# Low and volatile oil price environment. Technical responses in the Pannonian basin

SPE HUN Workshop

Garden Hotel, Szolnok, 17/11/2016

# Production System Selection For High-Pour Point Crude Producing Well

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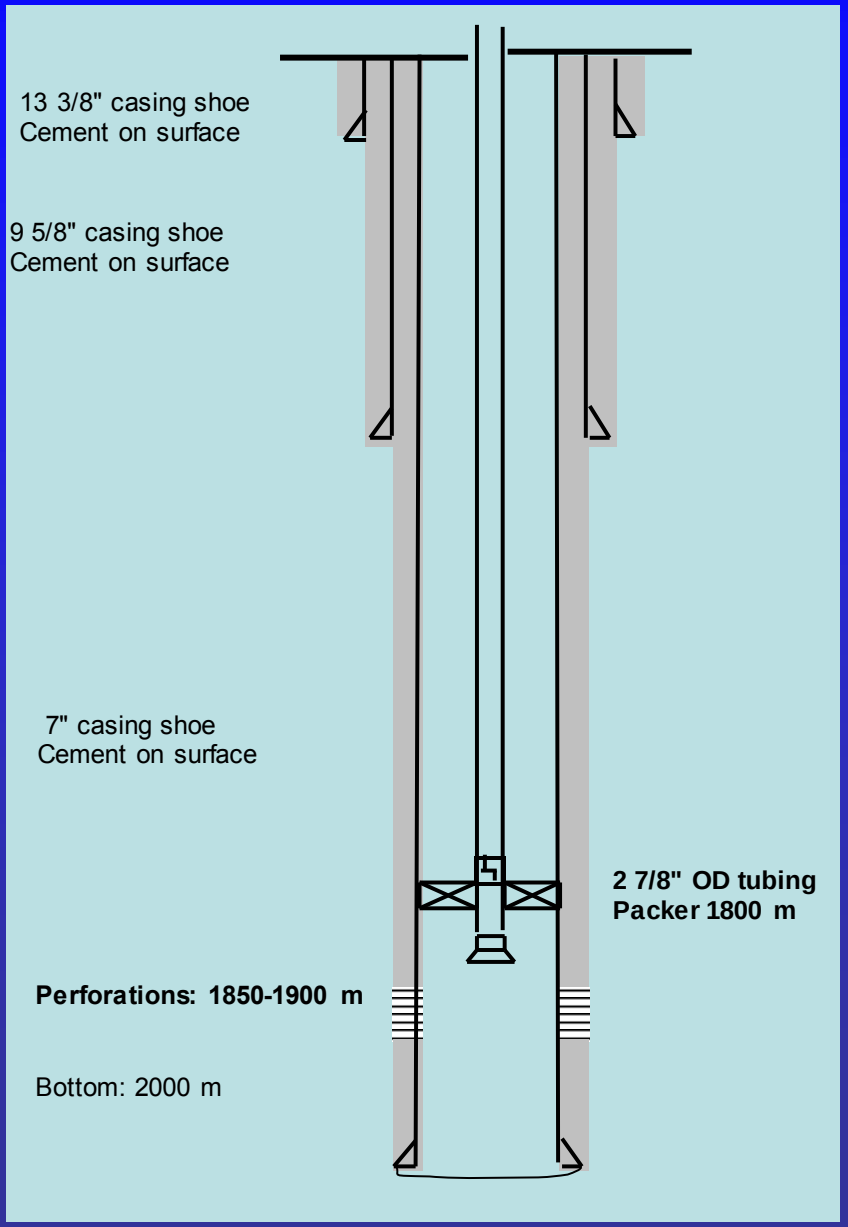
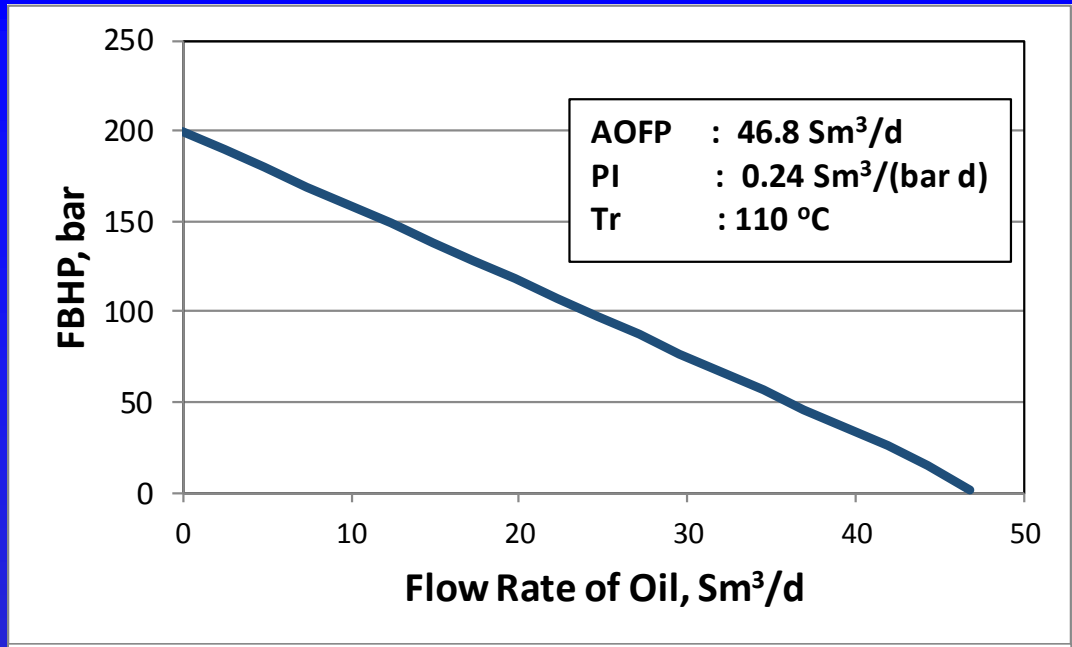
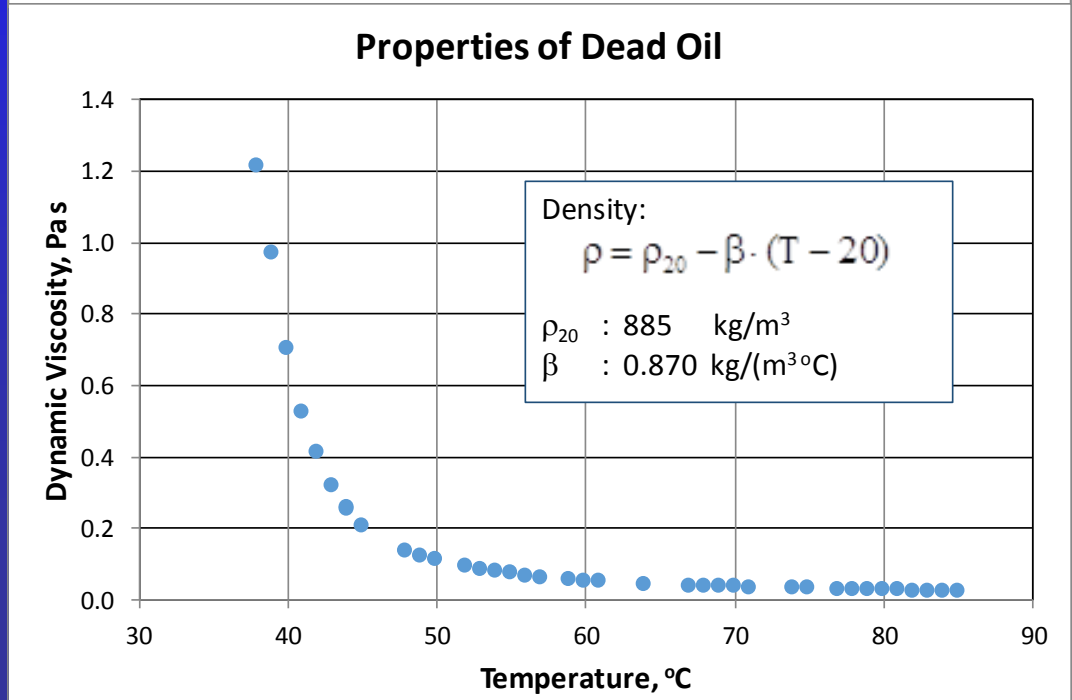
# Well Data


