Enhancing organic matter removal in desalination pretreatment systems by application of dissolved air flotation

Membrane fouling in reverse osmosis (RO) systems caused by organic matter (OM) remains a significant operational issue during desalination. Dissolved air flotation (DAF) has recently received attention as a pre-treatment option for seawater OM removal; however, only a limited number of studies have been undertaken. This may be because it is difficult to characterise OM in seawater due to the high salt content and low carbon concentration. In this study, DAF pre-treatment experiments were conducted using a model seawater solution, and real seawater and brackish water samples. DAF performance was determined via conventional water quality parameters as well as fluorescence excitation-emission matrix (FEEM) spectroscopy and liquid chromatography with organic carbon detection (LC-OCD). Biopolymers and humic substances were the major organic fractions removed between 38 and 84% and 20-61% depending on the sample, respectively. The optimal normalised coagulant dose (Fe3+ to DOC ratio) was observed to be 0.5-4 at pH 7.5. At pH 5.5, the optimum coagulant dose increased with increasing humic character of the feed water. Overall, the OM removal efficiency by DAF observed in this study was higher than reported for other membrane-based processes; a combination of DAF and biofiltration is likely to be complementary.
The potential of recirculating aquaculture systems (RAS) in the aquaculture industry is increasingly being acknowledged. Along with intensified application, the need to better characterise and understand the accumulated dissolved organic matter (DOM) within these systems increases. Mature RASs, stocked with rainbow trout and operated at steady state at four feed loadings, were analysed by dissolved organic carbon (DOC) analysis and fluorescence excitation-emission matrix (EEM) spectroscopy. The fluorescence dataset was then decomposed by PARAFAC analysis using the drEEM toolbox. This revealed that the fluorescence character of the RAS water could be represented by five components, of which four have previously been identified in fresh water, coastal marine water, wetlands and drinking water. The fluorescence components as well as the DOC showed positive correlations with feed loading, however there was considerable variation between the five fluorescence components with respect to the degree of accumulation with feed loading. The five components were found to originate from three sources: the feed; the influent tap water (groundwater); and processes related to the fish and the water treatment system. This paper details the first application of fluorescence EEM spectroscopy to assess DOM in RAS, and highlights the potential applications of this technique within future RAS.
Monitoring RAS organic matter by fluorescence EEM spectroscopy

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Fluorescence analysis and monitoring of recirculating aquaculture systems (FAMoRAS) (39177)
FAMoRAS aimed to investigate fluorescence spectroscopy for potential utilization within 3 main areas of recirculating aquaculture system operation:
(1) system "health" monitoring
(2) treatment performance
(3) feed utilization.

Using sensitive lab-scale spectroscopic analysis and mathematical modeling, the project aimed to identify single wavelengths for future use as online, in-situ aquaculture system sensors.

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