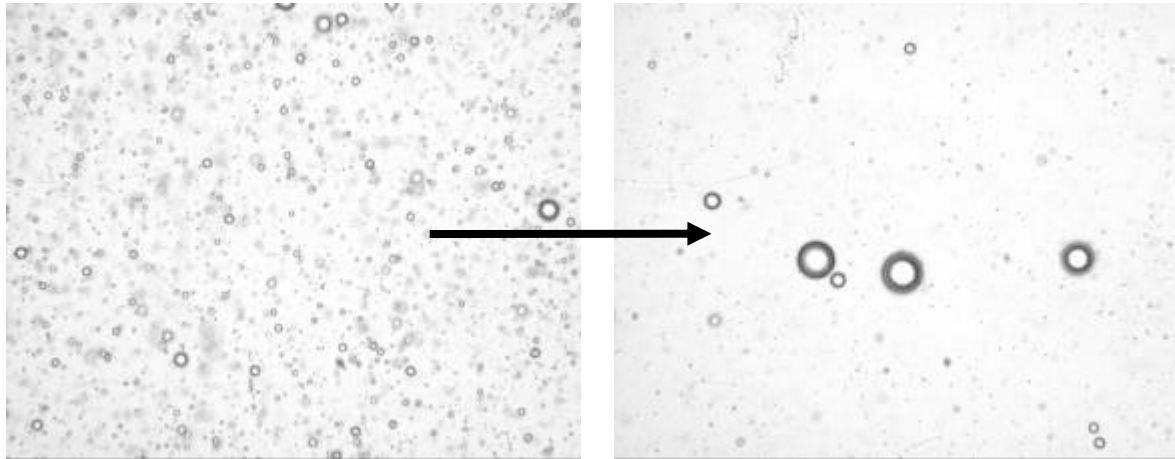


Novel coalescer technology also for improved water quality

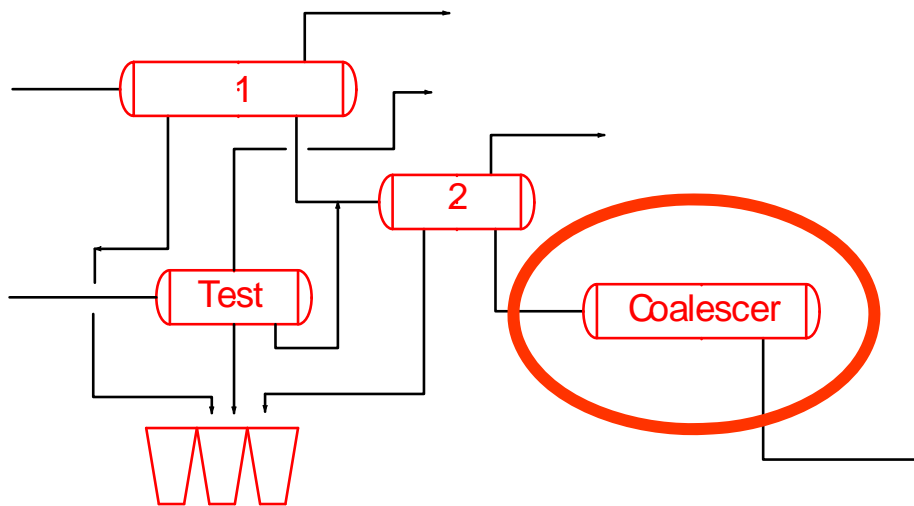


Traditional Electrostatic Coalescers



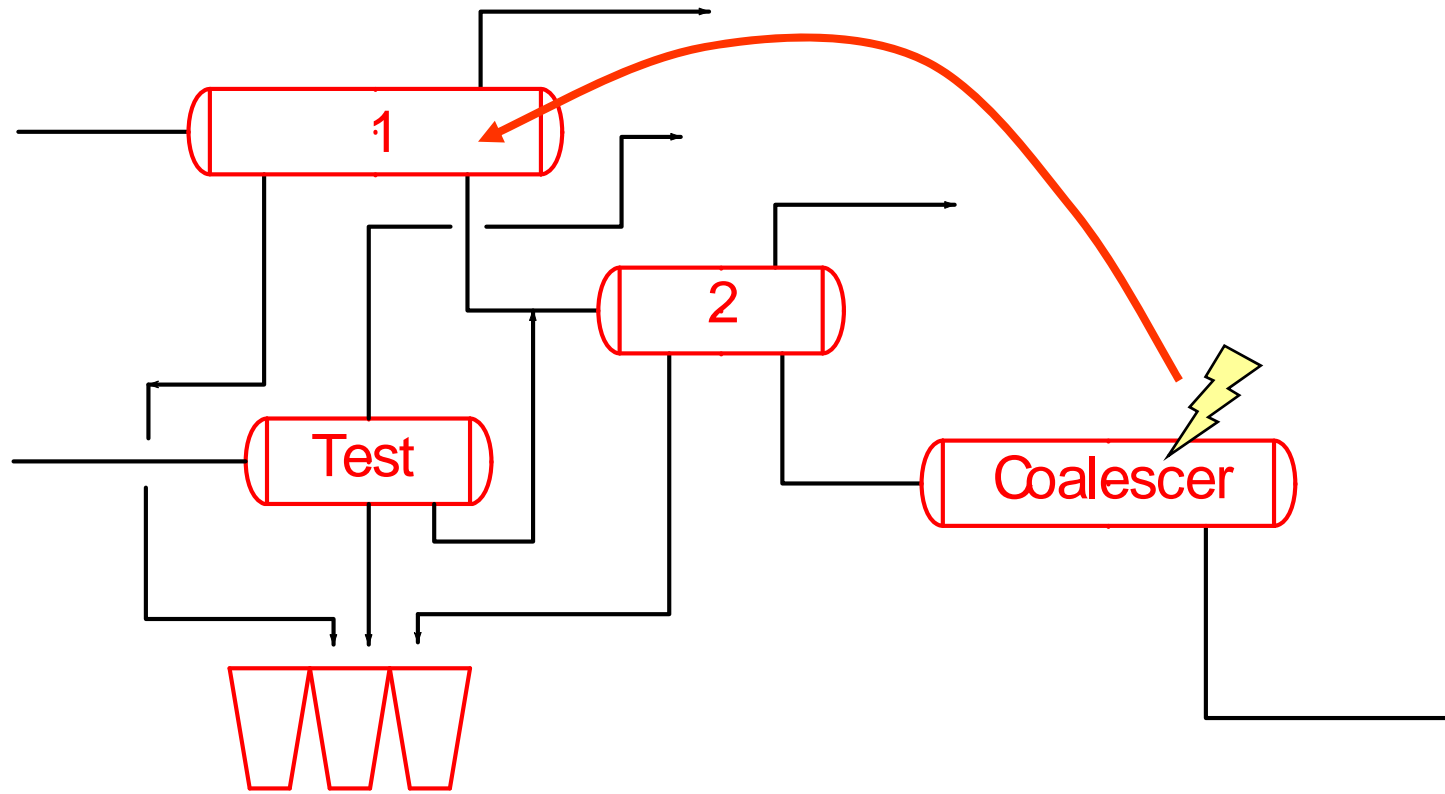
Growth of water droplets in oil from electrostatic force,