13 3/8" casing shoe
Cement on surface
9 5/8" casing shoe
Cement on surface
7" casing shoe
Cement on surface
2 7/8" OD tubing
Packer 1800 m
Perforations: 1850-1900 m
Bottom: 2000 m

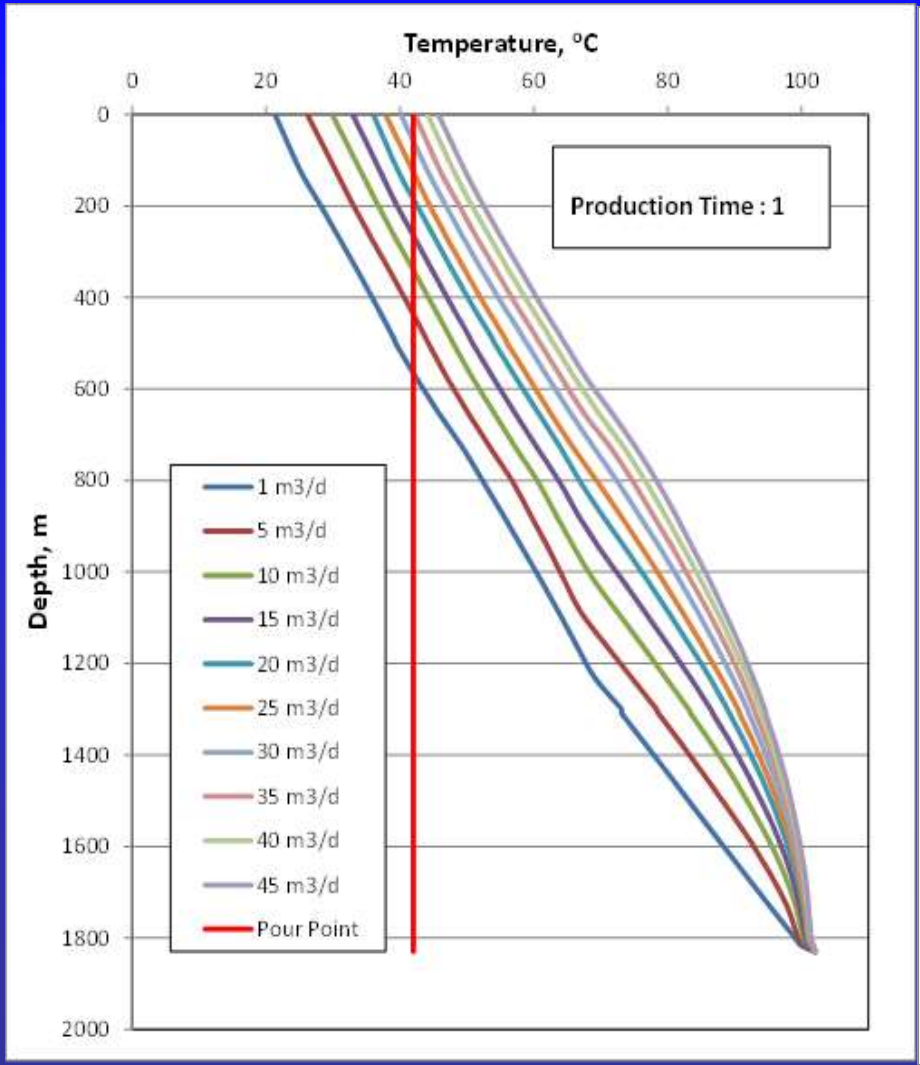

AOFP : 46.8 Sm³/d
PI : 0.24 Sm³/(bar d)
Tr : 110 °C
FBHP, bar
Flow Rate of Oil, Sm³/d
250
200
150
100
50
0
0
10
20
30
40
50

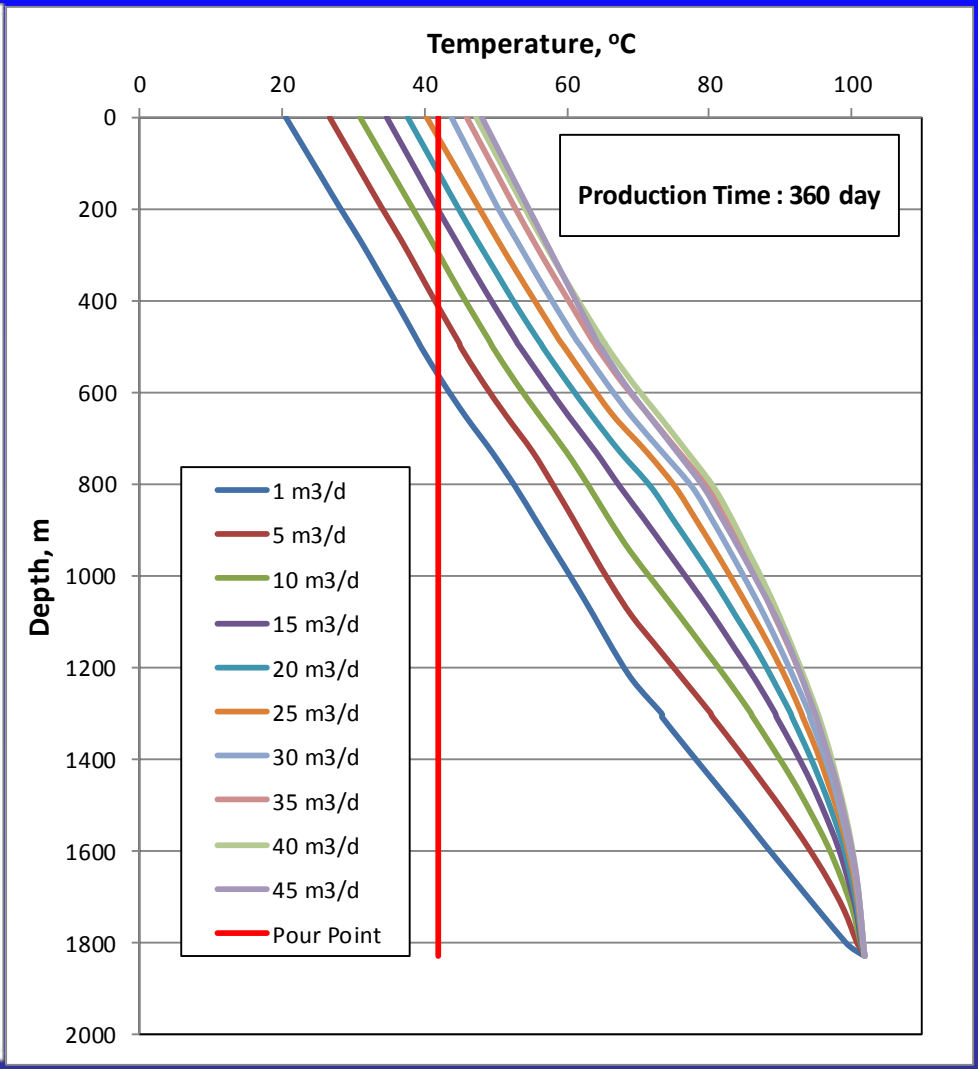

Properties of Dead Oil
Density:
$\rho = \rho_{20} - \beta \cdot (T - 20)$
$\rho_{20}$ : 885 kg/m³
$\beta$ : 0.870 kg/(m³ °C)
Dynamic Viscosity, Pa s
Temperature, °C
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
30
40
50
60
70
80
90

# Problems

- High Pour Point Crude
- Limited Reservoir Energy, Small Rates
- Sytem for Production Test(/Production)

