Standardized Produced Water Treatment Packages

3D model of Standardized PWT Package

Process Description

Frames Deoiling Hydrocyclones are typically designed to remove free oil droplets of 20 microns and larger from the produced water. Hydrocyclones are effectively gravity separators that rely on the differential density between the oil and the water droplet to allow separation. The hydrocyclone liners have a tangential inlet creating a swirl with enhanced centrifugal force. This G-force generates fast separation of the two liquid phases in a small volume providing compact vessels for high flow rates.

Frames Compact Flotation Units (CFU) are characterized by a clever combination of physics and designed to reduce the oil-in-water outlet content from upstream hydrocyclones, typically from 200 ppm down to 20 ppm. The tangential inlets create a swirl within the CFU that results in a centrifugal force to enhance the separation. The use of 2 tangential inlets provides maximum stability of the swirl and centrifugal forces. Flotation units require a certain quantity of gas in the feed to act as flotation gas to coalesce small oil droplets. If the dissolved gas content is too low, additional flotation gas is required. This is generated with a pumped recycle/eductor loop. The ideal bubble size for flotation is generated by the bubble shear plates installed at the inlet nozzles from the CFU.

Product Definition

Frames has developed standardized produced water treatment packages to reduce the oil-in-water content typically from 2000 ppmv down to 20 ppmv. The package includes hydrocyclones for bulk oil removal followed by a compact flotation unit for removal of remaining small oil droplets.

The Frames Produced Water Treatment packages can be extended with a desanding module to process water suitable for reinjection. Co-mingling of produced water with seawater provides substantial savings on the design of the seawater injection system.

The packages are available for flow rates of 300, 600, 900 and 1200 m³/h. Footprint and weight has been reduced to an absolute minimum to save on CAPEX without comprise on safety and accessibility. Furthermore the Frames Standardized Packages are supplied with minimum engineering efforts providing further CAPEX saving and reduction of delivery time.
Design & Supply Features

Frames Standardized Produced Water Treatment packages are available in a variety of different materials depending on fluid characteristics and design lifetime. Design is in accordance with GEP/GMP/PIP standards and ASME or EN vessel design codes. Subcontracted items are supplied by Frames key vendors from various world-wide locations close to the clients’ construction yard. Local supply chain and project management will be available from Frames International Offices in Kuala Lumpur, Houston, Rio de Janeiro, Dubai or Saudi Arabia.
Standardized Produced Water Treatment Packages

Unique Features

- Smaller footprint / Lower weight
- Vertical Hydrocyclone
- Vertical Recycle Pumps (OH3)
- High Turn-Down up to 10%
- Modular design
- Reduction of lead time for project schedule
- Reduction of CAPEX due to minimum engineering costs
- Complete FAT in shop
- Simplification of logistics
- Reduction of site work

References (selection)

- KSA - Total E&P, The Netherlands
- Kraken FPSO - EnQuest, United Kingdom
- P-58 & P-62 FPSO - Petrobras, Brazil
- Replicantes (P-66 / P-71 FPSO) - Petrobras, Brazil
- Petrojarl 1 FPSO - Teekay, Brazil

Technical Details

<table>
<thead>
<tr>
<th>Technical Details</th>
<th>Unit</th>
<th>HCFU-300</th>
<th>HCFU-600</th>
<th>HCFU-900</th>
<th>HCFU-1200</th>
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<tbody>
<tr>
<td>Flow rate</td>
<td>m³/h</td>
<td>300</td>
<td>600</td>
<td>900</td>
<td>1200</td>
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<tr>
<td>Dimensions (lwxhx)</td>
<td>m</td>
<td>8 x 6 x 8.5</td>
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<td>9 x 6 x 8.5</td>
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<tr>
<td>Weights*</td>
<td>MT</td>
<td>45</td>
<td>65</td>
<td>75</td>
<td>110</td>
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<tr>
<td>Tie-in nozzle sizes</td>
<td>inch</td>
<td>8/8/3</td>
<td>12/12/4</td>
<td>14/14/6</td>
<td>16/16/6</td>
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<tr>
<td>Turn-down</td>
<td>%</td>
<td>10</td>
<td>10</td>
<td>10</td>
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</table>

* Estimated, subject to confirmation during detailed engineering
Frames Family Tree

Onshore

Oil & Water
- Production Separators (High & Low Pressure)
- Test Separator
- Degasser & Knock-Out Drum
- Water Oil Separator (WOSP)

Gas
- Demisting
- Scrubbers
- Filters
- SwirlSep

Separation Technologies
- SwirlSep
- Electrostatic Coalescers
- Dehydrator
- Desalter

Produced Water Treatment
- Deoiling & Desanding
- Hydrocyclones
- Gas Floationation
- Media Filtration
- Solids Removal & Cleaning
- Stripping

Separation Internals
- Heat Exchangers

Gas Separation
- Shell & Tube Heat Exchangers

Flow Control & Safeguarding
- Wellhead Control
- Subsea Hydraulic Power Units
- Hydraulic Power Units
- IWOCs
- (Intervention Workover Control Systems)
- TUTU (Topside Umbilical Termination Unit)
- Cargo Ballasting Systems

Hydraulic Systems
- GTA (Gas Targetting and Air Separation)

Air-Cooled Coolers
- Glycol (TEG)
- Molecular Sieve

Dew Point Control
- Low Temperature Separation (LTS)
- Solid Desiccant

Hydrate Inhibition
- MEG/DEG Recovery
- Methanol Recovery
- MEG/DEG Desalination

Light Hydrocarbon Recovery
- Condensate Stabilization
- Fractionation

Fuel Gas Treatment

Multiphase Separation
- Production Separators (High & Low Pressure)
- Test Separator
- Degasser & Knock-Out Drum
- Water Oil Separator (WOSP)

Compact Inline Separation
- SwirlSep

Services

Asset Life Cycle Management
Maintenance & Field Services
Commissioning
Spare Parts
Operator Training
Engineering Studies
- Conceptual
- FEED and Basic

Total Plant Solutions
- Industrial CO₂ Modules
- Early Production Facilities
- Wellsite Packages
- Biogas

Frames
Separation Technologies
Glazenmakersweg 3
3449 JK Woerden
The Netherlands

+31 88 003 3300
separation@frames-group.com
frames-group.com