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ROTTERDAM, THE NETHERLANDS

 GET2024

GEO THERMAL ENERGY

CONFERENCE

**IMPACT OF LIFT METHODS AND SHUTIN TECHNIQUES
ON WELLTEST ANALYSIS IN GEOTHERMAL WELLS**

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SCAN WELL 'ORANJEOORD-01'

Well test objectives

1. Testing the reservoir and wellbore damage
2. Testing shutin techniques
 - *Surface shutin*
 - *Downhole shutin*
3. Testing artificial lift methods
 - *Gaslift*
 - *Venturi pump*
4. Testing modes (production / buildup / injection / falloff)
5. Testing impact of injection temperature in injection tests

This
presentation



OPERATIONAL STEPS

Testing shutin techniques

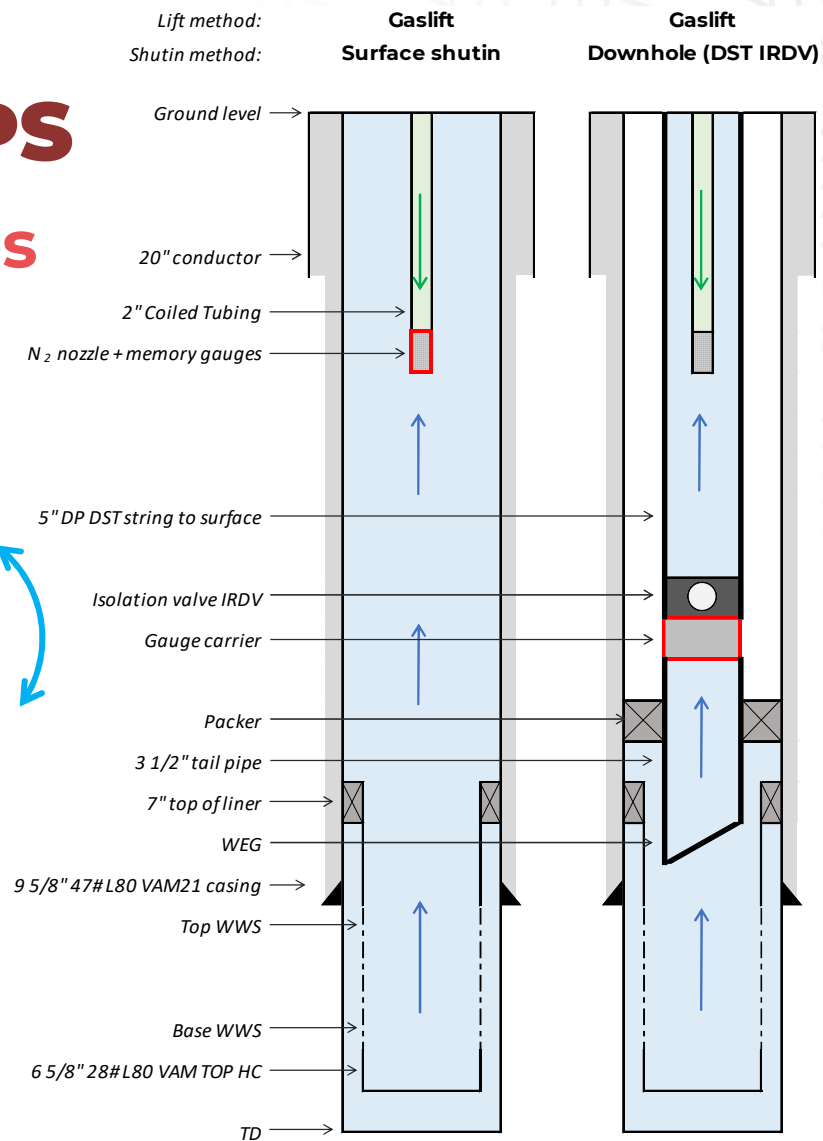
Drilled and completed in April / May 2024

1st welltest 9th and 10th May

- **Gaslift injection** (N₂) via 2" coiled tubing
- Steady water production at ~ 75 m³/h.
- Shutin for buildup (13 hours) using **surface shutin**

