ABSTRACT

Conventional monolithic materials have limitations in achieving good combination of strength, stiffness, toughness and ductility. To overcome these shortcomings and to meet the ever increasing property demands, composites are being increasingly used in several high performance applications. Metal Matrix Composites (MMCs) which exhibit attractive combination of properties like high specific modulus and strength, enhanced elevated temperature properties, wear resistance, good abrasion resistance properties are being considered for a wide range of applications in space shuttles, commercial airliners and automobiles. Generally, low density metals are advantageous for the fabrication of MMCs and metals like aluminium, magnesium and titanium are the popular matrix materials of current interest.

MMCs have been fabricated using a variety of methods such as stir casting, squeeze casting, compocasting, powder metallurgy, spray forming, liquid metal infiltration, mechanical alloying and in-situ methods. Particle or discontinuously reinforced MMCs are relatively inexpensive and are found to possess isotropic properties compared to fiber reinforced MMCs. Among the various types of particulate reinforcements such as boron, silicon nitride, boron nitride, silicon carbide, titanium carbide, extensive research has been directed towards the development of alumina and zircon particle reinforcement.

In the present work, the effect of particle size on aging behavior of age hardnable A356 alloy/zircon composites synthesized via stir casting technique was investigated. The composites were synthesized by reinforcing A356 alloy with different size and wt. % of zircon. In order to study the influence of zircon particulates on aging behavior, as cast samples were

solution treated and age hardened at 170ºC for different intervals of time. The samples were then investigated for microstructure as well as mechanical properties. Addition of zircon was found to accelerate the aging response of the matrix alloy. It was also found that the peak hardness increased with increase in wt. % as well as decrease in the size of zircon particles. The time to attain peak hardness also decreased with increase in wt. % and decrease in the size of zircon particles. The composites were found to exhibit better mechanical properties like hardness, compressive strength and impact strength. From the wear studies, the composites were found to exhibit abrasive wear and particle pull out as the common feature of wear mechanism.

Further, a detailed study on age hardened A356 alloy/alumina and zircon hybrid composites synthesized via stir casting technique was investigated. To study the effect of reinforcement on the mechanical properties and corrosion behaviour of these composites, the alloy was reinforced with different amounts of zircon and alumina particles with a limiting reinforcement content of 15 wt. %. As cast samples were solution treated and the aging behaviour of the alloy and the composites were studied for their microstructure and mechanical properties. The addition of reinforcement particles was found to accelerate the aging response of the composites by reducing the time to attain the peak hardness. The composites were found to exhibit better mechanical properties like hardness, compressive strength and impact strength. As in the case of age hardened A356 alloy/zircon composites, the composites were found to undergo abrasive wear and particle pull out wear mechanisms. Unreinforced alloy and its composites were studied for their corrosion behaviour in 1N HCl corrosion media. The weight loss of all the composites was found to decrease with time due to the formation of passive oxide layer on the sample surface. From the results, it can be concluded that composites exhibit superior corrosion resistance compared to unreinforced alloy.