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Feasibility study on produced water oxidation as a pretreatment at offshore platform

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Produced water (PW) generated worldwide are steadily increasing and has lately become a significant issue of environmental concern. PW has a complex composition and suitable treatment at offshore platforms would be needed to achieve zero harmful discharge into the sea. In PW treatment, no single technology can meet regulation values, and combined physico-chemical with biological treatment of PW might be necessary. The feasibility of electrochemical oxidation (EO), heat-activated persulfate (SPS) and ozonation (O_3) was investigated as PW pretreatment step. The main goal was to remove organic species and improve biodegradability, and/or reduce toxicity to bacteria for the subsequent biological process. The experiments were performed with real PW sample from offshore platform. A common treatment level of 5% and 10% equivalent removal of chemical oxygen demand (COD) were established in order to compare the methods performance. EO showed to be an efficient method for COD reduction in terms of partial conversion. The process was independent of the tested anode materials, and mainly controlled by current density. SPS reaction was time-consuming and largely dependent on temperature, as well as initial oxidant concentration. Both methods reduced COD and biochemical oxygen demand (BOD), but high oxidant doses might compromise any improvement in PW biodegradability due to by-products generation. Comparing the three methods, ozonation showed the most promising results applying ozone doses ranging from 3.5 to 151 mg O_3/L. The best results were achieved with 7.8 mg O_3/L corresponding to the energy consumption of 0.12 kWh/m^3. Benzene in PW was reduced up to 71% alongside with a significant toxicity reduction (>70%), and PW biodegradability (BOD/COD ratio) improvement (from 0.41 to 0.46). The results obtained indicate that ozonation might be an appropriate technology for PW pretreatment at offshore platform, but further research is required testing PW samples from different fields with different characteristics, e.g. lower initial BOD/COD ratio.