



Estaciones Depuradoras, S. A.

PETROCHEMICAL INDUSTRIES

Produced Water treatment by ceramic
membrane filtration

Produced Water treatment by ceramic membrane filtration

- Produced water (PW) is any fossil water that is brought to the surface along with crude oil and natural gas.
- Produced water is the largest by-product or waste stream by volume associated with oil and gas production.
- This water cannot be reinjected to oil wells or discharged to receiving waters because they contain high concentrations of oil, grease and suspended particles.
- Typical composition ranges include 50-1000 ppm total oil and grease and 50-350 ppm total suspended solids.

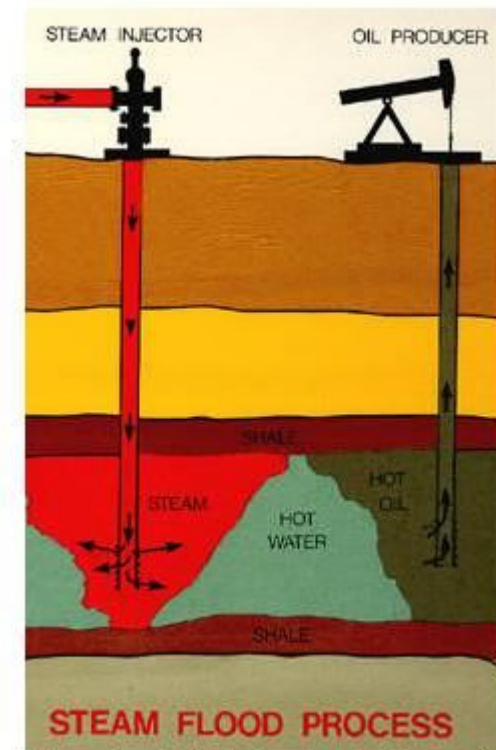


Photo courtesy California Department of Conservation
Enhanced oil recovery



Produced Water treatment by ceramic membrane filtration

ADVANCED TREATMENT is required for discharge and/or reuse PW:

- European standard for effluent from onshore petroleum activities: <5mg/L O&G and <10 mg/L TSS
- Offshore installations: < 29mg/L O&G, <10mg/L TSS
- Re-injection: < 5 mg/L O&G

Produced Water treatment by ceramic membrane filtration

CERAMIC MEMBRANES Filtration:

- ✓ Suspended Solids removal
- ✓ Oil & Grease removal

Why CERAMIC MEMBRANES?

- ✓ Ceramic material: the best for oil/water separation
- ✓ High T and pH resistance
- ✓ Chemical resistance (solvents, oxidants...)
 - ✓ Longer lifetime
 - ✓ Easy regeneration

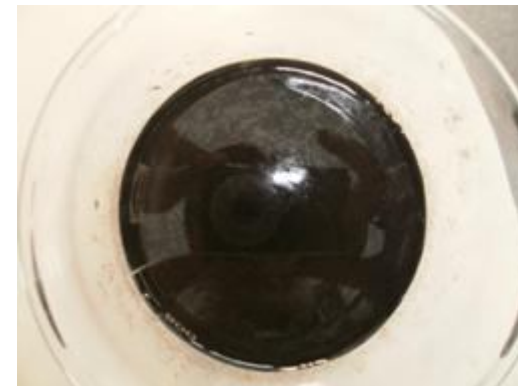


Produced Water treatment by ceramic membrane filtration

Oxycompact 's previous experience

Real PRODUCED WATER from BRAZIL (Off-shore installation)

A&G (mg/L)	Densidad 20°C (g/cm ³)	Cloruros (mg/L)	Salinidad (mg/L)	Dureza total (mg/L)	Calcio (mg/L)	Magnesio (mg/L)	pH	Hierro total (mg/L)	Sulfato (mg/L)	Hidróxidos (mg/L)	SS (mg/L)
250	1,0460	40191,7	66316,3	7911,7	1741,5	867,2	7,90	10,2	41,0	0,0	60





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Oxycompact's previous experience

Real PRODUCED WATER from BRAZIL (Off-shore installation)

Oxycompact Ceramic membrane filtration:

- ✓ Membrane cut-off: 0,1 μm
- ✓ Multi tubular: Dext=25 mm, 19 channels, Dch=3,5 mm
- ✓ Pilot plant filtration tests in recirculation and concentration modes