2nd welltest 12th May

- **Gaslift injection** (N₂) via 2" CT, inside 5" DST string
- Steady water production at 37 m³/h.
- Shutin for buildup (8 hours) using **downhole shutin** (surface operated hydraulic valve)



OPERATIONAL STEPS

Testing artificial lifts

Drilled and completed in April / May 2024

1st welltest 9th and 10th May

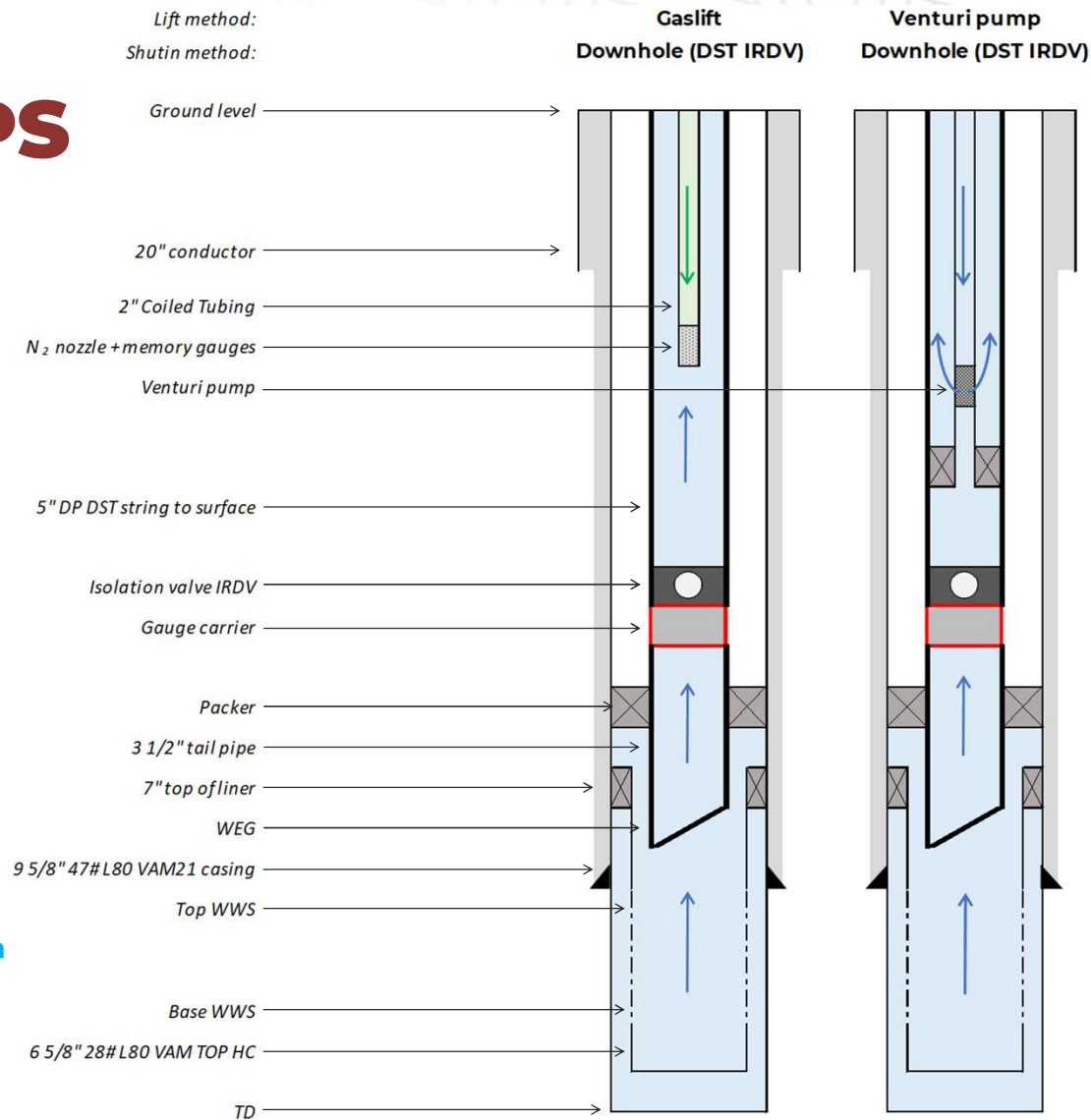
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2nd welltest 12th May