Since 1911



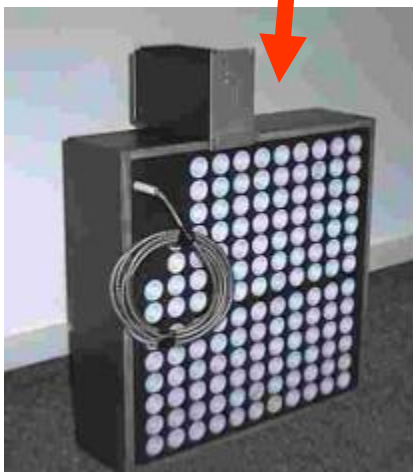
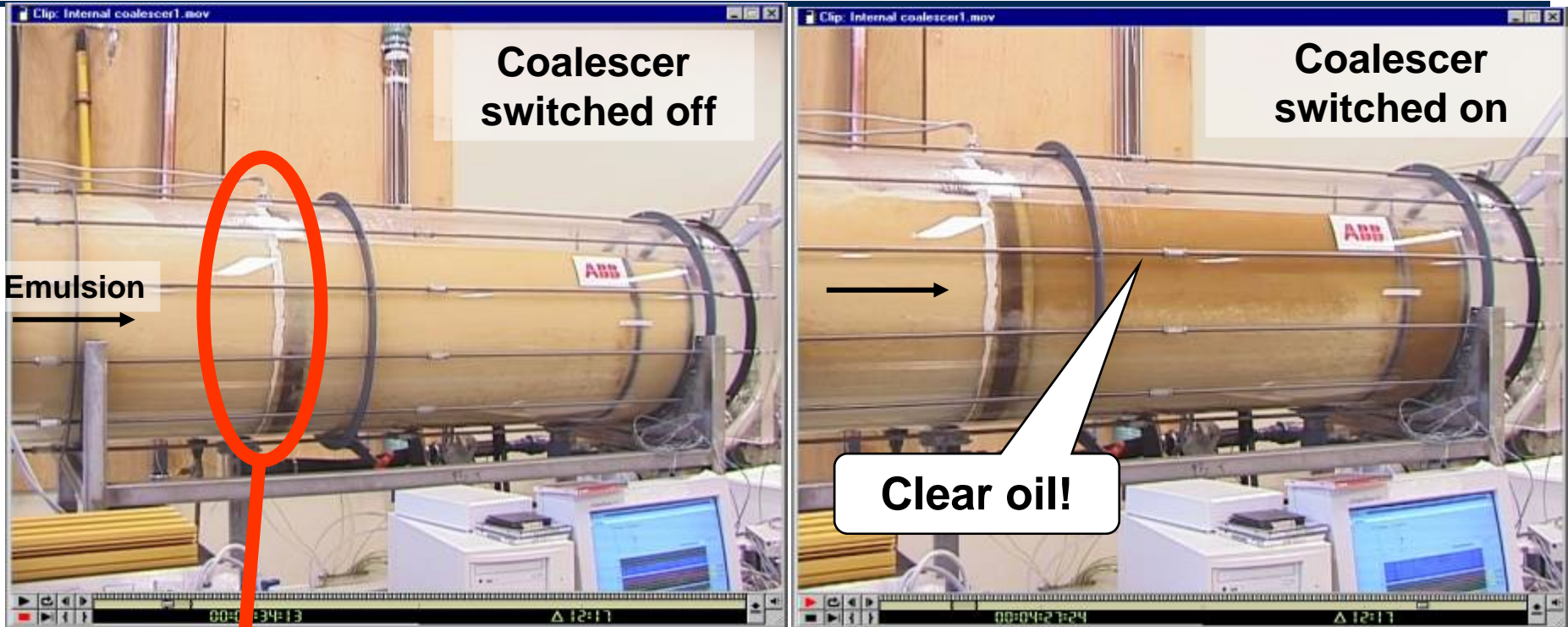
- ◆ Requires low water content and no free gas
- ◆ Removes remaining water
- ← Downstream location

Move coalescing functionality upstream



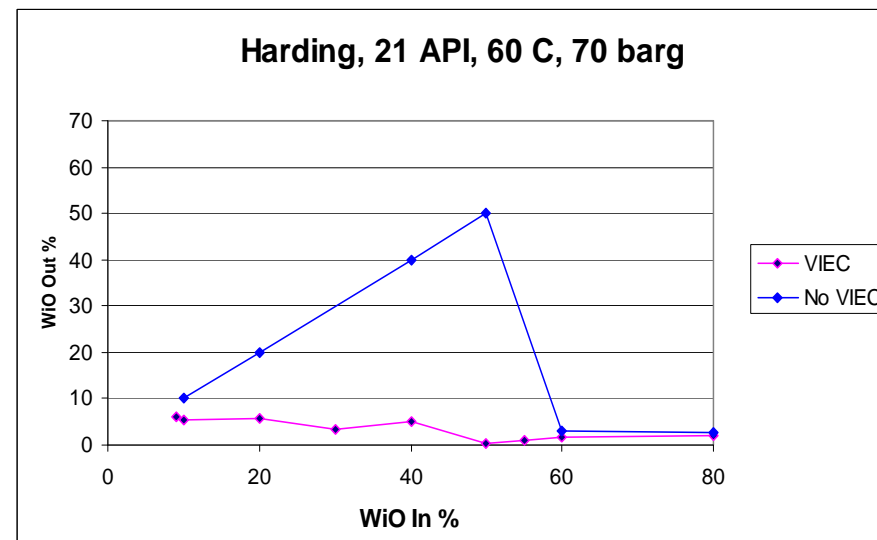
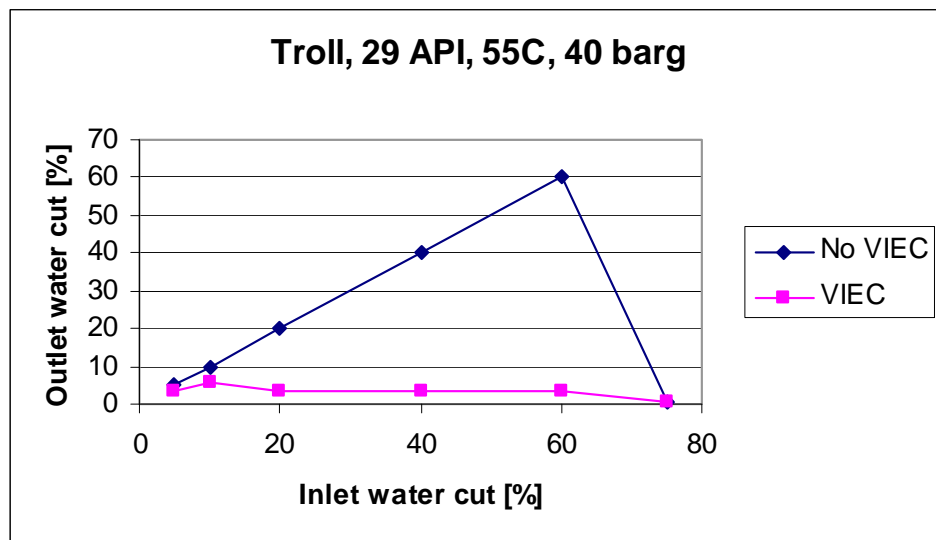
- ◆ Reduce chemical consumption
- ◆ Increase production
- ◆ Improve BS&W
- ◆ Reduce fluid heating
- ◆ Improve level control
- ◆ Improve water quality