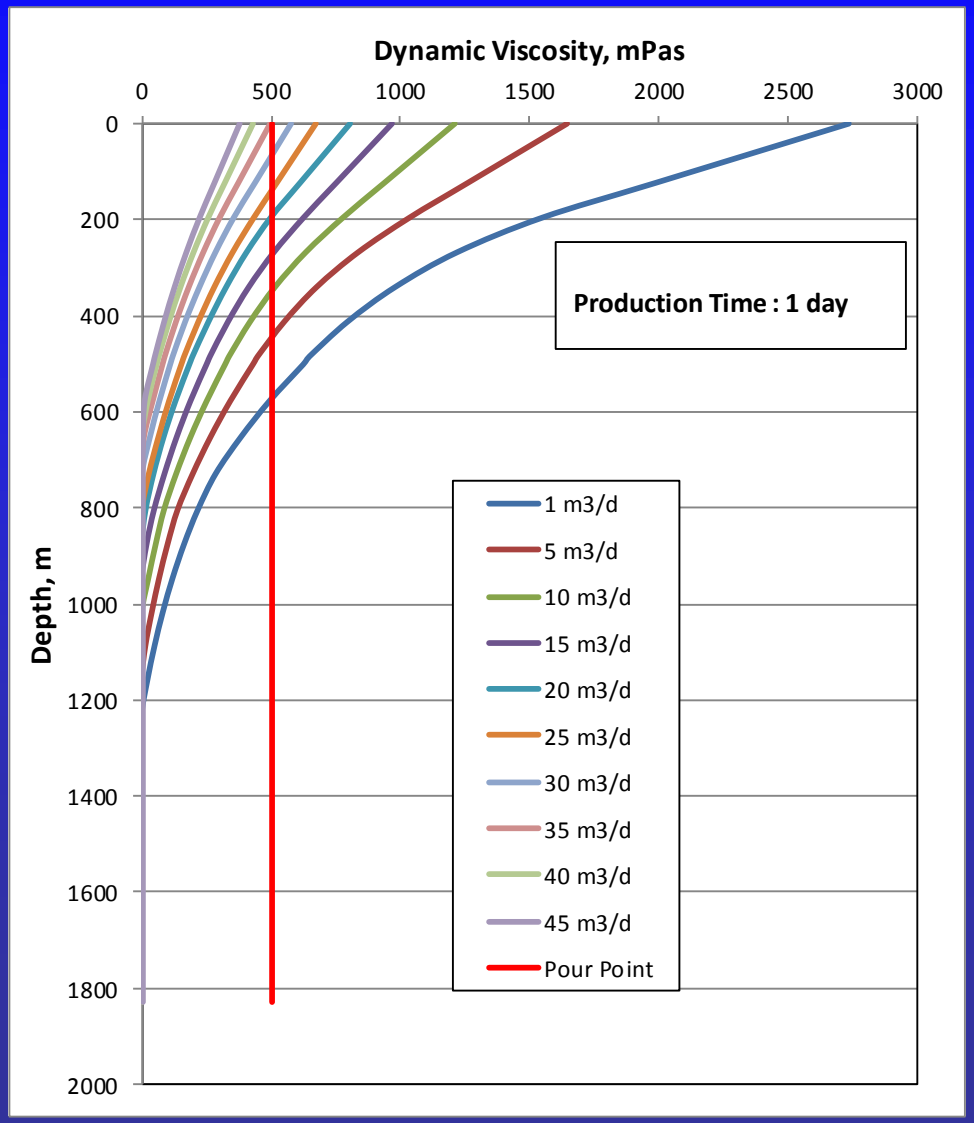
# Flowing Well
# Transient Temperature Distribution by Enthalpy Balance