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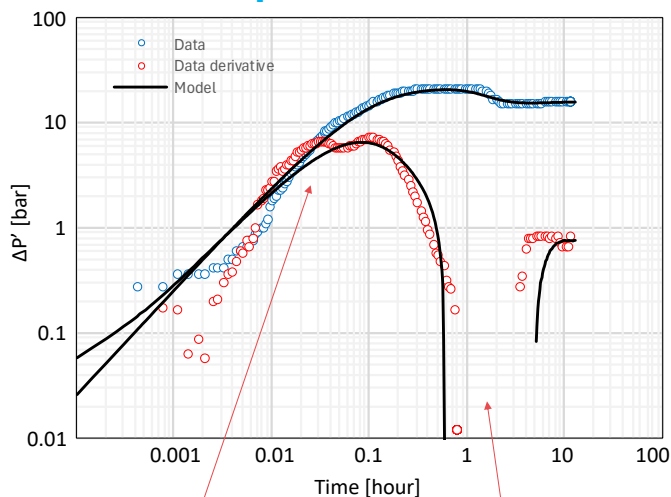
3rd welltest 14th May

- **Venturi pump** on 2" CT, inside 5" DST string
- Steady water production rate at 22 m³/h*.
- CT pump pressure 180 bar; CT pump rate 11 m³/h
- Shutin for buildup (16 hours) using **downhole shutin** (surface operated hydraulic valve)



RESULTS SHUTIN TECHNIQUES

Buildup - Surface shutin

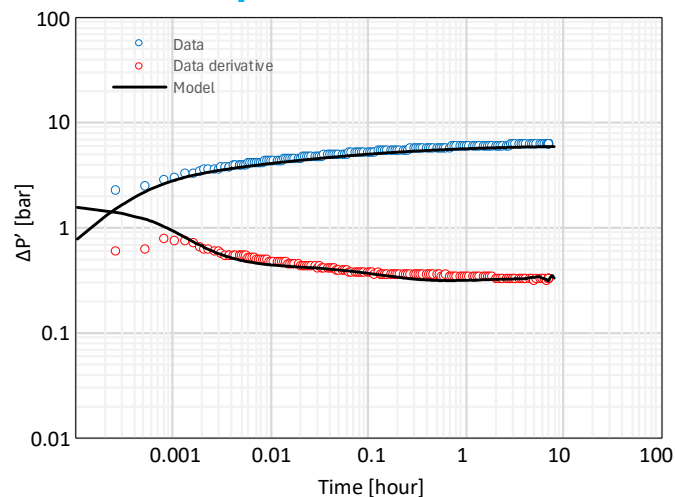


Data: major double-hump dominates the first part of the graph. What is this?

Data: off-scale between 0.8 and 2 hours (or 0.2 to 5 if transition periods are included). This translates to a radius of investigation of 400 meter; or 800 meter diameter.

All the geology within this 800 m circle is invisible in this welltest.

