Active Monitoring of Gas Lift Wells with Distributed Temperature Sensing

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Outline

- Fiber-optic system components
- DTS operating principles
- System performance
- Gas-lift principles
- Event identification with DTS (case study)
- Data automation and management
The Fiber

- Higher Power
  - Higher signal/noise ratio

- Lower Power

Multimode

- Primary coating - protective jacket
- 50/125 Fibre
- Core: 50 μm
- Cladding: 125 μm
- 250 μm

Singlemode

- 9/125 Fibre
- Core: 6-9 μm
- Cladding: 125 μm
- 250 μm
DTS - Principles

- Pulsed Laser travels through fiber
- Back-scattered light returns to fiber optic box
- Back-scattered light is processed to get useful information (Temperature, Strain, Sound)
- Raman (DTS) – Temperature Measurement (0.01 °C)
- Brillouin (DTSS) – Strain and Temperature (0.5 °C)
- Rayleigh (DAS) – Acoustic measurement

Zrelli Amira, Mohamed Bouyahi, Tahar Ezzedine ‘Measurement of Temperature Through Raman Scattering’ AWICT 2015
Specifications

- Range: 0-10 km
- Temperature resolution: <0.01°C
- Spatial resolution: 1m
The Fibre is the Sensor

- **Distributed measurement**
- **Core components**
  - Surface acquisition unit
  - Optical fiber
- **Depth resolution**
  - As low as 0.5m
- **Temperature resolution**
  - Better than 0.01°C (no post processing)
- **Temperature Range**
  - Up to 700 °C
- **Range**
  - Up to 100km
- **No electronics or moving parts in monitoring zones**
- **Deployment**
  - Permanent (Attached to production tubing)
  - Intervention
DTS Temperature Profile
Gas-Lift Principles

Warm fluid produced through the tubing

Cold fluid injected through the tubing

Cooler Annular temperature

Warmer Tubing Temperature

3.5°C

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Gas-Lift Principles

- DTS Cable clamped to the production string at every joint
- Gas injected through the annulus
- Annular space with flowing gas will have lower temperature compared to region with no flow
- Temperature reading at clamped point will be more reflective of warmer tubing temperature
- Temperature reading of free hanging fiber will be more reflective of cooler annular temperature
2D Plots

3 day worth of data


Production

Unloading
2D Plots – Selected Traces

Joule Thomson cooling

3D Plots
Slugging

Closed GLV

Intermittent opening and closing of GLV

Open GLV
Automate?

Data
Identify Opportunities
Validate opportunities
Build Models / Algorithms
Implementation
Validate Results
Processed Data
Solution Overview

Acquisition
- Well Data
- Log Data
- Fibre Optics

Transmission
- Wireless Wired Manual

Data Management Application/Software
- Repository
- Processing
- Alarms

Analysis
- Visualisation
- Modelling

Point Data
- PDG
- Qo, Qw, Qg
- ICV
Event Detection - Gas Lift wells

Event Detection - Gas Lift wells

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Temperature (°C)

Flow rate (m³/hr)

Mandrel Open
Mandrel Closed

HR  VR  SR  WR  AR  OR
Summary and Conclusion

- Temperature along the length of the well can be measured using DTS.
- Measured temperature can be used to monitor gas-lift system integrity and identify events like active mandrels and slugging valves.
- This information can be used to plan intervention or optimise gas-lift design.
- DTS data size can grow quickly making manual data analysis tedious or difficult.
- Automating the monitoring and analysis process can significantly reduce the amount of man hours needed and also deliver more timely information.
- This is made possible with effective data management systems.
Thank You