The influence of hydrostatic extrusion on the stress cracking corrosion of Al-Mg model alloys in simulated seawater

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Résumé

Three model aluminum-magnesium alloys, containing 1, 3 and 7.5 % wt. of magnesium, were subjected to plastic deformation by means of hydrostatic extrusion (HE). The process was held in two variants with various diameter reduction in order to obtain two different degrees of deformation. The microstructures of wrought materials and after deformation were observed with the use of light microscopy (LM). Materials in all states were subjected to tensile tests in order to determine the values of maximal tensile strength and elongation at rupture. Stress cracking corrosion was promoted in the samples by combining immersion in the 3.5 wt.% water solution of sodium chloride (3.5 wt.% NaCl) simulating seawater with applied stress equal to 0.8 of materials' yield strength values in ambient temperature. Materials were exposed to the described conditions for 90 days. The experiment was designed in accordance with the adequate standard. Samples after exposition to stress cracking corrosion were subjected to analogical tensile tests. Obtained results were used to calculate the relative loss of maximal tensile strength and elongation at rupture due to stress cracking corrosion. Microscopic observations (LM) revealed significant changes in the materials' microstructures after hydrostatic extrusion. In each alloy the average grain size was decreased, and the effect was more intensive for the higher degree of deformation. However, the refinement of the microstructure depended also on the amount of magnesium in the alloy. The more Mg the lower the grain size refinement. What is more, in the undeformed material the grain size decreased significantly with the increase of the magnesium amount. The relative loss of maximal tensile strength and elongation at rupture due to stress cracking corrosion depended both on the degree of deformation and the amount of magnesium in the alloy. Therefore, it may be related to the microstructural differences between the materials. The highest loss of both parameters for each alloy was observed in the undeformed state. The value of maximal tensile strength loss was the highest for the alloy with 3% of magnesium, while the elongation at rupture loss was the highest for the alloy with 7.5% of Mg.

Mots-Clés: Al, Mg alloys, stress cracking corrosion, simulated seawater, hydrostatic extrusion

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