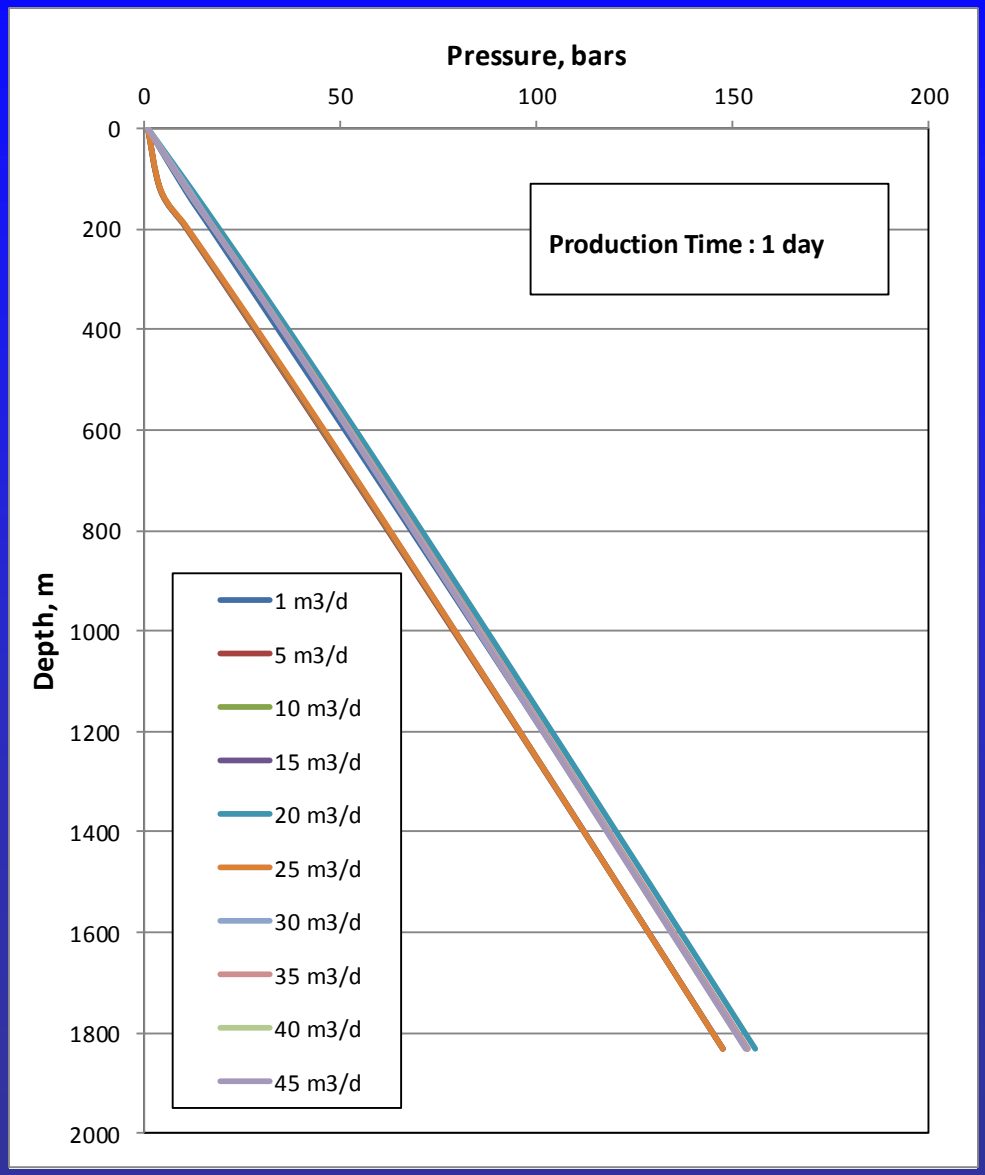




**Temperature profile stabilized in short time!**

# Flowing Well
# Dynamic Viscosity vs. Depth



# Flowing Well, Pressure vs. Depth



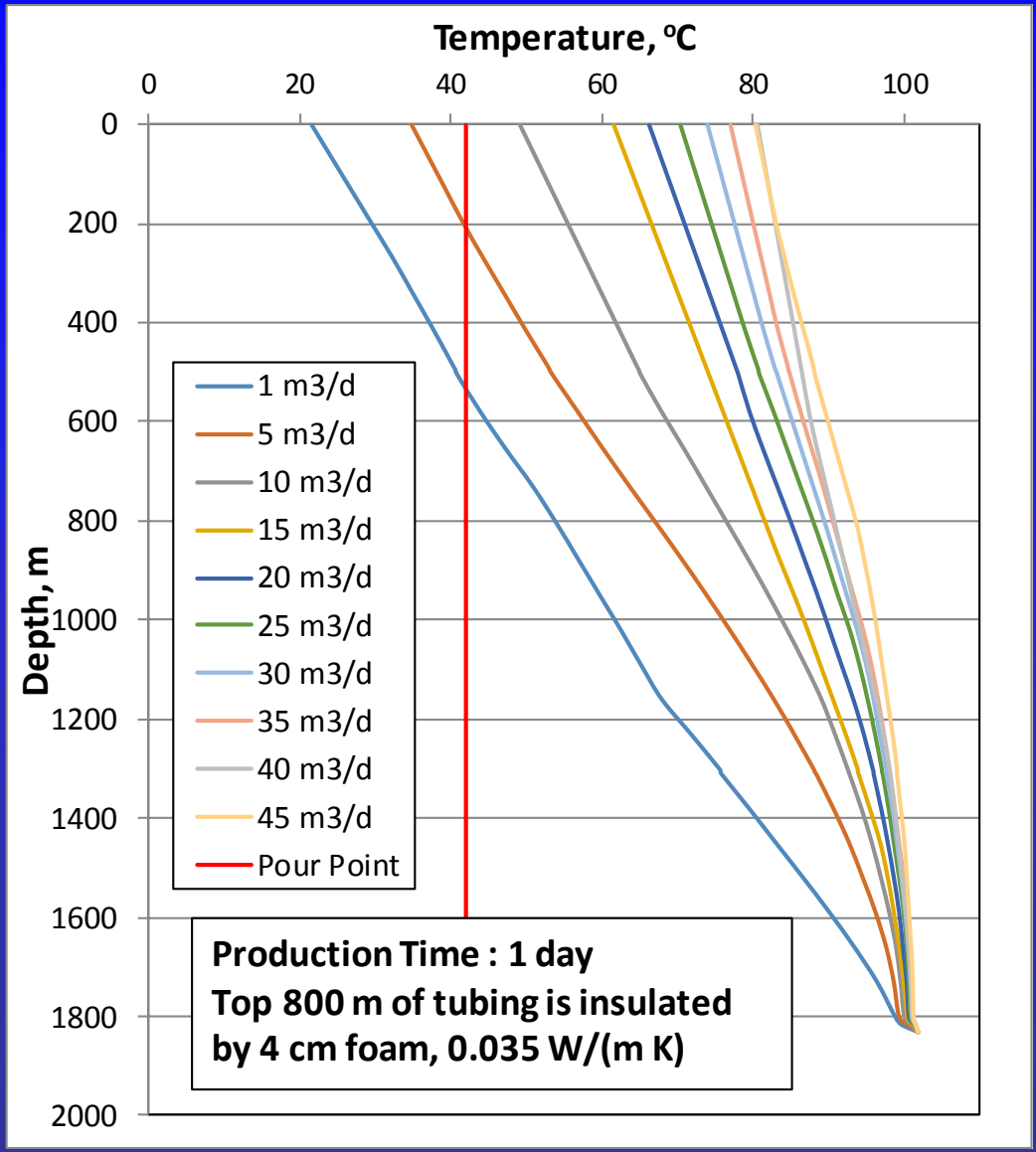

No significant difference!

Friction loss is not significant!

Main task is the fluid lifting not the friction loss due to high viscosity!

The chart does not show the effect of cooling in production breaks, neither the paraffin deposition on pipe wall!
Both are serious problem!

# Flowing Well, Insulated Tubing




Reduced Deposition on Pipe Wall!

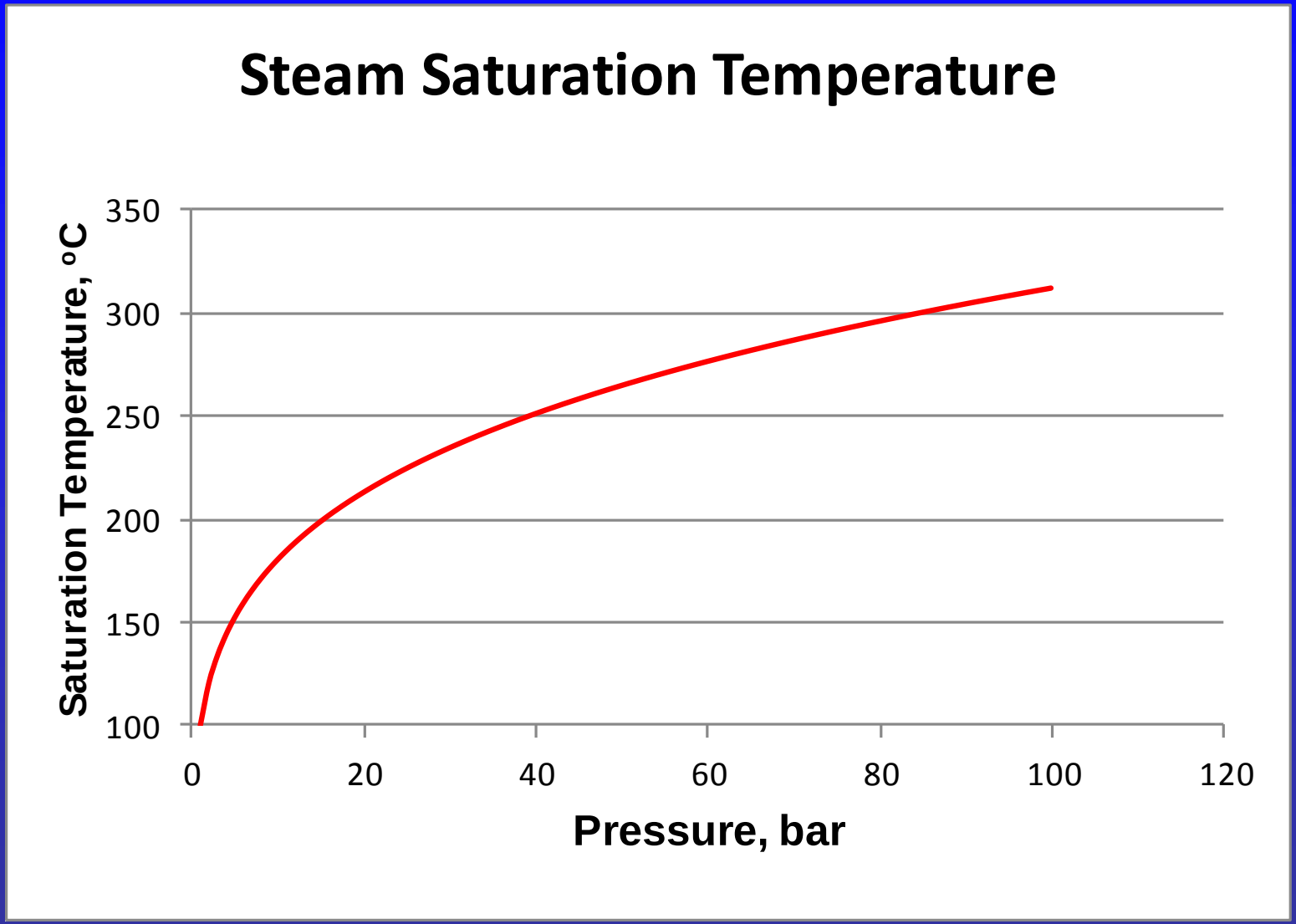
Cooling Down Remain Problem in Production Breaks!

Fluid Lift Required!

