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# Evaluation of Corrosion Studies of as Casted Aluminum 6065 Metal Matrix Composite by Weight Loss Method

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***Abstract:***
*Aluminum matrix composites (AMCs) are a range of advanced engineering materials that can be used for a wide range of applications within the aerospace, automotive, biotechnology, electronic and sporting goods industries. AMCs consist of a non-metallic reinforcement (SiC, Graphite etc.) incorporated into Aluminum matrix which provides advantageous properties over base metal (Al) alloys. These include improved abrasion resistance, creep resistance, dimensional stability, exceptionally good stiffness-to-weight and strength-to-weight ratios and better high temperature performance. Present paper involves the study of corrosion properties of aluminum metal matrix composites and unreinforced alloy. AMCs is prepared using Silicon Carbide and Graphite. Al 6065 series alloy is used to prepare composite with varied percentage of SiC (0, 2, 4%) and hybrid composite with equal amount of SiC and Graphite is prepared by liquid metallurgy technique using vortex method. The corrosion studies were carried out by weight loss method by immersing the specimen for 24 hrs., in various corrosion medium such as acid chloride, acid sulphate and neutral mediums. Results indicate that hybrid composite shows more resistance to corrosion.*

***Keywords:*** *Aluminum, composites, silicon carbide, graphite, corrosion rate*

## 1. Introduction
Aluminum and its alloys are used in a large number of applications due to their excellent combination of properties e.g.good corrosion resistance, thermal conductivity, high strength to weight ratio, easy to deform and high ductility. Aluminium alloys have been generally used in manufacturing automobile and aircraft components because of high strength to weight ratio in order to make the moving vehicle lighter, which results in saving in fuel consumption [i-iii]. Composite materials usually refer to a combination of several materials that provide unique combination of properties which cannot be obtained by the individual constituents acting alone [iv, v]. Metal matrix composites consists of two components, one is metal matrixand the second component is reinforcement. The matrix is defined as a metal in all cases, but a pure metal is rarely used as a matrix. It is generally an alloy. In the productivity of the composite, the matrix and the reinforcement are mixed together. SiC is used as reinforcement in the form of particulates, whiskers or fibres to improve the properties of composite. Current work involves the study of corrosion behaviour of Aluminium 6065 metal matrix composites reinforced with SiC and Graphite. Metal matrix composites are produced by liquid metallurgy technique using vortex method. Pitting corrosion experiments are conducted to know the corrosion resistance of SiC and graphite reinforced Al (6065) metal matrix composites in acid chloride, acid sulphate and neutral chloride mediums [vi, vii].

## 2. Experimental Method and Materials Selection
The material selected for the present research work is Aluminum 6065 alloy which is commercially available. Its composition is given in table 1.

| Cu | Fe | Mg | Si | Zn | Ti | Bi | Zr | Cr | Mn | Al |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.274 | 0.4 | 1.028 | 0.609 | 0.06 | 0.06 | 1.25 | 0.12 | 0.03 | 0.05 | 96.11 |

*Table 1: Composition of Al 6065 alloy(wt%).*

The mediums used for corrosion testing are 0.1M solutions of acid chloride, acid sulphate and 3.5% neutral chloride. The method used for corrosion characterization is static weight loss corrosion method.

**3. Composite Preparation**

Matrix selected is Al 6065 which is procured in the form of Ingots. Ingots are melted using electrical resistance furnace. Mechanical stirrer is inserted into molten metal and rotated to create vortex. SiC particulates are added to vortex and stirring was done. The molten composite was taken out of furnace and poured in to sand moulds in the form of cylindrical rods in order to obtain 2, 4% MMC and hybrid composite. Hybrid composite is obtained by adding equal quantities of SiC and graphite into the vortex. 0% Al 6065 alloy is prepared without adding SiC/graphite into the vortex.

**4. Specimen Preparation**

The specimen is prepared from the bar castings in the form of cylindrical size of 20 mm x 20mm and the specimens are thoroughly polished with different grade emery papers, finally it is washed with acetone and dried.

**5. Experimental Details**

Corrosion tests was conducted at room temperature using static weight loss method. The prepared cylindrical shape specimens were weighed initially using four decimal balance and immersed in different mediums of 0.1M acid chloride, 0.1M acid sulphate and 3.5% NaCl for 24 hours. The specimens were taken out from the solution and thoroughly washed with water followed by acetone and dried in oven for 10minutes. Weights of the specimens were measured using four decimal balance. The same process is continued for seven days. Weight loss was calculated and converted into corrosion rate expressed in mils penetration per year (mpy). Corrosion rates were evaluated using formula.

Corrosion rate = **534 W / DAT.**

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

**6. Results and Discussions**

Fig. 1-7 shows the corrosion rate of composites with different percentage of SiC composites reinforced with SiC and graphite particulates.

Fig. 1-3 shows hybrid composite shows more resistance towards corrosion in all the three mediums.

Fig. 4-7 shows that Al 6065 alloy, 2%, 4% and hybrid composites are more corroded in acid sulphate medium.

