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Which deoiling technologies to choose for Upstream Oil and Gas applications? A multi-criteria approach

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Suez Water Technologies & Solutions

Michael Cavill – Deputy Chief Technology Officer
Suez Oil & Gas Systems

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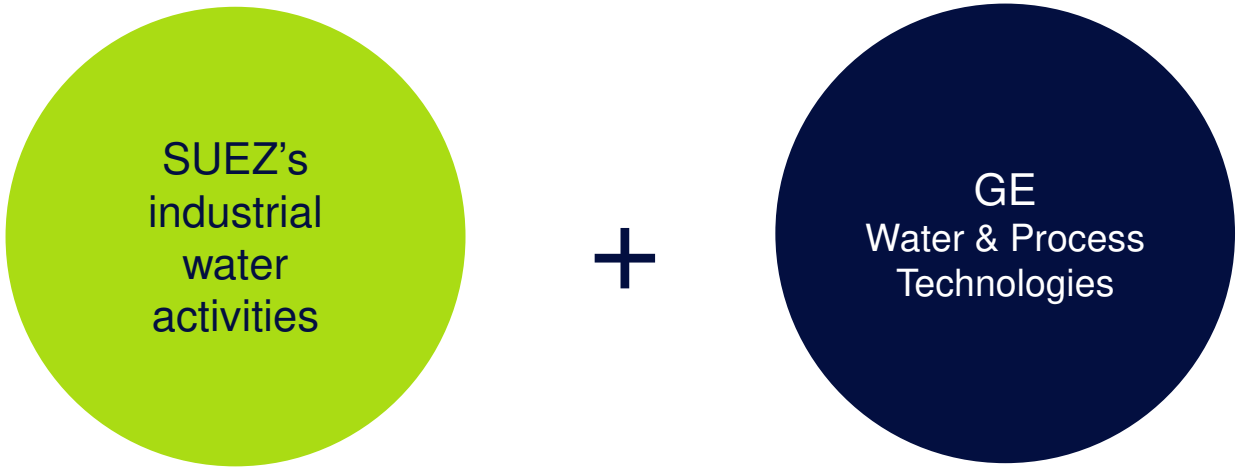


The combination of GE Water & Process Technologies' and SUEZ's industrial water activities enables SUEZ to strengthen its position as a **worldwide resource** (water and waste) **technology and solutions leader for industry,** dedicated to improve our customers' economic and environmental performance

Introduction

- Several Conventional Technologies are available for deoiling in upstream and downstream
- Tighter outlet requirements → Emerging technologies, especially membrane-based technologies
- Different features leading to different benefits

Which treatment line for which situation?

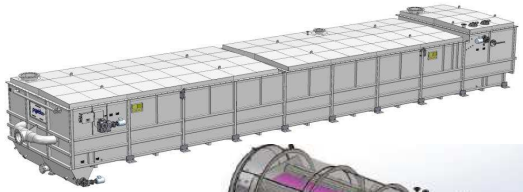
Content

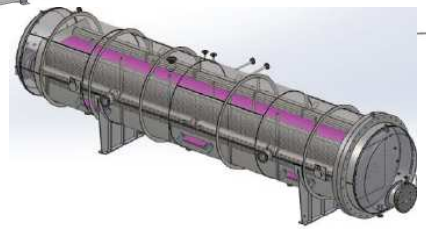
Deoiling Technologies Overview

Primary Separation

By Gravity API/CPI/VOWS

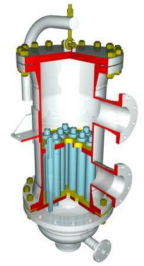
- Inlet range: 1000 – 5000 ppm
- Outlet range: 100 – 300 ppm
- No moving part, robust
- Oil recovery
- Large footprint
- Limited performances

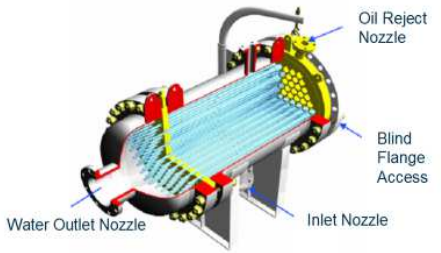




By centrifugal forces Hydrocyclones

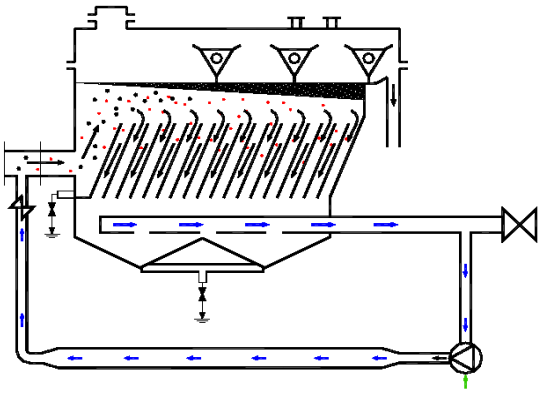
- Inlet range: 1000 – 2000 ppm
- Outlet range: 20 – 50 ppm
- Compact
- Oil recovery
- High performances
- Oil and TSS removal cannot be combined
- High pressure



