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Impacts of thermal dispersivity ratio on the relevant heat transport processes in groundwater heat pump (GWHP) systems

Byeong-Hak Park and Kang-Kun Lee
Seoul National University, School of Earth and Environmental Sciences, Seoul, Korea, Republic Of (pbh3000@snu.ac.kr)

In general, thermal dispersion has been underestimated in the simulation of heat transport in porous media because thermal diffusion occurs hundreds times faster than solute diffusion and groundwater flow velocity is relatively slow. In recent years, many studies in the field of shallow geothermal applications have indicated that thermal dispersion is one of important transport mechanisms. Most of them, however, assumed the fixed ratio of longitudinal to transverse thermal dispersivity values. The influence of such assumption have not been investigated so far.
In this study, a laboratory experimental system was designed to examine the impacts of thermal dispersivity ratio on the relevant heat transport processes. Before heat tracer tests, preliminary experiments were performed to estimate the physical properties of fully saturated porous media. Then, heat transport experiments using two different heat sources of resistor and warm water were conducted at various background flow velocities. The experimental results were analyzed by analytical and numerical models to identify the relationship between longitudinal and transverse thermal dispersivity values and to investigate their effects on the thermal plume propagation from the groundwater heat pump (GWHP) systems.

Keywords: groundwater, groundwater heat pump (GWHP), thermal dispersion, thermal dispersivity ratio, heat transport

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