Produced Water treatment by ceramic membrane filtration

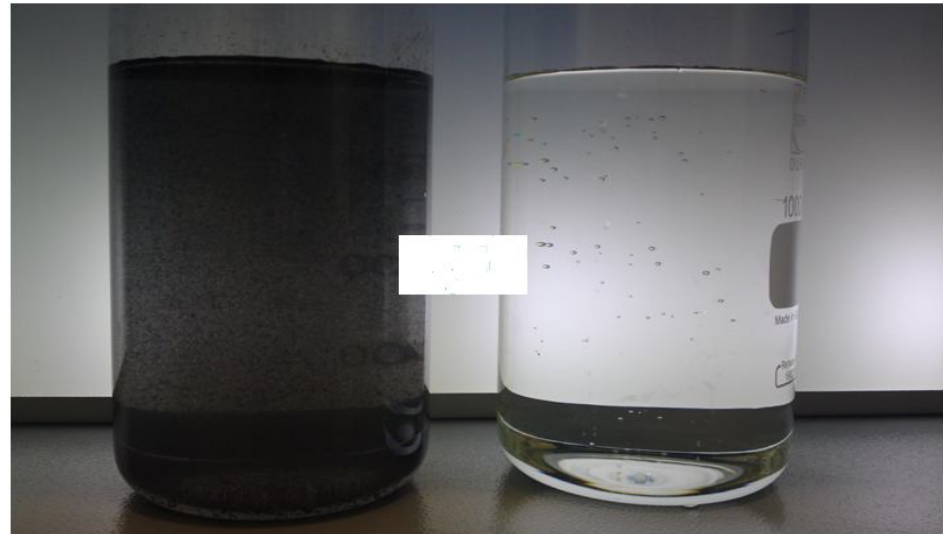
Oxycompact's previous experience

Real PRODUCED WATER from BRAZIL (Off-shore installation)

OPTIMUM permeate quality:

- ✓ Suspended solids: NOT DETECTED
- ✓ Oil & Grease : 0,4 mg/L
- ✓ Turbidity < 1 NTU

HIGH QUALITY EFFLUENT
FOR REINJECTION
(Reuse)

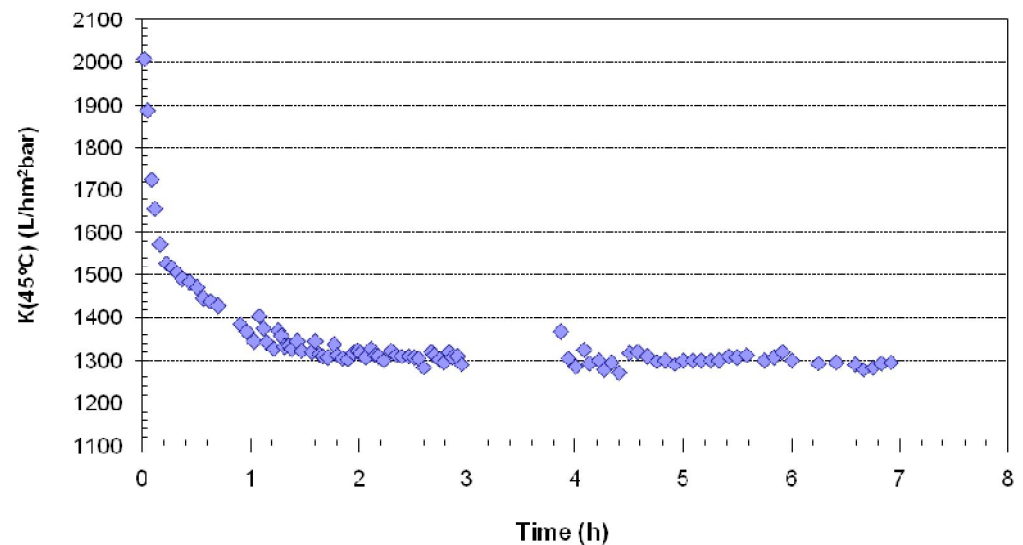


Produced Water treatment by ceramic membrane filtration Oxycompact's previous experience

Real PRODUCED WATER from BRAZIL (Off-shore installation)

High filtration performance:

- ✓ CFV=3 m/S, TMP=1,5 bar
- ✓ Very high permeability **1300 L/hm²bar** (45°C)
- ✓ 80% volumetric concentration: 800 L/hm²bar (45°C)
- ✓ Good membrane regeneration by CHEMICAL CLEANING





