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Application of empirical models using evaporation method to estimate unsaturated hydraulic properties of soft rock

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Abstract

For the long- term isolation of hazardous nuclear waste the sedimentary soft rock can be utilized as a host rock. This hazardous waste can be stored in deeply excavated tunnels. However, the formation of high permeable Excavation Damaged Zone (EDZ) around the storage tunnel may seep out the hazardous nuclides after the closure of disposal site. Therefore, precise estimation of unsaturated hydraulic properties (UHP) is needed for this type of rocks to estimate the drying process and to assure the safety of the disposal. Samples of Tertiary sedimentary soft rock were collected from the Rokkasho Low Level Waste (LLW) disposal site in Aomori Prefecture of Japan; five sandstone samples and five pumice tuff samples. Applicability of two empirical models of UHP; Campbell (CB), and van Genuchten (VG) models that have been commonly applied for the soil hydraulic property estimation were studied. The difference between the CB and VG models were discussed in this paper. The transient evaporation method together with the inverse estimation technique was used to select the best parameter in each model. Further, in this method the Genetic Algorithm (GA) was adopted as an optimization tool. According to the results the measured evaporation change and the UHP of soft rock can easily estimate by the CB model.

Keywords: Excavation damaged zone, tertiary sedimentary soft rock, unsaturated hydraulic properties, transient evaporation, genetic algorithm