

1-19 Safe Storage of Spent Cesium Adsorbent

— Characterization and Evaluation for Hydrogen Production and Corrosion —

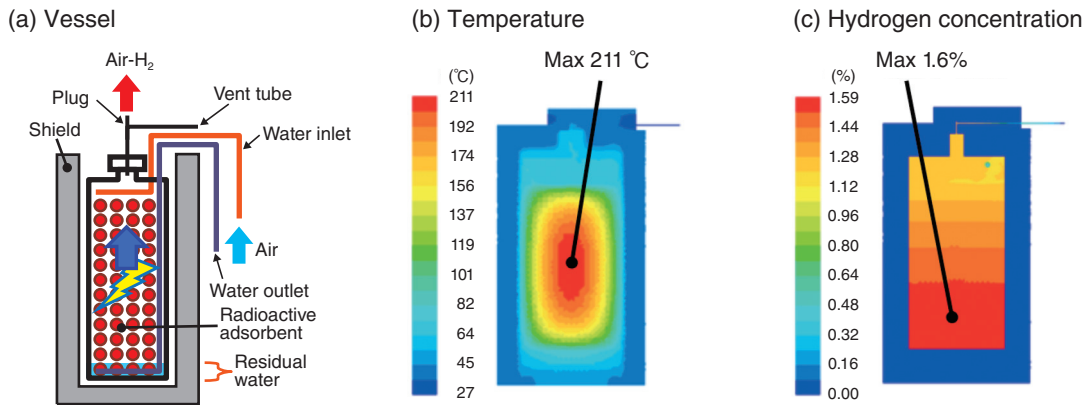


Fig.1-39 An example of the thermal hydraulic analysis of a Cs adsorption vessel with residual water

A reference vessel (decay heat 504 W, water level 24 cm, hydrogen production 20.5 ℓ/d, absorbed dose rate at the bottom 755 Gy/h) was evaluated. Air is introduced by the water inlet and released through the vent plug. The maximum temperature and hydrogen concentration are 211 °C and 1.6%, respectively. The temperature of the residual water is below 47 °C.

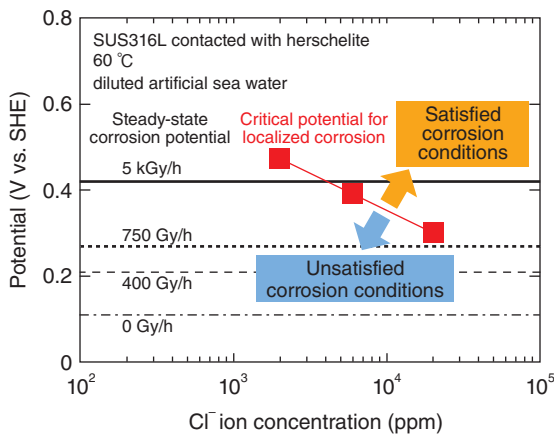


Fig.1-40 Electrochemical corrosion tests of stainless steel SUS316L

The electrochemical potentials of SUS316L in contact with herschelite were measured in diluted sea water to determine its immunity to localized corrosion. The critical potential for localized corrosion decreases as the Cl⁻ ion concentration increases. Conditions for localized corrosion are satisfied when the critical potential for localized corrosion is lower than the steady-state corrosion potential. Under the conditions of the reference vessel shown in Fig.1-39, the localized corrosion of SUS316L in contact with herschelite would not immediately occur at Cl⁻ ion concentrations of 20000 ppm.

Stainless steel vessels containing mineral adsorbents (herschelite, etc.), which possess high selectivity toward cesium (Cs), are used for the treatment of radioactive saline water at the accident at the TEPCO's Fukushima Daiichi NPS. The spent vessel is highly radioactive and temporarily stored with the shield (Fig.1-39(a)). For long-term storage, we evaluated the hydrogen production and corrosion of herschelite adsorption vessels.

As fundamental properties of herschelite, we investigated its thermal conductivity, hydrogen production yield, and Cs adsorption coefficients, as well as determined the Cs activity, decay heat, absorbed dose rate, and hydrogen production rate. The hydrogen concentration in a reference vessel of uniform Cs distribution was evaluated based on these fundamental properties. Fig.1-39(b) shows that the maximum temperature is 211 °C, below the self-ignition temperature of hydrogen (500–571 °C). This thermal hydraulic behavior maintains the

maximum hydrogen concentration below 1.6% (Fig.1-39(c)) and well below the lower explosive limit of 4%.

An electrochemical method was employed to determine the immunity to localized corrosion. Fig.1-40 shows the potentials of SUS316L in a mixture of herschelite and sea water. The critical potential for localized corrosion decreased as the Cl⁻ ion concentration increased. The conditions for localized corrosion are satisfied when the critical potential is lower than the steady-state corrosion potential. Therefore, under the conditions (temperature < 60 °C, adsorbed dose rate of 755 Gy/h) shown in Fig.1-39, the localized corrosion of SUS316L in contact with herschelite would not immediately occur at Cl⁻ ion concentrations of 20000 ppm.

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Reference

Yamagishi, I. et al., Characterization and Storage of Radioactive Zeolite Waste, Journal of Nuclear Science and Technology, vol.51, issues 7-8, 2014, p.1044-1053.