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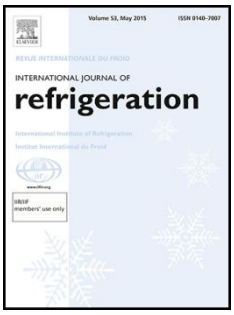

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Impact of a vertical geothermal heat exchanger on the solar fraction of a solar cooling system

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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 m^3. 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)
η	solar global efficiency from DC to AC
G	solar radiation (Wm^{-2})

Subscripts

1,2,3…	system's point designation (Fig. 1)
c	condenser
e	evaporator
fanc	condenser fan
fane	evaporator fan
com	compressor
amb	ambient