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Effects of morphology and length scale of microstructural phases on corrosion resistance of Zn-Mg-Mn ALLOYS.

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This work has evaluated the evolution of solidification microstructures of Zn-Mg-Mn alloys with solidification thermal parameters on the resulting electrochemical corrosion resistance. Zn-1wt%Mg-0.5wt%Mn and Zn-3wt%Mg-0.5wt%Mn alloys castings were directionally solidified (DS) under transient heat flow conditions, thus permitting a wide range of solidification cooling rates and length scales of representative phases forming the microstructures to be examined. Both alloys castings presented macrostructures consisting of equiaxed grains along their entire lengths. The Zn-1wt%Mg-0.5wt%Mn alloy exhibited a complex microstructure characterized by a dendritic Zn-rich matrix with a eutectic phase in the interdendritic regions along with the entire casting. On the other hand, a microstructure characterized by a eutectic mixture was observed for the Zn-3wt%Mg-0.5wt%Mn alloy. Experimental growth laws are proposed relating the secondary dendritic arm and the eutectic interphase spacings with the experimental cooling rate. The corrosion behavior of the alloys has been evaluated for samples having quite different microstructure length scales in a 0.06M NaCl solution. The results of corrosion tests, potentiodynamic polarization and electrochemical impedance spectroscopy (EIS), showed that coarser microstructure arrays have provided better corrosion resistance as compared to those of samples having refined microstructures. The corrosion resistance is also shown to improve for higher Mg content of the alloy, i.e., Zn-3wt%Mg-0.5wt%Mn ? Zn-1wt%Mg-0.5wt%Mn.