A Study of the Effects of MnS Particle Size on the Fracture Toughness of Low Alloy P/M Steel

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Abstract

Round compact tension (RCT) specimens and transverse rupture bars, made of R3755 low alloy steel with MnS additions having particle sizes of -6 μm, -15 μm, and -29 μm, and with the MnS content varying from 0.35% to 1.00%, were sintered in a nitrogen atmosphere. Three compacting pressures were used to obtain densities ranging from 6.4 g/cc to 7.0 g/cc. The transverse rupture strength and fracture toughness were found to be more sensitive to MnS content than to MnS particle size, although both properties appear to decrease with increasing MnS content and MnS particle size. The effects of MnS particles on the toughness of P/M sintered steels were then discussed from the viewpoints of powder packing, cohesion between MnS particles and the iron matrix, and volume fraction, shape, and distribution of MnS particles in the interparticle boundaries. The MnS particle distribution in the sintered matrix was further analyzed. It was found that the majority of the MnS appears to segregate to the interparticle boundaries and pores, and little MnS was found within the particles. The shape and size of MnS particles along the interparticle boundaries were classified based on optical and electron microscopic observations. Finally, an ideal MnS particle size for improved machinability while maintaining optimum toughness and ductility of sintered low alloy P/M steel was discussed.