INFLUENCES OF ELECTROCHEMICAL PROPERTIES OF SACRIFICIAL ANODIC ALLOYS OF AL-ZN-CA

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Abstract

Characteristic of standard sacrificial alloys on the base of aluminum is extremely low contents in them are the cathode impurity elements. Due to this requirement the stable electrochemical parameters and high efficiency of aluminum anodes is not always achieved.

Falling characteristics of tread material can be attributed to their passivation - reduction of oxidation of the material of the tread due to the formation of a thick oxide layer on the surface of anodic protetkor.

This paper presented data as to how to stabilize the electrochemical properties of sacrificial zinc anodic materials that contain aluminum, zink. Discussed the principles of alloying that help to reduce passivation of the tread material.

Keywords: sacrificial aluminum alloys, alloying of calcium, electrochemical characteristics.

1. INTRODUCTION

Sacrificial protection is one of the widely used, reliable, affordable and effective means of combating the electrochemical corrosion of metal structures and constructions in sea water. Electrochemical protection of metals from corrosion is based on the fact that corrosion of metals is terminated under the influence of a constant electric current. The surface of any metal, electrically non-uniform, which is the major cause of corrosion in water. Thus only broken portions of the metal surface with the most negative potential (anode), with which the current flows into the external medium and the areas of metals with a positive potential (cathode), in which current flows from the external environment, not destroyed.

With the use of protectors protect metal hulls and submarines, offshore platforms, pipelines, reservoirs and tanks, structures port area, the metallic elements of underground structures, etc..

As sacrificial materials are used alloys based on magnesium, aluminum and zinc [3]. The most widely used in galvanic protection systems obtained aluminum alloys (Table. 1).

Table 1. Chemical composition of the aluminum alloy tread AP1 * (GOST 26251-84)

Alloy grade	Mass fraction of main components,%		
	Aluminium	Magnesium	Zinc
AP1	rest	-	4,0-6,0

*Note: * The maximum allowable content of impurities in alloys of iron ≤ 0,10%, copper ≤ 0,01%, Si ≤ 0,10%.*

However, under operating conditions of cast protectors of different types of aluminum alloys decrease basic electrochemical properties sacrificial material [2]. One of the causes of reduction of electrochemical characteristics, is the uncontrolled content of harmful impurities and passivation of sacrificial material [2, 3]. Passivation of the tread material - this is a sharp decline in the rate of dissolution (and corrosion protection), because of the strong oxidation of the surface of the tread.

2. EXPERIMENTAL STUDIES

Below are the results of experimental studies on the effect of calcium supplementation on the main electrochemical characteristics of the tread of the alloy AP1. Were selected for study of calcium concentration in the alloy AP1: 0.01%, 0.05%, 0.1%, 0.5%, 1.0% by weight.

Samples for electrochemical testing were obtained by casting in metal molds at a casting temperature of 740 ° C. Calcium is introduced in granular form with metallized aluminum coating. The calcium content in such a ligature was 99 wt%. The chemical composition of the samples were tested for X-ray fluorescence spectrometer ARLADVANT'X (Thermo) in a laboratory X-ray analysis VISU.

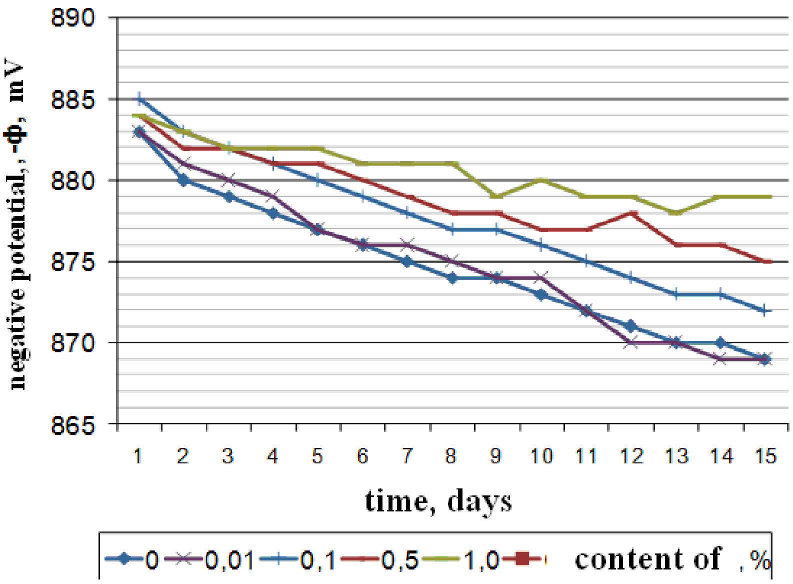

Fig. 1. Change stationary potentials AP1 alloy samples (with a change in the Ca content of 0 to 1.0%.

