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Powdered activated carbon for fouling reduction of a membrane in a pilot-scale recirculating aquaculture system

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ABSTRACT

Recirculating aquaculture systems (RAS) are essential for the reduction in fresh water usage as well as the discharge of nutrients along with aquaculture effluents. A RAS consisting of an anoxic reactor, a membrane bioreactor (MBR) and a UV-disinfection unit was used to process 10,000 L/d of aquaculture effluent providing high-quality treated water for recirculation to a Barramundi fish culture. The system maintained low levels of nitrate (<20 mg/L), nitrite (<3 mg/L) and ammonia (<0.6 mg/L) in the fish tank. Permeate from the membrane that was recirculated to the fish tank contained <21 mg/L of nitrate, <2 mg/L of nitrite and 0 mg/L of ammonia. However, the rate of fouling of the membrane in the MBR was around 1.47 kPa/d, and the membrane in the MBR required cleaning due to fouling after 16 days. Cleaning of the membrane was initiated when the TMP reached around 25 to 30 kPa. In order to reduce the rate of fouling, 500 mg of powdered activated carbon (PAC) per litre of MBR volume was introduced, which decreased the rate of fouling to 0.90 kPa/d. Cleaning of membrane was needed only after 31 days of operation while maintaining the treated effluent quality. Thus the frequency of cleaning could be halved due to the introduction of PAC into the MBR.

Keywords: Denitrification; Fouling; Membrane bioreactor (MBR); Powdered activated carbon (PAC); Recirculating aquaculture system (RAS); Transmembrane pressure (TMP)

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