

New compact coalescer removes oil output bottleneck at reduced cost

Thoroughly tested in the Norwegian North Sea, this technology allows operators to adapt varying crude characteristics within older fields to export oil specifications while keeping modification costs to a minimum

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Following full-scale use in production at Statoil's Glitne field (Norwegian North Sea), a new technology for improving export crude oil quality is ready for commercialization. Aker Kvaerner, Statoil and other JIP (joint industry project) companies have developed this product, which destabilizes water in oil emulsions, thereby reducing water content and corresponding salt in crude oil. As owner of the technology, Statoil has granted exclusive global marketing & manufacturing rights to Aker Kvaerner's subsidiary, Kvaerner Process Systems (KPS).

Named CEC (Compact Electrostatic Coalescer) Technology, this very compact unit has great potential for improving existing oil production processes, especially for mature fields where changing crude characteristics, or existing processing equipment, limit operators' abilities to reach export oil specifications, Fig. 1. As a result, oil companies must pay an off-spec. penalty to the receiving refineries or terminals. This is now a common problem for many existing North Sea installations, as well as worldwide, and several oil-producing companies have shown great interest in the solution. Due to the CEC's compactness and simplicity, overall costs for an offshore modification project will be reduced drastically.

KPS will initially focus on mature production regions, such as the North Sea, Gulf of Mexico and Middle East. A market for subsea versions of the CEC is also being developed.

Case study. A full-scale CEC unit is installed at PGS Production's *Petrojarl I* FPSO, operating at Statoil's Glitne field in the North Sea. The unit

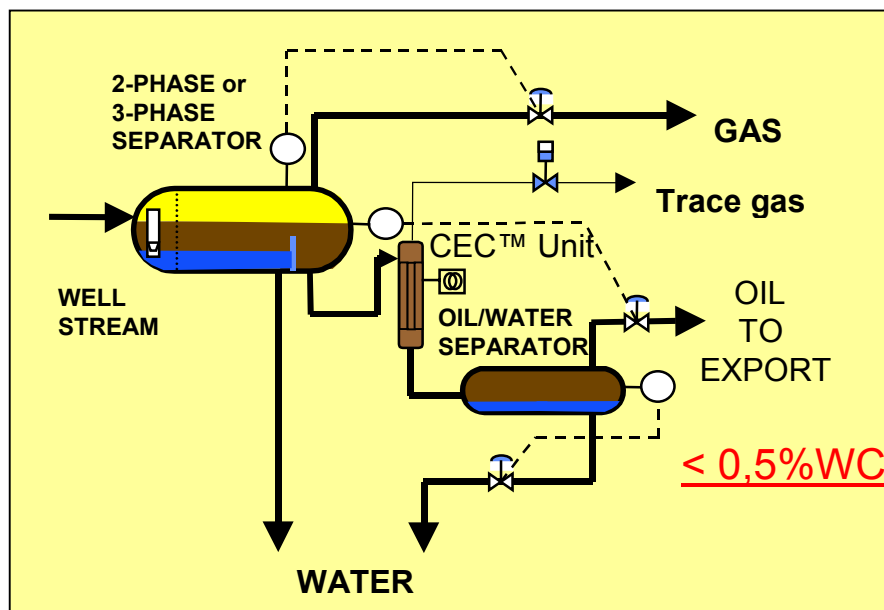


Fig. 1. Partially dewatered crude oil enters the CEC unit and flows downward through the annular electrode channel(s). Very rapid droplet growth occurs—residence time in the electrostatic field is less than 10 sec. Crude oil then exits the unit's base and passes to the downstream separator.

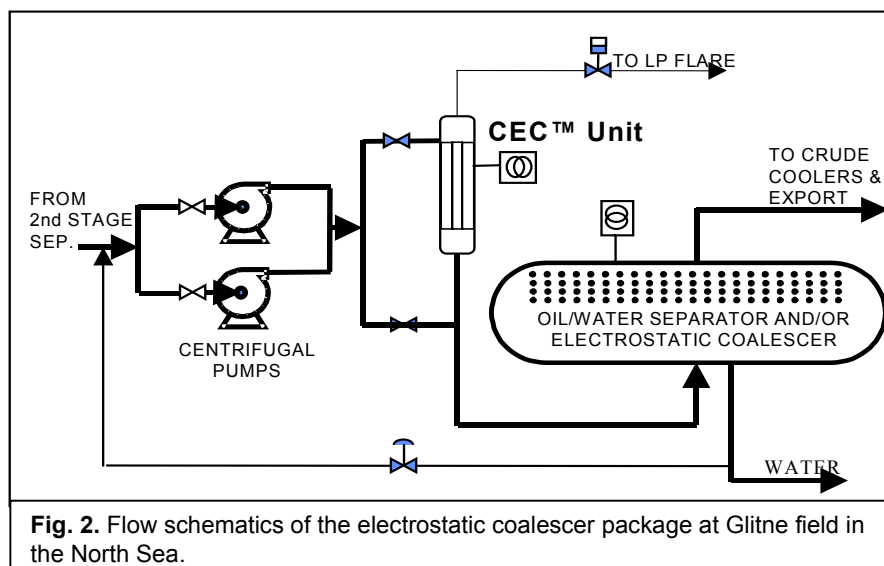


Fig. 2. Flow schematics of the electrostatic coalescer package at Glitne field in the North Sea.

has been operating successfully without interruption since early July 2002, ensuring that the 32° API export crude oil is within the client's specification of less than 0.3% water content in oil. (This performance is consistent

with numerous tests that have been carried out during the technology's development.)

