“Efficient use of energy wells for heat pumps”

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Review

- Generalities about borehole heat exchangers
- Our Research Project
- Results so far
- Project goal
Ground Source Heat Pumps

Our experimental rigs

- Two houses

  Family house 250 m²
  2 boreholes - 220 m

  Family house 760 m²
  6 boreholes - 260 m
Collectors

- **U pipe – Reference**
  - 40x2.4 mm
- **3 pipe**
- **Double U**
  - 40x2.4 mm
- **U-pipe with spacers**
  - 13mm
- **Inner helix**

Borehole characterization

<table>
<thead>
<tr>
<th>Response Test</th>
<th>Borehole Deviation</th>
<th>Groundwater flow</th>
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</thead>
<tbody>
<tr>
<td><img src="image" alt="Response Test" /></td>
<td><img src="image" alt="Borehole Deviation" /></td>
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</tbody>
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Detailed measurements

Secondary fluid

Groundwater

The system - Hammarby
• Our experiments

The borehole and control room
Temperature profile

Undisturbed Temperature profile

Measurements with Thermocouples
Temperature profile during HP start up

U pipe (BH4) vs Spacers (BH5)

0.5 l/s

Re BH4: 3409 - 4555
Re BH5: 3418 - 4534

<table>
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<tr>
<th>Heat Extraction BH4 (kW)</th>
<th>Heat Extraction BH5 (kW)</th>
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<td>12.477</td>
<td>12.225</td>
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Flow: 0.5 l/s

One working period of the heat pumps

Temperature (ºC)

Depth (m)

Optical Fibre BH4
Optical Fibre BH5
Thermocouples BH4
Thermocouples BH5
Heat Extracted from Boreholes

Heat absorbed by the secondary fluid at different flows
The borehole thermal resistance

\[ q_{RbT} = \Delta \]  

(Gehlin 1998)
Borehole Thermal Resistance

Borehole Thermal Resistances for down and upward BHE channels at different flow rates
When the project is over...

- We hope to be able to show methods to decrease the temperature difference between the ground and the evaporation temperature by 3 degrees, so that the COP can increase in 8-10 %

- Swedish Heat Pumps give today 6 TWh heating with a COP of 3. The project goal would imply energy savings of about 0.2-0.4 per year

Thank you!

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