Downhole Sand Ingress Detection Using Fibre-Optic Distributed Acoustic Sensors (DAS)

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Downhole Sand Monitoring – the business need

**Challenge:**
- Ineffective sand control completions can lead to excessive sand production
- Precise sanding interval unknown

**Current response:**
- Well choked back to reduce sand production
- Plugs installed to shut off sand intervals

**Consequence:**
- Deferred oil production
- Non-sanding reservoir intervals also shut off.
- Continued sanding if plug placement is not accurate
- Loss of well integrity

**Solution:**
- Use in-well fibre optic cables for DAS
- Develop digital signal processing techniques using DAS to identify sand ingress
- Creation of DAS sand log to enable targeted remediation
What is DAS? How is it installed?

Permanent fibre installation example:
Fibre optics in control line

Fibre can be deployed in a number of other ways, such as on wireline

Ref: SPE 95419
Determining the “acoustic fingerprint” of sand ingress using DAS: Flow loop experimentation

Flow loop experimentation used to study and distinguish sand ingress “signals” from fluid noise

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Key results – Field trial 1

- Signal processing methodology for sand ingress signal extraction works
- Multiple sand ingress zones
- DAS can monitor sand transport from ingress to surface
- Good correlation observed with surface and sub-surface data
- DAS “sand log” generated
Key results – Field trial 2

- Field trial 2: conducted six months after first field trial
- Well ramped up in steps
- Cumulative sand logs constructed to observe temporal behaviour of sand ingress
- More zones are seen to produce sand at higher drawdowns
Key results – Field trial 3

- DAS sand logs used to remediate the sanding zones using mechanical patch technology
- Well brought into production post remediation
- Results both on DAS and surface measurements show substantial reduction in the overall sand production (by over 70%) post sand shut off
- Corresponding increase in oil rate: over 2000 barrels per day
Summary and conclusion

Technology development progress

Concept

Flow loop experiments

Field trial 1: Post-processing of raw data. Big data challenge (1TB/hr)

Field trial 2: Real time data streaming and visualisation of processed acoustic data

Field trial 3: Complete end-to-end solution build and verification

Current

Deployment at scale within BP

• New downhole, real-time sand detection technology developed using DAS as primary sensor feed
• Data processed at source to generate sand logs in real time, overcoming the big-data problem.
• Technology currently used for:
  • Targeted remediation to increase hydrocarbon production
  • Optimal drawdown control to manage sand related risks during well ramp up and production operations
  • Sand control equipment reliability monitoring that helps inform future sand control completion equipment designs