HEAT TRANSFER CHARACTERIZATION USING HEAT AND SOLUTE TRACER TESTS IN A SHALLOW ALLUVIAL AQUIFER

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Very low enthalpy geothermal systems are increasingly considered for heating or cooling using groundwater energy combined with heat pumps. The design and the impact of shallow geothermal systems are often assessed in a semi-empirical way. It is accepted by most of the private partners but not by environmental authorities deploring a lack of rigorous evaluation of the mid- to long-term impact on groundwater. In view of a more rigorous methodology, heat and dye tracers are used for estimating simultaneously heat transfer and solute transport parameters in an alluvial aquifer. The experimental field site, is equipped with 21 piezometers drilled in alluvial deposits composed of a loam layer overlying a sand and gravel layer constituting the alluvial aquifer. The tracing experiment consisted in injecting simultaneously heated water and a dye tracer in a piezometer and monitoring evolution of groundwater temperature and tracer concentration in 3 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.