Vessel Internal Electrostatic Coalescer (VIEC)



VIEC test results & Norsk Hydro HP test loop

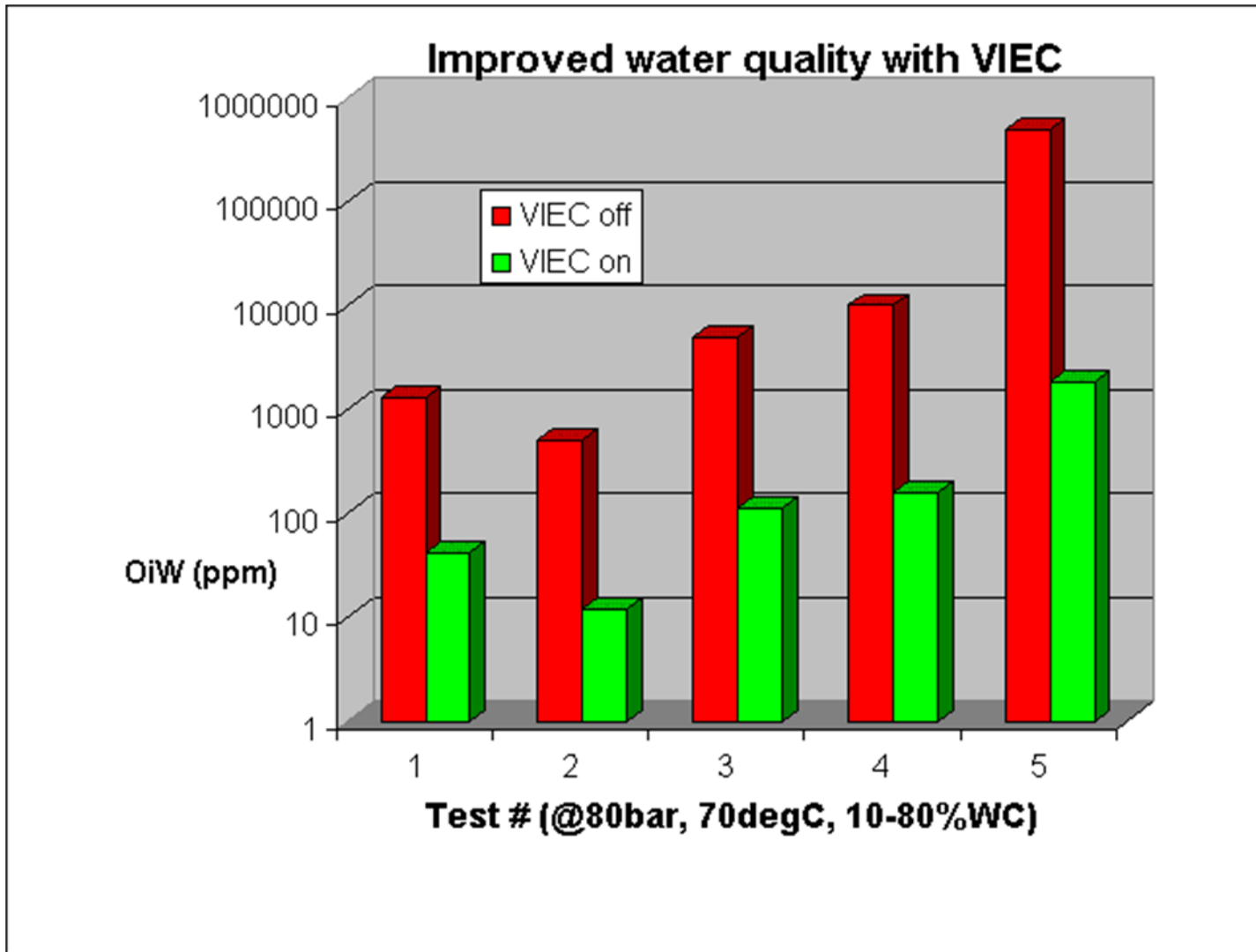
- ◆ Testing at Norsk Hydro high pressure loop, 24" separator
- ◆ 75-150 s residence time, no chemicals, gas saturated



Also tested at similar T/P:

