A STUDY ON CORROSION BEHAVIOUR OF DIFFERENT AL MATRIX COMPOSITES

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Abstract: Different Al matrix metal compozites' s corrosion behavior is studied as literature rewiev. Al 6061 and Al 7075 matrix with SiC reinforcement are examined by using literature. SiC reinforcement action of compozite corrosion is identified by experiments. Optimum reinforcement volume rate is detected. Also, different method is examined for corrosion behavior. Besides, Al 2024 matrix metal compozites' s corrosion experiments which different method used, are submitted.
Keywords: composite, corrosıon, Al matrix,

Introduction

Aliminum is one of the materşal which is used after steel. Al is found in natüre easily. It has a density of 2,71 g/cm 3 nd the value is one third of steel's density.

Draft limit value of some Al alloys are higher than lot's of steel alloys. For this properties Al alloys are prefable for lightness desired applications.

Al based metal matrıx composıtes are important class of materıal, with non metallic reinforcements incorporated in metal matrices. Al alloy matrices, mainly 2024, 6061 and 7075 have been widely used as matrix materils with silicon carbide as their maor reinforcing agent. These materials have received incrased attention due to their potentially high fracture toughness and hıgh strength to weıght ratio.

The high thermal conductivity and low coefficient of thermal expansion of these materials have lead to a number of applications especially in automobile engine.

In corrosıve medıum, Al surface is coated with oxide layer to give a corrosion resistance to Al. With this property al is frequently used alloys. Al alloys consist of some elements such as Si, Zn, Mn and these are suitable for obtain galvanic ells. So that, ın terms of corrosion experiment Al is must be used for unique material. On the other hand, mechanical strength of Al is weakand single use of Al is not common (Chen 2016).

Mechanical and chemical properties of Al is change with micro structure and alloy elements. Most important alloy elements of Al are copper, Si, Magnezium and Zinc.

Medium strength and curable AlSiC alloys are well-formed and common used. Also, corrosion resistance of these alloys are high. SiC is the most common reinforcement element in metal matrix composites. The advantage of SiC is high thermal resistance.

Al7075 is top alloys of reinforcement metals and excellent power, low density, corrosion resistance, high thermal stability, are some important roperties. Unlike, using of metal cage composites, Al7075 is to increase corrosion rate, it is a disadvantage.

Al6061 has a high hardness strength, high corrosion resistance and well weldable. The corrosion resistance of Al6061-SiC is lower than püre Al alloy. On the other hand tensile strength of alloys is quite high.

Finally, Al2024 alloys, heat treatment processes are workable and fatigue strength is high. With surface coating, corrosion resistance is increasing. Because of its high strength and low density ; Al2024 is extensively used as structural materials in the aircraft and aerospace industries.

In thıs study, SiC reinforcement Al alloys studied for effecting corrosion resistance and literatur rewiev is done. Al7075, Al6061 and Al2024 alloys are studied seperately and results are compared.

Materials and Methods

Al7075, Al6061 and Al2024 corrosion experiments are done different methods. All of alloys SiC used as a reinforcement element with %15 weight ratio. Firstly, before corrosion experiments Al alloys are obtained from different metods also. Then the corrosion experiments are started. In (Table 1.) chemical compositions of Al7075, Al6061 and Al2024 and (Table 2.) properties of these alloys is given respectively .

Table 1. Chemical composition of Al2024 Al6061 and Al7075.

Element	Cr	Cu	Fe	Mg	Mn	Si	Ti	Zn	Al
Al2024	0.10	5.3	0.5	0.4	0.3	0.50	0.15	0.15	Balance
Al6061	0.04-0.35	0.15-0.4	0.7	0.8-1.2	0.15	0.4-0.8	0.15	0.25	Balance
Al7075	0.2	1.55	0.4	2.82	0.11	0.27	0.15	0.3	Balance

Table 2. Physical and chemical properties of Al2024, Al6061 and Al7075.

		Al2024	**Al6061**	**SiC**
Physical properties	Density (g/cm^3)	2.83	2.7	2.64
Chemical properties	Thermal Conductivity (W/mK)	196	167	200

Sun and friends studied that Al 7075 is an alloy which is well known for its structural properties and which is used in the production of metals which are also affordable and light weight. 0.1 M solution of acid chloride and 3.5% of natural chlorite were used in corrosion tests of Al7075 alloy. SiC with grain size of 60-90 micron was used as reinforcement element. Alloy was obtained by adding 2% and 4% by volume of SiC to the molten Al metal in the composite formation. In the corrosion tests of the obtained Al7075 alloy, weight loss was used as a method (Manjunatha 2016).

