University of Oradea, Department of Visual Arts

The GSHP system consists of a ground source heat pump prototype manufactured by OCHSNER Wärmepumpen GmbH, coupled to 10 single U borehole heat exchangers 130 m deep each. The system provides heating and cooling to a building with six offices, one computer laboratory, eleven seminar rooms and laboratories for art works (paintings, sculptures, decorative designs, etc.), and one technical room (where the heat pump is installed) in Oradea campus, in Romania. The heating/cooling distribution system in the building consists of thin PE pipes plastered in the walls, plus four fan coil units at the two corridors and two restrooms.

Country ........................................ Romania
Building type .............................. Tertiary sector / education
Year of construction ...................... 1920
Heated/ cooled building area ......... 735 m²
Specific heat load ......................... 50.45 W/m²
Specific cooling load ................. 41.17 W/m²
Building energy category ............... Low Energy House
Heat pump type ......................... water-to-water, reversible
Year of installation ...................... 2010
Purpose ..................................... heating and cooling
Heat source/sink .......................... brine (water with monoethylene glycol, -5°C)
Heat source system ..................... 10 single U BHX, 130 m deep, 10 m spacing
Distribution system .................... radiant walls and 4 fan coil units
Design heating temperature .......... supply: 40°C / return: 35°C
Design cooling temperature .......... supply: 18°C / return: 23°C
Operation mode ........................ active heating, active cooling, passive cooling
Refrigerant .................................. R407C
Alternative/ complementary
heating system ......................... 7 kW electric resistance
Comments on measurement results

The monitoring and data acquisition system installed on site allows a detailed follow-up of system energy performance every minute. COP values obtained verify the test results of the OCHSNER manufacturer performed at its laboratory. According to the available results, the electric power consumption of the heat pump compressor is 6.5 kW, and the heating capacity is 36.66 kW, the resulting COP of the prototype being therefore 5.64, about 10% higher than the COP of the similar commercial unit currently manufactured by OCHSNER.

Operation experiences

The heat pump has been used during the last two heating and cooling seasons without any significant problems.

Lessons learned/ suggestions for improvement

A ground source heat pump coupled with in-wall heating/cooling piping can provide both efficient heating in winter and cooling during summer, with superior thermal comfort to building users. Proper design of a BHE with adequate length can maximize energy output and further improve system efficiency.

Seasonal Performance Factor (SPF)

The seasonal performance factors (1-compressor, 2-plus BHE pump, 3-plus all pumps, 4-plus fan-coils) during operation for the cooling season of summer 2013 are presented in the figure below, while overall SPF values in the table after the figure. The high values of SPF observed, are attributed to favorable system operating temperatures, which during the said cooling period, were 17-19°C cooling water supply to the building by the heat pump (return ~20°C) and ~18°C supply temperature from the borehole heat exchanger to the heat pump (return to earth 23-24°C). Indoor temperature was maintained at ~21°C all the time.

![Graph showing SPF values over time](image_url)

<table>
<thead>
<tr>
<th>Overall SPF1</th>
<th>SPF2</th>
<th>SPF3</th>
<th>SPF4</th>
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<tbody>
<tr>
<td>7.37</td>
<td>6.80</td>
<td>5.34</td>
<td>5.34</td>
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</tbody>
</table>

More Information

Responsible project partner .......... University of Oradea, Romania
GROUND-MED project website .......... http://www.groundmed.eu/
Heat Pump Best Practice Database .... http://www.groundmed.eu/database/