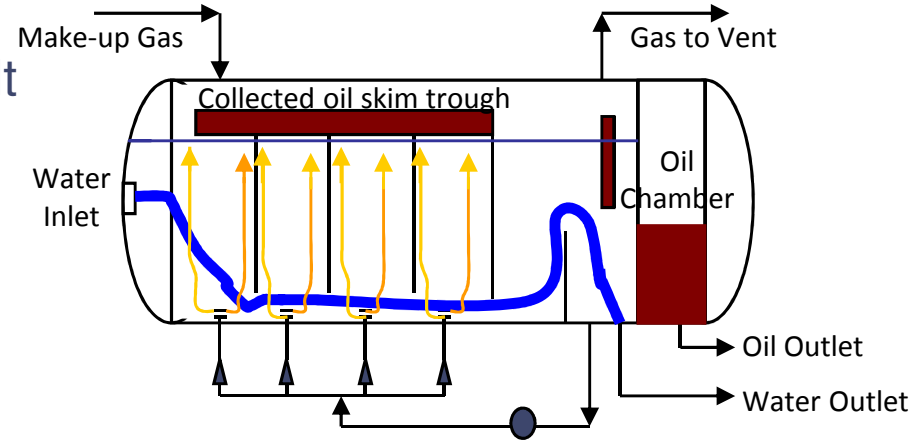


Secondary Separation

By Flotation IGF/DNF



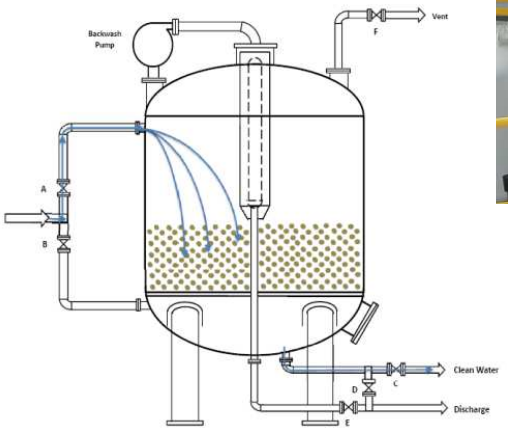
- Inlet range: 100 – 500 ppm
- Outlet range: 15 – 30 ppm
- Good performances
- Atmospheric/Low pressure
- Chemical required
- Oil recovery more difficult



Polishing

By Media Filtration
NSF

- Inlet range: 15 – 50 ppm
- Outlet range: 5 – 30 ppm
- Good performances
- Not absolute cut-off
- Requires Backwash



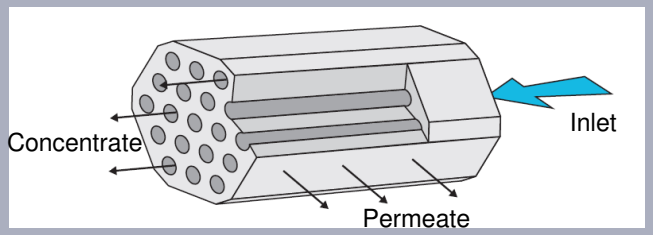
By Membrane Filtration
Ultrafiltration

- Inlet range: 50 – 300 ppm
- Outlet range: 1 – 5 ppm
- High water quality
- Controlled particle size
- Requires Backwash/Cleaning