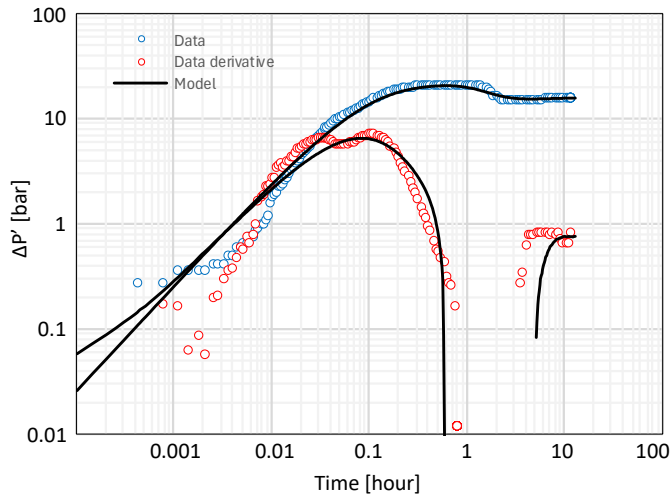
Buildup - Downhole shutin



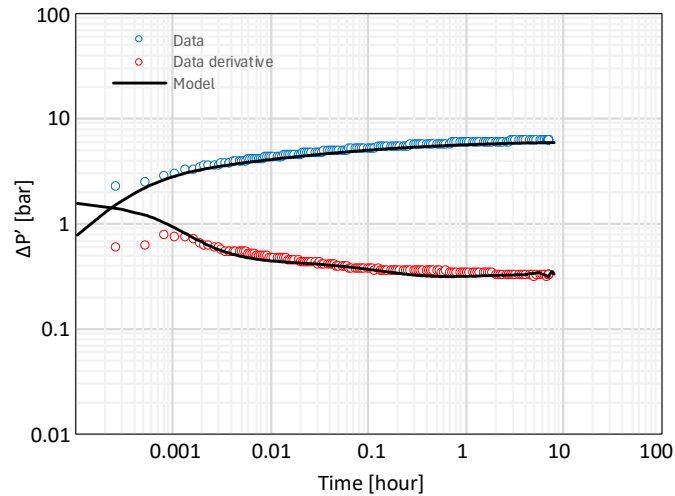
Data: all just fine

RESULTS SHUTIN TECHNIQUES

Buildup - Surface shutin



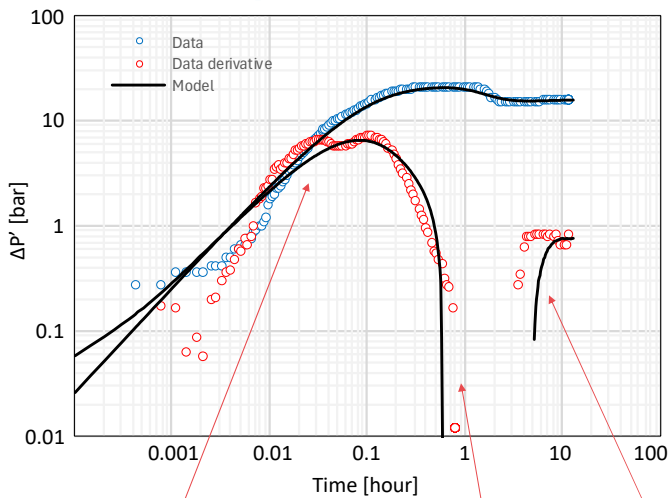
Buildup - Downhole shutin



Changing wellbore storage model (automatic regression)	Constant wellbore storage model
Mechanical skin = 2	
Vertical limited entry well model (effective perforation length = 130.4 m; reservoir thickness = 177 m.	
Homogenous reservoir model (kh = 22 Dm)	
Infinite boundary model (no faults)	

RESULTS SHUTIN TECHNIQUES

Buildup - Surface shutin

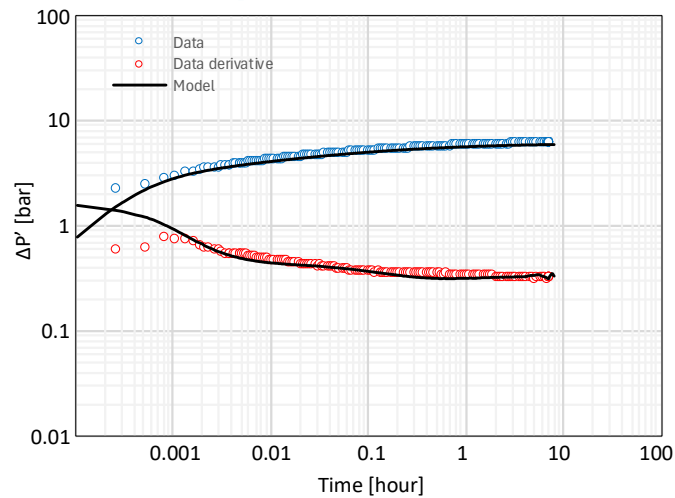


Model: poor match to the **early** time (single hump v.s. double hump)

Model: poor match to the **middle** time

Model: poor match to the **late** time (only after 10 hours a match is achieved)

Buildup - Downhole shutin



Model : 'perfect' match

Match is very poor with a surface shutin, but changing the skin, kh, etc is not justified!

