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# Studies of corrosion behaviour in acid environment of binary Mg-Li alloys for plastic forming

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## Abstract

The article discusses studies and corrosion tests of binary Mg-Li alloys for plastic forming examined in an acid medium (5% HCl solution) for the time of 0-144 hours. In short it can be stated that corrosion of the examined Mg-Li alloys in 5% HCl solution proceeded in a similar mode in all the studied alloys, regardless of the lithium content.

**Keywords:** Ultralight Mg-Li alloys, Corrosion in acid media

## 1. Corrosion tests of Mg-Li alloys in acid medium

The object of corrosion studies were as-cast samples of Mg-Li alloys of 30 x 20 x 10 mm dimensions designated as:

- alloy no. **1** containing 3,54% Li (monophase α hcp alloy),
- alloy no. **2** containing 8,15% Li (two-phase alloy; β phase and α+β eutectic),
- alloy no. **3** containing about 13,9% Li (monophase β bcc alloy).

Laboratory tests of the corrosion behaviour of Mg-Li alloys were carried out by immersion of samples at ambient temperature, according to the following standards: PN-76/H-04601, PN-78/H04610, PN EN ISO 16151. The principle of the method consisted in subjecting the samples of Mg-Li alloys to the effect of a solution prepared in a laboratory. The immersion test was conducted in 5% aqueous solution of HCl. To prepare this solution, analytically pure chemical reagents and redistilled water were used. The duration of individual measurement cycles was 6 h, 24 h, 48 h, 72 h and 144 h.

Samples of the examined alloys (3 samples from each melt) were subjected to corrosion tests in accordance with the adopted programme of research. Figures 1 and 2 show in graphic form the results of corrosion-induced weight loss and corrosion rate.

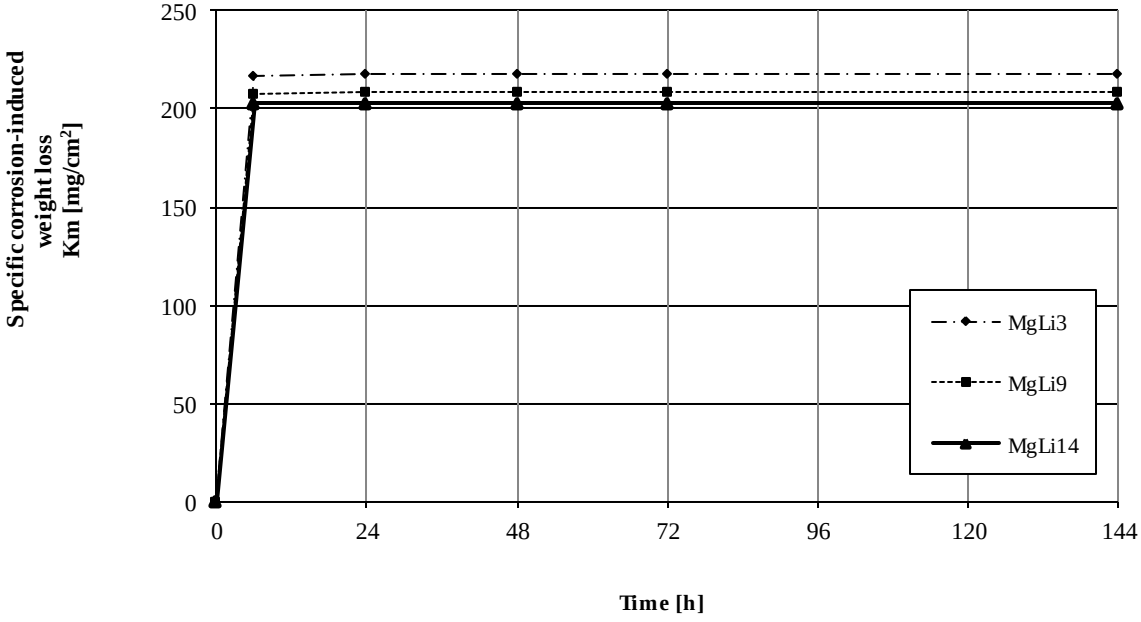


Fig. 1. Comparison of the results of the corrosion-induced weight loss test carried out for Mg-Li alloys in 5% HCl solution – corrosion-induced weight loss Km in time

