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Effects of particle size and thermal properties on thermal dispersion characteristics in porous media

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Understanding heat transport process in saturated porous media is essential, in regard to a widespread use of ground source heat pump systems and design of geologic repositories for high-level nuclear wastes. However, knowledge of thermal dispersion occurred due to advective heat flow is limited in the mechanisms of heat transport process. In this study, one-dimensional heat and solute transport experiments were conducted using glass beads with different size fractions, and stainless steel sphere with high thermal conductivity. Effects of particle size, thermal properties, and flow velocities on thermal dispersion characteristics and the difference between thermal and solute dispersion characteristics were discussed based on the column experiments. Glass beads with smaller size fraction showed smaller increase in thermal dispersion coefficient at higher flow velocity as compared to the one with larger size fraction. Flow velocity dependency on thermal dispersion coefficient was insignificant for stainless steel sphere, indicating thermal conduction dependent heat transport is dominant in the column due to higher thermal conductivity of the stainless steel.

Keywords: thermal dispersion, solute dispersion, thermal properties