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Studies on properties of as-cast Al6061-WC-Gr hybrid MMCs

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Abstract

Aluminum (Al) alloys started replacing cast iron and bronze alloys in the manufacture of wear-resistant parts and are materials of interest owing to their low density, higher strength to weight ratio, which is an additional advantage in aerospace, marine and automotive applications. Al-metal matrix composite (MMC) materials are very much popular due to the reason that these composites possess good mechanical properties and higher wear resistance. This article is aimed to present the experimental results of microstructure, hardness, tensile, yield and compression strength, percentagage elongation, volumetric wear loss, and wear rate of Al6061-Tungsten Carbide (WC)–Graphite (Gr) reinforced hybrid MMCs. The composites were prepared using the liquid metallurgy technique, in which 0 to 4 wt% of WC particulates were dispersed into the matrix alloy in steps of 1 wt% by maintaining the Gr to 4 wt% constant. The experimental results indicate that the density of the hybrid-MMCs increases with increased WC content and further, agree to the values obtained through the rule of mixtures. The physical, mechanical and the tribological properties of the Al6061-WC-Gr hybrid MMCs were found to increase with increased WC content in the matrix at the cost of reduced ductility. The WC and Gr reinforcements contributed significantly in improving the wear resistance of Al6061-WC-Gr hybrid MMCs.

Keywords

Hybrid metal matrix composites, mechanical properties, dry sliding wear

Introduction

Aluminum alloys are the commonly used matrix materials for the preparation of the Al-based composite materials. Al6061 is heat treatable, highly corrosion resistant and possess excellent extricable and have moderate strength. Al6061 alloy is used in applications like building and construction, high way, automotive, and in marine applications.[1] They are widely used as high-speed rotating or reciprocating mass items such as pistons, connecting rods, drive shafts, brake rotors, and cylinder bores.[2] Compared with the corresponding monolithic alloys, Al-MMCs are attractive because of their improved strength, stiffness, creep behavior, wear resistance, and low thermal expansion.[3] Moreover, they are lightweight and their applications will be greatly expanded in the near future if problems like cost and fabricating are well resolved.

From the recent past there has been several studies on the wear behavior of Al-based hybrid MMCs, which are reinforced with more than one species of reinforcing phases such as Al_2O_3, SiC, C, or Gr, having different forms, such as particle, whisker, long or short fiber. In all the investigations, an improvement in wear resistance has been reported for the hybrid composites as compared to the composites reinforced with a single species. The introduction of a small volume fraction of hard reinforcements into the matrix materials has been reported to improve wear resistance. Researchers observed that the addition of SiC particles to Saffil short fiber reinforced Al-MMCs gives rise to a remarkable improvement in wear resistance. They attributed it to the considerable reduction in the change in

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