

## Long-term monitoring for groundwater temperature at closed loop GSHPs installed site

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This study was performed to evaluate the influence of closed loop ground source heat pumps (GSHPs) on groundwater temperature. The closed loop ground source heat pumps was installed in 2009 and their capacity is 6,952 kW. The monitoring well was installed between wells used to closed loop GSHP and was located approximately 3.5 m away from well used to closed loop GSHP. The groundwater temperature were hourly measured from May 2010 to June 2013. The air temperature had ranged from -15.7 to 30.4°C and showed significant seasonal variations. The water temperature at monitoring well ranged from 13.3 to 16.3°C and their fluctuation trend was similar to air temperature. However, background of groundwater temperature showed narrow range (12.8 to 14.7°C) compared with that at monitoring well. In addition, background of groundwater temperature showed relatively weak seasonal variations. The phase difference between air and groundwater temperature at monitoring well was from approximately 4 to 5 months. The slope of regression line for air and background groundwater temperature was -0.006 and -0.01 °C/day, respectively. In contrast, the slope of regression line for groundwater temperature at monitoring well was 0.05 °C/day. These results indicate that thermal energy is cumulated in groundwater owing to operation of closed loop GSHPs in the study area. These trends can keep going. Therefore, the influence of closed loop GSHPs on groundwater temperature has to be evaluated to conserve groundwater from thermal contamination by operation of closed loop GSHPs and to keep energy efficiency. This work is supported by the Korean Ministry of Environment under "The GAIA project (2014000530001)".

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