SHUTIN TECHNIQUES

Conclusions

Surface shutin:

- Wellbore storage dominates the buildup period
- Wellbore storage obscures skin, kh and faults
- Tests executed with surface shutin will undoubtedly lead to incorrect interpretations
- Surface shutin should not be used for low enthalpy geothermal wells!

Downhole shutin:

- Clean reservoir signal
- Free of unwanted noise
- Reliable interpretation
- Downhole shutin should always be used for low enthalpy geothermal wells!

Note: additional modelling and evidence for the necessity of downhole shutin in geothermal wells:

Bruijnen, P. "Numerical and analytical modelling of wellbore storage effects in low enthalpy geothermal welltests". EAGE Geoenergy (in press, 2024 or 2025)

VENTURI PUMP

New lift method for welltests

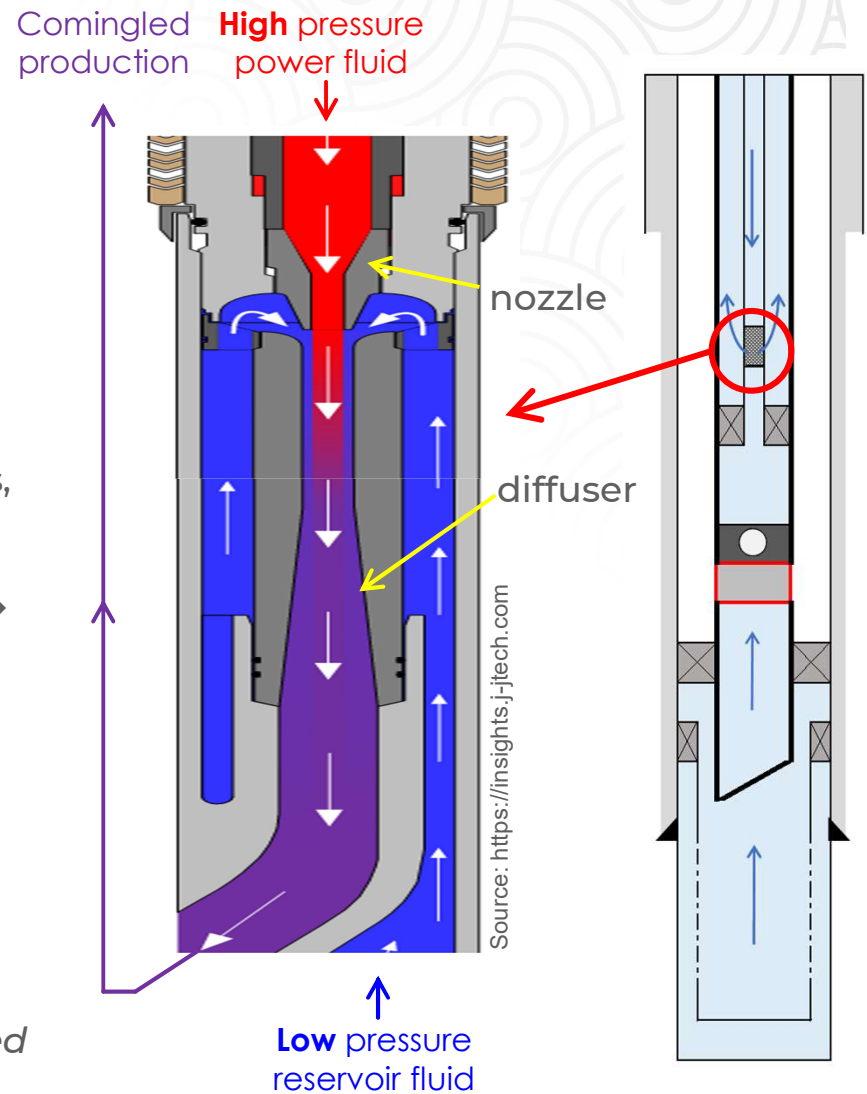
Working principle

- Power fluid (water) pumped from surface into well at high pressure.
- Power fluid is directed into nozzle → velocity increases, pressure drops (venturi effect) → reservoir fluids enter venturi pump and comeingle with power fluid
- Comingled fluid enters diffuser → velocity decreases → pressure increases → lifting capacity