A full-scale pilot unit has been installed in parallel with conventional technology, Figs. 2 and 3. This CEC unit is used on a daily basis. Based on results of oil quality gleaned from the gravity separator outlet, this technology is working as well as conventional methods, Fig. 4. Additionally, installation of this unit can result in reduced use of chemicals, as demulsifier is not needed - i.e., the operator is able to run a "greener," environmentally friendly operation, Fig. 5.

While higher regularity during bad weather conditions relative to a conventional unit (trips due to level fluctuations) has been noticed, the operator and manufacturer do say that long-term operation is still needed to fully demonstrate the unit's robustness.

Technology description. The patented CEC is a small, lightweight in-line device that greatly enhances performance of downstream separation equipment. It achieves enhanced performance by coalescing emulsified water droplets entrained in the crude oil into much larger droplets that readily settle in a downstream gravity separator. The coalescing action takes place very rapidly under turbulent flow conditions, as the emulsion is subjected to an intense electrostatic field inside the unit.

Keeping the coalescence and separation steps separate has allowed for creation of a far more compact, flexible and robust technology than conventional

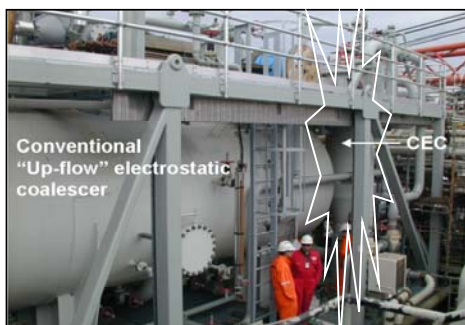


Fig. 3. The electrostatic coalescer package at Statoil's Glitne field, where the CEC is in series with the "up-flow" electrostatic coalescer, which upon power-off, acts purely as an "up-flow" gravity separator.

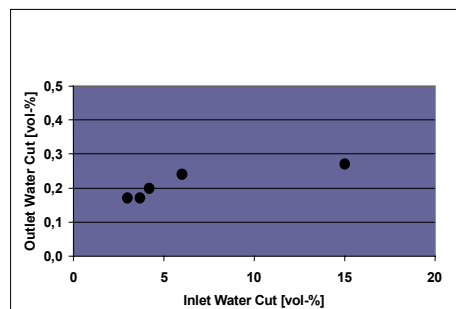


Fig. 4. Gravity separator oil outlet quality with CEC unit in operation as function of feed inlet water cut, August 2002.

electrostatic treaters. Thus, the CEC unit can replace or augment such treaters. The main objectives are:

- To remove water and corresponding salt from crude oil
- To comply with refinery/terminal specifications
- To reduce corrosion in export pipelines and shuttle tankers
- To avoid formation of hydrates in crude oil export pipelines.
- Easy to combine with wash water injection for desalting applications

As envisioned by the manufacturer, key installations will include onshore or topside retrofits, to increase production throughput and/or solve poor operation of existing conventional equipment. Another prime use will be installation on floating production vessel, to minimize problems caused by wave motions.

A number of key benefits can be realized. For instance, the new technology improves the water-in-oil quality while maintaining low energy consumption. The coalescer is compact and lightweight, with a small footprint, allowing for simplified retrofits, with minimal associated costs. In addition to its robust, simple design (no moving parts), this unit can be easily and economically designed for high-pressure operation. Additionally, very effective water droplet growth (emulsion destabilisation) provides highly efficient separation. For retrofit applications, production throughput can be increased. The unit reportedly operates well over a wide range of water cuts (1% to >25%), with an ability to tolerate high cuts (30% to 40%). Insulated electrodes provide short-circuit protection, allowing slugs of up to 100% water for short periods. Recent field testing showed no turn-down limitations, and engineers noticed a reduction in sensitivity of plant-to-wave motions. They also believe there is a potential for large savings in emulsion-breaking chemicals. Further results and characteristics will be tracked and compiled as the coalescer enters its commercial phase.

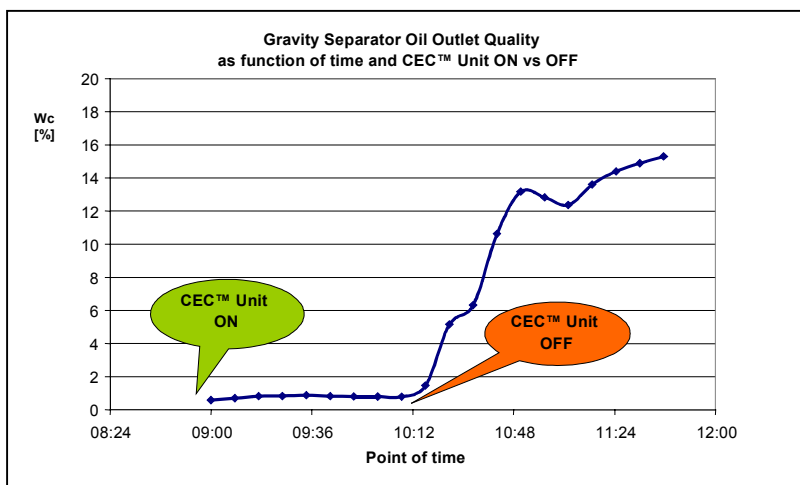


Fig. 5. Results of applying the coalescer technology on Glitne crude without any chemicals. Data from CEC system testing in Norsk Hydro's multi-phase flow loop, Norsk Hydro O&E Research Centre, Norway. Test parameters: Statoil's Glitne crude 32°API, 20% inlet water cut; no chemicals added; operating temperature/pressure: 70°C/5 barg; ~5 min. oil residence time.