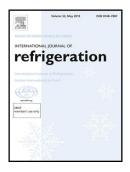
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ACCEPTED MANUSCRIPT

Impact of a vertical geothermal heat exchanger on the solar fraction of a solar cooling system

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Highlights

- A cooling system that incorporates solar and geothermal energy was analyzed.
- The study presents a theoretical model, a simulation, and experimental results.
- The geothermal heat exchanger depth affects the solar fraction.

Abstract.

This paper presents the influence on the solar fraction of coupling a Solar Cooling System (SCS) with a Geothermal Heat Exchanger (GHX). The SCS analysis was made using a mathematical model and was supported by experimental data of a vertical GHX. First, the cooling capacity of the SCS was calculated, considering the cooling load required for a building of 420 m³. The results show that a 12.30 kW cooling capacity SCS would be necessary to satisfy the maximum cooling load requirement during the summer. A 1 kW PV array was considered to assist the SCS. With the constructed GHX a soil temperature model was validated to estimate the temperature of the output water at different GHX depths. The solar fraction meets between 10-23% of the energy demand when the condenser is air cooled. However, when a GHX of 1, 2, 4 and 10 m is implemented the solar fraction increases.

Keywords: solar cooling, geothermal heat exchanger, solar fraction, COP.

Nomenclature

- COP coefficient of performance
- h enthalpy (kJ kg⁻¹)
- m mass flow (kg s⁻¹)
- Q heat transfer (kW)
- T temperature (°C)
- P pressure (bar)
- *K* thermal diffusivity (m^2s^{-1})
- W electric energy consumption (Wh)
- $\eta \qquad \qquad \text{solar global efficiency from DC to AC}$
- G solar radiation (Wm-²)

Subscripts

1,2,3	system's point designation (Fig. 1)
с	condenser
e	evaporator
fanc	condenser fan
fane	evaporator fan

- com compressor
- amb ambient

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