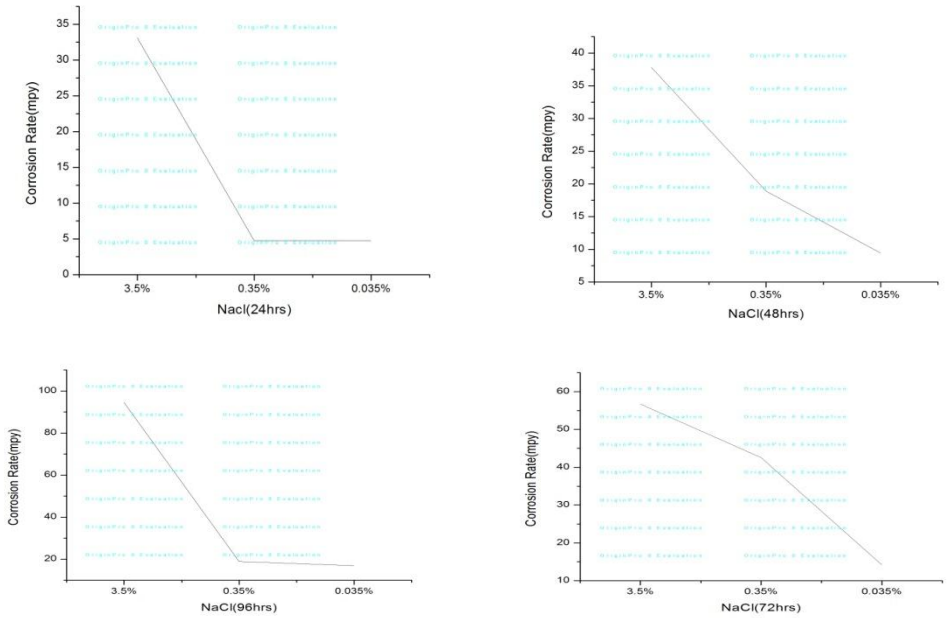

Fig2. *Weight Loss Corrosion Test of Al 8081 in Different Concentration of NaCl Solution at 25^{0}C*

RESULTS AND DISCUSSION

The results of weight loss corrosion tests in different concentrated solution HCL are given in the figures 1-2, Figures 1-2 show the results obtained for the static weight loss corrosion test of Aluminium8081 the matrix alloy in 0.025N, 0.05N,0.075N and 0.1N HCL & 3.5%,0.35%,0.035% NaCl respectively for different times of exposure.

Effect of Time on 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 aluminum 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 2 it can be clearly observed that for both as cast and composite, corrosion rate decreases monotonically with increase in Concentration of mediums. In the present case, the corrosion rate of 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 leads 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.

Corrosion Morphology

By the visual examination of the specimen of Al8081 after the weight loss ocpt potentiodynamic corrosion experiment showed pits, cracks and flakes are formed on the surface of the specimen. The cracks is found to be perpendicular to the axis of the specimen the wide spread pitting are also observed on the surface of the specimen

$$2Al + 6HCl \longrightarrow 2AlCl_3 + 3H_2$$

$$2Al + 6H_20 \longrightarrow 2Al\,(0H)_3 + 3H_2$$

The above reaction raises directly influenced by the variables i.e. the temperature of the acidic solution specimen exposure area hydrogen concentration in solution exposure time of the specimen and the specimen area is exposed the researcher have reported on static corrosion the rate of corrosion decreases with increase in exposure of the time.

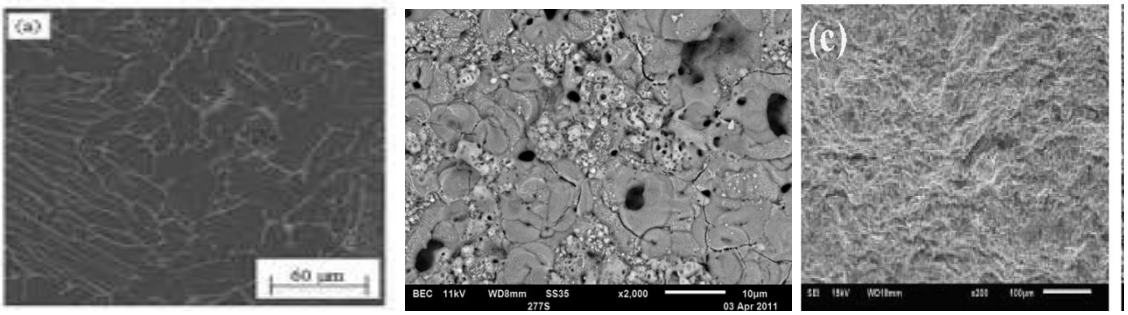

Fig9. *Sem Micrographs of Al 8081/TiO2 alloy with and without corrosion in HCL and NaCl solution*

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