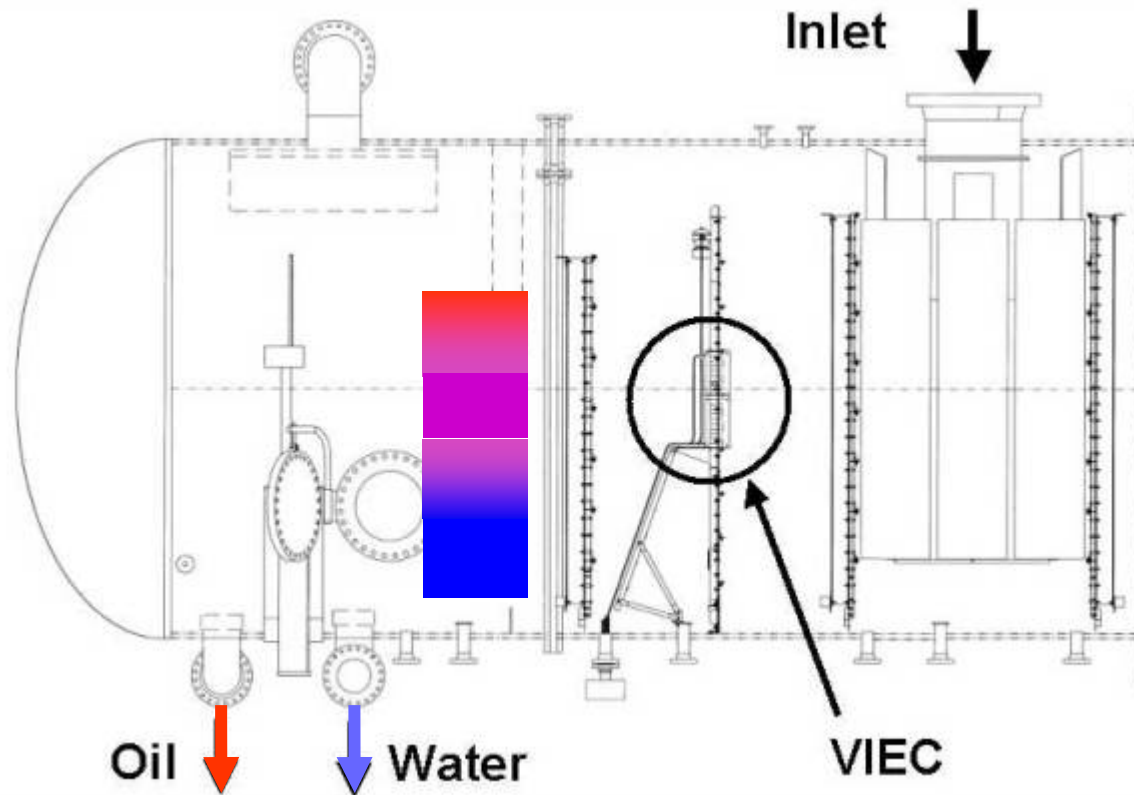
- ◆ Oil C, 32 API
- ◆ Oil D, 19 API

HP test with API 29 – Improved water quality



Improved water quality for all water cuts

Full size pilot 2003 - TROLL C – problem description



220,000 BOPD
15' dia. x 50' T/T
Center inlet

Symptom: 

- ◆ High water in oil
- ◆ Difficult control
- ◆ **Accidental discharge of oil in PW**

Finding: 

- ◆ 3 ft emulsion layer

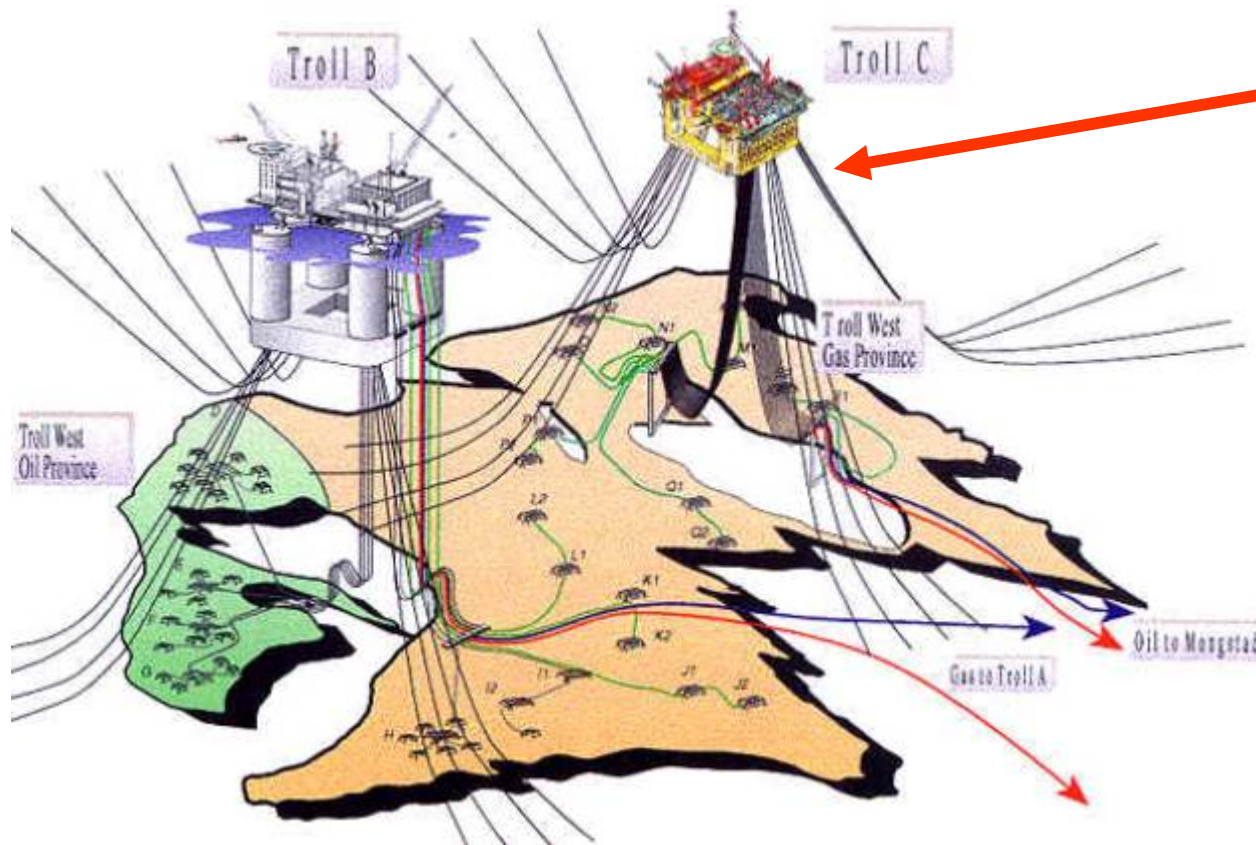
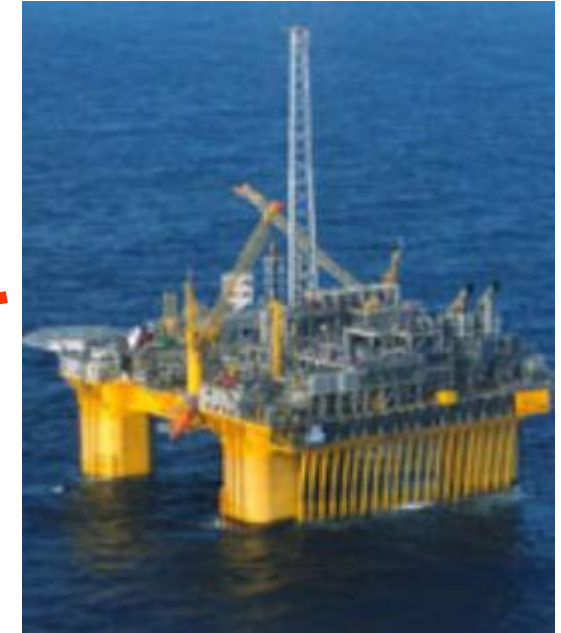
Solution:

