The Role of Thermal and Microstructural Parameters on Corrosion Resistance of Unsteady-State Horizontally Solidified Aluminum-Copper Hypoeutectic Alloys

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This article analyzes the effects of Cu content, thermal and microstructural parameters on the mass loss and electrochemical corrosion resistance of two directionally solidified Al-XCu (X=3wt.% and 6wt.%) hypoeutectic alloys. The investigated solidification parameters include the growth rates (V_L), cooling rates (T_R), secondary dendrite arm spacings (λ_2) and Al_2Cu intermetallic phase. Open circuit potential (E_{OC}), anodic and cathodic polarization curves with the respective corrosion potential and current (E_{CORR} and I_{CORR}) and H_2 release volume evolution (H_2Vol) corresponding to corrosion kinetics were used to study the corrosion resistance in a 0.2 mol.L^{-1} solution of HCl with an immersion time of 10 min at $25\text{ }^\circ\text{C}$. The corrosion tests were performed at two different positions in relation to cooled interface of the studied alloys. It was found that the corrosion resistance is higher at position closer to the metal-mold interface, in which the V_L and T_R values are higher and the λ_2 value is smaller. The results have shown, for both investigated alloys, that the Al_2Cu intermetallic particles are more susceptible to electrolytic corrosion for higher secondary dendrite arm spacings. On the other side, considering a same value for λ_2 these particles are less resistant to corrosion in the eutectic matrix of the Al-3wt.%Cu alloy. Thus, the results have indicated that the Al-6wt.%Cu alloy has better electrochemical corrosion resistance than the Al-3wt.%Cu alloy.

Keywords: Al-Cu alloys; solidification; corrosion resistance; microstructure; Al_2Cu intermetallic particles

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