Wear Optimization of Aluminium and Hybrid Reinforcement Metal Matrix Composites Using Response Surface Methodology

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Abstract

Aluminum 6061 alloy-based alloys were used to make various motor vehicle parts such as connecting wire, O-ring, circular blocks, disc brakes and aircraft primary components, but the use of alloys was restricted in some of their applications due to their low strength, poor stiffness and high friction wear resistance. Hybrid Aluminium Metal Matrix Composites are achieved the potential mechanical properties compared to single reinforced composite materials. Tribological behaviour of hybrid composites were optimized by Response Surface Methodology (RSM) using Design of experiment statistical analysis. The contribution of various parameters rotational speed, sliding distance and axial load on hybrid composite materials were evaluated by Analyses of Variance (ANOVA). For each output response, a multilayer linear equation was used to examine the relationship between the parameters. According to the results, hybrid compounds provide greater adaptability and reliability in the development of a component of the product depending on the reinforcement composition and structure.

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Wear Optimization of Aluminium and Hybrid Reinforcement Metal Matrix Composites Using Response Surface Methodology

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Introduction

Aluminum AA6061 hybrid reinforcement composites are plays important role in various industrial applications such as automobile (engine components), safety, construction and aircraft structures due to the development in properties. The aluminium alloy properties are reduction in weight, high corrosion resistance, enhanced thermal properties and high wear resistance [1,2]. The lifespan of the materials is affected by a wide range of factors, and the composition used has a significant impact on the quality of life. The choice of material for the appropriate application will vary based on the price of the material, the estimated density, strength, modulus and functional parameters.

Reinforcement metal oxides silica, B_4C, SiC, BN and TiN are used to form alloy matrix alloys [3,4]. Aluminium metal matrix composites of tribological characteristics such as wear and friction contribute a significant role while the manufacturing process as reported by the previous researches [5,6]. The moving and rotary parts that are designed to operate in greasing circumstances might ultimately have to operate in semi-lubricated or dry wet conditions. As a result, wear increases due to high operating temperature fluctuations, leading to replacement of mechanical components during operation. As a result, it is one of the main problems to be considered in trying to extend the life of a broken material. Hybrid composite materials are selected as alternatives to compounds in the dry lubricate conditions.

Uvaraja et al 2012 examined the varying wear parameters such as sliding speed, applied load, sliding distance and different volume fractions on AA6061 aluminium reinforced with B_4C and SiC composites [7]. The results show that 10 wt% SiC and 3% B_4C have better wear resistance. Also, the measured hardness values are higher than those of pure aluminum alloys. The addition of 5% SiC and 15% B_4C to AA6061 alloys had significant effects on the interface. Radhika et al 2011 improved the wear parameter such as load, sliding distance and sliding speed used by ANOVA using the Response Surface System (RSM) respectively for the coefficient of friction and the rate of wear. The prediction ‘smaller the better’ have used to analyse the wear performance of aluminium-based metal matrix composites [8,9].

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