Geophysical Research Abstracts
Vol. 19, EGU2017-4734, 2017
EGU General Assembly 2017

Suburban heat island effect in groundwater energy utilisation in Nordic climate - case study

Teppo Arola
Geological Survey of Finland (teppo.arola@gtk.fi)

We present the preliminary results from the initial thermogeological characterization of Finland's first-ever planned large-scale aquifer thermal energy storage (ATES) facility. The site is located in the Asko area (Lahti), at a latitude of 60°59'N. In particular, emphasis is put on the results from an aquifer's pumping test performed in July / August 2016 to investigate the potential implication of suburban heat island (SUHI) effect to ATES system on the naturally cold groundwater area.
The site has been under geological investigation since July 2015. At a regional scale, the groundwater's natural temperature is about 5.8- 6°C. However, preliminary measurements during the investigations revealed that local groundwater temperature ranged between 7.5 to 8.7 °C in Asko area. The highest temperature was observed underneath buildings, suggesting that higher-than-average temperature is most likely influenced due to anthropogenic heat flux into the ground.
The pumping test was performed for 39 days, of which 28 days with groundwater withdrawal and 11 days of heads recovery. The pumped volumes range from 350 to 540 m3/d leading the total volume of 10400 m3 of groundwater. Groundwater temperatures were continuously measured from pumping test well and two observation piezometers during the entire test. The results indicated that aquifer's temperature remained nearly constant being between 7.4 to 7.9 °C during the test period. Heat pulses with temperature variation of 0.1 to 0.3 °C were observed in the pumping well and nearest monitoring well (19 meters from pumping well) during the pumping test and recovery phase. We estimate that the pulses were due to rapidly changed groundwater flowing conditions and pulse indicate "new groundwater" flow to the well.
Overall, the preliminary test suggests that groundwater temperature are expected to remain elevated during the ATES system operation.
Elevated temperature due the SUHI effect increases groundwater heating potential significantly. Similarly groundwater cooling potential decrease but groundwater still constitutes an effective cooling energy reservoir because groundwater temperatures remain below air temperatures during the summer and the COP for cooling is extremely high.
In Asko site SUHI effect has been recognised from the beginning of the project. Energy and economical calculations are based on anthropogenic influence to ground temperatures. More research, i.e. detailed groundwater thermogeological modelling, is needed to design the multi well ATES system based on elevated groundwater temperatures.