Machinability Study on Aluminium Alumina Composites

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ABSTRACT

In this paper processes for fabrication of aluminium-alloy composites containing paniculate non-metals, the net shape forming of these composites, their microstructures, their friction and wear behaviours and their mechanical properties are described. Composites of two wrought (2014 and 2024) and one cast (201) aluminium alloys containing 2 to 30 wt% of Al_2O_3 and SiC particles in the size range of 1 to 142μm were prepared. The non-metallic particles were added to a partially-solid vigorously-agitated matrix alloy. The particles were then retained in the matrix until interface interaction, for example, the formation of $MgAl_2O_4$ spinel in the case of Al_2O_3 particles, were faciliated. These composites were solidified and subsequently reheated to above their liquidus temperature and formed under high pressure in a closed-die forging type of apparatus. Composites with particulate additions of size larger than 5μm possessed homogeneous structures; particles of size 1μm, however, tended to cluster. The wear behaviour of the composites was studied using a pin-on-disc type machine. It was shown that composites containing large amounts of non-metals, ≈ 20 wt%, exhibit excellent wear resistance whilst those with small to moderate amounts of non-metals possess tensile properties comparable to the matrix alloy. Increasing the amount of particulate additions results in reduced ductility. Finally, a method was investigated of producing components with high weight-fractions of non-metals near their surface.

1. INTRODUCTION

Composite materials continually displace traditional materials in engineering. A composite material is a combination of two or more phases that are chemically distinct and insoluble; its properties and structural performance are superior to those of the constituents acting separately. The extensive use of composites will contribute to significant material and energy savings and, in several cases, it minimizesenvironmental pollution. Aluminium and its alloys occupy a third largest place among the commercially used engineering materials. New materials used in recent times are the aluminium metal matrix and hybrid composites (AMMHCs), which have the capacity to meet the demand for advancement in processing applications. Composites of aluminium matrix offer improved mechanical and tribological properties over conventional metals and are currently considered as potential lightweight material and well suited in the automotive, space, aircraft, defense, and other engineering sectors. Because of its high strength to weight ratio, high tensile strength, durability, high wear resistance it pursued composites of the metal matrix. In the preparation of metal matrix composites, several need to be considered, including the difficulty of achieving a uniform distribution of matrix reinforcement, high processing costs with methods other than casting, availability of low-cost reinforcement and, if required, composite machining after fabricating of product. The most widely used reinforcement materials in recent times are SiC, Al_2O_3, TiB_2, B_4C along with some fewer research reported on organic powders such as fly ash, rice husk, coconut husk, lignite ash to achieve a better combination of properties. The present paper reviews the recent development for the manufacturing of AMMCs, various processing methods, processing parameters, and mechanical propertiesto the synthesis of AMMCs composites.

2. LITERATURE SURVEY

Aminum metal matrix composite have the potential to replace the conventional materials because of obtaining superior properties such as high specific strength, high stiffness, high hardness, high wear and resistance
low density. In the past three decades composite materials were playing a vital role in various sectors especially in
aeronautical, avionics and automotive sectors. The present works dealt with the mechanical behaviour of aluminum
metal matrix reinforced with graphene particles in different weight fractions such as 0.33%, 0.55% and 0.77% were
prepared by stir casting method. The result revealed that 0.33% weight fraction of graphene is recommended for obtaining optimum results by stir casting process.

3.PROBLEM DEFINITION

Aluminium matrix composites (AMMCs) are considered to be new generation potential materials for many engineering applications. kinds of reinforcement have been infused into the aluminium matrix in order to improve hardness, toughness, stiffness, wear resistance, fatigue properties, electrical properties and thermal stability as compared to their conventional unreinforced counterparts. The characteristics of AMMCs depend largely upon the type of reinforcement materials, interface bonding and processing parameters. In this article we have attempted to investigate the development of aluminium metal matrix composites (AMMCs) along with associated challenges and significant application areas.

