Advance Completions Application in Gas Production

Fiber Optics Permanent Downhole Monitoring and Auto-Gas Lift (AGL) Advance Completions Application

IndoGAS - 28th Jan 2015

Gordon Goh (Principal RE)
Schlumberger Completions Domain
Asia (ASA)
Agenda

1. Overview of Fiber Optics (FO) : Distributed Temperature Sensing (DTS) - Permanent Downhole Reservoir Monitoring

2. Overview of Auto gas-lift (AGL)

3. Questions and Discussion
Fiber Optics (FO) :  
Distributed Temperature Sensing  
(DTS) Permanent Downhole  
Reservoir Monitoring
Evolution of Monitoring Technology

Drivers:
Reservoir Management, Zonal Allocation, Production Optimization, Recovery Improvement, real time reservoir diagnostics

Monitoring!!
Who needs it?
Surface or memory gauges
Permanent Single gauge
Permanent Multiple gauges
Permanent Distributed measurements
LWP Beyond P/T

Completions
DTS - Distributed Temperature Sensing

Directional Coupler

Laser Source

Optical Coupler

Optical Fibre Sensor

Raman Scattering

Optical Filtering

Signal Processing

Backscattering of Light caused by molecular vibration

Source

Time for back scattered signal gives Distance along Fibre

Amplitude (Ratio of Wavelengths) Gives Temperature

Detector
DTS Measurement Output

Single Trace Outputs
- Flow Contributions Analysis

3 Dimensional Answer Products
Gas Flowrate & Temperature Profile

- Calculated temperature
- Geothermal gradient
- Flow distribution
- Joule-Thomson cooling on inflow
Multi-zone high gas rate reservoirs

Flow distribution

Calculated temperature

Joule-Thomson cooling
DTS Application Case History (1): Gas Breakthrough
A gravel-packed well with DTS monitoring

Recorded DTS data in 3D over the reservoir interval in producer

Increasing Joule-Thomson cooling with time

SPE 11064
DTS Application Case History (1): Gas Breakthrough
A gravel-packed well with DTS monitoring

DTS 11 January
Flowing 30,000 bopd

DTS 1 April
Flowing 15,000 bopd

Gas breakthrough
Gamma ray

Gas Breakthrough zones identification by DTS plots
DTS Application Case History (2): Gas Well Well Temperature Profile over time at Reservoir section

Selected DTS curves showing flowing and shut-in profiles

SPE 115816
DTS Application Case History (2): Gas Well
Well Temperature Profile over time at Reservoir section

SPE 115816

DTS Thermal simulator flow analysis compared to a PLT spinner flow log
DTS Application Case History (3):
WAG Injector Wells in Texas carbonate reef Coqdell Reservoir

Map of the Cogdell Reservoir in Texas carbonate reef reservoir

SPE 90248
DTS Application Case History (3): WAG Injector Wells

Reservoir CO2 injection profiles and warm-back

Major Gas Outflow
DTS Application Case History (3): WAG Injector Wells

Reservoir CO₂ injection profiles and warm-back
Other DTS Application Examples (1):
Gas Lifting monitoring / Leaks / Seals integrity
Case Study (2): Screen failure and influx of sand - Fiber Optics in vibration mode (Sand-Control Monitoring)
Auto Gas-Lift Application: Associated or non-associated gas layer
What is Auto Gas-Lift?
- Auto / Natural / In-situ

A way of gas-lifting using gas…

- Produced from a reservoir (Associated or NAG)
- Controlled by an active flow control valve

The flow control valve…

- Can be adjusted from surface
- Has several different positions
- Is opened further for more gas
- Is closed for less gas
Why Use Auto Gas-lift?

- To eliminate or reduce:
  - Gas compressors
  - Slickline interventions
  - Gas transport pipelines
  - Multiple gas-lift valves
  - Platform load requirements
The Auto-Gas Lift Valve
How do we Design a Natural Gas-Lift Installation?

Reservoir and production

- Well unloading
- Well production

Completion (hardware)

- Design objectives
- Well integrity
- Minimizing risks
Pressure Terminology in AGL

- SPE 104202 (6th December 2006)
  PD = Downstream Pressure
  PT = Tubing Pressure
  PU = Upstream Pressure
  PWF-IPR = Flowing Pressure of Gas Zone
An Example of AGL Completions Schematics
Completions Real Time Answers

- Automated collection and validation of all available well production data.
- Standardized and effective basic monitoring and surveillance (Trending, KPIs)
- Development of answer products and workflows that analyze well behavior in order to optimize its performance and productivity.

IT infrastructure

ESP Optimization (real-time with Advanta)

Gas Lift Diagnostics with DTS (new RT)

Drawdown Management (RT Analytics)

Data Log (RT at bore level)

- Multiple PDHG gauge data
- Aggregate Q at well head

Rate Normalized Log-Log and Cartesian Plot

- Rate Splitting for Commingled Production
  - Channel PPD
  - Channel S-Channel

Rate Trending Figure RT Analysis

- Continuous Drawdown Level
- Out of Area

Schlumberger
Loggin-while-Production (LWP)

Dynamic Update & History Matching

Proactive Response

Real-time enabled

Modeling Update

Optimization

Control

Monitor

Execution

Real-time enabled
Summary:

• Reservoir Monitoring with Fiber Optic DTS
  – Depth-Continual and real-time temperature surveillance and Analysis
  • Gas well
  • GLV monitoring
  • Leak detection
  • Others: Gas / WAG injection, GLV slugging, Gas break, etc. al

• Auto Gas-Lift Intelligent Completions Technology
  – Reduced surface footprint and investment
  – Optimised production life; better incremental with downhole “lift” control

• Logging-while-Production (LWD)
  – Real-time Production Optimisation and lesson learnt feedback loop: lower risk and minimise intervention
  – Reservoir Modeling Updates, history-matching and better prediction
Thank you