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Research Paper

AN APPROACH FOR IMPROVING WEAR RATE OF ALUMINUM BASED METAL USING RED MUD, SIC AND Al_2O_3 MATRIX COMPOSITES

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In this paper we describe the behavior of Metal matrix composites. As we know that these metal matrix composites are used mostly in liberty ships, aerospace, automotive, and nuclear. In the present paper the study on sharp show off activities of Aluminum metal matrix composite reinforced with Red Mud, SiC and Al_2O_3 has been carried out. There are various production technique offered where the value fraction of reinforcements could be inflamed and are likely to vary the wear performances of the composite. Composites posses excellent Strength and Stiffness and this describes that these are very light Materials. So this paper describes that these possess high resistance to oxidization, chemicals and other weather agents. Our paper also describes the advantages of MMC's as it provides Dimensional stability, Wear and Corrosion resistance, Reduced Weight. As we know that Red mud emerges as the major waste material during production of alumina from bauxite by the Bayer's process. Enormous efforts have been directed worldwide towards red mud management issues, i.e., of utilization, storage and disposal. Different avenues of red mud utilization are more or less known but none of them have so far proved to be economically viable or commercially feasible. It is studied that micro hardness and resistance to wear of MMCs is produced by reinforcement and also the wear properties are improved remarkably by introducing hard intermetallic compound into the aluminum matrix.

Keywords: Red mud, SiC, Al_2O_3, MMC

INTRODUCTION

A composite material is a material composed of two or more constituents. The constituents are combined at a microscopic level and are not soluble in each other. Generally, a composite material is composed of reinforcement (fibers, particles/particulates, flakes, and/or fillers)

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embedded in a matrix (metals, polymers). The matrix holds the reinforcement to form the desired shape while the reinforcement improves the overall mechanical properties of the matrix. When designed properly, the new combined material exhibits better strength than would each individual material. The most primitive man-made composite materials are straw and mud combined to form bricks for building construction (Prasad and Acharya, 2006; and Narinder *et al.*, 2010). Composites posses excellent Strength and Stiffness. They are very light Materials and they possess high resistance to corrosion, chemicals and other weathering agents. They have High strength to weight ratio (low density high tensile strength), High creep resistance, High tensile strength at elevated temperature and high toughness.

For many researchers the term metal matrix composites is often equated with the term light Metal Matrix Composites (MMCs). Substantial progress in the development of light metal matrix composites has been achieved in recent decades, so that they could be introduced into the most important applications. In traffic engineering, especially in the automotive industry, MMCs have been used commercially in fiber reinforced pistons and aluminum crank cases with strengthened cylinder surfaces as well as particle strengthened brake disks. These innovative materials open up unlimited possibilities for modern material science and development; the characteristics of MMCs can be designed into the material, custom-made, dependent on the application (Veeresh *et al.*, 2010).

MATRIX AND MATRIX MATERIAL

The matrix is the monolithic material into which the reinforcement is embedded, and is completely continuous. This means that there is a path through the matrix to any point in the material, unlike two materials sandwiched together. In structural applications, the matrix is usually a lighter metal such as aluminum, magnesium, or titanium, and provides a compliant support for the reinforcement. The most common matrix materials used in composite are as follows:

- Aluminum matrix
- Copper matrix
- Titanium matrix

OBJECTIVES OF METAL MATRIX COMPOSITES

Increase in yield strength and tensile strength at room temperature and above while maintaining the minimum ductility or rather toughness.

REINFORCEMENT

The role of the reinforcement in a composite material is fundamentally one of increasing the mechanical properties of the neat resin system. All of the different particulates/fibres used in composites have different properties and so affect the properties of the composite in different ways. The desirable properties of the reinforcements include:

- High strength
- Ease of fabrication and low cost
- Good chemical stability
- Density and distribution

Red Mud as Reinforcement

Red mud is the caustic insoluble waste residue generated by alumina production from bauxite by the Bayer's process at an estimated annual rate of 66 and 1.7 million tons, respectively, in the World and India (Prasad and Acharya, 2006) (Figure 1). Under normal conditions, when one ton of alumina is produced nearly a ton of red mud is generated as a waste. This waste material has been accumulating at an increasing rate throughout the world.

Figure 1: Red Mud Structure

Need for the Reinforcement of Red Mud into Aluminium Matrix

The chemical analysis showing that Red Mud contains silica, alumina, iron oxide, calcium, titanium as well as an array of minor constituents, namely: Na, K, Cr, V, Ni, Ba, Cu, Mn, Pb, Zn, etc. The variation in chemical composition between different red muds worldwide is high.

MICRO HARDNESS MEASUREMENT

A micro hardness tester MVH-1is used for the micro hardness measurement. The surface being tested generally requires a metallographic finish and it was done with the help of 100, 220, 400, 600 and 1000 grit size emery paper. Load used on Vicker's micro hardness tester was 200 grams at 10X optical zoom with dwell time 20 seconds for each sample.

The result of Vicker s Micro hardness test for alloy 6061 without reinforcement (Sample No. 1) and the wt.% variation of different reinforcements such as SiC, Al_2O_3 and Red Mud in Al alloy 6061 MMCs (Sample No. 2-13) are shown in Table 1.

Table 1: Micro Hardness Measurement

Sample No.	Sample Name (Al alloy 6061+)	Mean Micro Hardness No. (VHN)
1	Pure (Base Alloy)	49.7431675
2	2.5% Sic	57.3006500
3	5% SiC	65.7694000
4	7.5% SiC	92.7731000
5	10% SiC	100.2060250
6	2.5% Al_2O_3	90.4551500
7	5% Al_2O_3	99.4015000
8	7.5% Al_2O_3	109.6999250
9	10% Al_2O_3	110.8675000
10	2.5% Red Mud	60.2283570
11	5% Red Mud	76.6930125
12	7.5% Red Mud	114.2908000
13	10% Red Mud	104.0187500

CONCLUSION

It is concluded that stir formed Al alloy 6061 with Red mud, SiC and Al_2O_3 reinforced composite is undoubtedly finer to base Al alloy 6061 in the comparison of micro hardness, i.e., the micro hardness increases after addition of SiC, Al_2O_3 and we conclude that the Red Mud particles in the matrix. Red mud, the waste generated from alumina production

can be successfully used as a reinforcing material to produce Metal-Matrix Composites (MMCs). It can be replaced by other expensive reinforcement materials such as SiC and Al_2O_3. Thereby saving of expensive reinforcements could be achieved.

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