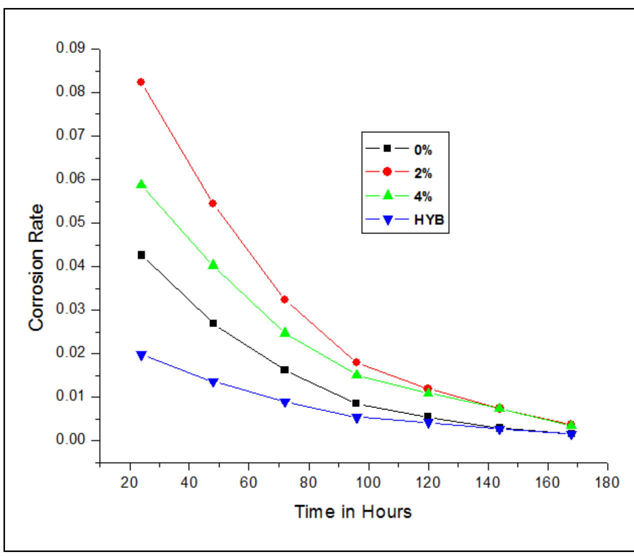


*Figure1: Corrosion rate of Al6065 alloy and its composites in HCl*

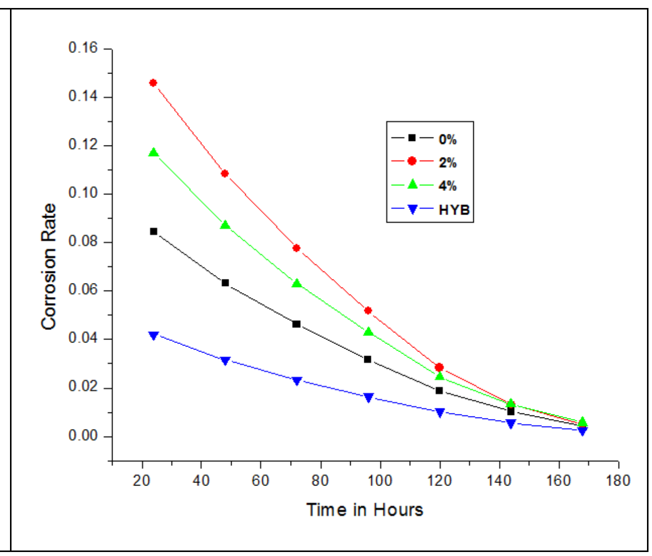


*Figure 2: Corrosion rate of Al 6065 alloy and its composites in $H_2SO_4$*

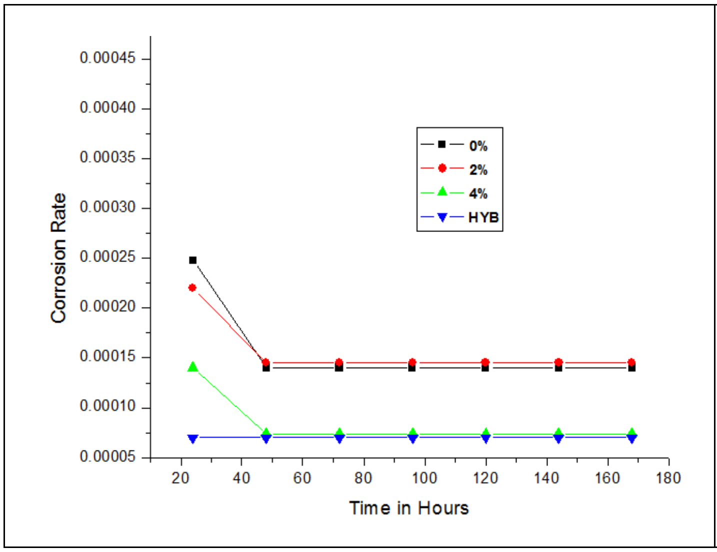


*Figure 3: Corrosion rate of Al6065 alloy and its composites in NaCl*

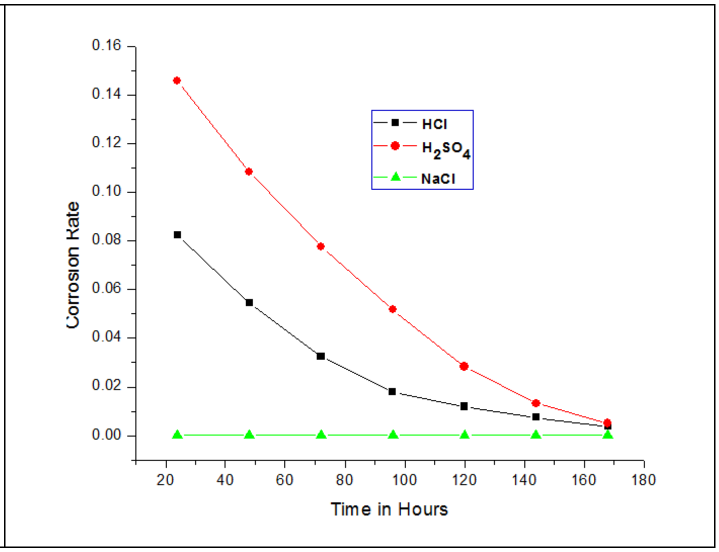


*Figure 4: Corrosion rate of Al 6065 alloy*

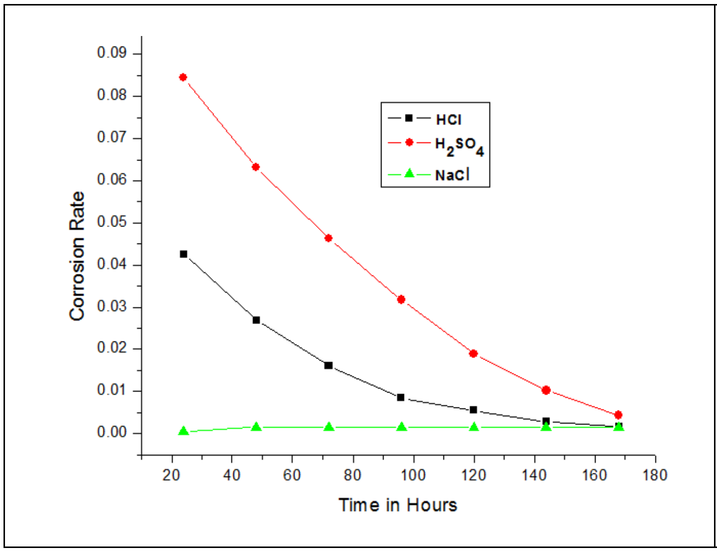


*Figure 5: Corrosion rate of 2% Al 6065 Composite*

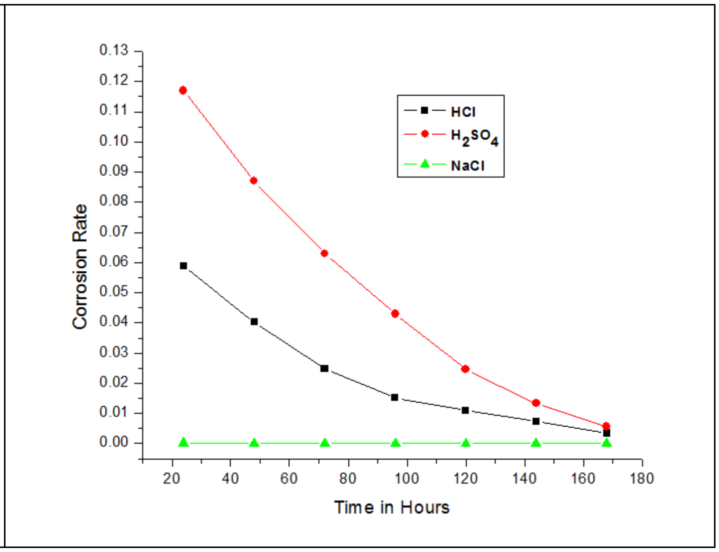


