Analysis of Unsaturated Hydraulic Characteristics Based on Analysis of Grain Size Distribution

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1. Introduction

This study analyzed unsaturated hydraulic characteristics, which are one of the important characteristic data in safety analysis of low-intermediate level radwaste disposal. To secure the accuracy of analysis we analyzed grain size distribution on the target grain. To obtain unsaturated hydraulic conductivity we performed column experiment of multistep outflow method. HTDRUS ID code was used in analyzing experiment data.

2. Methods and Results

For an accurate analysis of unsaturated hydraulic conductivity, analysis of grain size distribution and column experiment of multistep outflow method were performed.

2.1 Analysis of grain size distribution

The subject grain of experiment was divided into silty soil and clayish soil. To secure the property of matter before analyzing grain size distribution, gravity of grain should be tested. Specific gravity test was performed by KS F2308 method. The test result indicates that specific gravity of clayish soil was 2.646 and specific gravity of silty soil was 2.638. Analysis of grain size distribution was performed by Sieve Analysis, KS F 2309-95 method, Hydrometer method and KS F 2302-92 method. The silty soil had sand, silt and clay fractions of 73.68, 23.92 and 2.00%, respectively. The clayish soil had sand, silt and clay fractions of 63.54, 34.80 and 1.66%, respectively.

2.2 Column experiment on Multistep Outflow method

Laboratory Outflow experiments are generally used in determining water retention function and unsaturated hydraulic conductivity function simultaneously. [1] In this experiment Onestep Outflow[2] method and Multistep Outflow [1,3] method are used. In this study Multistep Outflow method was selected. Pressure was applied in each step to values of 50, 101, 204, 510 and 1020cm.

2.3 Analysis of unsaturated hydraulic conductivity

For the analysis, HYDRUS 1D code was adopted. HYDRUS 1D consists of HYDRUS (version 7.0) computer program and the HYDRUS1D interactive graphic-based user interface. HYDRUS 7.0 numerically solved the Richard's equation of saturated-unsaturated water flow and convection-dispersion type equation of heat and solute transport.[4] HYDRUS 1D finds the optimized parameter to analyze water retention function based on the experiment value. This study analyzed multistep outflow experiment data and analysis data of grain size distribution with HYDRUS 1D code and evaluated unsaturated hydraulic characteristics. The optimized parameters was optimized by HYDRUS 1D code. The silty soil had θ_r, θ_s, α, n and K_s parameters of 0.1011, 0.3533, 0.0141[cm^{-1}], 1.8000 and 2.75E+00[cm/h], respectively. The clayish soil had θ_r, θ_s, α, n and K_s parameters of 0.0818, 0.4275, 0.0276[cm^{-1}], 1.1579 and 1.90E-01[cm/h], respectively.

Unsaturated hydraulic conductivity resulted from analyzing Multistep Outflow experiment data is in Fig. 1.

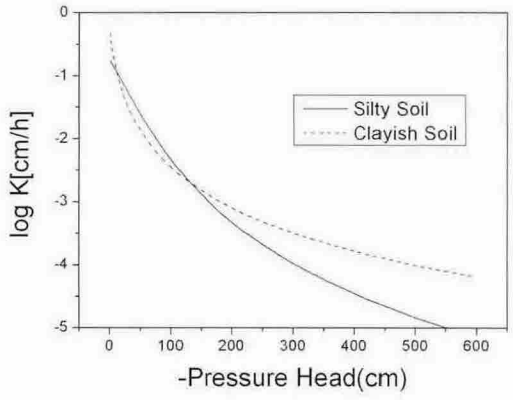

Figure 1. Unsaturated hydraulic conductivity curves

2.4 Analysis of soil water retention

Soil water retention curves resulted from analyzing Multistep Outflow experiment data and soil water retention curves of typical silt and typical clay are compared in Fig. 2 and Fig. 3. They show that the shapes of soil water retention curves of silty soil, clayish soil, typical silt, and typical clay are quite different. These characteristic values are of importance

in analyzing nuclide transport on low-intermediate level radwaste disposal sites. Therefore, they should be applied to safety analysis of low-intermediate level radwaste disposal by analyzing accurate soil water retention curves and hydraulic conductivity through analysis of grain's basic characteristic value.

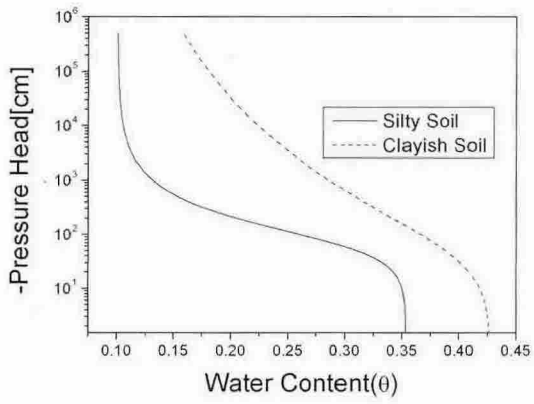

Figure 2. Soil water retention curves

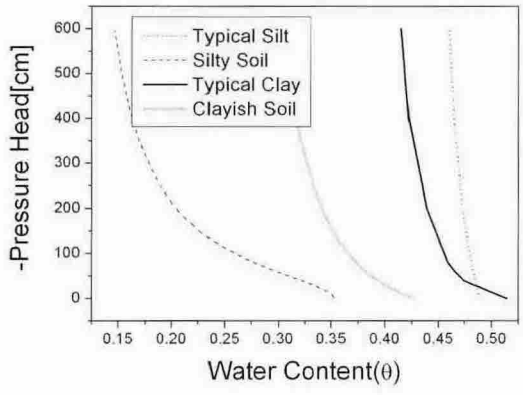

Figure 3. Comparison of soil water retention curves

3. Conclusion

Evaluation of nuclide transport is of importance in disposal safety analysis of low-intermediate level radwaste disposal sites. In this sense analyzing hydraulic characteristics of soil that composes disposal sites is important. This study analyzed soil water retention curves, which are the major hydraulic characteristics, and hydraulic conductivity. To enhance the credibility on safety analysis, accurate analysis of basic characteristics of soil is imperative.

Acknowledgement

This work was supported by KHNP Nuclear Environment Technology Institute, Daejeon, Republic of Korea and was financially supported by MOCIE through IERC program.

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