ABSTRACT

Austenitic manganese steels (AMS) are mainly used where high impact abrasion wear resistance is required due to its very high work hardening capacity. However, at the low impact abrasion conditions they are unable to experience sufficient work hardening, which limits its application. Therefore, the aim of the present investigation is to improve the impact abrasion wear resistance of AMS at low impact load by applying thermo mechanical treatment and reinforcing the AMS with hard ceramic particles like TiC. Fe-17Mn and Fe-17Mn-3Al austenitic manganese steels and 10 vol% TiC reinforced Fe-17Mn and Fe-17Mn-3Al steel matrix composites were produced by the conventional melting and casting technique. The applied thermo mechanical treatment for the steels consisted of forging, followed by solutionisation at 1100° C, multipass hot rolling and heat treatment at 650 and 800° C. In the case of composites the sequence of operation was solutionisation at 1100° C, forging, multi pass hot rolling and then heat treatment of the rolled composites at 800° C. The same sequence of operation was also applied to the steels so that the properties of the steels and composites can be compared under the identical processing condition.

Application of thermo mechanical processing (TMP) to the Fe-17Mn/Fe-17Mn-3Al steel can refine the austenite grain size from 169 to 9-13μm. A significant increase in the hardness (~50%), elastic modulus (~40%), and impact abrasion and sliding wear resistance can be obtained for both the steels by applying TMP. However impact toughness of both the steels decrease after the application of TMP. The corrosion resistance of Fe-17Mn-3Al steel is better than that of Fe-17Mn steel. The corrosion resistance improves initially with the application of TMP due to closing up of casting defects. However, as the degree of deformation increases the corrosion resistance decreases due to the refinement of the grain size.

It is also observed that an incorporation of TiC particles in the Fe-17Mn and Fe-17Mn-3Al steel increases the hardness, elastic modulus, and impact abrasion and sliding wear resistance. However, the impact toughness and corrosion resistance decrease due to TiC incorporation. Application of TMP to the composites further improves the hardness, elastic modulus, impact abrasion and sliding wear resistance and corrosion resistance, but it deteriorates the impact toughness.

Key Words: Austenitic manganese steel, Work hardening, Impact abrasion wear, Thermo mechanical processing