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Treatment of produced water in oil and petroleum extraction

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Oil content and salinity of produced water from offshore and onshore activities during the extraction of gas and oil can be reduced through various physical, chemical, and biological methods. Infact, produced water is the largest waste stream generated in oil and gas industries and it is a mixture of different organic and inorganic compounds. In this research, an evaporation plant with mechanical vapor recompression (MVR), in figure 1, is compared with an evaporation plant with boiler, in figure 2, in order to desalinate the produced water. The plant has an evaporation capacity equal to 0.025 kg/s. A simulation of the process in ChemCad is carried out. The feed is 1 m3/h flow rate and has the following composition: water 96.6 %w/w, NaCl 3.3 %w/w, benzene $9.9 \cdot 10^{-3}$ %w/w, toluene $1.7 \cdot 10^{-2}$ %w/w. Results show that the feed temperature does not influence the process, while the vacuum degree and the vaporization fraction play a crucial role on energetic and investment expenditure and on the disposal costs, due to the rich solution of NaCl and pollutants. A sensitivity analysis determines the optimal operating conditions: temperature of feed of 298 K, vacuum degree 0.37 bar, vaporization fraction 46.5%, compressor power 34.7 kWh, evaporator area 7 m^2 and concentration factor of 1.83. In this condition, the disposal cost is equal to 160 €/h, the energetic cost is 8.8 €/h while the evaporator costs is 100000 €. Comparing the same plant with a boiler, results show that the process provides a lower specific energy expenditure equal to 10.7 €/m^3 while the plant integrated by a boiler provides 16.7 €/m^3 of energy expenditure. Future researches should verify the obtained results in a real plant.

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