Rethink water injection

DO IT ALL SUBSEA!

SWIT - New breakthrough in subsea treatment and injection of seawater

SWIT - Subsea Water Injection & Treatment (patented)

Our sponsors so far:

- ConocoPhillips
- Norges forskningsråd

Well Processing
Topsides Seawater Injection comes at a price:
- Large, heavy treatment plants
- Costly
- Operator intensive to run
- Limitation in Injection well slots (which could be used for production)
- Difficult to expand for future tie ins

SWIT: a subsea water treatment system that enables:
- Increased oil recovery by more effective well placement
- Flexibility in waterflood design
- Reduced cost, weight, and space
- No W.I. pipelines / deviated wells
- Reduced environmental impact
For Secondary Recovery, water injected into the oil reservoir has to displace oil. Therefore, in general terms water has to be treated to:

1. Avoid blocking / plugging of the reservoir injection zones (caused by solids / scaling / microbial growth)
2. Ensure microbiological control (caused by bacterial growth)

**SWIT address these challenges in 3 main areas where the system also contains significant levels of innovation:**

- Solids reduction of both inorganic and organic solids.
- Continuous Seawater sterilisation
- System sterilisation via shock dosing of dissolved solids biocides
SWIT – Solids Removal Testing

Test variables
- External Flow Rate
- Injection Rate
- Temperature
Seawater sterilisation for the SWIT system is achieved in two, continuous, on-line steps:

**Step 1) Chlorination** \((\text{NaCl} + \text{H}_2\text{O} \rightarrow \text{NaOCl} + \text{H}_2)\)

As the seawater is sucked into the Still Room it passes over electrical grids that generate NaOCl. The long residence time in the Still Room (e.g. 3 hours) gives ample ‘preliminary sterilisation’

**Step 2) Hydroxyl Radical generation** \((\text{H}_2\text{O} \rightarrow \text{OH}^- + \text{e}^- + \text{H}^+)\)

A **new method** of generating hydroxyl radicals, with stable BDD electrodes, enables effective, on-line use of one of the most powerful oxidizing agents known to man.
SWIT – Seawater Sterilisation Test Facilities

CONTROL (no treatment)  Chlorinator treatment  Hydroxyl Radical treatment

NIVA’s Marine Research Station

Test Loop Arrangement

Well Processing
1) Solids biocide chemical is dissolved to concentrated solutions using a thermo-siphon flow loop
2) The saturate solution is sucked into the main seawater flow as a ‘shock dose’ of biocide
Subsea Water Injection and Treatment Testing - Conclusions

Solids Removal
- Testing Test Results confirm a significant reduction in particle sizes from inlet to ‘injection’ point. Mean inorganic particle sizes down to ca. 10µ can be designed
- Reduction of organic matter can be expected due to electrochlorination and hydroxyl radical treatment

Seawater Sterilisation Testing
- Extraction from the seabed gives SWIT some inherent advantages
- Both the EC unit and the HRG unit have the potential for almost total inactivation of planktonic bacteria, both total heterotrophic and sulphate reducing bacteria (SRB).
- No sessile SRB’s were detected in the treated biofilm test streams
- Although growth rate is significantly reduced, biofilm growth will still occur – i.e. system sterilisation (biocide dosing) is still required

Biocide Dissolution and Effectiveness Testing
- Dissolution of solids biocides is feasible and effective in system sterilisation
SWIT interest growing worldwide on a number of different applications:

Current enquiries for a variety of applications worldwide:

- As a subsea ‘treatment centre’ prior to distribution to injection wells
- As a stand alone treatment and injection well system at significant water depths
- To provide good quality water to an onshore treatment plant
Subsea Water Injection and Treatment
Where Next?

JIP application with ITF in Aberdeen
• **Increased Oil Recovery**
  – Ability to inject unlimited amounts of water into all areas of a reservoir enables greater recovery of known reserves. SWIT also overcomes difficulties in supplying injection water to satellite fields hence increasing recovery economics.

• **Less topsides equipment**
  – Lift pumps, Filtration systems, Chemical Injection skids, Deaeration Towers, Booster pumps, Injection pumps are not required topsides. SWIT only requires electrical interface topsides.

• **Significantly reduced costs**
  – Significant savings can be expected in CAPEX, reduced topsides facilities, installation and OPEX costs

• **Reduced environmental impact**
  – SWIT uses significantly less energy and less transported chemicals per barrel of injected water

• **No seabed pipelines or long deviated wells**
  – SWIT wells can be drilled directly above the area where the water is to be injected. No injection wells are required on the platform thus freeing up slots for production wells

**Applicable To:-**
All offshore engineers associated with IOR / secondary recovery on oilfields.
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