TRANSFORMING ABANDONED HYDROCARBON WELLS TO GEOTHERMAL DEEP BOREHOLE HEAT EXCHANGERS

Peter Naderer[1], Paul Fruehling[2], Oliver Dinstl[3]

[1]OMV Exploration & Production, Trabrennstraße 6-8, A-1020 Vienna, Austria

[2]University of Leoben, Franz-Josef-Str. 18, A-8700 Leoben, Austria

[3]OMV Austria Exploration and Production, Protteser Str. 40, A-2230 Gaenserndorf, Austria

peter.naderer@omv.com, paul.fruehling@unileoben.ac.at, oliver.dinstl@omv.com

1. Introduction

The design of a deep borehole heat exchanger has already been implemented and tested several times, with different concepts of realization[1,2,3]. In our case, a depleted hydrocarbon well (Prottes T11) has been redesigned to a deep borehole heat exchanger with two coaxial tubings, circulating a heat transport medium in the annulus without establishing a mass transport to the surrounding formation. In populated regions, the redesign of depleted hydrocarbon wells to borehole heat exchanger is an attractive option to generate base-load heat. Important research topics are:

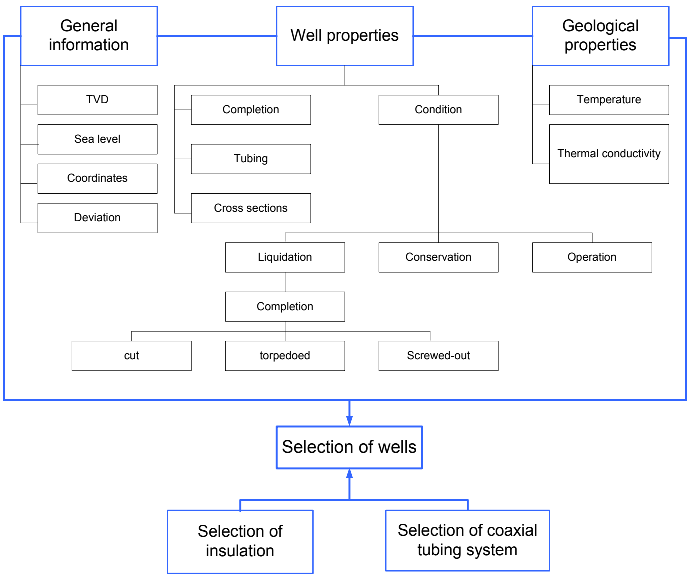
- investigation of critical design parameter of borehole heat exchanger systems which previously were designed as hydrocarbon well
- investigation of insulation methods (ease of well completion)
- investigation of instationary demand (heat reflux to the well)

The application of different insulation methods and alteration of tubing systems is investigated in a 100kW borehole heat exchanger facility in combination with the software *Geothermal Planning Tool* for depleted oil and gas wells.

2. Concept of evaluation

In order to get a preview of the operation and design of a depleted hydrcarbon well, a simulation and planning model has been developped, called *Geothermal Planning Tool*[4]. This tool allows to categorize depleted wells and variate important paremters of the borehole heat exchanger:

- design of tubing
- design of insulation
- operation parametes (massflow, expected injection temperature)
- operability (direct thermal utilization or heat pumps)
- properties of heat transport medium

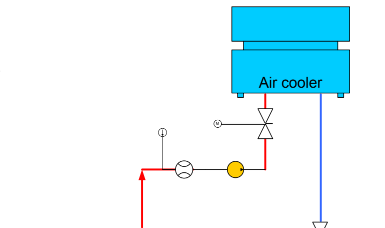


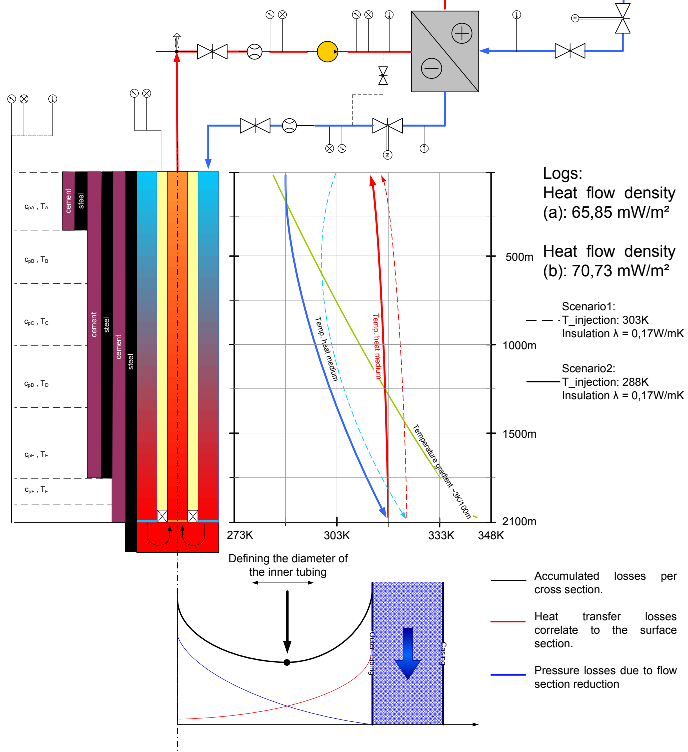
3. Operating testing facility for software calibration

Using the geothermal planning tool, different scenarios can be investigated. Main simulation parameters are variation in mass flow, heat medium, injection temperature and insulation parameters, glass-fibre materials have been neglected.

Parameter:

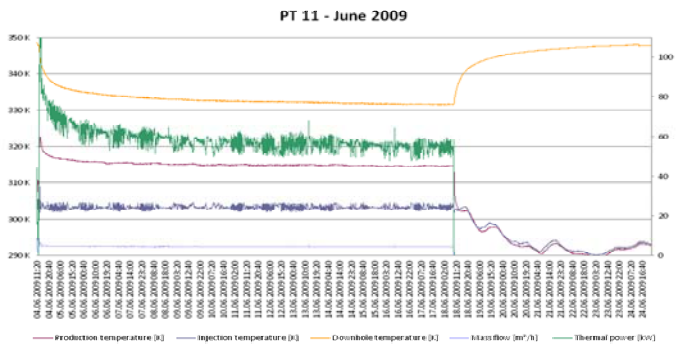
Mass flow	*= 2kg/s*
Injection temperature	*= 303K*
Production temperature	*= 316K*
Insulation typ	*Nitrogen Gas*
Insulation	*= 0,17 W/mK*
c_P cement	*~ 2kJ/kgK*
c_P rocks	*~ 2kJ/kgK*
Heat medium	*= 3,93kJ/kgK*
Casing	*7''*
Outer Tubing	*4 ½''*
Inner Tubing	*2 3/8''*





4. Measured Performance

To verify software simulation assumptions a field test has to be covered out. Measured results of the first measurement period correspond to numerical models:



Conventional heating systems do not operate at these temperature levels. For this reason, an heat-pump energy cascade will be used to increase the overall power output. Upcoming geothermal wells have to provide higher diameters and vertical depths to reach heating values of low-temperature heating systems.

5. Conclusions and Outlook

At present, all results of the simulations have led to the construction of the 100 kW Borehole Heat Exchanger. Subsurface installations have been completed, thermal conductivity tests are held in order to calibrate the geothermal planning software.

After completing the testing period, the borehole heat exchanger will deliver heat to a near sports centre.

After completing the geothermal planning tool, it is considered that further liquidated hydrocarbon wells well be reopened for geothermal purposes.

6 References

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