

Contribution ID: 13

Type: Paper

Study of the corrosion behaviour of welded systems for marine industry applications

Wednesday, 15 June 2022 15:10 (20 minutes)

The aluminium alloys most commonly used in the marine sector are those of the 5xxx (Al-Mg) and 6xxx (Al-Mg-Si) series, as they can guarantee both a good mechanical behaviour and good resistance to corrosion which is one of the main properties required for materials used in the marine constructions: sea water in fact contains high amounts of chlorides that can cause, after short exposure times, the failure of entire metal structures.

Since in a boat there is the coexistence of different materials, it is inevitable that some of them must be welded together: welds between dissimilar materials often require the use of non-traditional techniques, such as the process of Friction Stir Welding (FSW) and explosion welding.

In this work, the resistance to corrosion of welds made using the FSW technique between dissimilar aluminium alloys, AA5083 and AA6082, has been studied: this particular process ensures the achievement of joints with excellent mechanical properties and almost free from defects.

The behaviour of the various alloys in free immersion has been studied through polarization curves carried out on an area of 0.79 cm^2 and monitoring the open circuit potential (OCP) of the different samples for 24 hours. The characterization of the galvanic couplings between the various materials was performed by measuring over time the short-circuit currents and the OCP of the individual alloys, and observing by Scanning Electron Microscope (SEM) the surfaces of the samples before and after the test.

Potentiodynamic polarization tests with microcells were then carried out on the three different weld joints, in order to obtain information on their corrosion behaviour. Then, after metallographic attack, the microstructure of the joints was studied, paying particular attention to the characteristics of the interfaces between the different aluminium alloys in the thermo-mechanically altered areas and in the mixing areas.

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Session Classification: 2A

Track Classification: Material & production technology