*Figure 6: Corrosion rate of 4% Al 6065 Composite*

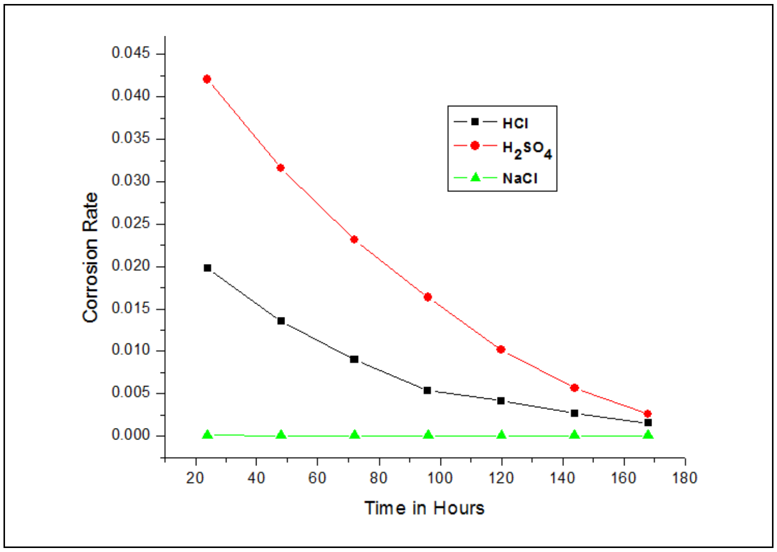


*Figure 7: Corrosion rate of Hybrid Al 6065 Composite*

## 7. Conclusion

The Silicon Carbide content in Aluminum 6065 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 there by significantly increased. Aluminum 6065 MMCs when reinforced with Silicon Carbide of weight percentage from 0 to 4% & hybrid are successfully produced by liquid melt metallurgy technique.

## 8. Acknowledgements

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