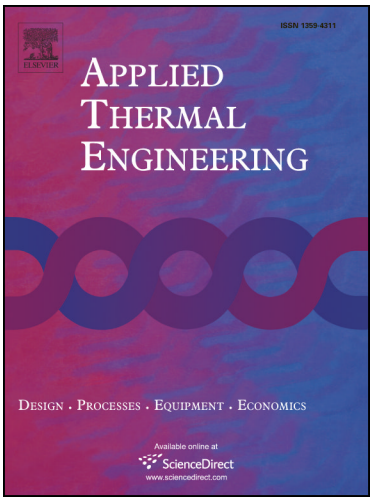

Research Paper

Effects of the total borehole length and of the heat pump inverter on the performance of a ground-coupled heat pump system

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Effects of the total borehole length and of the heat pump inverter on the performance of a ground-coupled heat pump system

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Abstract

Ground-Coupled Heat Pumps (GCHPs) are an efficient technology for building heating, cooling and DHW production, which reached a considerable development in the last decade. Accurate simulation tools are becoming important for the optimization of this technology. In this paper, a code for the hourly simulation of GCHP systems is presented, which allows the simulation of multifunction heat pumps for heating, cooling-dehumidifying and DHW production, considers the presence of storage tanks, and applies both to on-off and inverter-driven heat pumps. The energy needs of a residential building in Bologna (Italy) are selected as case study to analyze the effects on the system performance of unbalanced seasonal loads, of the total length of the borehole field and of the heat-pump inverter during a period of 80 years. The obtained results show that the long-term temperature decrease of the ground is small and does not cause relevant decrease of the seasonal *COP* or increase of the seasonal *EER* over the years. Increasing the total borehole length can yield an enhancement of the seasonal performance up to 20% for heating, 8% for cooling and 5% for DHW. Using an inverter-driven heat pump instead of an on-off one can improve the system efficiency up to 30% for heating, 40% for cooling and 10% for DHW.

Keywords

Ground-coupled heat pump; Dynamic simulation; Heating; Cooling; Domestic hot water; Seasonal performance.

Nomenclature

A	dimensionless load amplitude	[-]
BHE	Borehole Heat Exchanger	
COP	Coefficient Of Performance	[-]
c_p	specific heat capacity at constant pressure	[J/(kg K)]
D	borehole diameter	[m]
DHW	Domestic Hot Water	
EER	Energy Efficiency Ratio	[-]