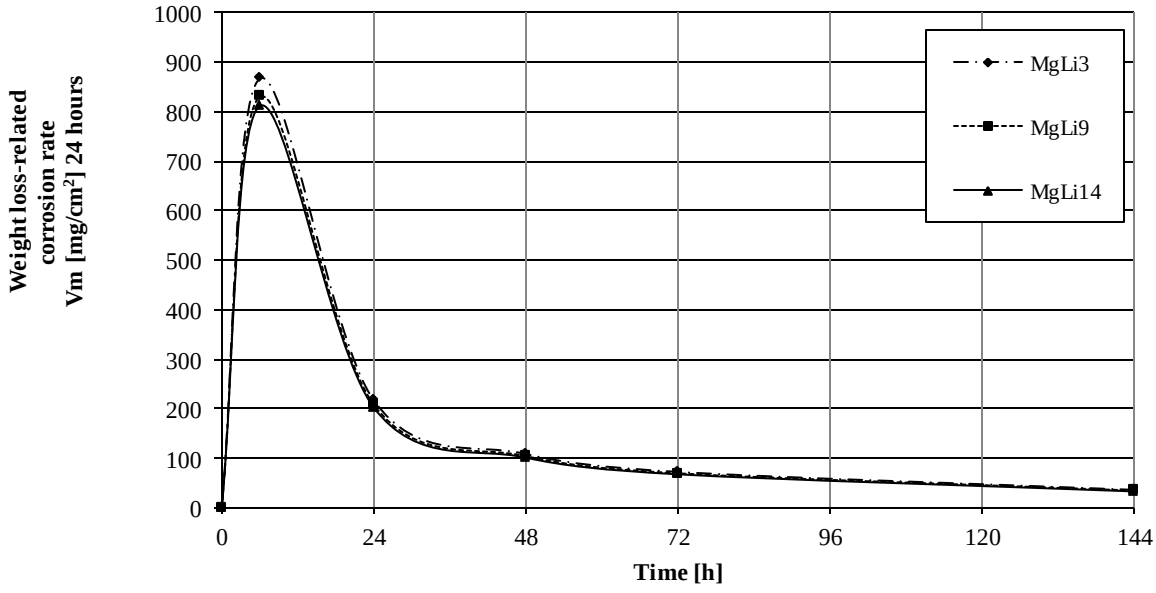


Fig. 2. Comparison of the results of the corrosion-induced weight loss test carried out for Mg-Li alloys in 5% HCl solution – weight loss-related corrosion rate Vm in time

Figures 3-4 show surface condition of samples of the tested alloys after 6, 72 and 144 hours of being immersed in 5% HCl solution.


Fig. 3. Corrosion behaviour of Mg-Li alloy samples after 6 h of being immersed in 5% HCl solution

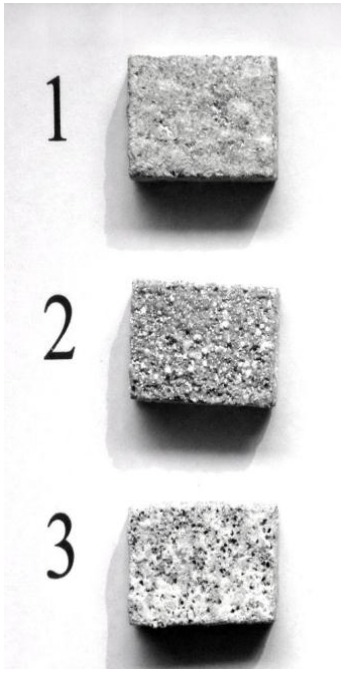


Fig. 4. Corrosion behaviour of Mg-Li alloy samples after 72 h of being immersed in 5% HCl solution

