



## **Environmental impacts of open loop geothermal system on groundwater**

Koo-Sang Kwon, Youngyun Park, Sang Woong Yun, and Jin-Yong Lee

Kangwon National University, Department of Geology, Chuncheon, Korea, Republic Of (hydrolee@kangwon.ac.kr)

Application of renewable energies such as sunlight, wind, rain, tides, waves and geothermal heat has gradually increased to reduce emission of CO<sub>2</sub> which is supplied from combustion of fossil fuel. The geothermal energy of various renewable energies has benefit to be used to cooling and heating systems and has good energy efficiency compared with other renewable energies. However, open loop system of geothermal heat pump system has possibility that various environmental problems are induced because the system directly uses groundwater to exchange heat. This study was performed to collect data from many documents such as papers and reports and to summarize environmental impacts for application of open loop system. The environmental impacts are classified into change of hydrogeological factors such as water temperature, redox condition, EC, change of microbial species, well contamination and depletion of groundwater. The change of hydrogeological factors can induce new geological processes such as dissolution and precipitation of some minerals. For examples, increase of water temperature can change pH and Eh. These variations can change saturation index of some minerals. Therefore, dissolution and precipitation of some minerals such as quartz and carbonate species and compounds including Fe and Mn can induce a collapse and a clogging of well. The well contamination and depletion of groundwater can reduce available groundwater resources. These environmental impacts will be different in each region because hydrogeological properties and scale, operation period and kind of the system. Therefore, appropriate responses will be considered for each environmental impact. Also, sufficient study will be conducted to reduce the environmental impacts and to improve geothermal energy efficiency during the period that a open loop system is operated. This work was supported by the Energy Efficiency and Resources of the Korea Institute of Energy Technology Evaluation and Planning (KETEP) grant funded by the Korea government Ministry of Knowledge Economy (No.20123040110010).