Oil Produced Water treatment for oil removal by an integration of coalescer bed and microfiltration membranes processes

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Oil Produced Water (OPW) is the major efluent stream of the oil production activities\textsuperscript{[1]}. The management strategies usually adopted to deal with this matter are disposal in the sea or into underground formations, reinjection in the formation for pressure maintenance, enhancement or recovery, and use in other production activities. In all of these cases, a specific treatment may be required.

Oil concentration in OPW is a parameter that requires a particular attention. Technologies commonly used for oil removal are not usually capable to reach the required efficiency\textsuperscript{[2]}, in particular if the oil droplets present in the OPW have diameters below 10 µm\textsuperscript{[3]}.

This article presents an experimental investigation of OPW treatment for oil removal by integration of two processes: coalescer bed and microfiltration membranes (MF). The main goal is to reach an effluent quality good enough for injection, discharge or reuse in surface activities. The objective of processes combination is to overcome operational problems and limitations that both processes present when used separately.

The MF effluent presents a very low oil content. However, membrane fouling still is a major operational disadvantage\textsuperscript{[3],[4]}. In this research, the coalescer bed is used as MF pre-treatment to attenuate the oil content in the OPW feed stream. The coalescer bed has been already successfully applied for OPW treatment\textsuperscript{[5],[6]}, although further improvement is required to achieve an effluent with a better quality.

In this work, the coalescer bed is formed by cationic exchange resins with diameters ranging from 0.43 to 1.28 mm, working in upflow condition. The MF unit used a polyetherimide hollow fiber submerged module with mean pore size of 0.4 µm and permeation area of 0.5 m\textsuperscript{2}.

The coupled processes performance was investigated by using synthetic OPW with oil concentrations from 200 to 400 mg.L\textsuperscript{-1} and oil droplets diameters from 3 to 8 µm. In the coalescer bed the surface velocity was investigated from 4.4 to 17.4 m.h\textsuperscript{-1} and the bed heights varied from 5 to 8 cm. The water recovery in MF was kept in the range of 75 to 90%, by using a transmembrane pressure (TMP) varying from -0.12 to -0.30 bar.

In the coalescer bed, steady state conditions was observed after 2-3 hours, reaching an oil removal of 36-48%, which allows an effluent with oil content as low as 8 mg.L\textsuperscript{-1}, corresponding an overall efficiency of 96%. This results indicate that the effluent in the coupled processes has quality not only for injection, but also to reuse purposes.
Key Words: oil produced water, membranes, microfiltration, coalescer bed.

References