In corrosion experiments for Al7075, composite samples were washed, dried with acetone and weighted electronic scale. The samples were then dipped and weighed for 24 hours. Corrosion studies were carried out in hydrochloric acıd, acid sulphate, acid nitrat and NaCl solutions. The weight loss of the samples was measured for 24 hours during 1 week. The beakers mouths were kept closed during the test to avoid weight loss. After a certain period of time, the specimens are removed from the solution and washed to remove the corrosion residues, washed with acetone water and dried. Then, weighed graphs were made by measuring the weights of the weighed samples (Manjunatha 2016).

Al6061-SiC metal matrix composite is prepared by mixing casting technique. In thıs method, %99 of pure SiC is used while corrosion experiment is done, % 15 volume of SiC is used and alloy is obtained as a rod form. Cylindrical test coupons were cut from the rods and sealed with epoxy resin in such a way that, the areas of the composite. It is then degreased with acetone, washed with distilled water two times and dried before immersing in the corrosion medium. Experiments are carried out using a thermostat at temperatures 30 C, 35 C, 40 C, in sodium hydroxide solutions of concentrations 0.05 M, 0.1 M and 0.25 M (Kumari 2016)

Finally, Al2024 corrosion experiment, corrosion specimens are soaked in prepared acid NaCl solution with silicone protection on both grip ends. The corrosion solution was %9,5 sodium chloride solution and pH value is adjusted to about 4 by adding dropwise of dilute sulfuric acid. After corrosion, specimens are washed with distilled water for 2 min and blown dry with air. Corrosion method is multiaxial fatigue tests for Al2024.

All of these corrosion experiment the results are commented and supported with SEM photos (Sun 2009).

Results and Discussion

For this paper Al7075, Al601 and Al2024 alloys's corrosion experiments are studied. Three different corrosion method is used. These are weight loss, multiaxial fatigue and corrosion in NaOH solution.

For all method results it is clear that corrosion is effected negatively physical properties of Aliminum alloys. Also, corrosion time is important for matrices and surface corrosion is obtained for three alloys with increasing corrosion time. This surface corrosion is about reinforcement elements, temperatures sometimes.

It ıs seen that Aliminum alloys (Al7075, Al061 and Al2024), which are consist of Mg element is slowly increase corrosion resistance and while adding other elements especially SiC, the mechanical properties are very well for three different corrosion methods.

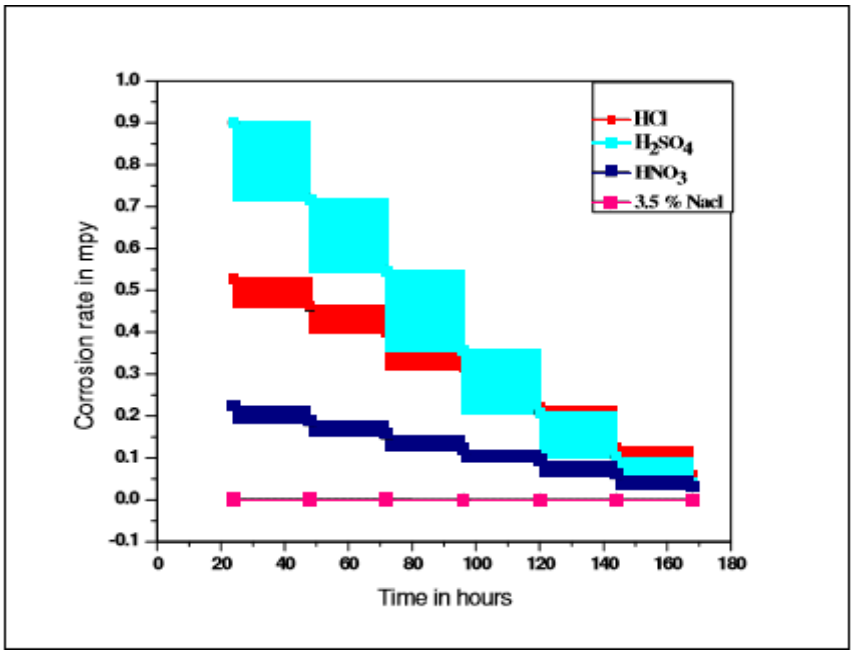

Figure 1. Weight loss corrosion test of Al 7075 alloy in different mediums.

As seen in Figure 1. Manjunatha and friends work's weight loss corrosion test results of Al7075, in NaCl, Sulfuric acid, Acid Nitrare and hydrochloric acid solutions. In NaCl solution, there is no corrosion rate. The maximum corrosion rate is obtained from sulfuric acid solution. In hydrochloric acid and acid nitrate solutions is also obtained high corrosion rate for Al7075 alloy.

