A Novel Approach to Investigating the Dissolution of Fe-based Intermetallic Compounds (IMCs) in a Commercial Steel Strip Coating Process

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Abstract

The precipitation of discrete iron-based intermetallic compounds (IMCs) is an inevitable phenomenon in a steel strip alloy coating pot due to the continuous supply of iron from the steel strip and temperature perturbations in the pot. These IMC particles grow by coarsening and agglomeration and are primary source of coating inclusions for the coated steel products. They are further responsible for excessive bottom dross build-up in the alloy coating pot. It is hypothesized that they will re-dissolve into the pot during the heating cycle in the coating bath, but their dissolution kinetics remains unclear. In this study a novel approach has been developed to investigate their dissolution kinetics. IMC particles are extracted by acid dissolution of bottom dross collected from a commercial alloy coating pot. A powder metallurgy route is then used to fabricate monolithic discs of the IMC. These monoliths are subsequently immersed in the Al-Zn-Mg-Si alloy coating bath under various processing conditions. Laboratory trials suggest that the dissolution kinetics of the IMC is sluggish in the coating alloy at 595^{o}C. A mass transfer coefficient (k_m) of 4.5×10^{-8} m/sec is calculated in an iron-unsaturated bath at 595^{o}C. The dissolution of the IMCs is dictated by iron in solution in the bath at a given temperature. If the temperature of the bath is increased, IMCs will start to re-dissolve until the iron solubility for the given temperature is reached. Since iron is not in equilibrium with bath, IMCs will continue to precipitate in a commercial steel strip coating pot.

Keywords: IMC, Al-Zn alloys, coating