



Reverse osmosis membranes for treatment of produced water: a process analysis

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ABSTRACT

The purpose of this paper was to develop and present a process suitable for the purification of the so-called produced waters, a by-product of crude oil extraction, by devising a treatment train aimed at industrial and agricultural water reuse. If compared to municipal wastewaters, produced waters have a very high salinity that requires specific attention for designing and managing the specific treatment device. Membranes, commonly used in the production of desalted water, appear to be a suitable technique to deal with these issues. In this paper, we propose a comprehensive process scheme for produced water treatment train: A Vibratory Shear Enhanced Processing (VSEP) membrane system is in charge of the secondary treatment, whereas a reverse osmosis (RO) unit realizes the tertiary treatment. Material and energy balances are carried out on the whole process, while the RO process is simulated by the IMSDesign Software by Hydranautics. We analyzed three different scenarios, at increasing produced waters salinity, getting a stream outlet as purified water with such low pollutants concentration and salinity to be reusable for different purposes. The RO process is carried out with a single-step or a double-step filtration; a cost analysis, performed on the different case studies, allowed computing the final specific costs per cubic meter of treated water, showing that a double filtration step allows a lower salinity water, albeit raising the costs up to about 5 €/m³, a high price justified only if a ultrapure water should be required for specific applications.

Keywords: Produced water; Hydrocarbon; VSEP membrane; Water reuse; Reverse osmosis; Process analysis

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