

Effects of Al Content on the Corrosion Behaviors of Low Cr Bearing Steels in NaCl Solutions

Shuai Wang^{1,2}, Qingyou Liu¹, Bo Lv³, Liping Xu^{4,*}

¹ Key Laboratory of High-temperature and High-pressure Study of the Earth's Interior, Institute of Geochemistry, Chinese Academy of Sciences, Guiyang 550081, China

² University of Chinese Academy of Sciences, Beijing, 100049, China

³ Yanshan University, School of Environmental and Chemical Engineering, Qinhuangdao, 066004, China

⁴ Zhejiang Pharmaceutical College, Ningbo 315100, China

*E-mail: xuliping98@163.com

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The effects of Al content on the corrosion behaviors of aluminum-bearing steels were studied in NaCl solutions. Electrochemical measurements and Raman and scanning electron microscopy (SEM) surface analyses revealed that the aluminum-bearing steel formed two passivation films: the outer layer film contained Al₂O₃ and Cr₂O₃, and the inner layer film contained lepidocrocite (γ -FeOOH), regardless of whether the NaCl solution was faintly acidic/alkali or neutral. Lepidocrocite is unstable and can transform to α -Fe₂O₃ and γ -Fe₂O₃ when exposed to air. The electrochemical impedance spectroscopy (EIS) results showed that the dominant anticorrosion effect comes from the inner layer film, but a larger Al content causes a larger charge transfer resistance and larger outer and inner passive resistances, which result in better anticorrosion properties. Furthermore, corrosion weight gain tests revealed that the Al content (Al%) and corrosion rate (V) exhibit a negative linear relationship $V = -1.3667Al \% (\text{wt.}\%) + 1.9691$ in the investigated conditions.

Keywords: Bearing steel; Al; Corrosion weight gain; Polarization curve; EIS; Raman spectra.

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