Thermal Conductivity Variation for the Bentonite-graphite mixture Ratio

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1. Introduction

The bentonite buffer is a crucial component in the engineered barrier system to dispose high-level radioactive waste. The design temperature of the bentonite buffer is 100 °C to keep functional properties, and disposal area is determined not to exceed 100 °C of the bentonite buffer [1]. The thermal conductivity of the buffer material has the greatest influence on the buffer temperature [2], and there has been many researches to increase thermal conductivity of the bentonite buffer.

Therefore, this paper suggested bentonite-graphite mixture to increase thermal conductivity, and graphite additive ratio was evaluated to find out the adequate mixture ratio.

2. Method and Result

2.1 Materials

This paper measured thermal conductivity of bentonite-graphite mixture for different additive ratio. Since thermal conductivity of graphite is a few hundred times higher than that of pure bentonite, additive ratio was 1-3%. Even though thermal conductivity was increased, hydraulic-mechanical-chemical properties should be maintained. In this reason, the minimum additive ratio was considered. The hot wire method was used to measure thermal conductivity, and specimen size was 10 cm x 5 cm x 1cm, and Gyeongju (KJ) bentonite was used.

2.2 Test results

Table 1 represents thermal conductivity variation for pure bentonite and bentonite-graphite mixture under the same condition. The dry density (γ_d) was 1.57-1.6 g/cm^3, and water content (w) was 12%. Considering thermal conductivity increase, 3% graphite addition might be reasonable.

Table I: Problem Description

Material	Thermal conductivity (W/cm-K)
KJ (100%)	0.85 (γ_d: 1.6)
KJ +graphite (1%)	0.85 (γ_d: 1.57)
KJ +graphite (2%)	0.92 (γ_d: 1.6)
KJ +graphite (3%)	1.11 (γ_d: 1.59)

Fig. 1 shows thermal conductivity variation for different dry density and water content values for the pure KJ bentonite and bentonite-3% graphite mixture. The range of dry density and water content was between 1.50-1.84 g/cm^3, and 0-23%, respectively. The thermal conductivity of bentonite-3% graphite mixture was 10-30% higher than that of pure KJ bentonite.

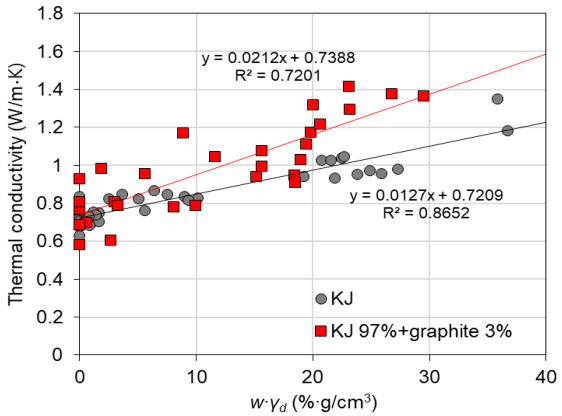

Fig. 1. Thermal conductivity variation.

3. Conclusive Remarks

This paper measured thermal conductivity for bentonite-graphite mixture. The 3% addition to the pure bentonite showed 10-30% higher thermal conductivity in comparison with pure bentonite. However, it is inevitably necessary to evaluate hydraulic-mechanical-chemical properties for the bentonite-graphite material to adapt it as a buffer material.

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