Agenda

- CEMENTICS* Cement Plug Placement Design
- Invizion Evaluation* Service – External Barrier Verification
- Sealing Fluids Technology Update
  - FlexSTONE*
  - FUTUR*
- Summary
Cement Plug Placement Challenges

Cement plug is typically small in volume, often contingency, hence prone to failure.
Cement plug failure can be very expensive and multiple failures are possible.
Failures can be caused by:

- Well condition (inaccurate temperature data, losses, hole size uncertainty, etc.)
- Slurry design (incorrect time to T, poor compressive strength, etc.)
- Oilfield placement technique and design (contamination with brine/spacer during placement, incompatible fluids, unstable base, etc.)
- Execution problem
Downhole Fluids Contamination

Critical part: Cement plug placement in the wellbore

- Far less tolerant to contamination than Primary cementing due to small volume
  - Fluid mixing while cement displacement down the pipe and up the annulus
  - Fluid mixing when POOH with cement stinger

- Resulting cement contamination with wellbore fluid with sub-optimal cement compressive strength development – failure in verification
CEMENTICS* Plug Design

Well & fluid data

Tubulars, open hole, formation, temperature, fluids

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CEMENTICS* Plug Design

- Well & fluid data
- Volume optimization

Pumping schedule

Volume Balance
CEMENTICS* Plug Design

- Well & fluid data
- Volume optimization
- POOH

Zoom

Extent of contamination zone
CEMENTICS* Plug Design

Control of the well

- Well & fluid data
- Volume optimization
- POOH
- Hydraulic placement

Volume Balance

Hydraulic simulator

Well Security

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CEMENTICS* Plug Design

Well & fluid data
Volume optimization
POOH
Hydraulic placement
Mixing during placement

Mixing due to fluid placement (pipe + annulus)

VOLUME BALANCE
POOH SIMULATOR
HYDRAULIC SIMULATOR
WELLCLEAN III

Fluids Concentrations:
- Mud
- MUDPUSH II
- Cement Slurry

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CEMENTICS* Plug Design

- Well & fluid data
- Volume optimization
- POOH
- Hydraulic placement
- Mixing during placement
- Combine mixing (POOH)

Combined mixing (placement + POOH)

Risk before POOH
- No slurry
  - High
  - Medium
  - Low

Risk after POOH
- No slurry
  - High
  - Medium
  - Low
Summary: CEMENTICS

Options offered:
- Optimizing under-displacement, or customizing for sensitivity analysis
- Allowing wet pull out simulation
- During placement and after POOH, showing individual fluid concentrations, not only contamination risk zones
- Accurate WOC time prediction!
Challenges in Annular Barrier Verification

- Multiple methods for identifying the presence of cement
- They all should corroborate
- Difficult to compare them with one another
- What about other wellbore data?
  - Open hole logs: gamma ray, resistivity, temperature, deviation, caliper
  - Pore pressure / frac gradient
  - Formation tops, rock types, known fractured zone

- How can we integrate all available well data to make the best possible assessment of cement integrity?
### Invizion Evaluation* Workflow

**Objectives, Formation Characterization:**
- Which formations / zones do you want to isolate?

**Drilling:**
- What the hole is telling us?

**Cement Placement:**
- How is your barrier placed?

#### Acoustic Logs:
- What are the logging results?

#### Interpretation:
- What are the outcomes and why?
- What formations / zones do you want to isolate?
Well Information Storage

- i-Find
- InterACT
- Petrel
- Techlog

- Wireline
- Cementing
- Mud-Logging
- Drilling Fluids
- Drilling and Measurements
Invizion Evaluation for Efficient P&A

- P&A Decision
- Relevant Well Info
- **Acoustic Logging** Data

Invizion Evaluation

- Annulus fill evaluation
- External Barrier Verification

P&A Program

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The need for full cement plug integrity is clear

Minimizing/eliminate microannuli by expansion

Better zonal isolation

Saving you time and money……a robust solution

Summary

FlexSTONE* Systems

- Particle Size Distribution
- Flexible Particle
- Expanding Agent

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To demonstrate that a FlexSTONE system can form a leak tight seal in a large-scale laboratory test under downhole conditions and at a differential pressure of 2.5 bar/m.

The conditions were those of the problematic well.

Proved expansion during dry-gas conditions (no H₂O).
FUTUR* Active Set Cement

**Self-Healing Cement-Based Blend**

- Matrix swells to re-establish the hydraulic seal across the cracks and/or micro annulus
- Presence of hydrocarbons (gas, condensate, oil) triggers the self-healing effect
- Can be mixed and pumped as part of primary cementing operation

Prevents downhole isolation failures from becoming surface problems (SCP, SCVF)
FUTUR Active Set Cement

Applications

- For wells in fields with history of leaks (SCP, SCVF)
- Remedial cementing - for Plug and Abandonment applications
- For wells in areas with environmental concerns
- Primary cementing of Gas or Oil wells on Land and Offshore, UGS wells
- In wells subjected to unplanned pressure and/or temperature changes
- For fields subjected to geological formation changes or tectonic activities
Summary

- CEMENTICS Software:
  - Reduce cement plugs costs & risk
- Integrity for eternity – Sealants that last
- Invizion Evaluation barrier verification:
  - Top of Cement – Formation creep
  - Barite sag – Casing centralization

Effective Internal Barrier Placement
Thank You