

Comprehensive properties of Al-Zn-In series sacrificial anodes in high temperature oil Wells

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Abstract

In recent years, aluminum-based sacrificial anodes have been widely used in many service environments because of their negative driving potential, large capacitance, good anodic activation solubility and long service life. However, in some harsh environmental conditions, such as high temperature oil sewage, oil and gas well environment, the traditional sacrificial anode in high temperature, high salinity, highly corrosive media, the use of poor, anode surface will appear serious pits, low dissolution activity, current efficiency decline, so that the oil well pipeline can not be effectively protected. Therefore, it is necessary to further improve its overall performance in this harsh environment.

In this paper, Al-Zn-In anode alloy is used as the primary tercomponent, and then the composition design is optimized through alloying and heat treatment. In terms of experiment, GB/T17848-1999 sacrificed-anode constant current experiment is carried out to test the open circuit potential, working potential, capacitance and current efficiency. At the same time, electrochemical tests such as polarization curve, electrochemical impedance spectroscopy, scanning Kelvin probe SKP (micro-region potential distribution measurement), metallographic structure observation and analysis were carried out for anode materials in high-temperature oil well produced liquid. Furthermore, virtual crystal approximation (VCA) was used to quantitatively design anode substrate composition. By calculating the anode work function and the adsorption energy of the main molecules and ions of the oil well produced liquid on the surface of the anode alloy, the interfacial affinity between the alloy composition and the oil well produced liquid is predicted: the greater the affinity, the greater the tendency of dissolution reaction between the alloy interface and the produced liquid solution, and the better anode dissolution activity is expected.

After optimization design, several new sacrificial anode samples were prepared, and comprehensive electrochemical protection performance tests were conducted.

Two sacrificial anode components were selected to meet the requirements of high-temperature and highly corrosive oil well environments.

Keywords: oil well produced fluid, sacrificial anode protection, electrochemistry, metallographic structure, adsorption energy