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An investigation on mechanical properties of AA336/Al_2O_3 composites by Duralcan process

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Abstract

The Duralcan technique was utilized to manufacture nanocomposites of aluminium metal matrix and Al_2O_3 nanoparticles. It is a form of stir casting in which metals and ceramics are layered one on top of the other and composites are formed by a heating and stirring process. The composite was composed of nano Al_2O_3 at weight percentages of 1%, 1.5%, and 2.5%, respectively. The wear test was conducted through a pin on the disc, and the frictional force analysis is also performed. The effect of the Al_2O_3 content in the matrix on the wear characteristics was investigated.

Introduction

The most common materials used to make pistons are alloy steel, cast iron, aluminium alloys, including aluminium–silicon alloys. Aluminum alloys are known for their machinability and formability properties. Among other disadvantages, these alloys have a high thermal expansion coefficient, deprived hardness, and deprived strength indices at elevated temperatures [1], [2], [3]. Cast-iron pistons are typically used due to their slide properties, their ability to retain mechanical properties at preeminent temperatures, and their low coefficient of thermal expansion. Due to their low heat conductivity and high density, cast-iron pistons cannot be used in modern high-speed engines. A synthesis of two or more radically dissimilar materials, which are superior in particular to the original substances, can be used to overcome these properties by a composite material consisting of one or more mixtures [4], [5], [6], [7]. Composites with particle reinforcements in aluminium metal matrix (Al-MMCs) are regarded as the promising alternative to provide better wear resistance to aluminium alloys. Increased wears resistance has been reported by the addition of silicon carbide and alumina into aluminium matrix. Various other types of reinforcement have been stated as effective reinforcements to improve the tribological possessions of aluminium-based alloys such as aluminium nitride, garnets, boron carbide, titanium dioxide and cerium dioxide. Wear resistance has increased due to the reinforcement phase's high hardness and strength, increasing the reinforcement content [8], [9], [10], [11], [12], [13], [14]. Earlier, several authors studied the interaction of metal matrix composites with various friction and wear aspects sliding distance, like applied load and reinforcement percentage. Taguchi analysis and variation techniques have been employed by a variety of researchers to isolate parameters affecting wear and friction. Wear behaviour, with an add-on of 5 percent graphite and addition of up to 8 percent Al_2O_3, of the A7075/graphite/ Al_2O_3 hybrid composites reported decreases in the friction coefficient. The friction coefficient in pure aluminium reinforced particulate matter decreases by up to 5 percent as sliding speed and sliding distances increase. Various studies have revealed that various field, wear parameters and processes affect AMC wear and coefficient of friction. In terms of wear, frictional performance, not all composites exhibit a uniform pattern of change in wear parameters [15]. The objective of this paper is to study the impact of Al_2O_3 reinforcement in AA336/ Al_2O_3 Composites Produced by Duralcan Process.

Section snippets

Matrix alloy

The alloy used in this study is AA336, which is a widely used aluminium casting alloy. AA336 has fewer tendencies to drag than with high silicon alloys containing no other alloying elements. In normal atmospheric conditions, AA336 alloy has high corrosion resistance. However, anodic treatment will affect the considerable increase in corrosion resistance; when the alloy is a heat-treated solution, a small increase in resistance will be achieved. Chromic acid treatment will produce a resistant…

Results and discussion

Abrasive and erosive wear processes where wear is essentially critical to particle size, distribution, incidence angle and particle velocity in erosive wear must be modelled in its full scale, although this can be done in a properly designed trial [16], [17], [18], [19], [20], [21]. Fig. 3 shows the Pin–On disc apparatus setup. Wear testing was conducted on a flat-on-cylinder machine in dry sliding conditions at a constant velocity of 0.24 m/s over a 60 mm distance. Deadweight loads in the…

Conclusion

Aluminium metal matrix composites reinforced with nano Al_2O_3 were prepared using the duralcan process. Using a pin on disc apparatus, the fabricated composites were tested for dry sliding wear behaviour at room temperature. As compared to MMNCs with reinforcements of 1 percent and 1.5 percent, the MMNC with 2.5 percent reinforcement demonstrated higher resistance to wear rate. After 250 s, the 2.5 percent nanocomposite increases the friction force since all nanoparticles are attempting to…

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.…

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