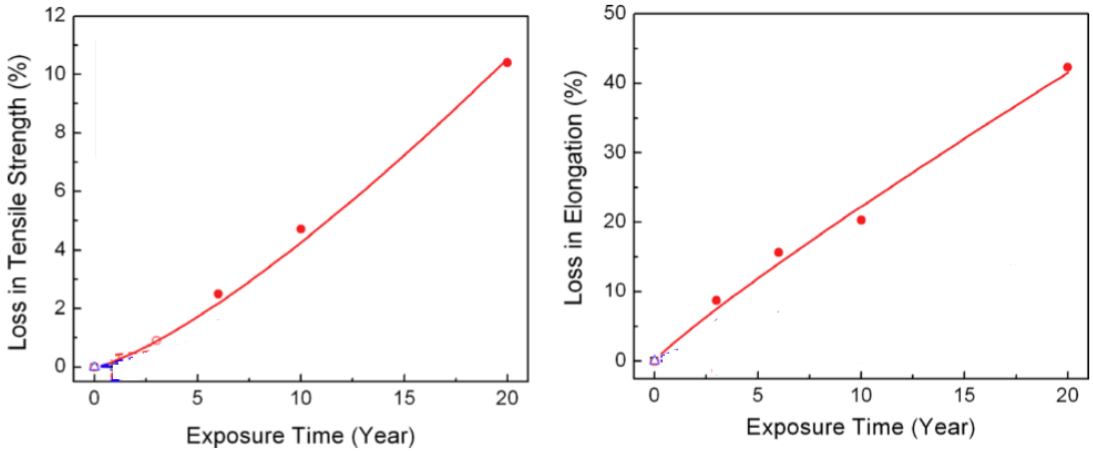

Figure 2. Losses in tensile strength and elongation for 7075 versus exposure time at wight loss method.

Tensile strength is important property for matrices and it is decreased with increaing corrosion rate and also corrosion rate is effected elongation. When the weight loss method is used in Al7075 alloy corrosion rate is effeccted mechanical properties. This method is effected negatively more than the others.

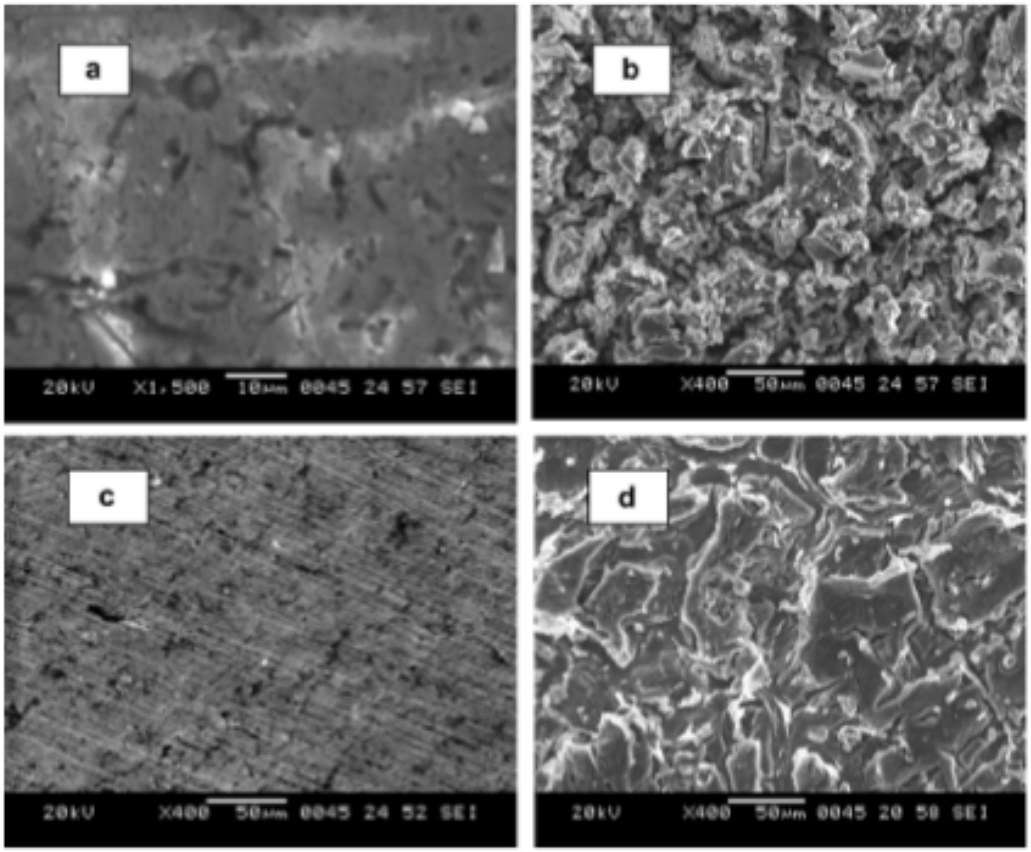

Figure 3. SEM image of Al6061 freshly polished surface of the composite (b) after immersion in 0.5 M NaOH. (c) Freshly polished surface of the base alloy (d) after immersion in 0.5 M NaOH.