- ◆ Install VIEC

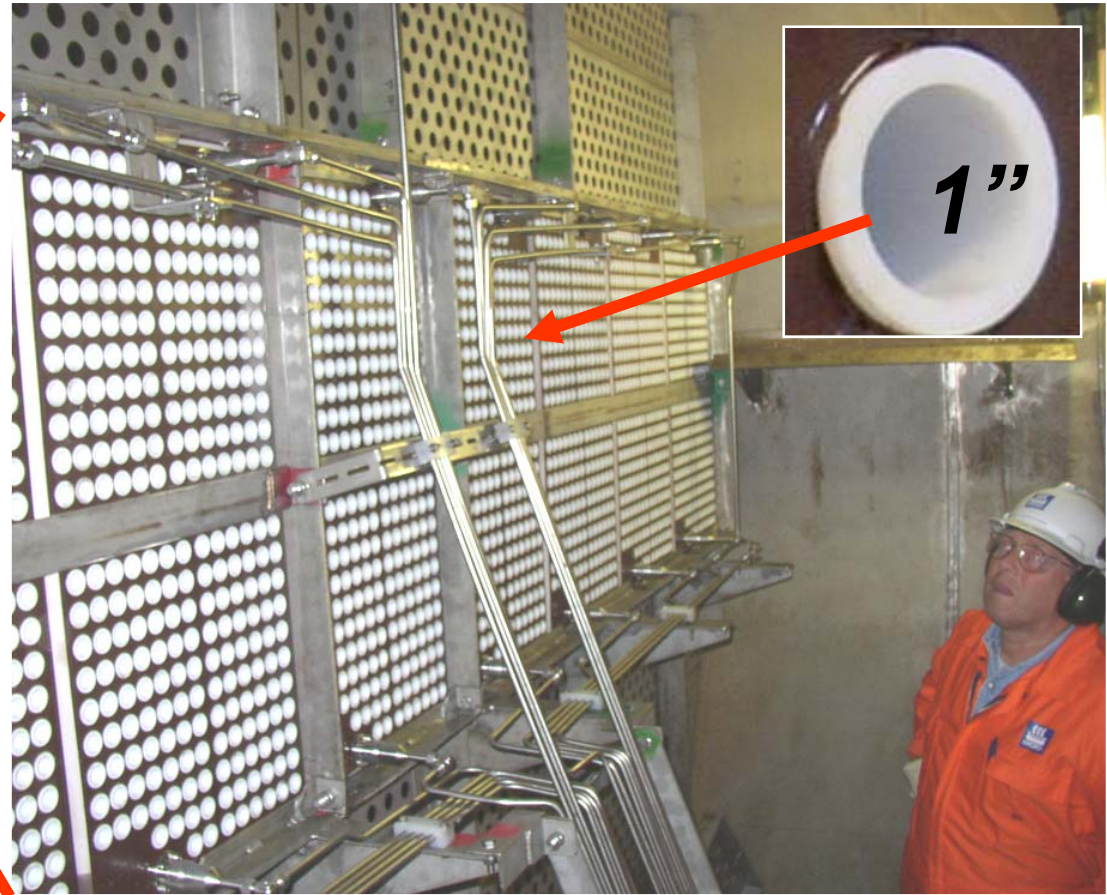
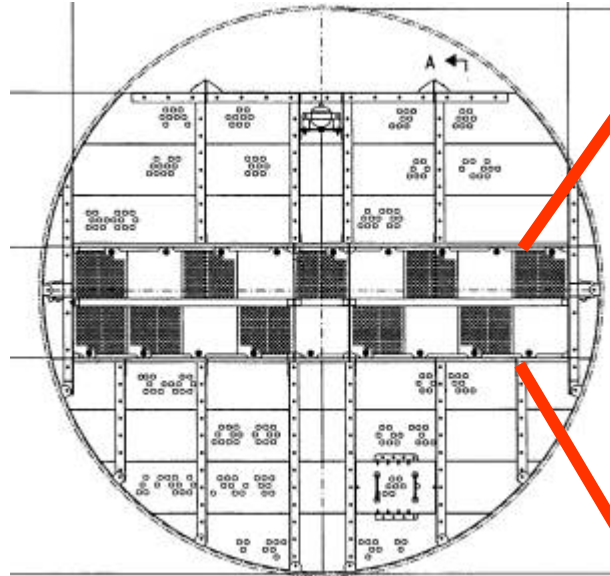


Troll oil field (platforms B & C)

- ◆ 80 km NW of Bergen, Norway
- ◆ Norway's largest oil producer
- ◆ Operator: Norsk Hydro



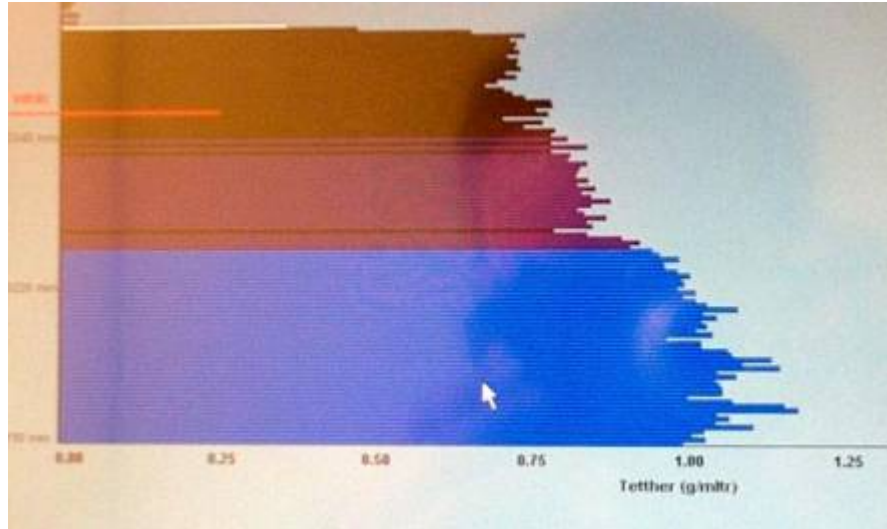
VIEC installed in Troll C 1st stage separator



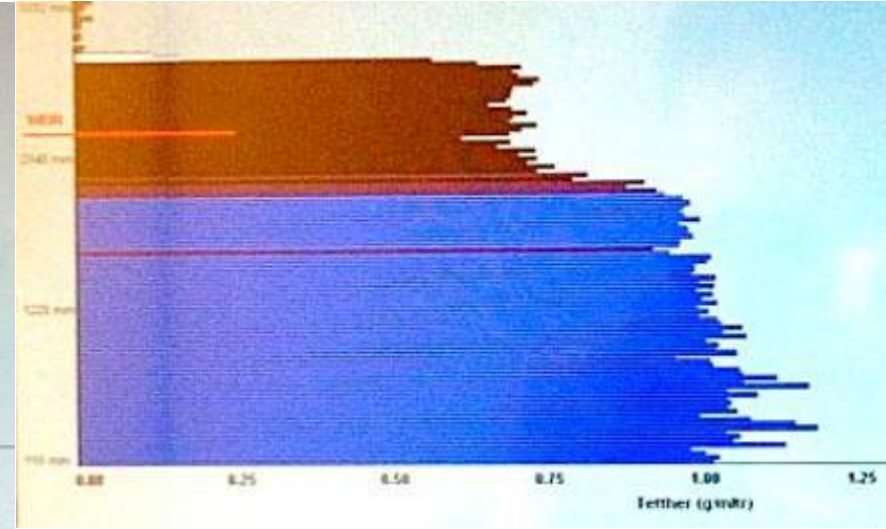
- ◆ 25% open area as for perforated plates
- ◆ VIEC Targets oil/emulsion layer

