
Study on the application of specified compaction method of soil materials using bentonite and the compaction density effects on the waterproof performance

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In this study, it is assumed that the quality control of engineered barriers for radioactive waste disposal facilities using bentonite is based on the construction-method-specified contract. Based on the construction-method-specified contract, the frequency of the on-site density test is about once per several hundred to 1,000 m³. At such frequencies, it is not possible to show representative values for the entire constructed soil structure. Therefore, it is difficult to evaluate the performance of the entire soil structure based only on the results of this frequency. In order to solve this problem, I used geostatistical techniques to evaluate the impervious performance of the entire soil structure by numerical analysis. The spatial distribution of dry density including unmeasured points was estimated by geostatistical methods. The 3D spatial distribution model of hydraulic conductivity was transformed from the spatial distribution of dry density by the correlation between dry density and hydraulic conductivity. Seepage flow analysis and particle tracking methods were used to evaluate the following three effects.

- (1) Effect of variation in hydraulic conductivity and permissible limit of variation
- (2) Effect of measurement frequency during construction
- (3) Permissible limit of variation in water content and bentonite mixing ratio

As a result, if less than 24% of the elements of the 3D spatial distribution model of hydraulic conductivity did not reach the target dry density (if the defect rate is less than 24%), the target waterproof performance could be secured. The permissible range of variation due to infrequent measurement, the permissible range of variation in moisture content and mixing ratio, and the permissible range of variation due to construction can be quantitatively determined as long as the defect rate is less than 24%.

In this study, I summarize the concept of setting the construction target value considering the variation caused by construction and the method of setting the number of measurements such as dry density that contributes to quality control. I also showed that

the construction-method-specified contract can be applied to the construction of bentonite-based engineered barriers for low-level radioactive waste disposal facilities.