Membrane type and Configuration

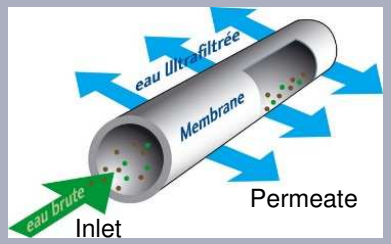
Ceramic Tubular

- High temperature and chemical resistance
- High flux
- Cross-flow



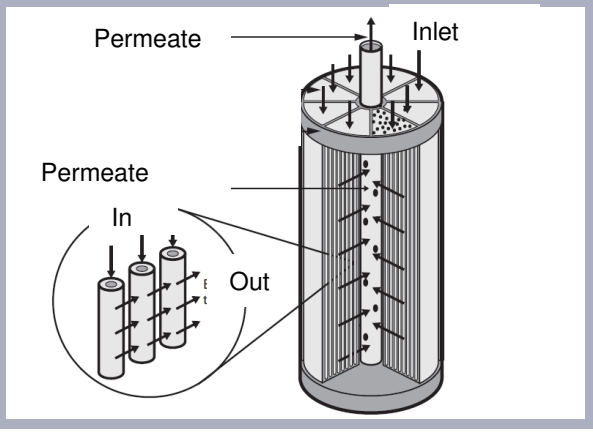
Polymeric Tubular

- Moderate temperature and chemical resistance
- High flux
- Cross-flow



Polymeric Hollow Fiber

- Lower temperature resistance
- Lower flux
- Semi dead-end

