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Corrosion Monitoring of Metals Used in Salt Production Line Using Multiple Electrodes System

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Summary

Saltery plant has been running under severely corrosive condition of aqueous solution saturated with sodium chloride and magnesium chloride at high temperature higher than 100°C. Crevice corrosion is one of serious problem found frequently between flanges in pipeline of the plant. The object of this study is therefore development of monitoring method for crevice corrosion under operation condition of the plant. For this purpose, we developed the multichannel electrode system and applied it to the artificial crevice corrosion of SUS316L, NAS64, NAS185N and NAS254N stainless steels immersed in 5 mol dm^{-3} NaCl solution at temperature up to 100°C. The specimen was constructed from five sheets of stainless steels to be wired, insulated, piled and embedded in epoxy resin. Small holes were made through five sheets to reproduce the crevice condition. These stainless sheets were connected to electronic circuit which enables measurement of galvanic coupling current on individual electrode under the coupling condition. Using this system, following results were obtained. (1) Distribution of coupling current as a function of crevice depth was evaluated for each stainless steels. (2) Coupling current distribution depends on kinds of stainless steel. For example, anodic or cathodic contribution in SUS316L crevice changed with immersion time, temperature, and concentration of dissolved oxygen. Transition of coupling current distribution was explained by the precipitation of corrosion product on the surface which suppresses charge transfer for, for example, reduction reaction of dissolved oxygen. On the other hand, for NAS64, NAS185N and NAS254N, the surface outside of the crevice always contributes as cathode and the surface in the crevice as anode. (3) For NAS64, NAS185N and NAS254N, the coupling current was large at the initial stage of immersion and then decreased down to in the order of nA for the case of NAS185N and NAS254N. However, this small coupling current may increase after development of corrosive condition in the crevice. Longer measurement for more severe crevice condition is thus desirable. (4) Dissolved oxygen affected the corrosion rate and coupling distribution for the case of SUS316L. For NAS64, NAS185N and NAS254N, however, DO value did not affect corrosion rate or coupling current distribution in the steady state condition. (5) For better simulation of practical saltery plant, severe crevice condition should be used as an artificial crevice. (6) Effect of $NgCl_2$ should be also evaluated. (7) Crevice corrosion monitoring system using the multichannel electrode system for practical saltery plant is proposed although some adaptation is necessary for, for example, complicated current path and large electric noise in the plant.