

CORROSION OF MAGNESIUM, ALUMINIUM AND TITANIUM IN ALKALINE-SALT MELTS

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The molten alkali metal hydroxides and their mixtures with salts are widely used in various industries such as metallurgy, metal working of light, colour, and heavy metals [1]. Are developed and the high performance methods of removing ceramics from metal surface in fused of alkalis are introduced in production. However, known data [1, 2] on corrosion behaviour of light metals in these environments it is not enough. The works that are devoted to the questions of interaction of light metals with alkalis for the theoretical substantiation the kinetics and the mechanism of this process it is not enough too.

We carried out researches of corrosion resistance of light metals (aluminium, magnesium and titanium) in molten alkali metal hydroxides (*LiOH*, *NaOH*, *KOH*) by the method of isothermal gravimetry at a temperature from the molten points of alkali hydroxides to 823 K. At higher temperatures occurs self-dispergation of sample, and its self-ignition is also possible.

It was established that rate of corrosion of light metals are increased with temperature growth (table 1, 2, 3).

Table 1. Corrosion of Magnesium in alkali melts.

Melts	Rate of corrosion ($g\ m^{-2}\ h^{-1}$) at temperature (K)						
	673	698	723	748	773	798	823
<i>NaOH</i>	0.015	0.018	0.021	0.025	0.028	0.031	0.037
<i>KOH</i>			0.030	0.035	0.041	0.047	0.052
<i>LiOH</i>				0.018	0.023	0.027	0.031

Table 2. Corrosion of Aluminium in alkali melts.

Melts	Rate of corrosion ($g\ m^{-2}\ h^{-1}$) at temperature (K)						
	673	698	723	748	773	798	823
<i>NaOH</i>	0.033	0.037	0.041	0.045	0.050	0.053	0.057
<i>KOH</i>			0.150	0.180	0.220	0.250	0.270
<i>LiOH</i>				0.030	0.035	0.042	0.050

Table 3. Corrosion of Titanium in alkali melts.

Melts	Rate of corrosion ($g\ m^{-2}\ h^{-1}$) at temperature (K)						
	673	698	723	748	773	798	823
<i>NaOH</i>	2250	2750	2890	3025	3100	3233	3400
<i>KOH</i>			3235	3589	3890	4000	4250
<i>LiOH</i>				2300	2500	2650	2800

The temperature dependence is satisfactorily described by the Arrhenius equation. The calculated values of effective energy of activation are within the range of 16 – 20 $kJ\ mole^{-1}$. These values speak that the processes of corrosion of magnesium, aluminium and titanium proceed in diffusive-kinetic area, and the rate of corrosion is defined by diffusion of active reagent (hydroxide of alkali metal) through slightly soluble film of products of corrosion (magnesium oxide, aluminates and titanates of alkali metals).

It was found that the average rate of interaction of given metals with the electrolytes increases in the series of melts *LiOH* — *NaOH* — *KOH*. It is explained by increase of alkaline properties of melts in this series.

In the series of metals *Mg* – *Al* – *Ti* corrosion growth, that coordinated to increase of acid properties of these metals.

The influence of the additives of chlorides of alkali metals has been investigated in the melts on basis of hydroxide of sodium. The experimental data are given in a fig. 1.

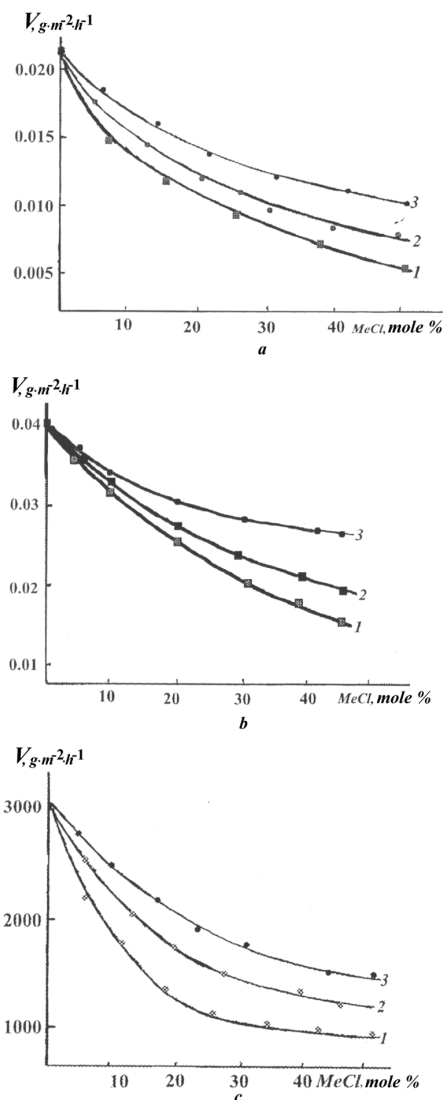


Fig. 1. Influence of the salt additive on rate of corrosion of light metals (a – magnesium, b – aluminium, and c – titanium) in the alkaline-salt melts.
1 – *NaCl*, 2 – *LiCl*, 3 – *KCl*.

When the contents of chlorides in a melt of sodium hydroxide are increased, the rate of corrosion of metals is decreased. It is possible to explain it to that the specified salts reduce activity of sodium hydroxide in relation to given metals. Thus in series of the salt additives *NaCl* – *LiCl* – *KCl* the inhibiting action weakens. It is possible to explain it by formation on the surface of samples of non-uniform, more friable film products in melts *NaOH* – *LiCl* and *NaOH* – *KCl* and consequently the diffusion of the active component through such film are less complicated.

References

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