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Effect of Particulate SiC on Grain Size, Aging Response and Tensile Fracture Behaviour of AM60 Magnesium Alloy Matrix Composites.

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I. Introduction

Metal matrix composites(MMCs) exhibit enhanced wear resistance, elastic modulus and tensile strength compared to un-reinforced metals and alloys, and offer great potential for structural applications. Among the MMCs, magnesium based MMCs appear to be excellent candidates as light structural materials because of their high specific stiffness and specific strength, high damping capacity and good creep properties[1]. Discontinuously reinforced magnesium metal matrix composites are bound to be of commercial interest to the automotive and aerospace industries. The primary advantage of using discontinuous reinforcements (which include particulates, chopped fibers and whiskers) is that it is relatively easy to fabricate the MMCs by powder metallurgy as well as ingot metallurgy techniques and the resulting products would exhibit near-isotropic behavior[2]. However, data available on Mg based MMCs is rather limited.

Squeeze casting technique is a novel process and is used in many research centres to produce MMCs. The inherent advantages of squeeze casting are its suitability for mass production, ease of operation and consistency in producing high quality components. In addition, squeeze casting process tends to eliminate micro porosity (shrinkage and gas porosity), provides isotropic properties and minimizes machining leading to near-net shape components[3].

While the metal matrix particulate composites, in general, exhibit markedly high stiffness and strength than the matrix alloys, they often suffer from lower ductility and inferior fracture toughness due to the presence of hard and brittle particles. Therefore the mechanisms of strengthening and failure in the metal matrix particulate composites are issues of academic and practical importance[4]. The aim of the present work was to investigate the Mg based (AM60 alloy), particulate(SiC) reinforced MMCs produced through squeeze casting and to study the effect of silicon carbide particles on the grain size and aging response of the MMCs produced . The structure-property relationship and the strengthening mechanisms of the composites were also investigated, and the above are compared with that of un reinforced base alloy. Tensile fracture behaviour of the squeeze cast un reinforced alloy and MMC are also covered.

II. Experimental Details

A. Materials

Magnesium alloy AM60(Mg-6Al-0.13-Mn)was used as the matrix material for the composites. The specified chemical composition of the alloy is shown in table I.

Table I. Nominal Composition of AM60 alloy .

Constituent	Mg	Al	Mn	Si	Cu	Zn	Ni
Weight in %	92.27-93.37	5.5-6.5	0.3 min	0.5max	0.35max	0.22max	0.03 max

High purity silicon carbide powder with an average particle diameter of 21.8μm was used as the particulate reinforcement.

B. Processing of composites

The process consisted of charging, melting magnesium alloy and then stir mixing of the pre-heated SiC particulates into the melt .The melt was then poured into the preheated cylindrical die and squeeze cast at a pressure 120MPa. Two different volume fractions of the reinforcement (viz.,10%V_f and 15% V_f) were tried out. Processing of the magnesium matrix composites is schematically shown in Fig 1.