A Novel Coaxial Borehole Heat Exchanger: Description and First Distributed Thermal Response Test Measurements

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Ground Source Heat Pumps

- Very common system for heating and cooling buildings
- Common method to exchange heat with the ground "Borehole Heat Exchangers"

www.svepinfo.se
Borehole Heat Exchanger (BHE)

- Three parts to be considered
  - Secondary Fluid
  - Tubes
  - Filling material
  - These represent a thermal resistance that must be minimized

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Borehole Heat Exchanger installations

- **U-pipe**
  - Depth = 260 m
  - Groundwater = 5.5 m

- **Annular coaxial**
  - Depth = 190 m
  - Groundwater = 3 m
Distributed Temperature Measurements in BHEs

Description of the Coaxial BHE
The coaxial installation procedure

Calibration of optical fiber cable

Ice bath

Fiber optic cable
Energy capsule
Borehole wall

Cable length [m]

Temperature [°C]

Cable length [m]
Distributed Thermal Response Test

- Distributed temperature measurements during TRT
- The TRT is evaluated at different sections along the depth

DTRT in U-pipe BHE
First DTRT in Coaxial prototype

Conclusions

- A Distributed Thermal Response Test allows evaluating TRTs along the borehole depth

- U-pipe BHEs have several constrains
  Measurements indicate thermal shunt flow between channels and varying pipe position along the BHE depth

- A novel coaxial annular Borehole Heat Exchanger has been suggested

- The installation of the coaxial BHE is relatively simple

- Temperature measurements in a U-pipe BHE and a Coaxial BHE were carried out during DTRTs
Conclusions

• The coaxial BHE prototype can potentially reduce the temperature difference between the secondary fluid and the ground

• A measurement of the borehole wall temperature in the coaxial BHE illustrates how effective the heat transfer is through the annular channel

• Future work:
  Complete analysis of the DTRT in the coaxial design at different flows
  Testing different central pipe alternatives

Thank you!

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