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Publication date:
2021

Document Version
Publisher's PDF, also known as Version of record

Link back to DTU Orbit

Citation (APA):

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Moving Bed Biofilm Reactor for produced water treatment on the seafloor

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Abstract: Produced water (PW) is the largest waste stream generated in oil and gas industries. It has a complex composition, containing various toxic compounds that should be removed before discharge into the sea. A general biological treatment of PW would be a substantial improvement compared to current technologies, in terms of stability, extents and rates. The main goal of this research work was to provide a proof-of-concept of Moving Bed Biofilm Reactor (MBBR) for PW treatment that due to space constraints at offshore platforms would be placed on the seafloor (Figure 1). PW was treated by MBBR established with AnoxKaldnes™ K5 carriers with attached biofilm adapted to high salinity. The effect of MBBR performance at two different temperatures (10°C and 40°C), as well as the general design and operational parameters for MBBR were assessed in the present work. The experiments were carried out with real PW samples from offshore platform. The MBBR reduced large fraction of total organic carbon, and removed problematic chemicals such as BTEX and H2S scavengers, thus decreasing PW toxicity. Bio-kinetics studies showed that using the high temperature (40°C) of PW compared to 10 °C in the sea, promoted a faster removal (approx. 30% difference) of soluble chemical oxygen demand (sCOD) reaching up to 58% in 1 hour and 83% within 3 hours. After 8 hours treatment, there were no differences in sCOD removal between cold and hot reactors. Changes in feed composition such as salinity and HRT did not affect reactors performance. These results underline that MBBR is a robust technology able to cope with changes in both PW characteristics and operational parameters.