A Thermodynamic Study on Swelling Stress of Bentonite as a Buffer Material Composing Engineered Barrier in Radioactive Waste Disposal

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Abstract

In many countries, bentonite is used as a buffer material composing engineered barrier (EB) in the geological disposal of a high-level radioactive waste (HLW). The EB system consists of vitrified waste, overpack (carbon steel container) and buffer material from inside, and the outside of the buffer material is rock mass. HLW is disposed of excavated tunnels in geological formation deeper than 300m (geological disposal). After being disposed, bentonite develops swelling stress by penetration of groundwater from the surrounding rock mass, and this parameter is important in designing buffer material and analyzing long-term behaviour of buffer material. We developed a thermodynamic model which can calculate the swelling stress of bentonite under standard condition (298.15K) based on the thermodynamic data (the activity of water and the relative partial molar Gibbs free energy) of interlayer water in montmorillonite which is the main component of bentonite and montmorillonite content in the bentonite in previous studies, and furthermore we also developed a thermodynamic model which can calculate the effect of temperature on the swelling stress of bentonite based on the relative partial molar enthalpy in recent studies.

This talk introduces outline of the thermodynamic model and thermodynamic data of interlayer water in montmorillonite obtained so far. Furthermore, we also introduce practicality of the model by comparison with measured data of swelling stress.

Biography:

Haruo Sato graduated from Department of Geotechnology, Doctor's Program of Graduate School of Mining and Engineering, Akita University in 1997 (DE, 1997). He studied on geological disposal for HLW in Power Reactor and Nuclear Fuel Development Cooperation (PNC, presently Japan Atomic Energy Agency (JAEA)), 1989-2014. He joined in the Horonobe Underground Research Laboratory project in Hokkaido, 2006-2012. Furthermore, he also joined in the research of environmental dynamics in Fukushima, 2012-2014. Since 2014 he has been employed as an Associate Professor at Okayama University. He is mainly specialized in backend engineering, environmental dynamics and radiation safety in the university.