# Artificial Lift Required!

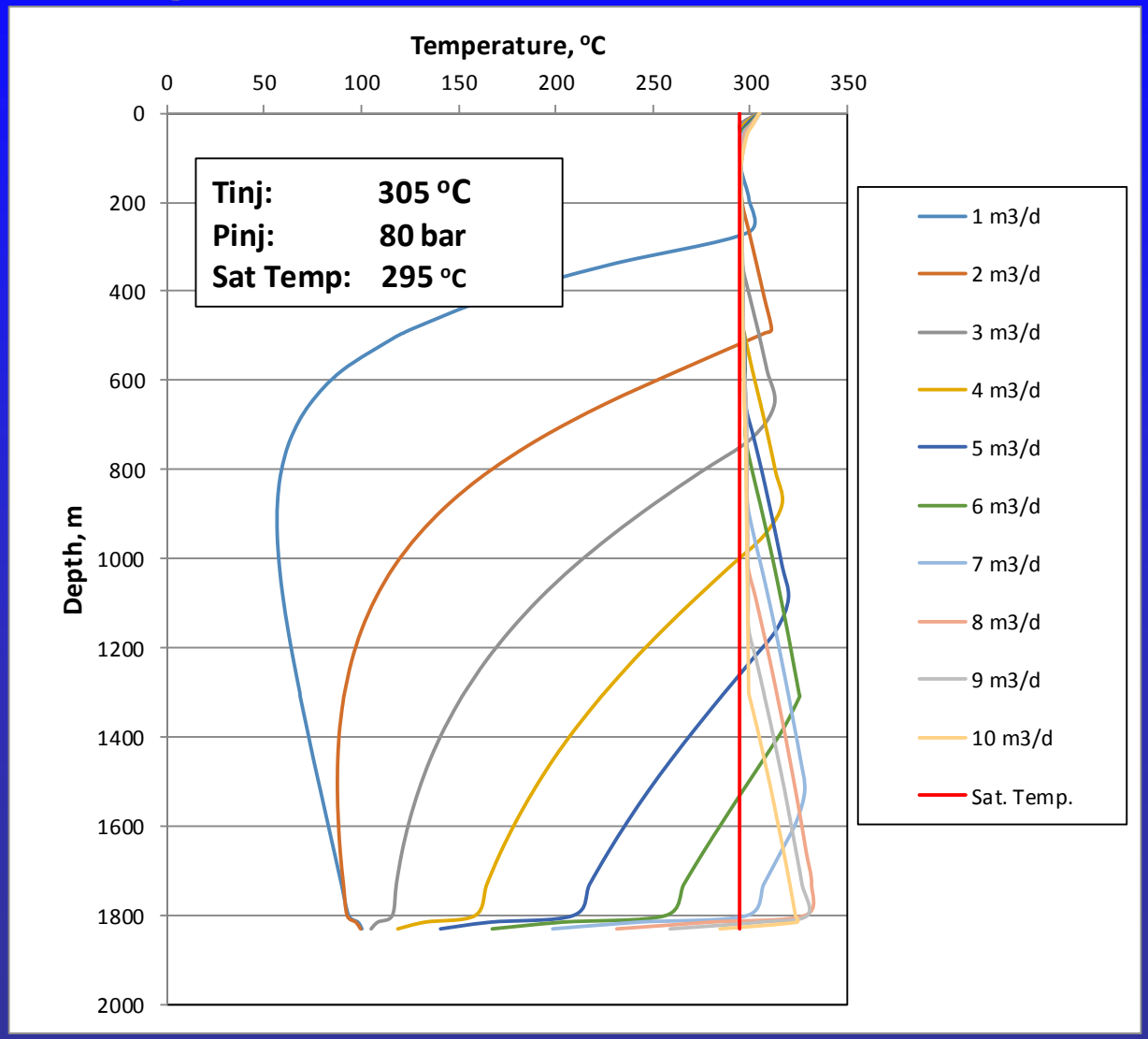
- **Appropriate for Production Test**
  - Cheap enough for single well
  - Easy to install
  - Flexible
  - Applicable for highy pour point, heawy oil
  - Applicability after production test is an Advantade

