Oil / Water / Sand Quality Measurement
Key Enabler for Subsea Separation Development
SUT Control Down Under - 19th October 2016
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Agenda

- Introduction
- Subsea Separation Process Overview
- Oil / Water / Sand Quality Measurement
- Conclusion
Advanced Subsea Production
Typical Subsea Process Block Diagram - Building Blocks

1) Gas Processing
   - Gas Treatment
   - Gas Liquid Separation

2) Oil-Water Processing
   - Oil Water Separation
   - Oil Treatment
   - Water Treatment

3) Boosting
   - Compressor
   - Pump

Production ➔ Host Facilities ➔ Injection
Subsea Separation Process

- Gas Outlet
- Oil Outlet
- Water Outlet

Crude HC Inlet
Subsea Separation Process – Sensing & Control

- Gas Outlet
- Oil Outlet
- Water Outlet

- Gas
- Foam
- Oil
- Emulsion
- Water
- Sand

Crude HC Inlet

- Solid Deposition?
- Quality?
- Quality?
- Quality?
Oil Quality - Sensing

■ What to measure?
  ■ Water in oil (WIO) quality

■ How to measure?
  ■ Water content sensor
  ■ Typically – microwave, capacitive

■ Why measure?
  ■ Understand the performance of separator
    ■ Lower the oil/water interface level, increase oil retention time
    ■ Addition of chemicals (eg. emulsion breaker)
  ■ Injection of hydrate inhibition chemicals (MEG / Methanol), as hydrate prevention measurements
Oil Quality Sensing Example (1)

- Consider 0.5% accuracy

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Graph showing WLR (%), Sensor reading, Stop MeOH Pump, Start MeOH Pump, Upper limit, and Lower Limit.
Oil Quality Sensing Example (2)

■ Consider 0.2% accuracy

A more accurate sensor will give less MeOH usage

Upper limit
Sensor reading
Lower Limit

Time

Start MeOH Pump

Stop MeOH Pump

WLR %

2
Water Quality - Sensing

- What to measure?
  - Amount of the oil (HC liquid) in the water phase

- How to measure?
  - Several types of technology
  - Photo-acoustic, fluorescent, optical, ROV sampling

- Why measure?
  - For water disposal to sea
    - Satisfy the environmental limits for water disposal to sea
  - For water reinjection to well
    - Ensure that the smooth operation, as offspec water may affect well injectivity
    - Reduced injectivity from excessive oil content is often reversible, i.e. will get better over time when clean water is injected
Water Quality Sensing – What is the “Oil in Water (OiW)”?

- Oil (HC) may exist in different forms in the continuous water phase.

- The definition of OiW is not uniform.

- Also, different types of oil sensors and analysis react to different HC components in the mixture.

- Key → understand the definition of OiW for any given specific application.
Sand Deposition - Sensing

What to measure?
- Sand accumulation in the separator

How to measure?
- Several types of sensor available
  - Nucleonic, thermal, ultrasonic

Why measure?
- To determine the when sand flushing is required
  - Flushing has a cost (performance of the separation, pump duty etc.), so one does not want to flush too often
  - If you flush too late, you may not be able to get the sand out (flushing system overwhelmed)
Quality Control Loops: Sand Flushing

Sand Flushing Sequence

Wells

Injection Well

QT

Flowlines to platform
Key Takeaway

- **Quality measurements** are vital during the design and operation phase of any given subsea system.

- The **type and suitability** of the sensors are dependent on the system design and specific applications.

- **Key to involve** subsea system vendor for the system design prior determining the sensors requirements.
Thank You / Questions
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