PERFORMANCE COMPARISON BETWEEN A TYPICAL VERY SHALLOW AND AN INNOVATIVE CONFIGURATION OF GROUND HEAT EXCHANGERS

Names of Authors (please underline corresponding author)	Francesco Tinti[a], Sara Focaccia[b], Alberto Barbaresi[c]
Institution/Company	[a]Department of Civil, Chemical, Environmental and Materials Engineering, University of Bologna, via Terracini 28, 40131 Bologna, Italy. [b]Serengeo srl, via Terracini 28, 40131 Bologna, Italy. [c]Department of Agriculture and Food Sciences, University of Bologna, viale Fanin 44, 40127, Bologna, Italy.
Address of corresponding author	Department of Civil, Chemical, Environmental and Materials Engineering, University of Bologna, via Terracini 28, 40131 Bologna, Italy
Telephone number of corresponding author	+390512090477

Ground Heat Exchangers (GHEs), very shallow (baskets, spirals) as well as vertical (Borehole Heat Exchangers), transfer heat to the ground through the filling material. Research on filling material has been developed to boost heat transfer and meanwhile protecting groundwater from pollution. Maximum result of filling material is a thermal conductivity similar to that of the ground (2.0-2.5 W/m·K). In very shallow applications, such as baskets and spirals, since high quality aquifers are not affected, filling material is the excavated soil itself, with very limited design possibilities to improve the heat exchange. Therefore, a possible way to maximize the heat exchange consists in modifying the configuration of the very shallow application. The scientific literature reports that water presence (phreatic aquifer or rainwater in superficial layers) enhances the GHE performance. Grouting and other filling materials, even with high thermal conductivity, lower the advection term due to the water movement and thus its contribution in the overall performance of the system. A solution to raise advection contribution, even in shallow systems, is to submerge geothermal pipes directly into the water. This can be achieved by the insertion of pipes into proper tanks buried in the ground.

The present work illustrates an experimental campaign conducted to verify the performance of a geothermal spiral (2 m deep) inside a water tank, by comparing it with the same spiral, directly installed in the ground, at 4 m distance. A low power TRT machine was used for simultaneous comparison of two spirals, by proper control of thermal power and water flow. This work illustrates the results of the 4 months' TRT campaign, showing how the innovative system improves, by a factor up to 200%, the thermal exchange between the geothermal pipes and the ground. On the opposite, on medium-long term, the decrease of efficiency, due to thermal saturation of the medium, was faster in the innovative configuration than in the typical one. The study provides a preliminary quantification of the benefits and limitations of the proposed configuration. Coupling water tanks to GHE seems a promising innovation, with remarkable potential. Further studies will be carried out to verify the marketability of these systems, by exploring double usage (Combined water/energy savings), selecting best materials for all new parts of the system, deepening the tanks and evaluating the feasibility in real applications for shallow and deeper systems.