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Technical Report

Effect of SiC content and sliding speed on the wear behaviour of aluminium matrix composites

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A B S T R A C T

In the present study effect of SiC content and sliding speed on the wear behaviour of aluminium alloy and composite was studied using pin-on-disc apparatus against EN32 steel counterface. These tests were conducted at varying SiC particles in 10, 15 and 25 wt.% and sliding speeds of 0.52, 1.72, 3.35, 4.18 and 5.23 m/s for a constant sliding distance of 5000 m. The results revealed that as the SiC content increases the wear rate and temperature decreases, but reverse trend can be observed for coefficient of friction. All these facts can be discussed on the basis of prevailing wear mechanism.

1. Introduction

Aluminium matrix composites have been emerged as advanced materials for several potential applications in aerospace, automobile, defense and other engineering sectors [1–8] because of their high specific strength and stiffness, superior wear and seizure resistance as compared to the alloy irrespective of applied load and sliding speed. Indeed, these promising new materials have found wide range of application in automobile industries, in the recent years in order to improve the fuel efficiency. Out of different automobile components, aluminium matrix composites (AMCs) have been found to be a more promising material, in brake drums, cylinder blocks, cylinder liners, connecting rods, pistons, gears, valves, drive shafts, suspension components, etc. Attempts have been made to examine the effect of sliding velocity on the wear behaviour of aluminium alloy and composites. Ranganath et al. [8] the wear rates of the composites were lower than that of the matrix alloy and further decreased with the increase in garnet content. However, in both unreinforced alloy and reinforced composites, the wear rates increased with the increase in load and the sliding speed. Qin et al. [9] the rate of wear increases with increasing load, but it varies from linear to rapid increase for all the test materials, i.e., mild and severe wear regime. Similarly, with the increase of sliding velocity, the wear rate increases as well. With the increase of sliding velocity, the surface temperature of the materials increase, which leads to the rise of plastic flow of surface and subsurface, and therefore the wear rate increases. Uyyuru et al. [10] clearly demonstrated the strong interaction between load and sliding velocity to cause wear of a material, both wear rate and friction coefficient vary with both applied normal load and sliding speed. With increase in the applied normal load, the wear rate was observed to increase whereas the friction coefficient decreases. However, both the wear rate and friction coefficients were observed to vary proportionally with the sliding speed. Lim et al. [11] has reported that composites exhibit slightly superior wear resistance under the lower load, but the effects of the SiC particulate reinforcements on wear resistance are not as conclusive under the higher load. Ramesh et al. [12] observed Al6061–Ni–P–Si_3N_4 composite exhibited lower coefficient of friction and wear rate compared to matrix alloy. The coefficient of friction of both matrix alloy and developed composite decreased with increase in load up to 80 N. Beyond this, with further increase in the load, the coefficient of friction increased slightly. However, with increase in sliding velocity coefficient of friction of both matrix alloy and developed composite increases continuously. Wear rates of both matrix alloy and developed composites increased with increase in both load and sliding velocity, similar observation was also made by Sharma [13]. Wear behaviour of aluminium matrix composite was studied by Rosenberger et al. [14] in which the matrix alloy AA6061, was reinforced with Al_2O_3, B_4C, Ti_3Al, and B_2Ti in volume fractions ranging from 5% to 15%. The wear conditions generate in all cases a mechanically mixed layer (MML). The results were compared to those obtained with the non-reinforced alloy, which for the same conditions does not form the MML. Some observations are made by Tang et al. [15], the wear rate of the composite with 10 wt.% B_4C was approximately 40% lower than that of the composite with 5 wt.% B_4C under the same test condition. Sudarshan and Surappa [16] reported that the wear resistance of Al-fly ash composite is almost similar to that of Al_2O_3 and SiC reinforced Al-alloy. Composites exhibit better wear resistance compared to unreinforced alloy up to a load of 80 N. Fly ash particle size and its volume fraction significantly affect the wear and friction properties of composites. Venkataraman and Sundararajan

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