# „Steam Lift”?



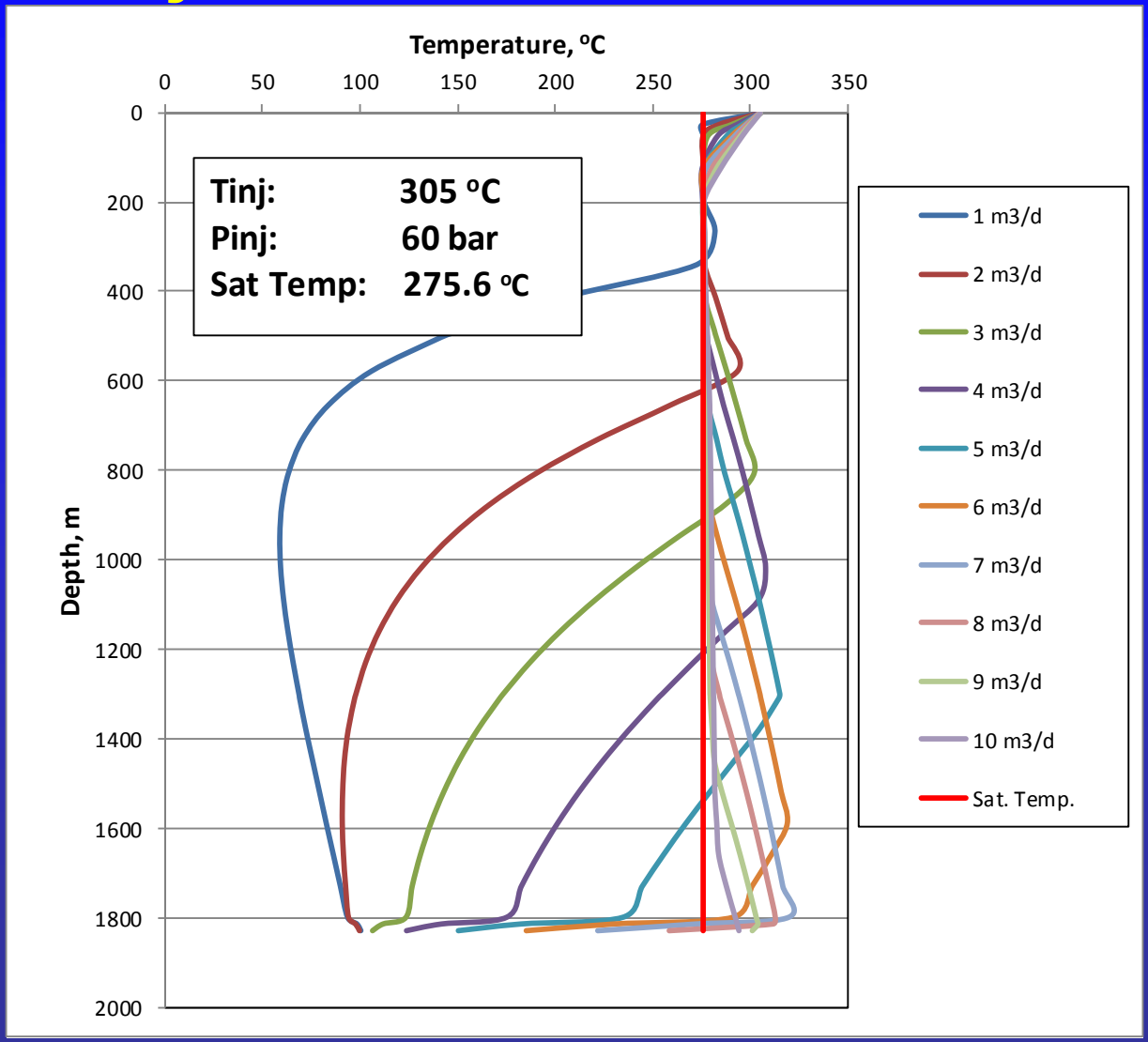

**Required Minimal „gas lift pressure” - 30 bar ~ 220 °C**
**Examined 305 °C ~ 80 bar**

# Temperature vs. Depth of Steam Injected into the Annulus



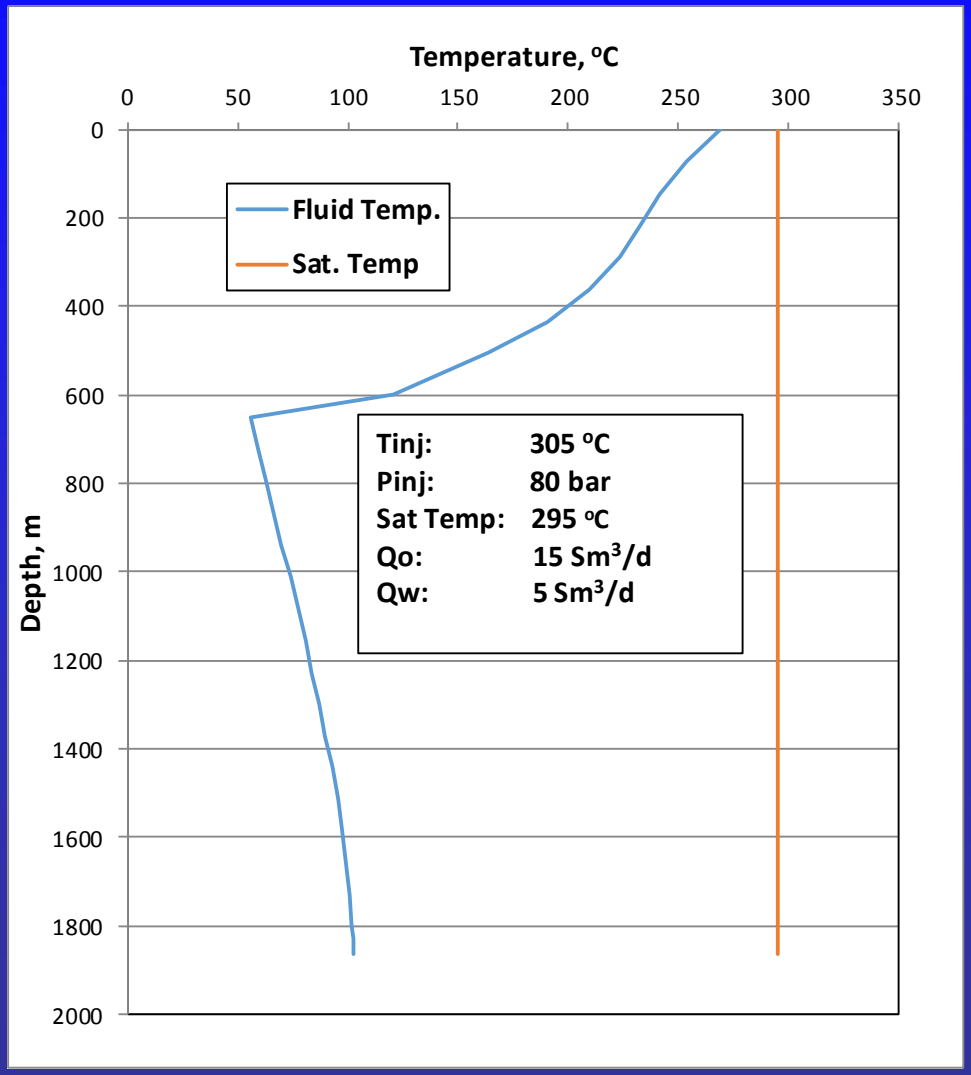

**The cooling effect of tubing is neglected!**

# Temperature vs. Depth of Steam Injected into the Annulus




**The cooling effect of tubing is neglected!**

# Temperature Distribution in Tubing




**Convective Heat Transfer!**

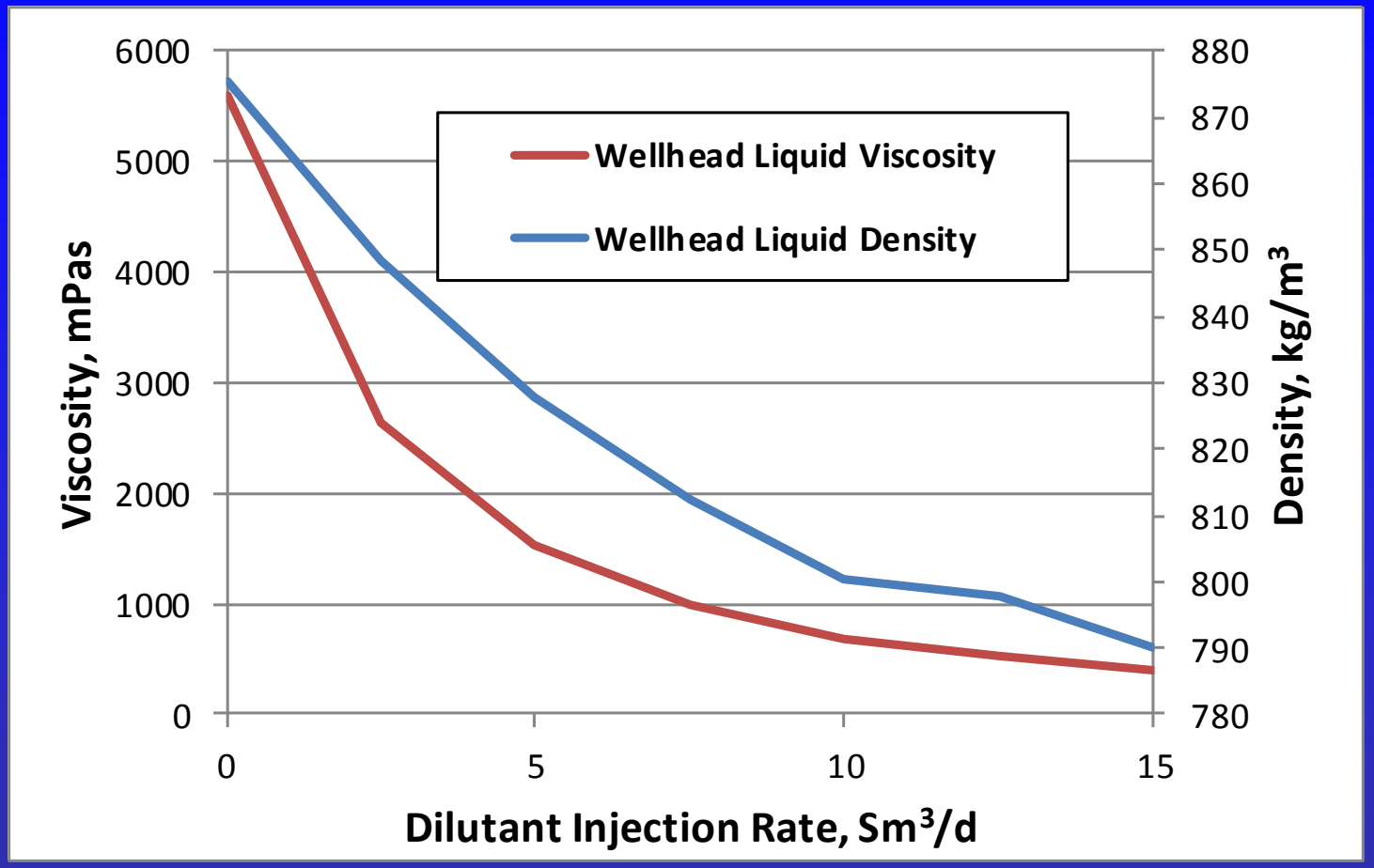
Steam Lift is not Possible in this case!

Possible:

- Small Injection Pressure,
- steam mass is greater than the produced fluid mass!

