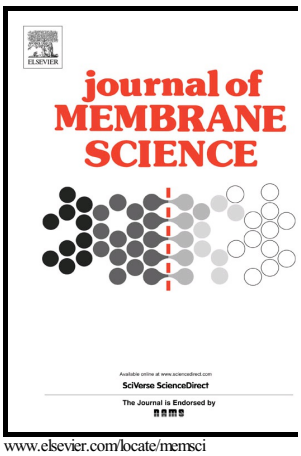

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S.E. Weschenfelder, C.P. Borges, J.C. Campos

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OILFIELD PRODUCED WATER TREATMENT BY CERAMIC MEMBRANES: BENCH AND PILOT SCALE EVALUATION

S.E. Weschenfelder*[a, b], C.P. Borges[c], J.C. Campos[b]

[a] Technologies for Water Treatment and Reuse Department,
Petrobras Research Center, Brazil
[b] School of Chemistry, Inorganic Processes Department,
Federal University of Rio de Janeiro, Brazil
[c] COPPE/Chemical Engineering Program,
Federal University of Rio de Janeiro, Brazil

* Corresponding Author
e-mail: silvioweschenfelder@petrobras.com.br ; Telephone / Fax number: (+55) 21 21623511.

Key Words: water reuse; desalination; pretreatment; cost estimation; long-term trials;

Highlights

- A pilot plant was applied to evaluate the oily water treatment efficiency.
- Backwashing and backpulsing frequency were investigated in long-term experiments.
- The permeation process generated an effluent suitable for reuse.
- Process costs were related to effective permeate flux and cleaning frequency.
- The total cost for a real-scale plant was estimated at US$0.40/m^3.

Abstract

Oilfield produced water contains a significant amount of suspended solids and oil and grease that need to be almost completely removed prior to reinjection or when subsequent desalination processes are applied. For the separation of both contaminants from oilfield produced water, membrane technology has been described as a potential solution. Therefore, for this study, zirconia oxide ceramic membranes in bench and pilot scale units were used to evaluate the permeate flux behavior in long-term tests. The effect of backpulsing and backwashing procedures on the process performance was also investigated. A 36% boost of the permeate effective flux was achieved when both techniques were applied simultaneously. Based on those results and from literature information, a cost estimation for a full scale plant was obtained. Different cleaning procedures intervals were simulated and related to the process cost. The operational cost and capital expenditure for a plant capable of generating 1,000 m^3.h^{-1} of permeate were found to be equal to US$ 0.27/m^3 and MUS$ 7.11, respectively, when the membrane renegeration interval was considered to be equal to 100 h.

1. Introduction

Oilfield produced water is considered a byproduct of oil and gas production and generally is treated by the industry as waste for disposal. Typically the produced water contains dispersed oil, suspended solids, dissolved organic and inorganic compounds, heavy metals and naturally occurring radioactive materials (Haghshenas and Nasr-el-din, 2014; Igunnu and Chen, 2012; Bakke et al., 2013). Depending on the type of production plant and reservoir characteristics, the produced water may have oil and grease concentrations (C_O) ranging from 2 to 565 mg.L^{-1} (Tibbetts et al., 1992), salinity or salt concentration (C_s) between 1,000 and 250,000 mg.L^{-1} (Pitre, 1984) and temperatures up to 92°C (as reviewed by Alzahrani and Mohammad, 2014).