ABSTRACT

TESTING THE PROPERTIES OF PROTECTIVE COATINGS OBTAINED BY THE METHOD OF PLASMA ELECTROLYTIC OXIDATION (MAO) ON AW-7020 AND AW-5083 ALUMINUM ALLOYS

This paper presents an analysis of the properties of two selected aluminum alloys AW-5083 and AW-7020 after covering their surfaces with Al_2O_3 oxide coatings produced by the plasma electrolytic oxidation (MAO) method. The work was divided into the theoretical part and the research part.

In the introduction to the work, attention was drawn to a relatively small numer of available studies on plasma electrolytic oxidation of aluminum alloys used in shipbuilding (e.g. 5XXX and 7XXX groups).

The theoretical part presents the current state of knowledge on plasma electrolytic oxidation of light metals, with particular emphasis on aluminum alloys. As part of the literature review, the properties of oxide coatings obtained on aluminum alloys using the traditional oxidation method (in acid electrolytes) were compared with the properties of oxide coatings obtained in the MAO process. The greatest advantages of the coatings obtained by the plasma electrolytic oxidation method over the coatings obtained in the traditional oxidation process are: greater coating thickness, lower porosity and much greater hardness resulting from the fact that they contain a very hard polymorphic form of aluminum oxide, i.e. α-Al_2O_3 (corundum).

The conclusions from the literature review allowed for the formulation of the main thesis, according to which the AW-5083 and AW-7020 aluminum alloys, along with other light metals, can be covered with Al_2O_3 coatings obtained in the MAO process, which are useful from the operational point of view. In order to confirm the usefulness of the obtained conversion oxide coatings on the AW-5083 and AW-7020 alloys, detailed theses, research hypotheses and work objectives were formulated.

The research part of the work presents the methodology of own research and the method of sample preparation, as well as the results of morphology, composition and microhardness tests obtained on samples of Al2O3 coatings. When selecting the types of research, the focus was on the possibilities of proving the research hypotheses of the dissertation, that is:

- covering of AW-5083 and AW-7020 aluminum alloys with Al2O3 coatings obtained in the MAO process does not adversely affect the operational properties of these materials, especially in an environment containing chlorine ions,

- coating of AW-5083 and AW-7020 aluminum alloys with oxide coatings using the MAO method significantly improves the tribological properties of these materials.

The tests of samples made of the above-mentioned of aluminum alloys as delivered and coated with Al_2O_3 MAO oxide coatings: testing the mechanical properties of the samples coated with oxide and comparing them to the properties of the samples from the alloy as delivered (determination and comparison of: Young's E modulus, Poisson numbers ν, tensile strength R_m, yield strength $Rp_{0.2}$ and $Re_{K\text{-}S}$); testing the strength and corrosion properties of samples with Al_2O_3 coatings (capturing changes in E, R_m, $Rp_{0.2}$ depending on the time of exposure to the samples of the corrosive environment in an artificial atmosphere); tribological tests of samples covered with MAO oxide coatings (determination of: friction coefficients μ, Ra, Rz values and depth of friction path profiles, changes in sample mass and counter-samples).

On the basis of the obtained test results, it was found that::

- Al_2O_3 coating resulting from plasma electrolytic oxidation on the surface of AW-7020 and AW-5083 alloys creates solid, tight and strongly adhering coatings, which due to the chemical inertness of Al_2O_3 increase the potential resistance of the alloys to pitting corrosion, also in the environment containing chlorine ions.
- Oxide coatings obtained in the MAO process significantly increase the hardness of the surface of both of the above-mentioned aluminum alloys (generalising about ten times).
- Increased hardness of surfaces covered with Al_2O_3 coatings obtained by the MAO method of AW-7020 and AW-5083 alloys significantly improves the tribological properties of both materials, both in dry friction and in friction with industrial oil lubrication.
- It is possible to determine the yield strength of AW-5083 and AW-7020 alloys using the K-S metric entropy calculation method, also after covering them with oxide coatings obtained with the MAO method.