

Experimental study on diffusion transport in soil-bentonite cutoff walls

Yuki Nakazawa

Key Words : soil-bentonite, diffusion transport, soil and ground water contamination, containment, numerical analysis

1. BACKGROUND AND OBJECTIVES

Soil-bentonite mixture (SBM) is one of materials having a hydraulic conductivity low enough to be used as a containment barrier for contaminated soil, and has some advantages such as high deformability and self-recovery in barrier performance. In low-permeable material such as SBM, effect of diffusion should be evaluated because diffusion transport becomes dominant in chemical transport. In this study, to evaluate effect of soil pore structure on diffusion phenomena, diffusion test using a cylindrical column was conducted on specimens having different content of bentonite powder (C_{BP}). In this study, 0.05 mol/L sodium chloride (NaCl) solution was used as a tracer solution. The apparent diffusion coefficient was estimated by comparing the results of experiment and numerical analysis by Dtransu2D-EL.

2. MAIN ACHIEVEMENTS

- (1) During the diffusion test, the flow from low concentration solution toward high concentration solution was observed because of difference in osmotic pressure. Especially, in the case of smaller C_{BP} , which leads higher hydraulic conductivity, this phenomena occurred relatively remarkable.
- (2) By comparing mass flux calculated from the results of experiment and that calculated by numerical analysis, the apparent diffusion coefficients of SBM with $C_{BP} = 100, 50, 25 \text{ kg/m}^3$ to chloride ion were estimated to be $1.6 \times 10^{-10} \text{ m}^2/\text{s}$, $3.0 \times 10^{-10} \text{ m}^2/\text{s}$, and $3.6 \times 10^{-10} \text{ m}^2/\text{s}$, respectively. It is obvious that the apparent diffusion coefficient becomes smaller as C_{BP} in SBM increase. (Fig.1)
- (3) Void ratio in SBM increased as increasing C_{BP} . The apparent diffusion coefficient of SBM to chloride ion decreased as void ratio in SBM increased. This indicates that decrease in effective porosity of SBM caused decrease in the apparent diffusion coefficient.
- (4) Even when maintaining water level inside the SBM cutoff walls at lower than the outside, relative concentration becomes higher than 0.3 in 50 years. (Fig.2)

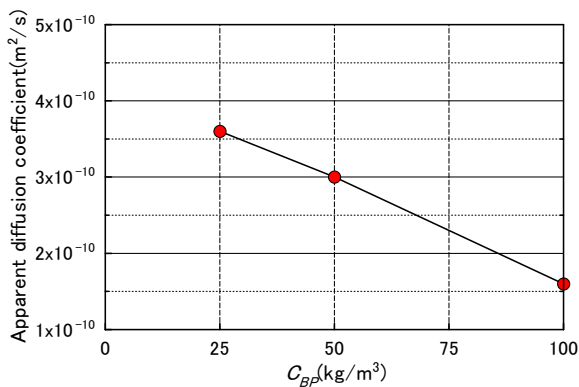


Fig.1 Relationship between C_{BP} and apparent diffusion coefficient

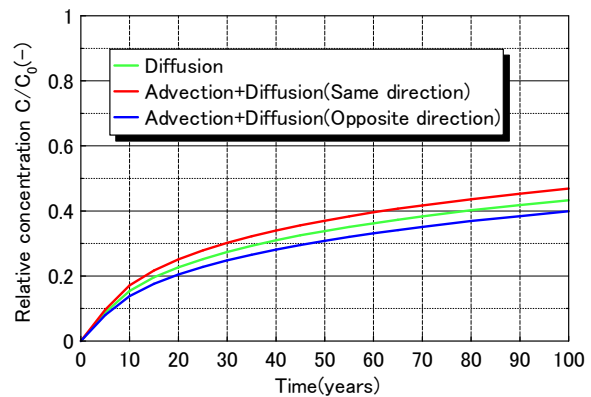


Fig.2 Transportation in SBM cut-off wall ($C_{BP} = 100 \text{ kg/m}^3$)