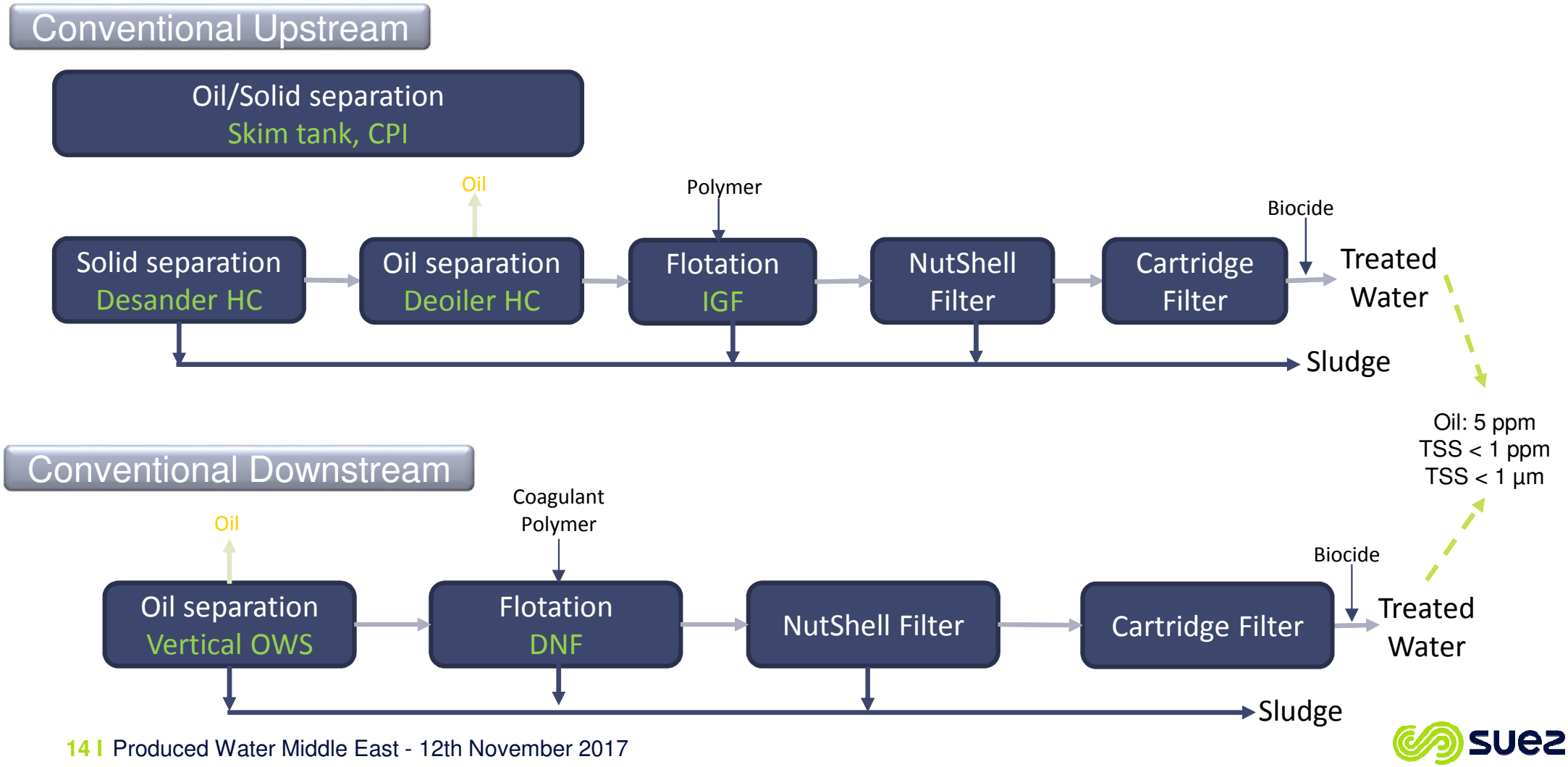


Technical evaluation through R&D program in the CIRSEE

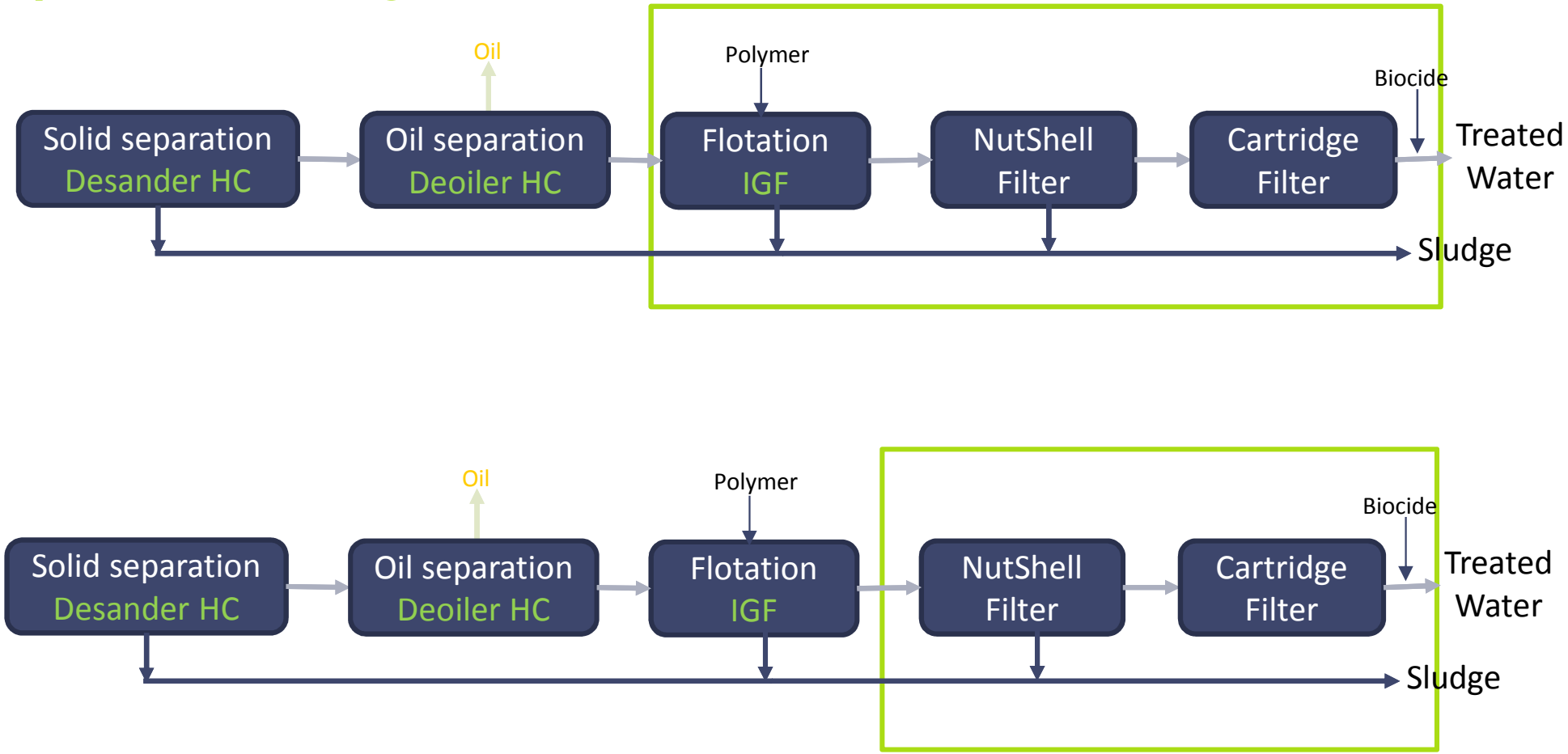
- Extensive program → Evaluation of more than 10 different membranes
- Assessment based on several criteria including filtration performances, fouling propensity, robustness…
- Case studies based on the findings of the program