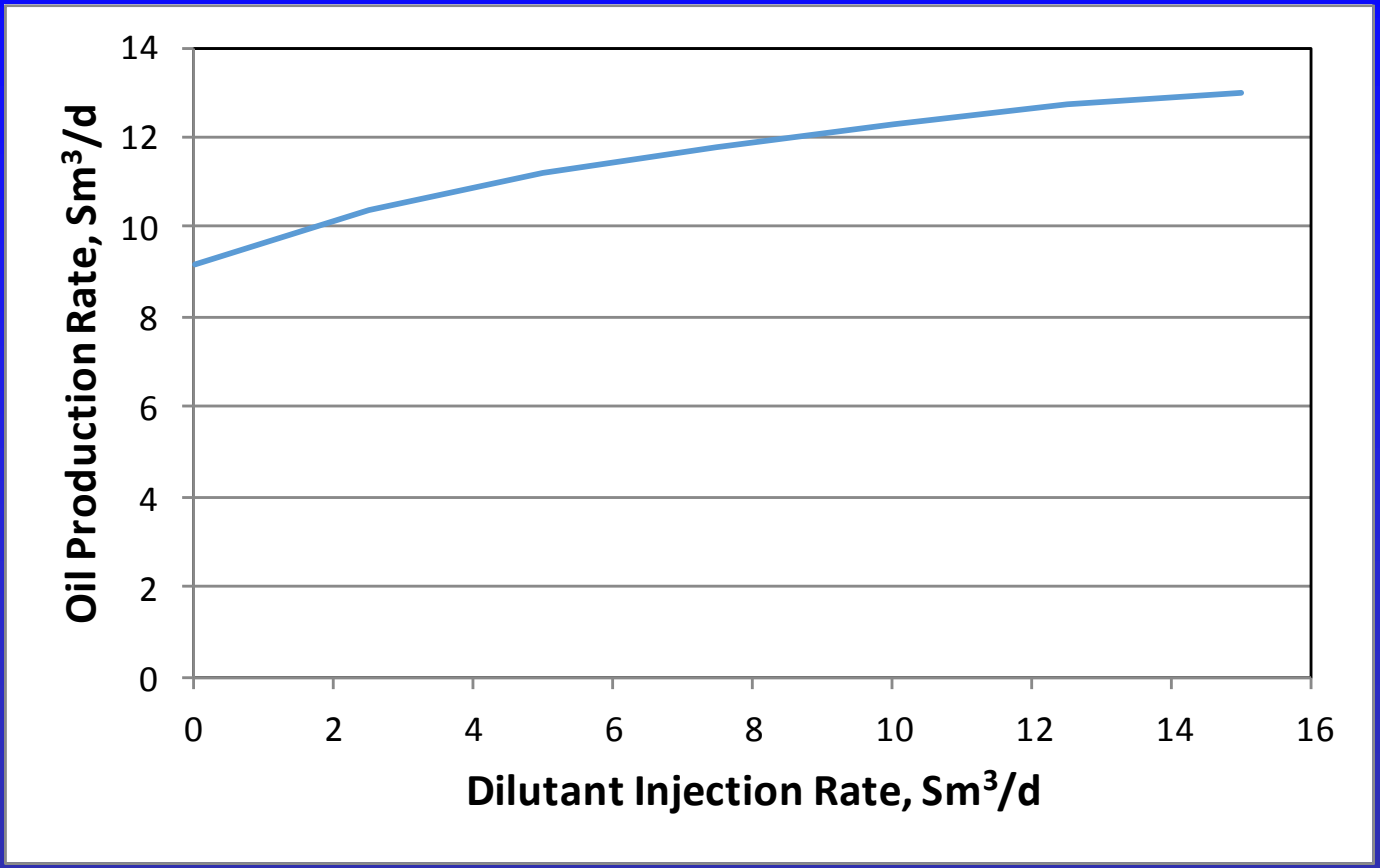
Uneconomic!

# Dilutant Injection




To Decrease Viscosity and Pour Point
Constant Effect, Production Break Problems Eliminated

# Dilutant Injection

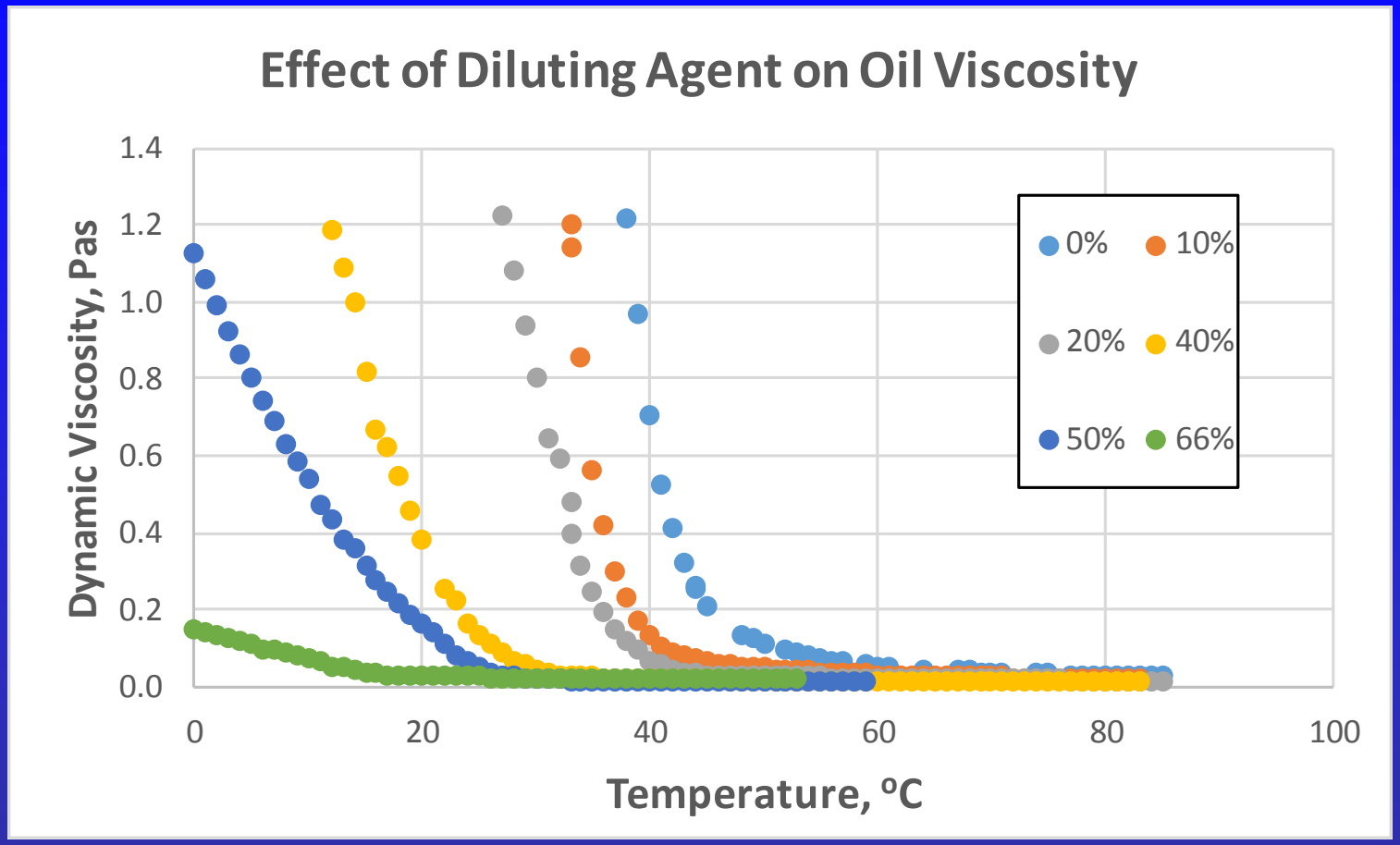



To Decrease Viscosity and Pour Point

Constant Effect, Production Break Problems Eliminated

Must be combined by artificial lift!

# Dilutant Injection




To Decrease Viscosity and Pour Point
Constant Effect, Production Break Problems Eliminated

# Jet Pump

- The diluting agent can be the power fluid of the jet pump system.
- Diluting agent can be:
  - heated water, revers flow application
  - heated well fluid, revers flow application
  - heated light oil, gasoline , lower temperature; normal or revers flow application

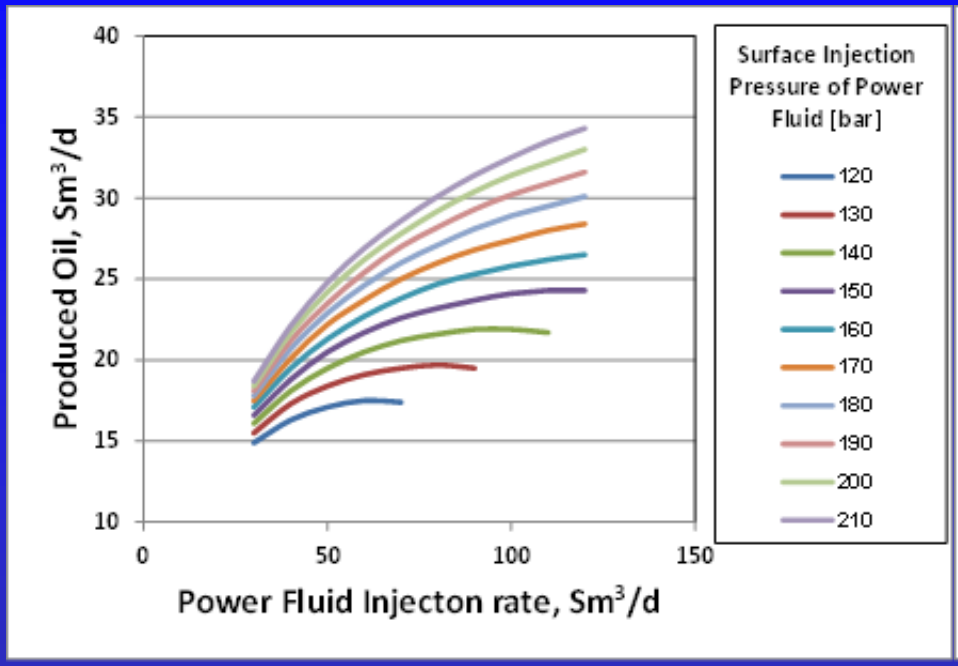
# Jet Pump

- Using heated water and heated well fluids
  - small power fluid requirement, continuous cleaning and recirculating
- Using light oil, or gasoline
  - continuous power fluid supply is required
- Possible power fluid choice could be water with 5-10 % gasoline, bigger safety in case of production breaks.
- The surface units required for jet pumping is slightly more complicated than in case of simple diluting agent injection.

