Accepted Manuscript

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PII: S0013-4686(18)30507-3

DOI: 10.1016/j.electacta.2018.03.019

Reference: EA 31385

To appear in: *Electrochimica Acta*

Received Date: 15 November 2017

Revised Date: 1 March 2018

Accepted Date: 4 March 2018

Please cite this article as: F. Safizadeh, N. Sorour, E. Ghali, G. Houlachi, Corrosion behavior of Fe-Mo and Fe-Mo-P cathodic coatings in the simulated electrolyte for sodium chlorate production, *Electrochimica Acta* (2018), doi: 10.1016/j.electacta.2018.03.019.

Corrosion behavior of Fe-Mo and Fe-Mo-P cathodic coatings in the simulated electrolyte for sodium chlorate production

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ABSTRACT

The corrosion behavior of electrodeposited binary Fe-Mo and ternary Fe-Mo-P coatings on cathodes was investigated in the simulated electrolyte for chlorate production, containing 300 g L^{-1} of NaCl and 4 g L^{-1} of $K_2Cr_2O_7$ at 80 °C. Electrochemical noise measurements (ENM), linear polarization resistance (LPR), electrochemical impedance spectroscopy (EIS) and scanning reference electrode technique (SRET) were used in this investigation under open circuit potential (OCP) in the simulated shutdown conditions of the chlorate production industry (decay). A filiform corrosion was observed on the surface of all electrodes and in the case of mild steel, a number of pitting sites were also detected. The ternary cathode ($Fe_{54}Mo_{30}P_{16}$) containing the highest phosphorous content showed the best resistance to corrosion compared to other coatings and mild steel. Using the ENM technique, a decrease of 67% of the corrosion rate was measured for the $Fe_{54}Mo_{30}P_{16}$ coating compared to $Fe_{53}Mo_{47}$ after 72 h of decay, whereas mild steel showed 6 times more corrosion compared to the $Fe_{54}Mo_{30}P_{16}$ electrode. The addition of phosphorous to the $Fe_{53}Mo_{47}$ alloy promoted resistance to corrosion. The corrosion resistance of ternary alloys of Fe-Mo-P were improved with the increase of phosphorous content from 9 to 16 at.%. According to LPR and EIS measurements, the $Fe_{54}Mo_{30}P_{16}$ showed 56%-60% less corrosion compared to the binary $Fe_{53}Mo_{47}$ electrode.

Keywords: Coating, Corrosion, Sodium chlorate production, Electrochemical techniques

1. Introduction