Basis for treatment line comparison

Treatment schemes for tight outlet specification



Treatment schemes for tight outlet specification
2 potential configurations



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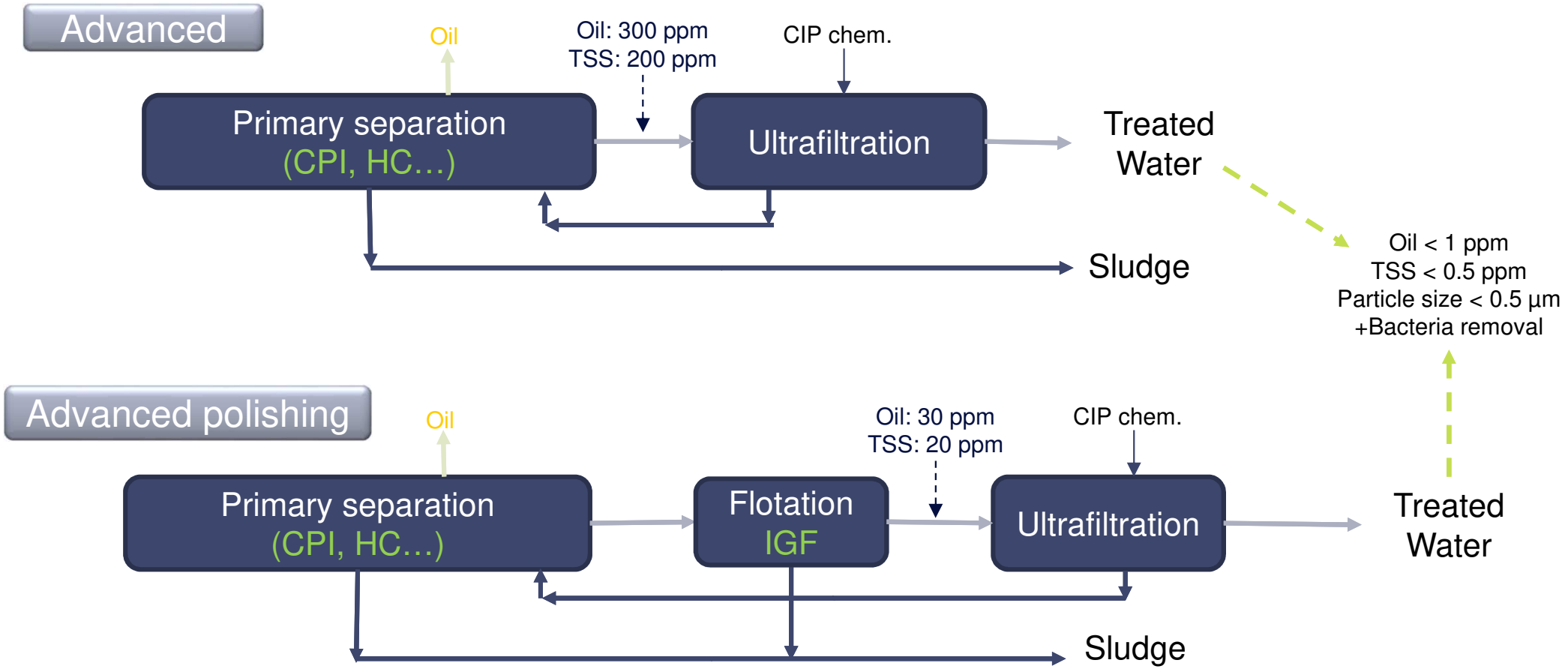
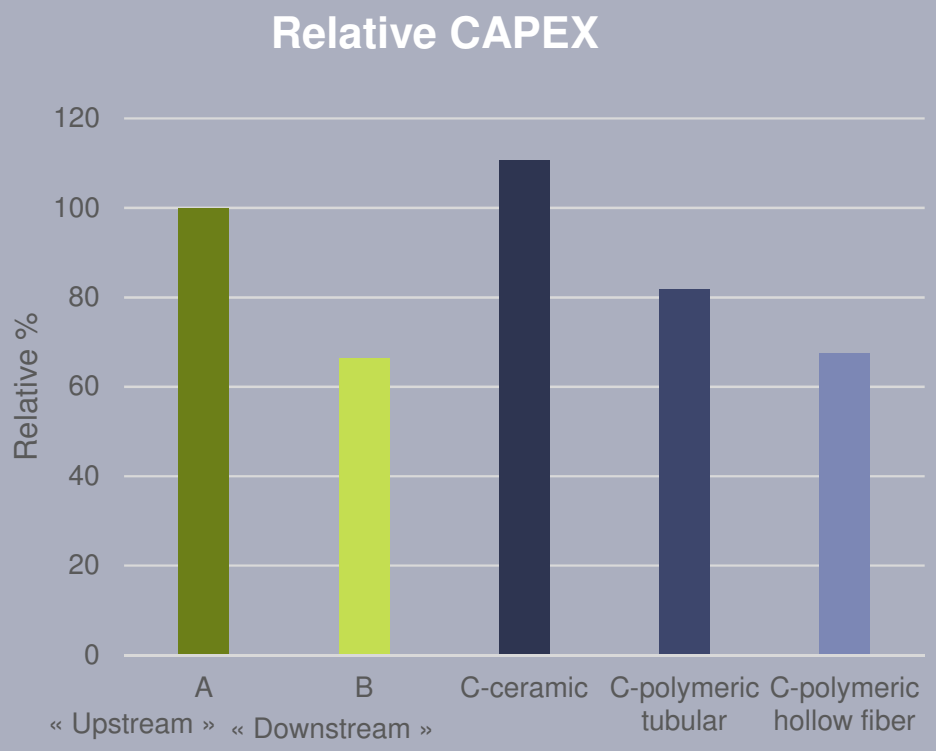
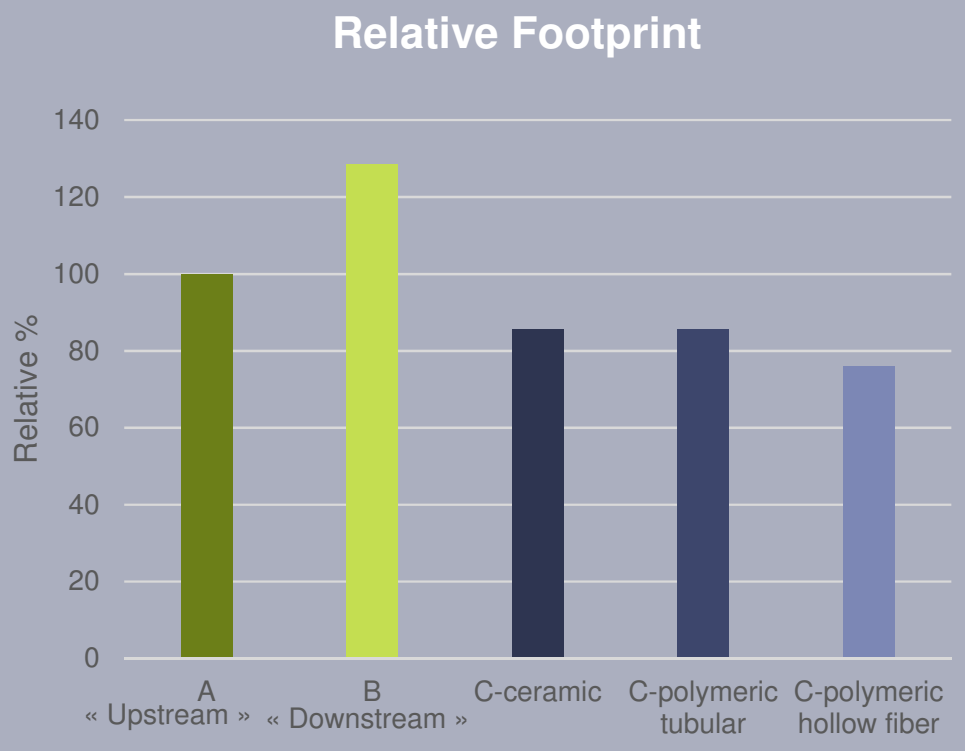