VIEC on 1st stage at Troll C –19 months of operation

Separator density profile VIEC off



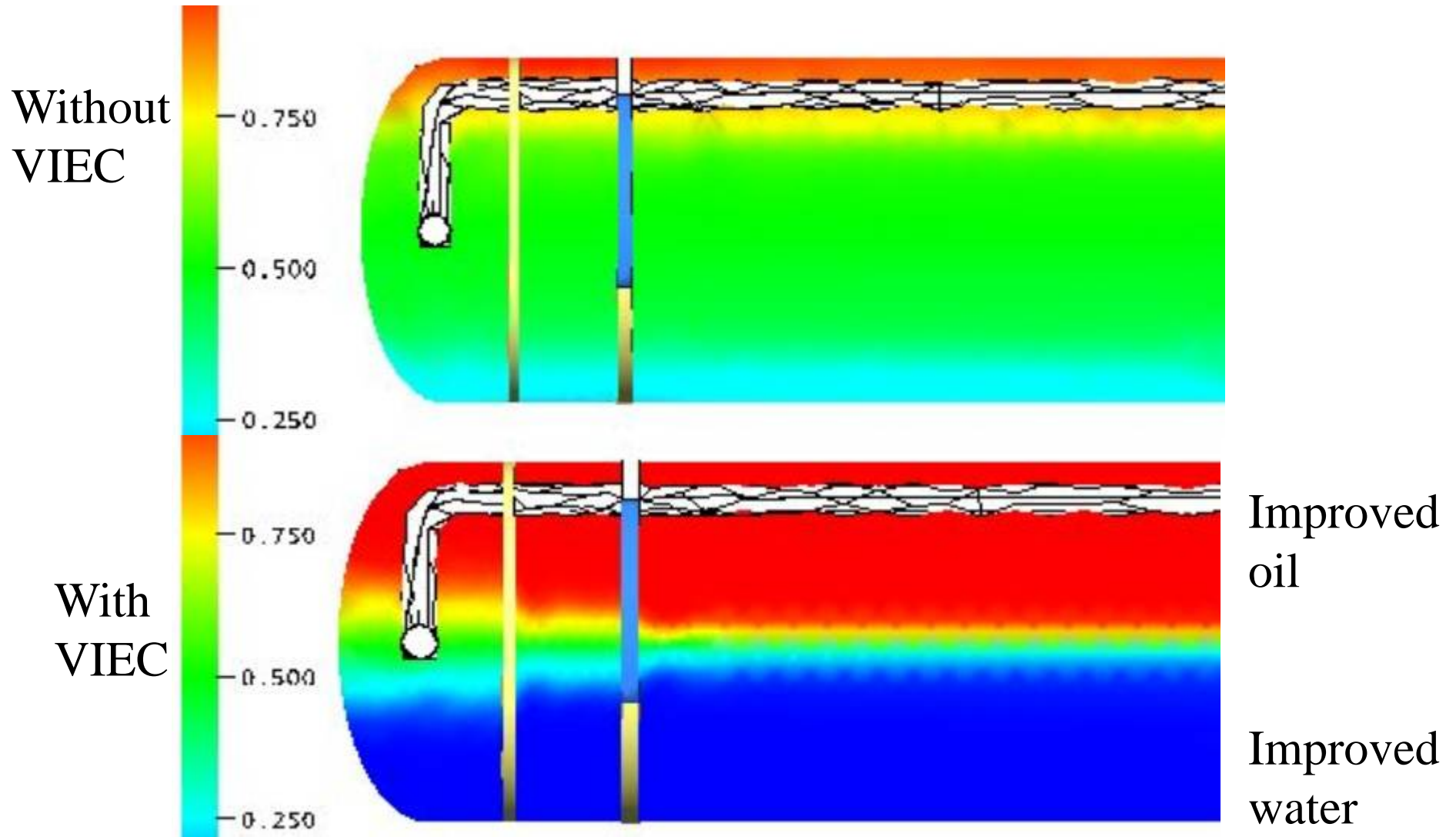
Clear phases with VIEC turned on



- ◆ Emulsion layer reduced by 80%, from 1000 mm to 200 mm
- ◆ BS&W
 - ◆ From 10-15 % to 5 % at normal gas production
 - ◆ From >20 % to 10% at design gas production

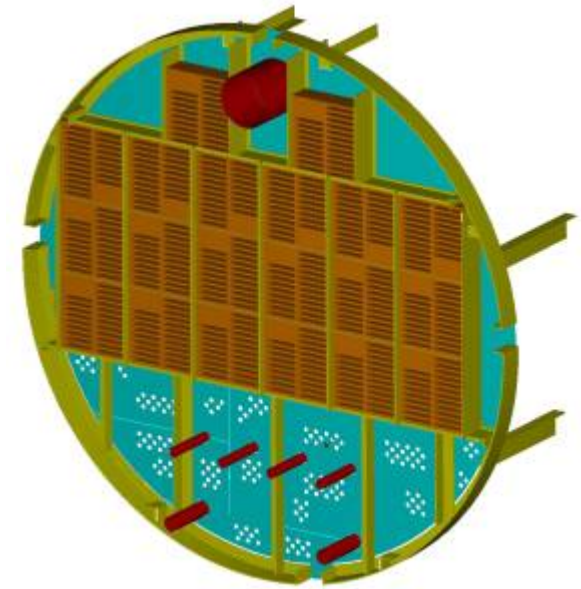
- ◆ Demulsifier from 10 to 2 ppm → 600,000 USD/yr cost reduction
- ◆ Increased production with 5-10%
- ◆ **No accidental oil discharges**

Two phase modelling – optimizing design





VIEC on Bluewater Munin for Xijiang Field

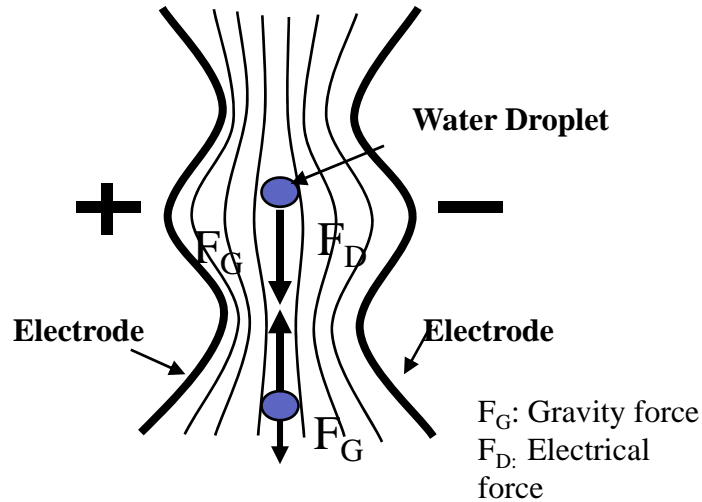


- ◆ Capacity increase with VIEC: 62,000 → 75,000 BOPD
- ◆ Fluid capacity: 125 000 → 150 000 BLPD
- ◆ Delivery: 1 August, 2004
- ◆ Start up: 1 October, 2004