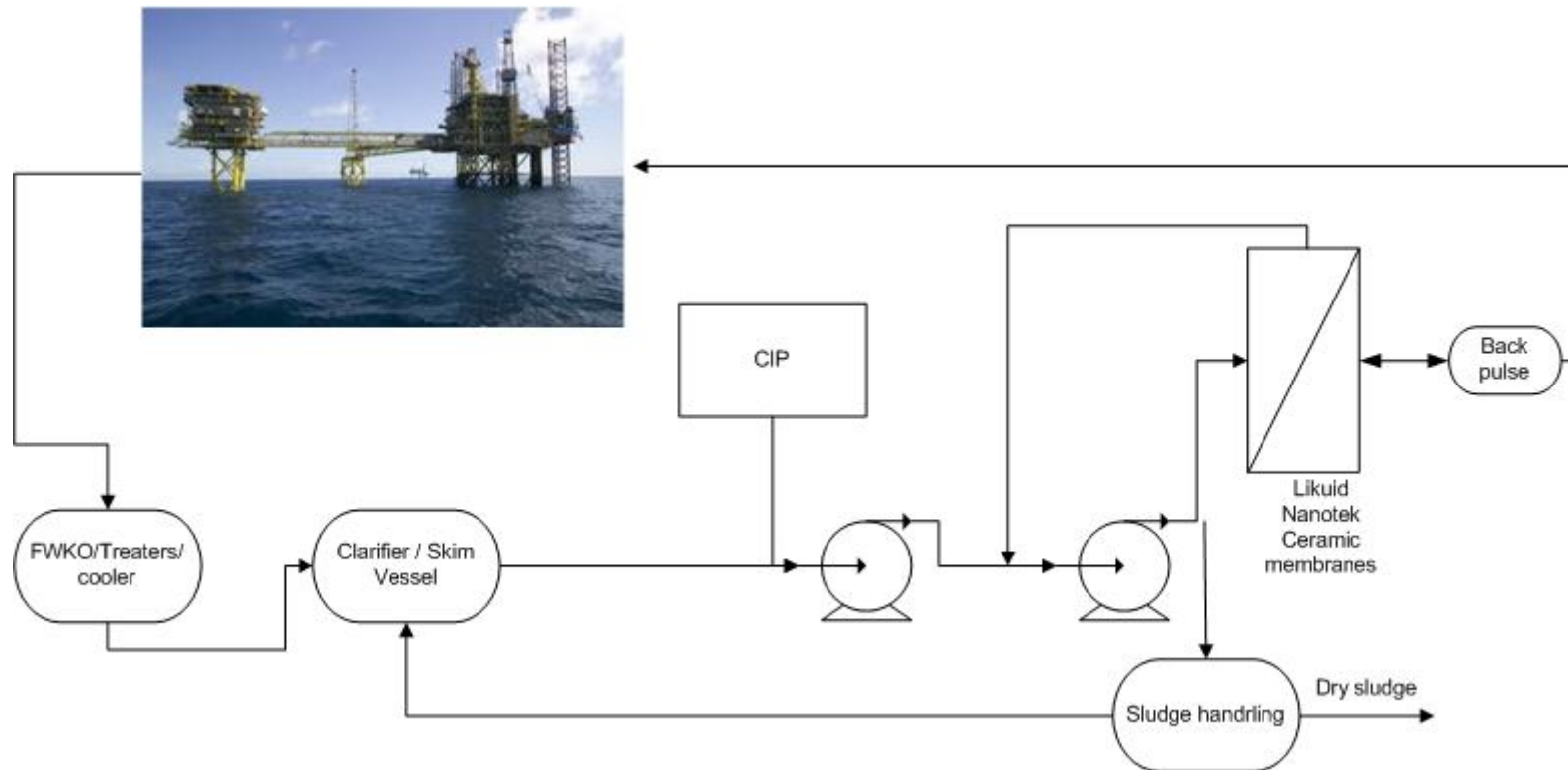
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Oxycompact 's previous experience

CONCLUSIONS:

- ✓ Ceramic membrane filtration allows to treat efficiently the PRODUCED WATER generated during oil and gas extraction
- ✓ Clear effluent, free of suspended solids and minimum O&G concentration (< 1 mg/L) is produced
- ✓ The most demanding discharge and reuse quality requirements are addressed
- ✓ Filtration performance is excellent, with average permeabilities of 1000 L/hm²bar
- ✓ As a result, PRODUCED WATER can be treated in compact installations, requiring minimum footprints and providing a robust treatment solution

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