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Abstract title

Heat transfer characterization in a shallow aquifer using heat and dye tracer tests

Abstract text

Very low enthalpy geothermal systems (open or closed) are increasingly considered for heating or cooling houses and offices using groundwater energy combined with heat pumps. However, the design and the impact of current shallow geothermal systems are often set up and assessed in a semi-empirical way. In our country, this situation seems accepted by most of the private partners but not by the authorities and responsible administrations evaluating the impact on groundwater with a mid- to long-term perspective. A rigorous methodology is needed based on a physically based estimation of heat transfer parameters. In this study, the simultaneous use of heat and dye tracers allows estimating simultaneously heat transfer and solute transport parameters in an alluvial aquifer. The experimental field site, located near Liege (Belgium), is equipped with 21 piezometers drilled in the alluvial deposits of the Meuse River. These alluvial deposits are composed of a loam layer (3 m) overlying a sand and gravel layer which constitutes the alluvial aquifer (7 m). The tracing experiment consisted in injecting simultaneously heated water and a dye tracer in a piezometer and monitoring the evolution of groundwater temperature and tracer concentration in a series of control panels set perpendicularly to the main groundwater flow. Results showed drastic differences between heat transfer and solute transport due to the main influence of thermal capacity of the saturated porous medium. The tracing experiment was then simulated using a numerical model and the best estimation of heat transfer and solute transport parameters is obtained by calibrating this numerical model using inversion tools. The developed concepts and tests may lead to real projects of various extents that can be now optimized by the use of a rigorous and efficient methodology at the field scale.

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