Numerical Evaluation for In-Situ Tests Investigating a Local Hydraulic Property on a Borehole

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1. Introduction

Deposition holes emplacing canisters can be damaged by changing stress conditions induced from excavation of the holes or other processes. In this study, previous researches for investigating local damages or fractures at boreholes were examined and numerical simulations were performed for evaluating the existing characterization methods.

2. Method

Previous works on single borehole tests, which can be applicable for estimating local properties of the vicinity or wall of boreholes were reviewed. Then, applicability of the analysis methods suggested in the reviewed works was determined by conducting a case study. A hypothetic groundwater flow system was assumed, and a single borehole test was simulated. With the simulation results, the hydraulic property of the system was estimated using the analysis methods from the previous works, and compared to the assumed one of the hypothetical groundwater flow system.

3. Results

3.1 Dipole Flow Test

From the reviewed single borehole tests, the dipole flow test (DFT), which makes groundwater flow circulate between multiple intervals of a test borehole and has been used to estimate a hydraulic property and anisotropy ratio at a local part of the borehole [1, 2], were considered as an available hydraulic test methods for in-situ conditions. In addition, the dipole flow tracer test (DFTT), which is a tracer test based on the DFT, was also examined to determine properties of solute transport such as dispersivity.

3.2 Numerical Simulations for Hypothetical DFT

From evaluating applicability of the test by numerical simulations, the analysis methods suggested in the previous studies were available for estimating a hydraulic property based on in-situ field tests. The methods were applied to results of numerical simulations with a hypothetical aquifer. From the analysis, the estimated horizontal hydraulic conductivity of the hypothetical aquifer had the same order (= 10^{-7} m/s) as the assumption.

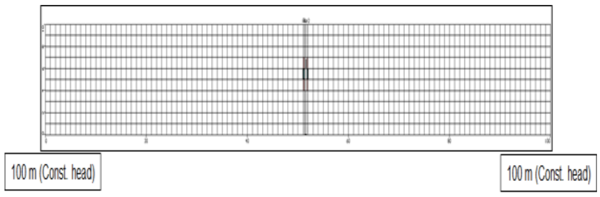

Fig. 1. Hypothetical aquifer and a test borehole.

Table 1. Parameters for Hypothetical aquifer

Parameters	Value
Horizontal hydraulic conductivity	10^{-7} m/s
Vertical hydraulic conductivity	10^{-8} m/s
Aquifer thickness	10 m
Boundary condition for both ends	100 m
Anisotropic ratio	3.16

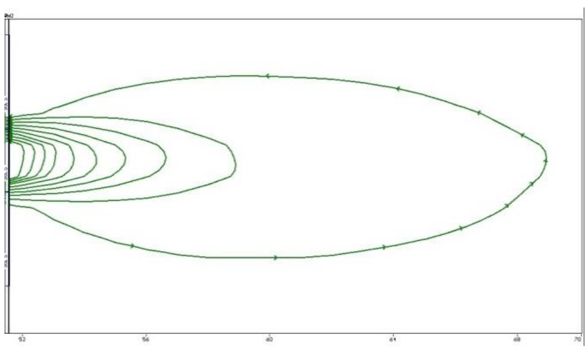

Fig. 2. Groundwater flow path simulated with the hypothetical aquifer.

4. Conclusions

To investigate locally damaged areas or discontinuity in a borehole, DFT was examined and tested in a hypothetical aquifer condition. It is thought that DFT is applicable to characterization of local structures in the vicinity of boreholes. Besides, it may be contributed to designing in-situ hydraulic test plans. The results of this study can be used for practical application to a deep geological disposal of high-level wastes.

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