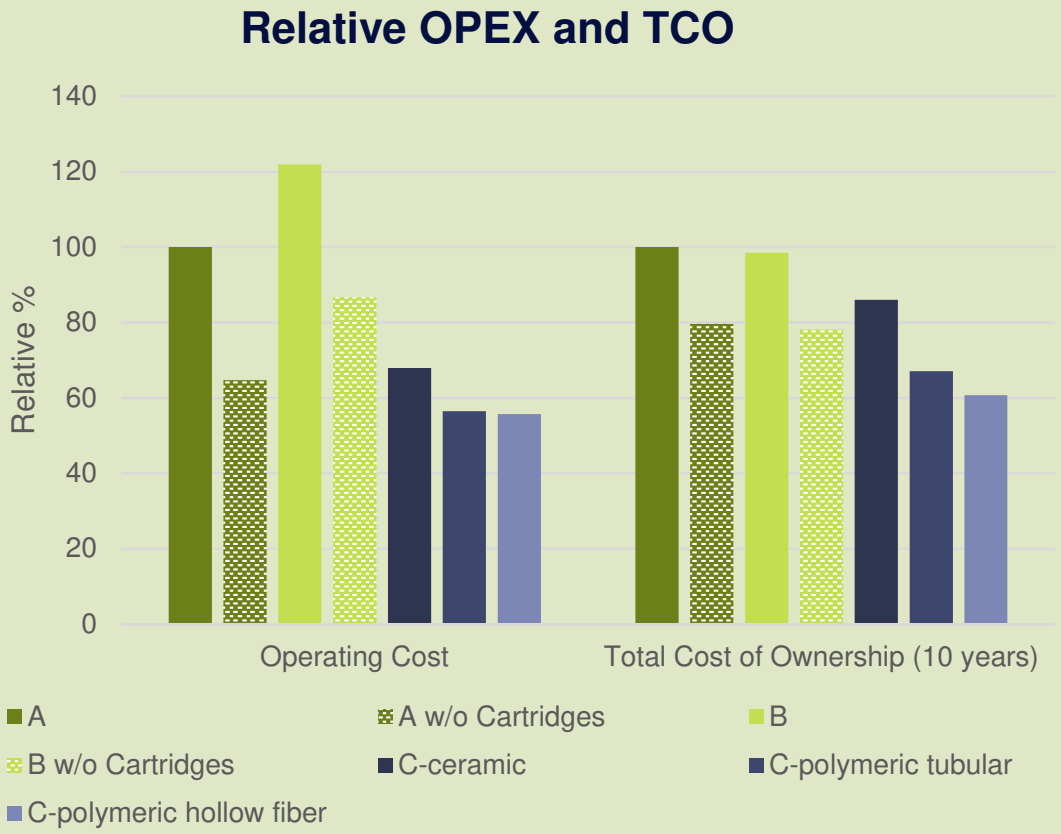
Treatment Line Comparison

CAPEX and Footprint evaluation for 2000 m^3/d





