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Sensor-Assisted Assessment of the Tribological Behavioral Patterns of Al–SiCp Composites under Various Environmental Temperature Conditions

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Abstract: Currently, the use of sensors and supporting technologies has become indispensable in the assessment of tribological behavioral patterns of composites. Furthermore, the current investigation focused on the assessment of the tribological behavior of the Al–SiCp composite for high-temperature applications. Moreover, the Al–SiCp composite was fabricated by adapting the liquid metallurgy route with varying weight percentages of SiC_p (x = 3, 6, and 9). Density, hardness, and high-temperature wear tests were performed to evaluate the hardness and tribological characteristics and properties of modern-day advanced composites. Moreover, the inclusion of SiC_p enhanced the advanced composite materials hardness from 60 HV to 110 HV due to a high degree of refinement of the α-phase. Subsequently, the fabricated samples' wear behavior was assessed by varying the wear parameter viz. the applied load (20 N and 30 N) and sliding distance (250 m, 500 m, 750 m, and 1000 m) with the constant sliding velocity (0.45 m/s) for various temperatures (40 °C, 150 °C, and 250 °C). Moreover, the results revealed that the enhancement in the reinforcement percentage improves the wear resistance. Consequently, the wear rate decreased at 250 °C, possibly owing to the development of the oxide layers. Therefore, the occurrence of delamination and plastic deformation were evidenced in the wear-out surface, thereby depicting the prevalence of delamination and the abrasive wear-mechanism.

Keywords: aluminum; SiC_p; stir casting; high-temperature wear; worn-out surface

1. Introduction

Industry X.0 is pushing manufacturing and production businesses to move forward from conventional practices towards the use of progressive digital technologies to accomplish sustainable development. The emergence and advancement of day-to-day science and technology will augment the necessity for lightweight materials with unique characteristics compared to conventional materials.