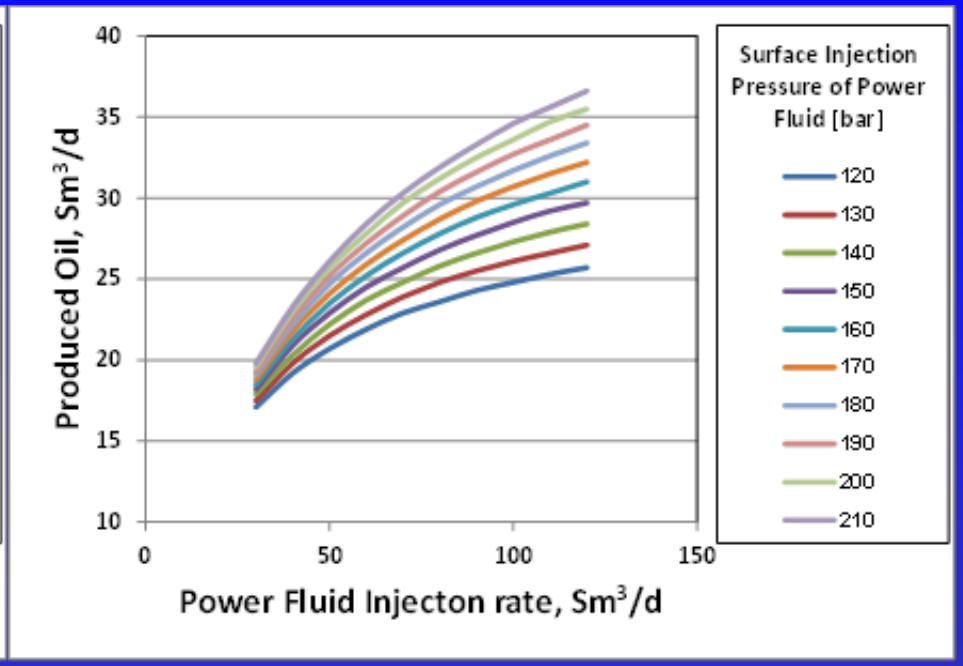
# Jet Pump

- No moving parts in the downhole pump, long production life, low repair cost
- If free-pump installation is used, the pump can be circulated to the bottom, to produce, or can be circulated to the surface for repair. No need for high cost tubing operations.

# Jet Pump

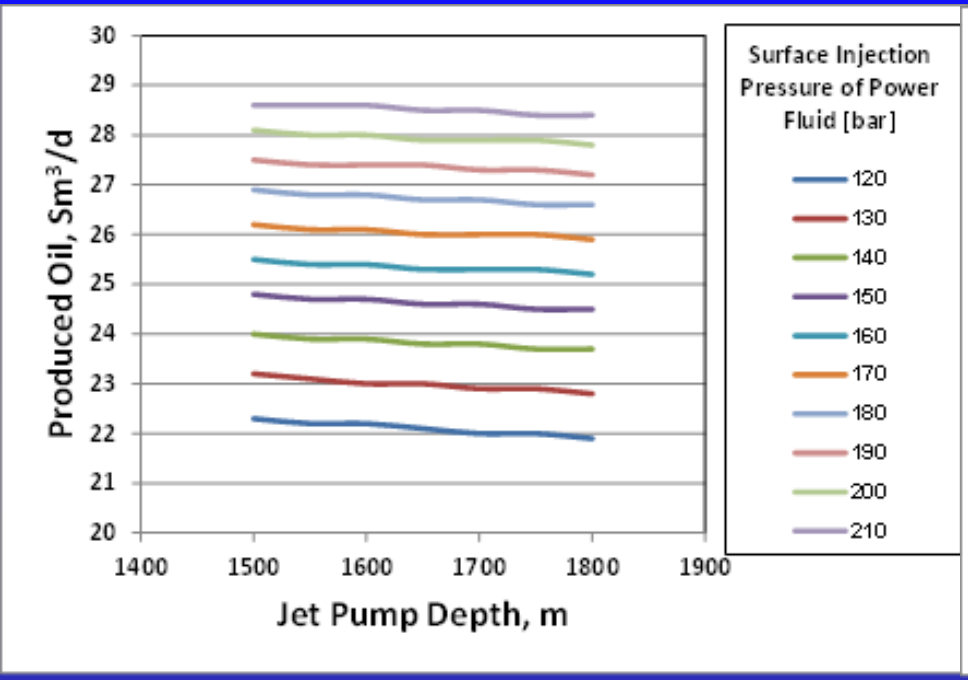



Reverse flow installation

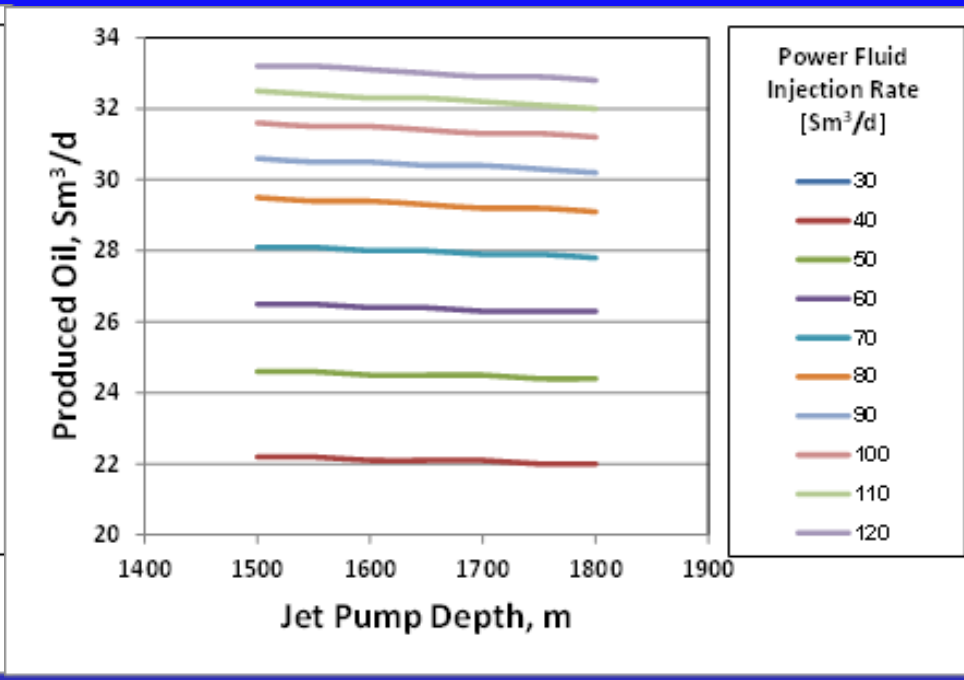



Normal flow installation

# Jet Pump




Normal flow installation




Normal flow installation

# Jet Pump

**The best fluid ratio (Produced liquid rate/Power fluid rate):**

**30 $Sm^3$/day power fluid rate**

**210 bars surface injection pressure.**

**Production rate < the required 30 $m^3$/day.**

**Suggested:**

**185 bar power fluid surface injection pressure,**
**60 $Sm^3$/day injection rate.**

# Conclusions

- In case of low rates the high viscosity does not cause high friction loss
- Insulation decrease the problems due to production breaks and deposition
- Fluid lifting is the main problem
- Steam Lift is not an economic solution
- Dilitant ijection Must be combined with artificial lifting
- Jet Pump is a valuable tool for heavy oil production

# Thank You for Your Attention!