Electrochemical testing of samples was carried out using galvanostatic mode at a 3% solution of NaCl in water, using chlorine-in silver reference electrode (Ag / AgCl) for 15 days at anodic polarization current of 3 mA at a standard procedure in a special unit. Analysis was performed on three parallels.
To evaluate the corrosion rate of the samples used gravimetric method. The samples were weighed using an electronic scale before and after the test, and then weight loss was calculated (Δm) and the corrosion rate (C) of formula:

$$Km = \Delta m / (S \cdot \tau);\ g / m \cdot day,$$

where Δm - mass change of the sample as a result of testing, g; S - area of the sample surface, m², τ - time day.

Research has shown that in samples with a high content of calcium (0.5, 1.0%) modulus of the negative stationary potential significantly less decreased during the test than the standard tread alloy AP1, and therefore, these alloys are less susceptible to passivation (Fig. 1). This can be explained by the fact that the calcium aluminum oxide film makes a loose, easily separated from the body protector.

Doping with calcium of from 0.1 to 1.0% of the tread AP1 alloy slightly increases corrosion rate (more than 0.01% Ca) (Fig. 2), and decreases the coefficient of the useful use (CUU) (Fig. 3), i.e somewhat reduces the basic properties, but in the indicated amounts calcium neutralizes the harmful effects of iron, has a modifying effect upon crystallization on the grain structure.

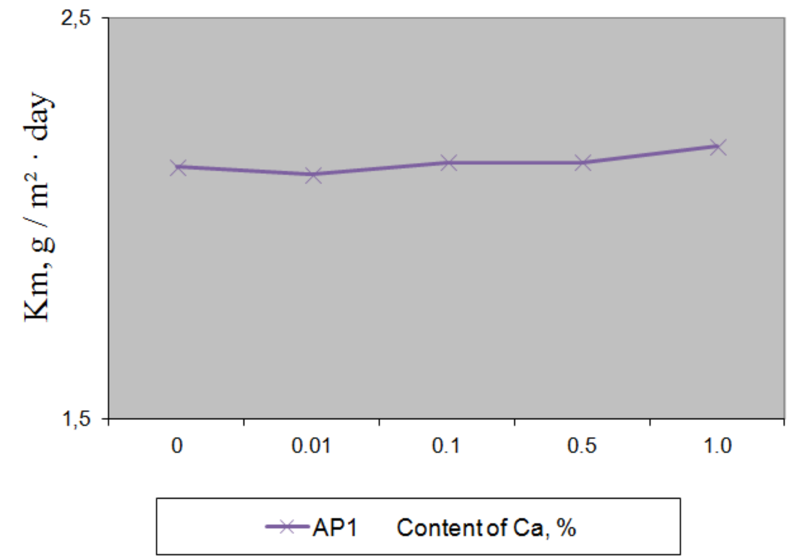

Fig. 2. The dependence of the corrosion rate of aluminum alloy tread AP1 of Ca content.

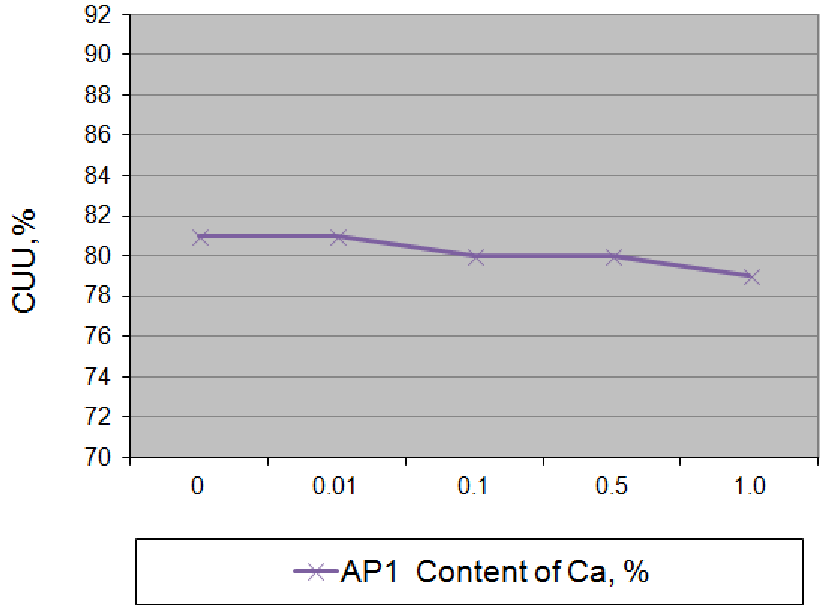

Fig. 3. Dependence CUU tread aluminum alloy AP1 of Ca content.

CONCLUSION

Supplements of calcium from 0.1 to 1.0% of the tread aluminum alloy AP1 significantly increase the rate of corrosion, reduce the efficiency of use, as well as bias potential of the alloy in the negative region, to prevent passivation of the surface of the tread aluminum alloy during operation of the tread.

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