Solid-liquid boundaries of bentonite slurry in development of low permeability

EMA YOSHIKAWA[1]*, HIDEO KOMINE[1], SHIGERU GOTO[1]

YASUTAKA WATANABE[2], SHINGO YOKOYAMA[2], MISATO SHINBASHI[2]

[1] Department of Civil and Environmental Engineering, Waseda University, #203, Building 58,3-4-1, Okubo, Shinjyuku-ku, Tokyo 169-8555, Japan (*correspondence: e-ma@suou.waseda.jp)

[2] Central Research Institute of Electric Power Industry, 1646 Abiko, Abiko-shi, Chiba-ken 270-1194 Japan

Solid- or liquid-like behaviors is observed in the mixture of clay and water such as the swelling of bentonite in geological disposal and sealing by mud water in boring constructions. However, it is difficult to understand properties of the solid-liquid boundaries.

To better understand an intermediate behavior between solid and liquid, the impervious performance at the solid-liquid boundaries of bentonite-based slurry was investigated. Permeability tests were carried out using the slurry. The montmorillonite content of the bentonite was 65 %. Three types of the slurry were prepared adjusting the dry density to 0.07, 0.09 and 0.11 g/cm^3, respectively. The specific gravity of those samples was approximately 1.1. Deionized water was passed the specimen through downwards in constant water head, one-dimensionally. The volumes of flow and specimen were measured to estimate the hydraulic conductivity of the slurry. The distribution of the dry density and the montmorillonite content of the specimen after permeation were measured.

The hydraulic conductivity of all samples was initially 10^{-7} m/s, and gradually decreased to 10^{-9} m/s. The dry density of the slurry after permeation was gradually increased along the flow direction, and the lowermost layer showed the highest dry density, 0.14 g/cm^3, in all cases. The distribution of the montmorillonite content varied depending on the mixture ratio of bentonite. In the case of 0.07 g/cm^3, fine particles which is montmorillonite and some accessory minerals moved and concentrated downstream. It is supposed that the development of low permeability during continuous flow was caused by changing the state of the slurry from homogeneous to heterogeneous. In addition, the almost same dry density of the lowermost layer having solid matrix suggested that the state of the slurry transitioned from a dispersed to a physically stable in all slurry.