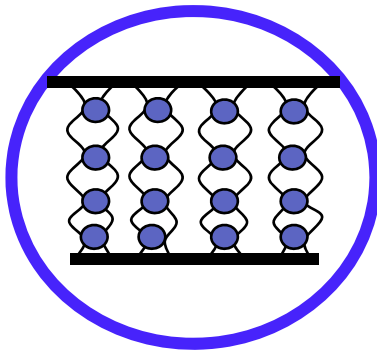
Details of Munin installation



The LOWACC Concept

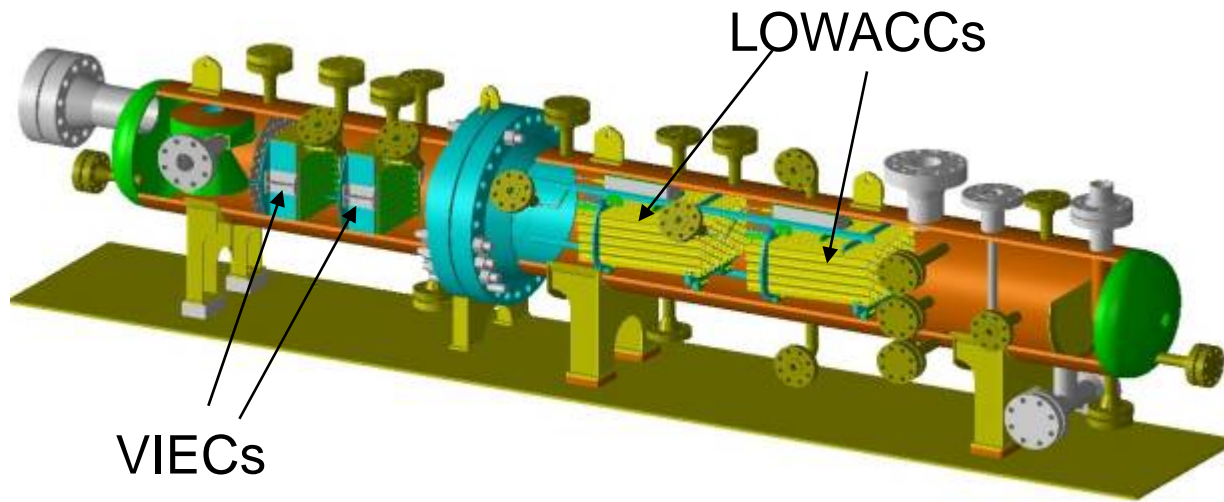


- ◆ Phenomenon called Di-electrophoresis
- ◆ Water droplets tendencies to move towards a stronger section of an electrostatic field
- ◆ Force imposed by the gradient field is in the order of magnitude 2-3 times the gravity force



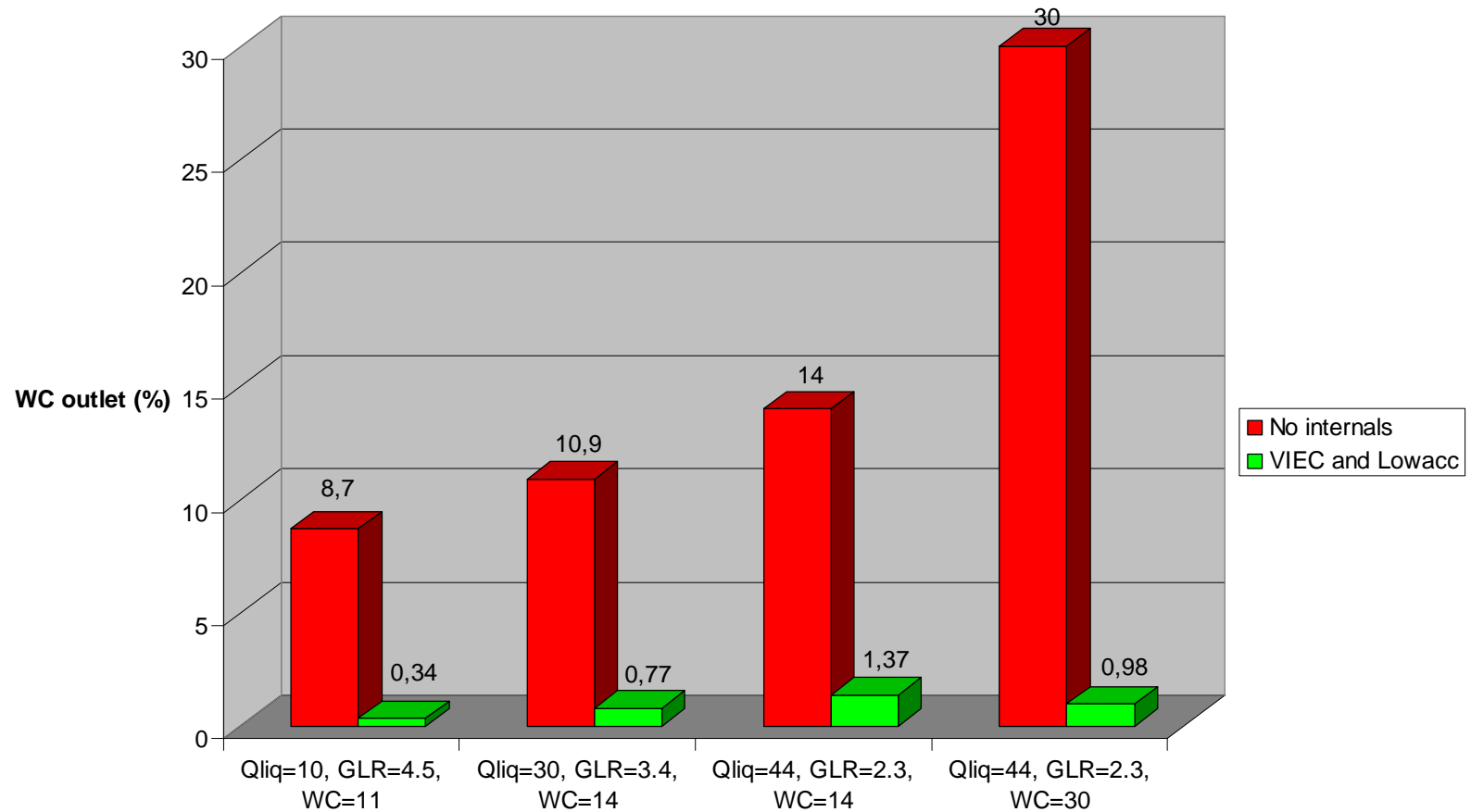
DEMO 2000 - Test Equipment – VIEC and LOWACC

