

Assessment and comparison of soil thermal characteristics by laboratory measurements

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Abstract

Soil thermal characterization is an important aspect affecting the performance of Ground Heat Exchangers (GHE) in a Shallow Geothermal Energy (SGE) system application. Thermal conductivity and specific heat capacity are the sole requirements in designing such systems and can be obtained using empirical prediction models, laboratory tests and in situ tests. Laboratory thermal tests can be performed under steady-state or transient conditions. Transient tests have the advantage of being fast and of requiring a small volume of soil. This has led to recent developments and types of heat probes commercially available, but for which there is limited comparative assessment of results. This paper focuses on the evaluation of thermal properties, namely the ground thermal conductivity, specific heat capacity and thermal diffusivity by means of two different probes; a needle probe and a surface probe, and on comparing and testing their accuracy. Comparison of the different samples was also performed using two different transient needle probes, from two commercially available equipment, Isomet-2104 and Hukseflux-TPSY02. The laboratory measurements are supported by numerical modelling using the COMSOL Multiphysics software which applies a finite-element analysis method on the convection-diffusion equation for heat transfer.