ABSTRACT

Aluminum, Al-2Mg and Al-4Cu alloys were reinforced with short steel fibers and die cast through the vortex method. Upto 10-wt% of fibers can be added successfully to the melt. Steel fibers were coated with copper and nickel by electro less deposition method to prevent chemical reaction between the reinforcement and aluminium, improve wettability between the two and thus obtain a better interface bonding. Microscopic investigation of the casting revealed that the distribution of fiber was reasonably uniform throughout the matrix with random orientation. High dislocation density in the composite resulting due to differential thermal expansion of steel fiber and aluminium and the presence of fiber-matrix interface results in an increase in heterogeneous nucleation sites for precipitation especially in the early stage of aging leading to accelerated ageing kinetics in the composites. The density and mechanical properties of these composites increased with addition of fibers whereas the % of elongation decreased. The improvement in tensile properties is dependent on the coating applied, which in turn decides the quality of the interface. Addition of 5% of copper coated steel fibers to aluminium improved the strength from 39 Mpa to 124 Mpa retaining reasonable ductility level. Addition of 2% Mg to aluminium melt the strength further increased to 162 Mpa. The composites could be mechanically work, the composites in hot condition giving upto 40% reduction and further improve the properties. On 40% reduction by hot rolling at 500^0 C the tensile strength of Al-5Cu composite increased from 124 Mpa to 148 Mpa. Failure of composites occurred exclusively within the reaction phase allowing the crack to propagate readily, link up with other cracks and cause premature failure. Cu coating on the steel fiber acts as a barrier between reinforcement and matrix minimizing the reaction phase. EDX analysis revealed that there is segregation of Fe, Cu and Ni at the interface. Wear resistance improves on incorporation of steel fibers into aluminium and its alloys. Coating of the fibers with copper gives rise to the highest improvement of wear resistance. Wear resistance increases with increased addition of fibers. For example on incorporation of 5% copper coated fibers to aluminium matrix the cumulative volume loss decreased from 15 mm^3 to 6 mm^3. The

coefficient of friction of all the composites was much lower than that of the matrix alloy. There is a change in wear mode of the composites from mild to severe when the applied load is increased. The transition load is dependent on fiber content with the load increasing with increase in fiber content. For 10% fiber content this is beyond 40N whereas in case of base alloy severe wear is noted even at 10N. Galvanic corrosion dominates the corrosion mechanism of the composites studied. Corrosion rate of composites in 1N NaCl solution increases on incorporation of fibers. Coating of the fibers increases the corrosion rate. Nickel coated fiber composites shows minimum degradation of corrosion rate.