As seen in (Figure 3.) SEM photos of composite surface and alloys photos which are in 0.5 M NaOH solutıon. It ıs clear that NaOH is formed high corrosıve medıum for Aluminum. Composıte samples are corrosive uniformly. The corrosion rate of Al-6061 increase with the increase in the concentration of sodium hydroxide. Also, it is observed the corrosion rate of Al6061 increase with the increase of temperature.

With multiaxial-fatigue corrosion method mechanical properties of Al2024 is also studied. Tensile strength, fatigue strength, tear strength and elongatıon values are seen in Figure 4. It ıs clear that increasing corrosion time of specimens loss in physcial properties are increasd also.

2024 under pre-corroded condition, multiaxial fatigue life decreases gradually with the increase of corroson time. With increasing corrosion time, stress concentration of specimens are increase.

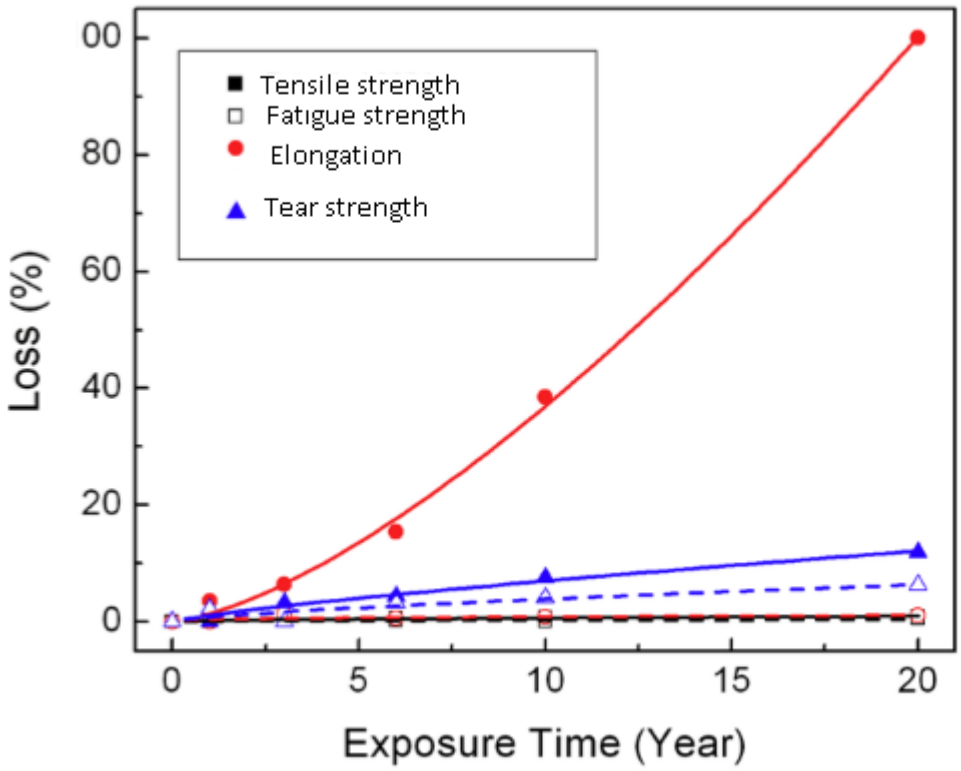

Figure 4. loss ın mechanical properties of Al2024 alloy.

It has been reported that the corrosion resistance of Al matrix composites depends on many factors such as proceessing technique; type and charasteristic of the matrix alloy; type, size, shape and amount of the reinforcement; the type of corrosive media, and the environmental factors. The fabricaion and processing of matrix composites sometimes lead to the formation of an interphase between the matrix and the reinforcements, which can also influence corrosion (Bedir 2015).

Some investigators have concluded that the increased corrosion rate is due to the formation of Al alloys at the reinforcement interface. It has been reported that the einforcing phase, in this work SiC is used reinforcement element, can also affected the corrosion behaviour of matrices by modifying the distribution of intermetallic phases in Al alloys (Zakaria 2014).

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