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The potential of district heating using geothermal energy. A case study, Greece

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Abstract

The purpose of this study is to investigate the possibility of using low-enthalpy geothermal energy from the geothermal field of Sousaki in the province of Korinthos, Greece, to cover the thermal needs of the nearby town of Ag. Theodori. The possibility of developing a system of district heating was examined based on a proposed town model. Total thermal demands were calculated on the basis of a model dwelling and prevailing weather conditions in the area. Subsequently, a heat transfer circuit is proposed, including the distribution network, the heat exchanger, the production and reinjection pumps, and the pumping station. Finally, energy indices are presented, such as demand in tons of equivalent oil and CO_2 emissions.

Keywords: District heating; Sousaki; Greece

1. Introduction

The Sousaki region, located in the Greek province of Korinthos, is endowed with considerable geothermal resources. The main geothermal fields are situated 5.5 km west of the town of Ag. Theodori and cover a total area of more than

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Nomenclature

A exposed surface area (m^2)
C_p specific heat capacity of atmospheric air (Wh/kg °C)
Dh degree-hours heating (°Ch)
L_f load factor (%)
M_g thermal capacity of the geothermal fluid mass flow (W/°C)
P_f conductive heat loss (W)
P_g geothermal power supply (W)
P_v ventilation heat loss (W)
Q_d annual energy demand (Wh)
Q_g geothermal fluid volume flow rate (m^3/h)
Q_{tot} total heat loss (Wh)
T_d demand temperature (°C)
T_e external temperature (°C)
T_{gi} temperature of the geothermal fluid at the wellhead (°C)
T_{go} disposal or return temperature of the geothermal fluid (°C)
T_i steady internal temperature (°C)
T_r return (rejection) temperature (°C)
U average heat loss coefficient (W/m^2 °C)
V volume of the building (m^3)
Y_g specific heat of the geothermal fluid (Wh/kg °C)
ρ_a density of the air (kg/m^3)
ρ_g density of the geothermal fluid (kg/m^3)

10 km^2 (Fig. 1). These fields have a proven yield of 200 m^3/h and a probable yield of 500 m^3/h (Kavouridis and Fitikas, 1988).

The area is characterized by very complex tectonic structures and is seismically active. The Sousaki region corresponds to a tectonic sinking of the Gulf of Korinthos, bounded by faults in an E–W direction. Field investigations initiated in 1971 have revealed two geothermal reservoirs (Vrelis et al., 1991).

The upper reservoir is located in conglomerates and ophiolites at a depth of 80–

Table 1
Flow-rate and temperature of the geothermal fluids from the production wells (Vrelis et al., 1991)

Production well	PW1	PW2	PW3	PW4	S1	S3
Depth (m)	106	126	116	104	902	1080
Casing diameter (in)	10 3/4	10 3/4	10 3/4	10 3/4	9 5/8	9 5/8
Aquifer depth (m)	46	51	42	?	?	117.8
Aquifer lithology	Conglomerates	Conglomerates	Conglomerates	Ophiolites	Limestone	Limestone
Flow rate (m^3/h)	81	60	50	90	160	150
Average temperature (°C)	63.3	58.8	59.5	75	61.5	58