4. EXISTING METHOD

Aluminium composite panels may be made in a variety of ways. Cold composite technique and heat composite method are two types of composite methods for plastic core panels and two-sided aluminium panels, respectively

1. PROPOSED METHOD

The composite panel is produced by a continuous lamination process, in which a sheet of the material that will make up the core is extruded and compacted between two aluminium sheets that are unwound at the same time. Finally, the flatness of the material is compacted and perfected and a protective film is applied.

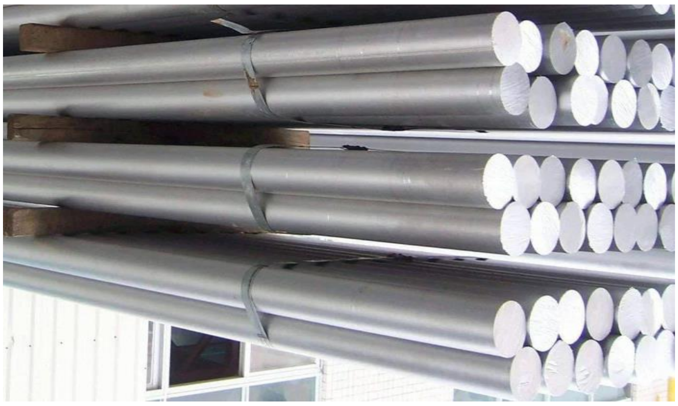
6. MATERIALS USED

- Aluminium alloys 28%
- Alumina Qxibe powder 11%
- Harded steels 35%
- Low hardner steel 11%
- Copper 15%

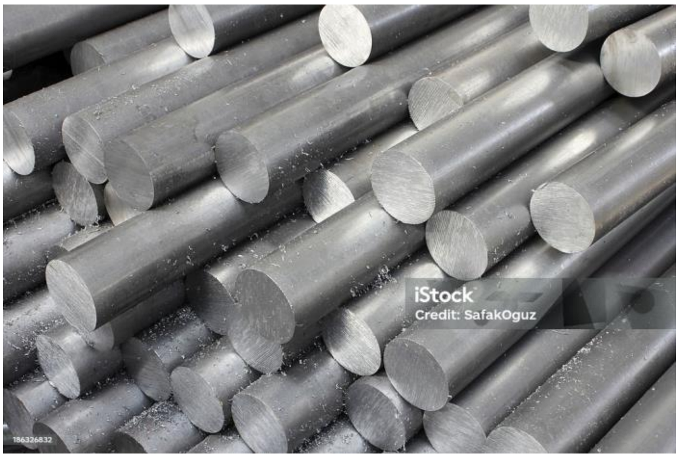
7. METHODOLOGY

PROBLEM IDENTIFICATION
↓
MODIFICATION
↓
RESEARCHING METHOD
↓
PROPOSED SYSTEM
↓
MACHINING
↓
APPLICATION

8. 3D DESIG



9. MODEL



11. CONCLUTION

The microstructure of cast Al6082, and the microstructure contains solid solution of aluminium and inter-dendritic network of aluminium silicon eutectic. The microstructure of cast Al6082 (Fig. 1(b)) reveals the formation of α-aluminium dendritic network structure which is formed due to super-cooling of casting during solidification, with less impurities present. The SEM image of manufactured composites is shown in Fig. 2(a)–(d). The microstructure of all composites reveals that there are large impurities with a non-uniform distribution of Gr particles along with clustering of Gr particles at some locations. The low density of Gr particles as compared to that of Al6082 causes the Gr particles to float in the aluminium melt resulting in non-uniform distribution. The microstructures of all composites contain solid solution of aluminium and inter-dendritic network of aluminium silicon eutectic. When the composites are solidifying, the Gr particles are prohibited in the direction of refined α-Al grains. Because of this, the further refinement of α-Al grains takes place and Gr particles act as nucleus on which the α-Al grains solidify and Gr particles offer confrontation against growing α-Al phase during the solidification process.

12. ACKNOWLEDGEMENT

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