Advantages venturi pump for well testing purposes:

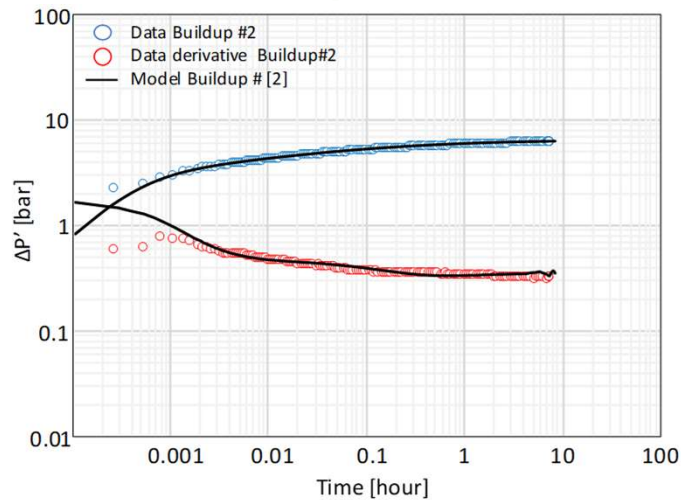
- + Simple design, no moving downhole parts
- + Rig equipment can be used (pumps, tubing, etc)
- + Minimal *additional* surface footprint (no VSD, no electricity, no N₂ pumps, no large separator etc.)
- + Cost reduction!

Note: Q_{water} for 3rd SCAN well "Heesch-01" is anticipated to be max 230 m³/h

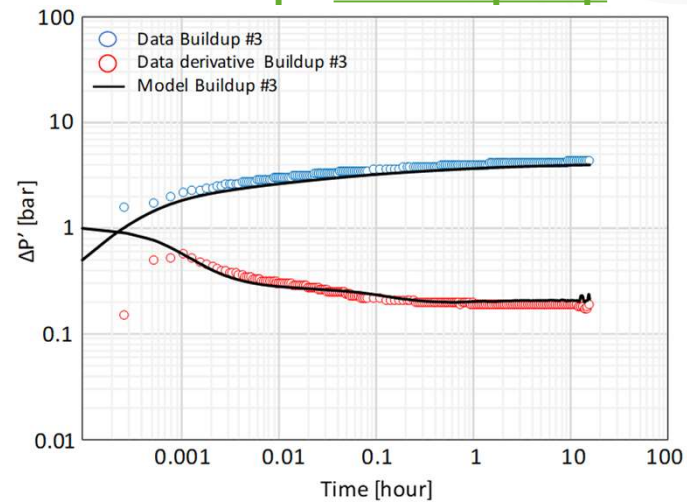


RESULTS ARTIFICIAL LIFT METHODS

Buildup - Gaslift



Buildup - Venturi pump



Constant wellbore storage model
Mechanical skin = 2
Vertical limited entry well model (effective perforation length = 130.4 m; reservoir thickness = 177 m.
Homogenous reservoir model (kh = 22 Dm)
Infinite boundary model (no faults)

ARTIFICIAL LIFT METHODS

Conclusions

- The choice of artificial lift has no impact at all on the quality of the data (provided that a downhole shutin is applied).
- Venturi pump is a good alternative for testing geothermal wells
 - *In terms of data quality: equally good*
 - *In terms of costs: (possibly) cheaper than the alternatives (gaslift, ESP)*

RECOMMENDATIONS

For all geothermal welltests

Shutin techniques

- Surface shutin: don't do it
- Downhole shutin: highly recommended, always!

Artificial lift methods

- Gaslift: works fine
- Venturi pump: works fine + cost reduction

THANK YOU!

Questions?

