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Groundwater aquifer scaling potential in the Naju city, Republic of Korea

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Groundwater is widely used in real life. In rural areas, a large amount of groundwater has been used for agriculture and for various utilities such as the groundwater heat pump (GWHP) system. The GHP system uses groundwater as the heat source or sink. The GWHP system requires a large supply of water to be cost effective and have potential problems such as clogging, mineral deposits, and corrosion in the system. Hence, the success of the GWHP system relies on the presence of an aquifer of sufficient productivity and water quality. The groundwater has different chemical properties by geology. Depending upon its specific chemistry, groundwater can promote scaling, corrosion or both. For the environment in which the ions in the groundwater precipitate, the formation of scale degrades the performance of the GHP system. Therefore, water quality is as important an issue as water quantity in the application of geothermal heat pump system. In Korea, water quality has not been considered and is an obstacle to the wide introduction of the GHP system. The object of the work was to identify the potential areas of the Naju city, Chonnam province, Korea, where scale may occur. The saturation index (SI) and the Langelier Saturation Index (LSI) were used for this purpose. The SI indicates whether the ions in the groundwater are oversaturated: the positive SI indicates a potential precipitation. Calcium carbonate is the most common form of scale deposition. The LSI is based upon the saturation of calcium carbonate and is a useful indicator of $CaCO_3$ (s) scale. If the calcium carbonate content exceeds the level that can be maintained in solution, scale will occur. Groundwater chemistry data reported in the nationwide hydrogeological survey carried out by the Korean government has been used to evaluate the groundwater aquifer scaling potential in the Naju city, Republic of Korea. The number of wells, the groundwater of which can produce the formation of the scale, was found to be only 8 of 200 wells. When groundwater is extracted, passed through a heat pump before being re-injected back into the discharge well, the temperature of groundwater extracted and re-injected becomes different. When considered for 40°C, the temperature at which water is re-injected into the aquifer, 30 wells show potential scaling. This information help installers and system owners plan for the regular maintenance that may be necessary to address the scaling and preserve system performance.