- ◆ Vessel with two independently controlled LOWACCs
- ◆ VIECs upstream
- ◆ Sampling points in all three phases up- and downstream every coalescer device
- ◆ Density profiler in the outlet section of the separator
- ◆ Test matrix includes crudes from API 14 - 32



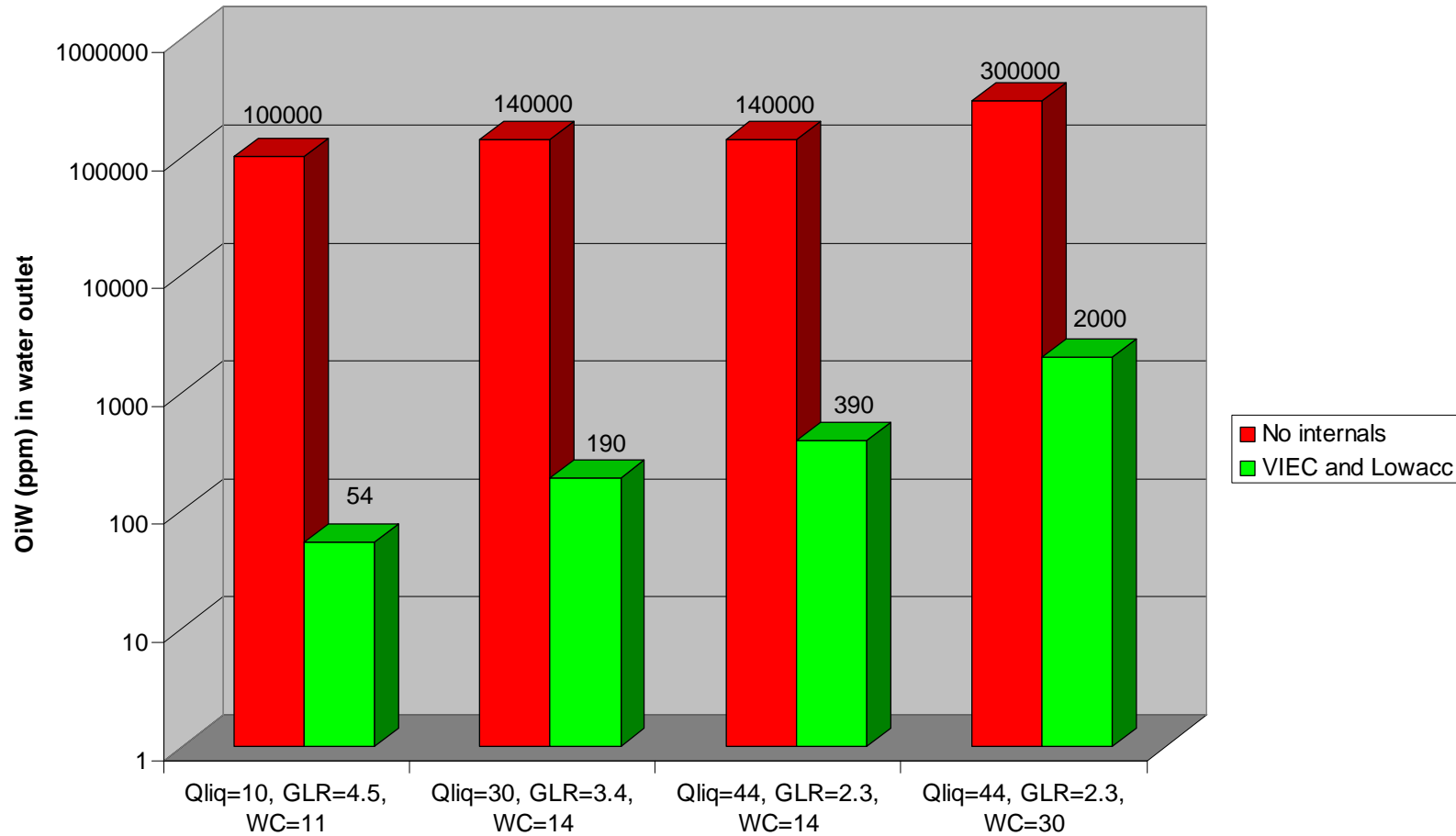
HP Test results –VIEC and LOWACC – Oil quality

VIEC and LOWACC - HP test - API 29 - no chemicals



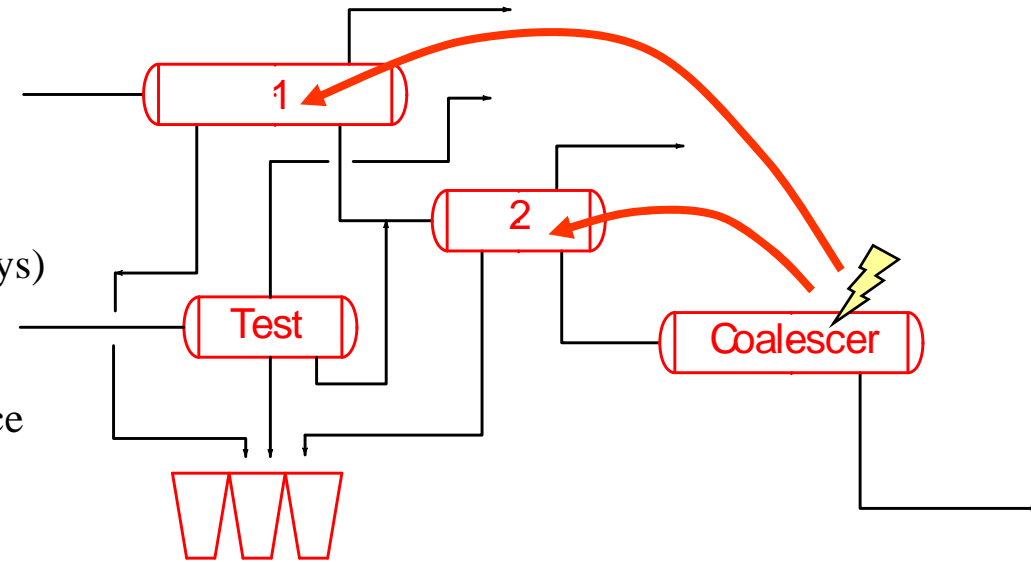
HP Test results –VIEC and LOWACC – Water quality

VIEC and LOWACC - HP test - API 29 - no chemicals



Conclusions - Novel coalescers

- Moving coalescers to 1st and 2nd stage with fully insulated coalescer elements.
- Modularised for retrofit during revision stops (4-5 days)
- Extensive testing in HP test rigs for real crudes
- Two field installations shows remarkable performance
- Combination of VIEC and LOWACC eliminates conventional coalescer



- ◆ Reduce chemical consumption
- ◆ Increase production
- ◆ Improve BS&W
- ◆ Reduce fluid heating
- ◆ Improve level control
- ◆ Improve water quality



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