RESEARCH PROGRAMME: WATER HANDLING

ERC-RPM
Engineering Research Center in Reservoir and Production Management
Workshop, 7th of June 2017
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Challenges

Call of Proposal – Water Handling

- Typical main drawbacks due to water production:
  - High cost of processing facility (CAPEX and OPEX)
  - Change in water handling capacity need during a field lifetime (CAPEX)
  - Energy consumed during water handling increase carbon footprint
  - Volume of water to be transported though risers to topside process facility
  - Potential risers also for produced water reinjection
  - Increased number of deep-water risers and/or increased dimension
  - Flow assurance
  - Lost oil production: processing capacity limitations or OPEX/energy use too high

- Reservoir injectivity: Complexity and cost - Challenge with water flooding as secondary recovery method
  - Injection requirements (flowrate, OIW, \( SO_4^{2-} \), particles, pressure, etc.)
  - Potential for formation damage
Technology Solutions

Call of Proposal – Water Handling

• Zone control in well
  − Inflow control devices
  − Injection of chemicals in reservoir

• Subsea processing
  − Reinjection into reservoir or dumping well
  − Subsea discharge to sea

• Topside processing of water
  − Deepwater marine risers
  − Cost effective riser with large diameter
  − Material challenges wrt welding and fluid content
Example subsea processing

Call of Proposal – Water Handling
Example subsea processing

Call of Proposal – Water Handling

Statoil technology needs:
- Investigation of alternative separation principles
- Enable subsea disposal of PW
- Dissolved gas in discharged water
- Quality monitoring technologies (particles)

Subsea discharge of treated produced water
- to sea
- to dumping well

1st stage 3-phase separation

2nd stage degassing

Oil treatment

Gas to topside

Condensate return from topside

Oil production pump

Water treatment

Balance with sea water

To crude oil tanker

Oil storage

Balance with sea water

Subsea discharge of treated produced water

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Technology Solutions

Call of Proposal – Water Handling: Water injectivity

Challenge

- Selection of injection water can influence injectivity and reservoir performance
- Near well plugging can be caused by particles, oil components or biomass, - separately or combined. Plugging mechanisms must be known to be able to
  - model and predict injectivity
  - to recommend mitigation strategies

Statoil technology needs

- Improved understanding of near wellbore plugging mechanisms
- Robust modelling and prediction tools
- Mitigating actions
Technology Solutions

Call of Proposal – Water Handling: Reservoir souring

Challenge

- Complex processes not fully understood, gives increased H2S in production volumes.
- Challenging to model and predict transportation of H2S in the reservoir.
- Lost oil production
- Pipeline material specification requirements (corrosion)

Statoil technology needs

- Improved understanding of reservoir souring processes
- Improved prediction of reservoir souring
- Mitigating actions with respect to reservoir management and production technology
Reservoir Sourcing
A reservoir process with multidisciplinary implications

- Monitoring H$_2$S surveillance
- Input to simulations
- Design basis

- Production Optimization
- Material Design & Spec
- Well location
- Flooding regime impact
- Drainage strategy

Sulfate (SO$_4^{2-}$) → Anaerobic sulfate reducing bacteria → Sulfide (H$_2$S)
Technology Solutions

Water Treatment and Quality Assurance

Challenges

- Strict OIW requirements related to disposal of produced water into the sea
- Matrix injection may require strict quality requirements related to particles (PW, SW) and oil (PW)
- Subsea measurement of water quality: reliability and robustness
- Subsea disposal of PW (possible enabler of certain oil fields)
- Cost-effective subsea factories with high production efficiency

Statoil technology needs

- Investigation of alternative separation principles
- Enable subsea disposal of PW
- Quality monitoring technologies
Technology Solutions

Topside processing of water: Steel deep-water risers

Challenge

- Number of risers – larger diameter
- Riser dynamics
- Riser concept/configuration/material/termination
- Installation of risers: marine operations
- Cost-effective subsea factories with high production efficiency

Statoil technology needs

- Cost effective deep-water risers with simple cross-section
- Cost effective installation methods
- Documentation of sour service resistance
- Documentation of integrity and fatigue life
Statoil Expectations

Call of Proposal – Water Handling

- From incremental to disruptive innovation
  - Investigation of novel solutions to treat produced water and sea water and monitor quality
  - Feasibility of subsea discharge of produced water in deep water
  - Robust modelling and prediction tools of reservoir injectivity
  - Investigation of the fundamental processes behind reservoir souring and formation damage caused by $\text{SO}_4^{2-}$ induced scaling and particles naturally occurring in produced water and sea water
  - Material technology to document integrity and fatigue life of structural components
  - Cost effective deep-water risers with simple cross-section (eg. steel)
There's never been a better time for good ideas

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