

Geothermal heat pump system and groundwater flow

Youhei Uchida[1]; Kasumi Yasukawa[2]; Norio Tenma[2]; Hikari Fujii[3]; Yuki Yoda[4]

[1] Geol.Surv.Japan, AIST; [2] AIST; [3] Earth Res. Eng., Kyushu Univ.; [4] Earth System, Kyushu Univ.

Geothermal heat-pump installation has extensively grown in western countries in recent two decades. Geothermal heat-pump may achieve higher coefficient of performance (COP) than conventional air-source heat-pump that contribute to energy (electricity) savings and environmental protection. However, the current number of its installation in Japan is quite limited. Therefore, rapid growth of geothermal heat-pump installation is desirable.

Geothermal heat-pump can be applied for both/either space heating and/or cooling depending on surface and underground temperature conditions. Although subsurface heat can be directly used without heat-pumps, application of heat-pumps enables us to extract more heat from underground. Therefore a heat extracting system from subsurface will be called as geothermal heat-pump system (GHP system) in this paper.

In Japan, many of the residential areas are located on alluvial deposits, where groundwater flow could influence the performance of GHP systems. Researchers have been made to examine the effects of groundwater flow on heat exchange performances of ground heat exchangers. In these studies, the enhancements of heat exchange rates by groundwater flow were confirmed with analytical and numerical computations. The overall performances of ground heat exchangers in large-scale GHP systems, however, have not been intensively studied using actual field data.

In this presentation, the authors will present some field surveys and numerical simulations for the installation of geothermal heat-pump system in Japan.