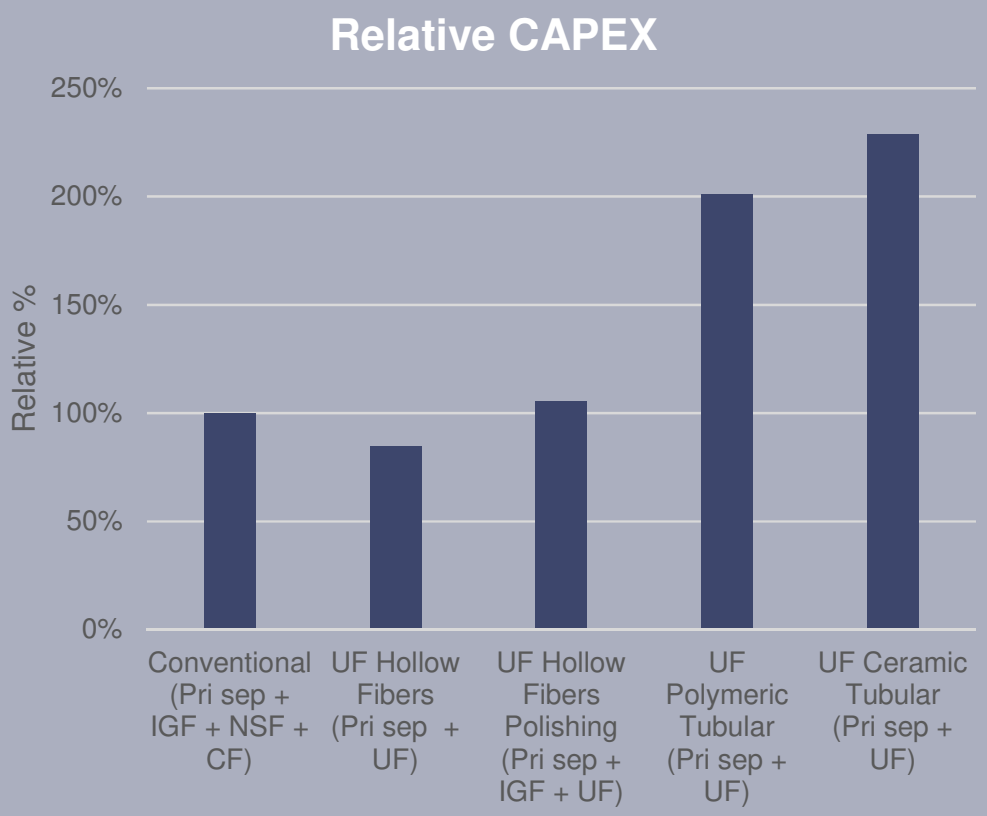
OPEX and main outcomes for 2000 m^3/d

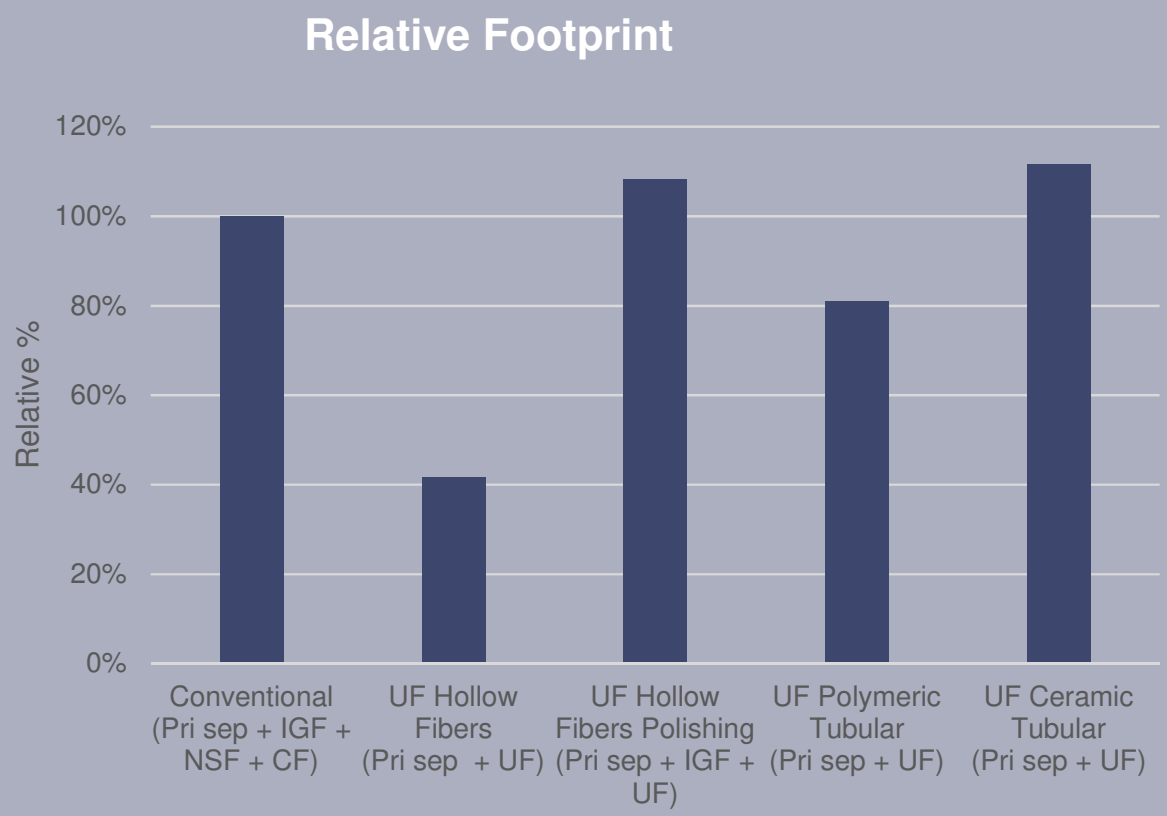


At low flow:

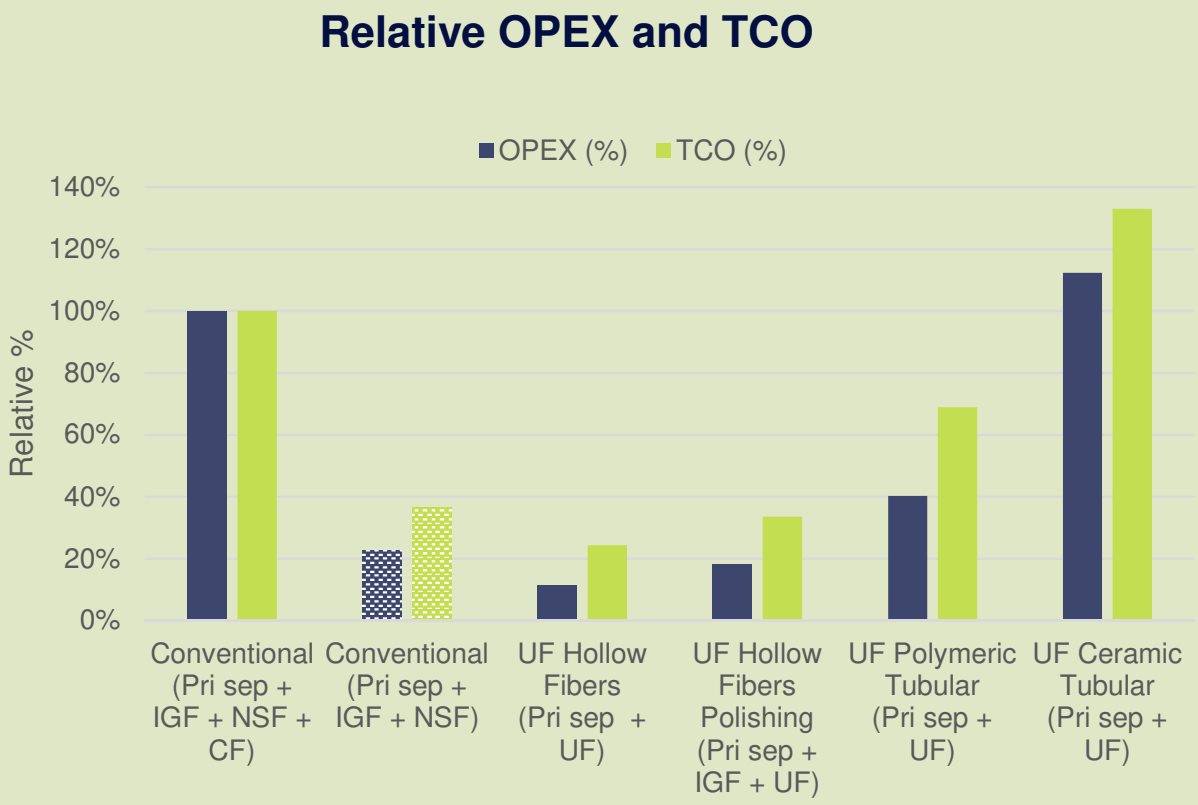
- Downstream technologies are less expensive (CAPEX wise) but with a higher footprint
- Membrane based lines are competitive CAPEX wise and OPEX wise, especially if there is a need for cartridge filtration, with an equivalent footprint
- Overall TCO is equivalent for upstream and downstream technologies
- Membrane-based technologies are all the more attractive when outlet specifications are tight

Cost evaluation for 60,000 m³/d





Footprint and main outcomes for 60,000 m^3/d



At high flow:

- Tubular technologies are not competitive (CAPEX wise)
- Hollow Fiber technologies are competitive CAPEX wise and OPEX wise with an equivalent footprint when place as a polishing step
- OPEX are low with membrane option due to cartridge replacement cost
- Overall TCO is higher for ceramic membranes but lower with polymeric membranes

Conclusion

Global Assessment and Conclusion

- Progression towards ZLD has seen emergence of new membrane technologies

- Suez investigation and testing program to find optimal configuration
  - Conventional Upstream & Downstream (CPI's, HC's, IGF/DNF, NSF, CF?)
  - Primary pre-treatment / advance polishing for satisfactory UF Membrane Life
  - Alternative (CPI's, HC's, UF)
  - Alternative advanced polishing (CPI's, HC's, IGF/DNF's, UF)

Global Assessment and Conclusion

- **Conventional – Robust and relatively competitive (if no requirement for CF)**
- **Tight Specs – UF competitive on CAPEX / OPEX / Footprint**
  - **Low Flows – Polymeric Tubular & Hollow Fibre best CAPEX / OPEX / Footprint**
  - **High Flows – Polymeric Hollow Fibre best CAPEX / OPEX / Footprint**
  - **Chemical and Temperature Resistance – Ceramic UF and/or Advanced Polishing Pre-treatment**
- **Consider all available technologies to treat water conditions / specs**

thank you

Acknowledgment

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Q&A