No. 2202

Development of Electric Protection Method for Stainless Steel Boiling Pot using Oxygen Evolution Anode for Seawater Electrolysis

Zenta Kato

Tohoku Institute of Technology

Summary

In the salt production, the process of boiling down seawater that has been concentrated to 5-6 times the concentration of normal seawater using an ion exchange membrane method is called decoction. Since this pot operates under conditions of high temperature and high concentration, Iron, Stainless-clad steel, and Titanium-clad steel have evolved to suppress corrosion. However, even these materials are subject to corrosion and require replacement after a certain period of use.

There are coating corrosion protection, cathodic protection, and corrosion protection with corrosion inhibitor. Among them, cathodic protection is a method of preventing corrosion by applying an electric current to metals in water or soil and manipulating the potential. Cathodic protection includes the sacrificial anode method, in which base metals are electrically contacted, and the external power source method, in which an external power source is used.

A platinum metal such as Pt, which is stable in anodic polarization, is usually used for the anode used in the external power supply method for cathodic protection. It is considered possible to suppress the corrosion of the materials used by applying this external power supply method for cathodic protection to the boiling pot. However, if ordinary Pt or the like is used, harmful chlorine will be generated.

So far, we have proposed the production of hydrogen by direct electrolysis of seawater, which is abundant on earth, and the production of methane by reacting it with carbon dioxide. In the seawater electrolysis, since the seawater contains chlorine ions Cl^-, the reaction $2Cl^- \rightarrow Cl_2 + 2e^-$ occurs when a normal electrode is used, generating highly toxic chlorine. Chlorine cannot be generated every time hydrogen is supplied. For this reason, we have been creating electrodes that generate only oxygen ($2H_2O \rightarrow O_2 + 4H^+ + 4e^-$) instead of chlorine for many years.

In this study, after examining the corrosion state of Stainless steel and Iron when immersed in 0.5 M NaCl, we investigated the corrosion state of these materials after applying cathodic protection using an oxygen evolution anode. It found that corrosion of Iron and Stainless steel can be significantly suppressed compared to the one without corrosion protection.