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Silicon Effect on Corrosion Behavior of Al-Mg Alloys in Marine Environment

Borges, J.S.(1); Dos Santos, J.R.(1); Vida, T.(1); Brito, C.(1);
(1) UNESP;

Aluminum-based alloys have been increasingly used to replace traditional alloys, e.g. steels, because of its intrinsic features such as better corrosion resistance and lower specific weight. Nowadays, this class of alloys is being used for a variety of engineering applications, mainly in the aerospace, automotive and offshore industries. Al-Mg-Si alloys can be used in the manufacture of metallic equipment and components, and as a coating to protect tanks, risers and pipelines exposed to marine environments. This work proposes a detailed analysis of the influence of Si content on the morphology of microstructure, and on the corrosion behavior of an Al-3wt.%Mg-X (X = 1 and 3 wt.%Si) alloy. A solidification apparatus promoting growth under unsteady-state heat flow conditions was used to obtain samples associated with a wide spectrum of cooling rates, thus permitting an extensive range of microstructures to be examined. Experimental results including microstructural characterization, nature and distribution of intermetallics associated electrochemical impedance spectroscopy (EIS) plots, potentiodynamic polarization curves, and equivalent circuits are used to evaluate the corrosion response. The solidification evolves from high cooling rate cells, followed by a transition from cells to dendrites that occurs at a cooling rate of about 1.0 K/s. In the two analyzed alloys, the best corrosion resistance was observed to be related to the refined cellular morphology.