Advanced Core for Energetics, Hiroshima University Vol. 54

HU-ACE NEWS LETTER

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Activities of the Core

Jun. 23, 2021	The 2nd Hiroshima University Biomass Premium Evening Seminar (co-organized)
Jun. 24, 2021	The 60th HU-ACE Steering Committee Meeting

HU-ACE Held Seminars on "Technology Development for Realizing Zero Greenhouse Gas Emission from University Campus"

In the 81st HU-ACE seminar (April 23, 2021), Dr. Sayaka Kindaichi (Associate Professor, Graduate School of Advanced Science and Engineering, Hiroshima University) gave a lecture on "Energy Saving of Air Conditioning with Geothermal Heat". She talked about the heat pump system technology for reducing energy consumption of air conditioning with relatively low temperature geothermal heat, its potential, and technical challenges. In the next (82nd) HU-ACE seminar (May 10, 2021), Dr. Naoto Yorino (Professor, Graduate School of Advanced Science and Engineering, Hiroshima University) gave a lecture on "Single-Phase AC Microgrid" as a new type of electric power network. In his talk, the microgrid based on the newly developed inverter was introduced. It was emphasized that the proposed technology contributes to the improvements of the stability and the transmission efficiency of the electric power network. Both lectures were quite interesting from the viewpoints of thermal engineering and energy system technology. HU-ACE is working toward utilizing local energy sources in the university campus and reducing the greenhouse gas emission, which will contribute to the realization of the Carbon Neutral x Smart Campus 5.0 Declaration of Hiroshima University.

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Prof. Naoto Yorino

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Member Introduction No.30

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Research Field: Building environment
Keywords: Energy savings / Unutilized thermal energy / Heat pumps

Abstract

Background

My research target is efficient energy usage in buildings. The carbon neutral movement has accelerated in Japan recently. Hiroshima University also made the “Carbon Neutral x Smart Campus 5.0 Declaration” with Higashi-Hiroshima City in 2021. Although the term “carbon neutral” tends to inspire decarbonization on the power supply side and power generation by renewable energy such as photovoltaic panels, energy saving is another important issue, because most CO_2 emissions are attributed to energy use on the demand side. It is a quite challenging task to reduce energy in the campus area comprised of various types of existing buildings.

Objectives

“Heat pumps” are an effective tool for energy saving in terms of heat demand such as air conditioning and hot water supply, which in total account for 40 to 50% of the energy use in buildings. Compared to the conventional type of heat pumps using an outdoor unit like an air conditioner, further improvement in energy efficiency can be achieved by unutilized thermal energy in the ground or water reservoirs. We focus on the operational management of unutilized energy source heat pump systems to keep high efficiency in moderate climate regions, including Hiroshima, where the imbalance between cooling and heating demands may lead to excess changes in the ground temperature in the long term.

Results

We measured the performance of a ground source heat pump system installed in a commercial building in Fukuoka Prefecture[1]. At present, although the system showed quite high efficiency during both cooling and heating, the exhaust heat during cooling reached more than four times that during heating, which resulted in an increase in the ground temperature. Based on this analysis, we predicted temperature recovery effects through operational improvement using a simple index (tp^* in Fig.1).

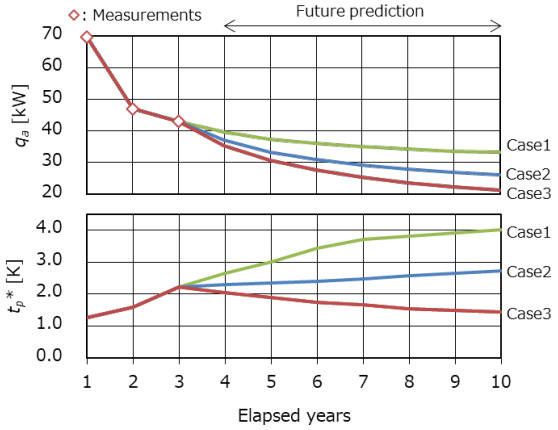

Fig.1 Future prediction of ground temperature using simple index tp^* (Operation improvement during cooling led to recover of tp^* in Case2 and 3 compared to Case1 as a BAU case.)

Reference

1) S. Kindaichi, D. Nishina, Simple index for onsite operation management of ground source heat pump systems in cooling-dominant regions, Renew. Energ. 127 (2018) 182–194.