Subsea Sampling on the Critical Path of Flow Assurance

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Outline

• Flow assurance along the fluid journey
• Fluid PVT and importance of representative samples
• Subsea sampling system
• Subsea sampling demo
• Project example – subsea sampling application for scale squeeze optimization
Flow Assurance
Interacts with All Disciplines Across the Fluid Journey
PVT & Fluid Behavior

Athabasca Bitumen $\rho > 1$

Asphaltene

Wax

Inorganic scale

Organic Scale

Gas Hydrate
PVT & Fluid Behavior

- Hydrate Curve
- Wax Curve
- Asphaltenes Curve
- Bubble Point
- CaCO₃ Equilibrium
- SrCO₃ Equilibrium

OPERATING PROFILE

Reservoir P&T Start
Reservoir P&T Long-Term Look-ahead
### Integrated Modeling to Diagnose and Optimize FA Problems

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<td>PIP PIPESIM</td>
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- **PVT Analysis**
  - ScaleChem
  - MultiScale
- **Corrosion Analysis**
  - OLI Analyzer Studio
- **Economic Analysis**
  - Prosper / GAP
- **Process Simulation**
  - HYSYS
Subsea Production Trends and Sampling Drivers
Multiphase Representative Sampling

- Strategically chosen, phase-rich sampling points
- Each phase is enriched and captured individually
- Isothermal and isobaric
Subsea Sampling System

Subsea Sampling Hardware

- **Sampling Interface**
  - Based on blind T, flexible access / retrievable
  - Dual pressure barrier philosophy

- **Sampling Module**
  - Isothermal and isobaric sampling
  - Phase detection and phase enrichment
  - ROV deployed skid
  - Remotely controlled system
  - Transportable sample receptacles

- **Topside Equipment**

Subsea Sampling Services
OneSubsea Sampling System - Demo
Project A – Subsea Sampling for Scale Squeeze Optimization

Offshore Scale Squeeze

- **Procedure**
  - Injection of inhibitors and retention
  - Inhibitor flowback for protection

- **Sampling and Analysis**
  - Inhibitor residual -> Re-squeeze when < MIC

**Design Requirement**

- Water Depth: 1100 m
- P/T: 10,000 psi and 121 degC
- Access: horizontal
- Samples: 4 x 600 cc
Subsea Sampling

- Representative Samples
  - Isobaric / isothermic
  - Subsea units in place

- Reliable Analysis
  - Enable accurate estimate of re-sqz time

Scale Squeeze Optimization

- Integrated modelling for accurate prediction
- Reliable scale control -> prevention
- Reduce intervention frequency
- OPEX saving and increased up-time
Integrated Subsea Sampling and FA Risk Analysis

Production management workflows

Modelling, EoS, Uncertainty, and decisions

Sampling interface

Sample extraction

QA, condition, segregate, restoration, and transfer

Analysis and reporting

Chain of Custody

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Thank you!

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