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Study on a numerical model for fluid flow and heat transport through permeable porous media

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Interaction between the atmosphere, the surface and the subsurface is one of the most important keys in understanding, managing and utilizing the water environment. Recently, technologies for estimating the shallow subsurface thermal environment adequately are required along with the popularization of the ground-coupled heat pump system and the heating and cooling system by direct use of groundwater. A numerical simulation model for being able to estimate processes of fluid flow and thermal transport in unsaturated and high permeable porous media is required in order to develop the technique of shallow geothermal energy utilization.

In this study, the one-dimensional infiltration experiments using a cylinder column and improving the numerical simulation model were carried out. In the experiment, highly permeable porous media 3 and 5 millimeters in diameter were used. The flow velocity and the temperature changes in the column were measured. The experimental results were represented by the numerical model.

As the results, the high-velocity flow in the permeable porous media was simulated by the model using multi-phases system. In addition, in the model the temperature of soil, liquid (water) and air were able to be simulated individually and the calculated results were agreement with the experimental results.