Corrosion Behavior of Zn-Mg and Zn-Mg-Y Alloys

Marián Palcut,[1, a)] Martina Kaľavská,[1, 2] Libor Ďuriška,[1] Ivona Černičková,[1] Marek Adamech[1, 3] and Jozef Janovec[1]

[1]*Slovak University of Technology in Bratislava, Faculty of Materials Science and Technology in Trnava, J. Bottu 25, 91724 Trnava, Slovakia*
[2]*present address: Wienerberger, s. r. o., Boleráz 632, 91908 Boleráz, Slovakia*
[3]*present address: VUJE, a. s., Okružná 5, Trnava, 918 64, Slovakia*

[a)] *Corresponding author: marian.palcut@stuba.sk*

Abstract. In the present work, the corrosion behavior of $Zn_{67}Mg_{33}$ and $Zn_{62}Mg_{29}Y_9$ alloys (element concentration in at. %) has been investigated. The alloys were prepared by induction melting of pure elements in an argon atmosphere. The microstructure and phase constitution of the alloys were studied by scanning electron microscopy and X-ray diffraction, respectively. The cast materials were found to consist of several microstructure constituents. The $Zn_{67}Mg_{33}$ alloy was composed of Zn_2Mg as the main component and a small amount of Zn_2Mg+(Zn) eutectic. The $Zn_{62}Mg_{29}Y_9$ alloy was composed of MgZn, Mg_7Zn_3, I-phase (Zn_6Mg_3Y) and H-phase ($(Zn,Mg)_5Y$), respectively, in approximately equal amounts. The corrosion resistance of the as-cast alloys was studied at room temperature using the electrode polarization method. A three-electrode cell with a saturated Ag/AgCl reference electrode, a Pt counter electrode and a metallic working electrode was used for the measurement. The progress of the reaction was controlled by potentiostat. Corrosion potentials and corrosion currents were found by Tafel extrapolation of experimental polarization curves. The corrosion currents were subsequently used to estimate the corrosion rate. Three aqueous solutions of HCl (0.01 mol dm^{-3}), NaOH (0.01 mol dm^{-3}) and NaCl (0.6 mol dm^{-3}) were chosen as corrosion media to study the effects of pH and chloride concentration on the corrosion rate. The highest corrosion rate of the alloys was found in the acidic HCl solution. The corrosion rate was found to decrease sharply with increasing pH of the electrolyte. The highest corrosion resistance of the alloys was found in the alkaline NaOH solution. For the investigated alloys, the corrosion mechanism is suggested and effects of both chemical compositions and microstructure are discussed.