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Investigation of wear behaviour of magnesium reinforced with boron nitride nanocomposite using ANN

The present study aims to study the wear behaviour of Mg reinforced with boron nitride nanocomposite. The dry sliding wear behaviour of Mg reinforced with boron nitride (0.5 wt.%) is reviewed by following ASTM standards G99, i.e., dry sliding on pin-on-disk wear test apparatus. Three wear parameters, namely load, sliding speed, and sliding distance, were considered in this study. The experiments for wear rate have been conducted as per ASTM standards G99. The wear rate obtained for Mg reinforced with boron nitride (0.5 wt.%) is predicted by the ANN toolbox of Matlab R2021a using the Levenberg-Marquardt (trainlm) algorithm, which trains the feed-forward neural network having 3-5-1 (three input neurons, five hidden neurons in the single hidden layer and one output neuron). Experimental data sets obtained from the pin-on-disk wear test have been utilized to develop ANN. The results concluded that the error for wear loss of Mg reinforced with boron nitride (0.5 wt.%) lies within 20%, with an average percentage error of 2.6% between experimental values and ANN predicted values.

Keywords: Mg nanocomposite, wear rate, and (ANN) artificial neural network.

1.0 Introduction

Mg is the lightest metal, making it very useful for the automobile, aerospace, and transportation sectors. Its potential is to dramatically reduce the weight of components that would otherwise be made from aluminum, which is 65% denser than magnesium [1, 2]. The addition of reinforcement to magnesium and its alloys improves its strength and stiffness. In any case, at room temperature these materials have very low flexibility compared to other materials and limit their broad applications [3–5].

Magnesium will watch out of the overwhelming majority of the problems checked out by enterprises during which the strength to weight proportion is significant, as an example, the car, space, and telecommunication industries. The literature shows that Mg usage is continually increasing and may be expected to still grow within the future [6,7]. Metal matrix composites produced by adding ceramic materials for reinforcement exhibit improved mechanical properties, including structural, wear, and creep properties, among others, and thereby find many applications. An MMC's properties mainly depend upon matrix material, particle size, and materials used to reinforce and manufacture the composite [8]. The main drawbacks of magnesium and its alloys are wear and consumption protections. From all the problems, wear is the most predominant problem in mechanical segments, prompting a lessened lifetime for magnesium-based parts and making magnesium unsuitable for use in bearings, gears, pistons, and cylinders [9–11].

The reinforcement stage in MMC's can be a particle, continuous and tiny fiber. Among these, particle-reinforced MMC's are isotropic and easier to fabricate. Its high damping capability associate degreed stiffness Mg are fortified with an assortment of ceramic particulates, as an example, Al2O3, zinc oxide, TiC, SiC, B4C, TiB2. Among these ceramic particulates, Al2O3 and twitching have emerged as exceptional creative fortifications because of their distinguished mechanical, optical, and electrical properties and intensive type of uses. [12-14].

Magnesium could be a better metal than Al and Ti in terms of its physical properties, as well as process, machining, and exercise properties, which might staggeringly cut back continual prices [17]. Even though friction and wear rate depend upon several factors, like applied load, sliding speed, material type, specimen geometry and surface roughness, it is ascertained with sliding speed and load had a considerable influence on the wear and tear rate [19-22]. Venkatesha, B K et al. [27, 29, 30] studied the mechanical properties of hybrid composites. In light-weight of this distinctive state of affairs, this analysis work aims to check the wear behaviour of Mg reinforced with boron nitride nanocomposite.

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