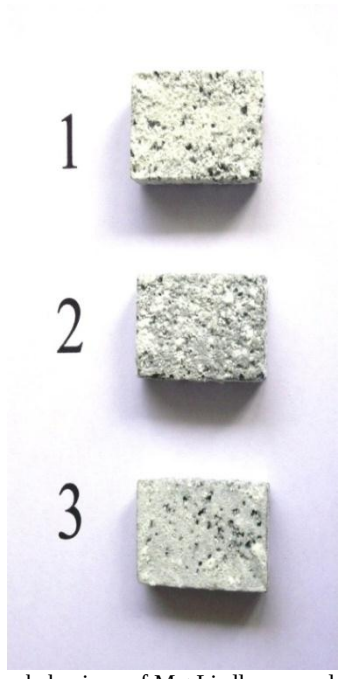


Fig. 5. Corrosion behaviour of Mg-Li alloy samples after 144 h of being immersed in 5% HCl solution

Macrographic studies were also carried out on the precipitates of reaction products on the surface of the examined alloy samples. Figures 6-8 show selected examples of the surface topography of the examined alloys.

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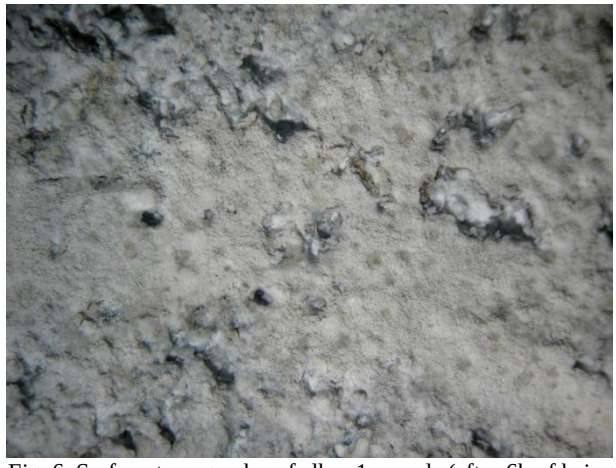

Fig. 6. Surface topography of alloy 1 sample (after 6h of being immersed in 5% HCl solution, 7x)

Fig. 7. Surface topography of alloy 2 sample (after 6 h of being immersed in 5% HCl solution, 7x)

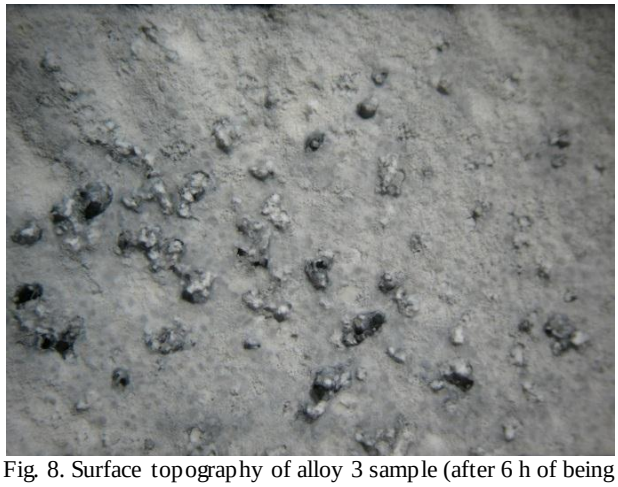

Fig. 8. Surface topography of alloy 3 sample (after 6 h of being immersed in 5% HCl solution, 7x)

## 2. Summary

Studies of the weight loss-related corrosion of Mg-Li alloys show a very large weight loss $K_m$ during the first measuring period (i.e. after 6 hours), reaching from 48,8% to 53,4% - in all the examined samples, as illustrated in Figure 1. This suggests a rapid transition of metal into solution in a short period of time. In subsequent measuring cycles, the weight of the measured test samples hardly changed. The rate Vm of the weight-loss induced corrosion was the highest during the first 6 hours, reaching the level of 811 - 867 mg/cm$^2$ in 24 hours, as shown in Figure 2. In subsequent measurement periods it decreased, reaching a value of 33 - 36 mg/cm$^2$ in 24 hours after 144 h of the corrosive effect of the medium. The surface condition of the examined alloys indicated an uneven corrosion; the surface of the test samples was coated with a white bloom, numerous pittings were also observed.

Summing up, the corrosion of the examined Mg-Li alloys in 5% HCl solution proceeded similarly in all the studied alloys, regardless of the lithium content.

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