[Poster presentation]

A Study on fouling control in MBR: Utilization of Quorum Quenching beads

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ABSTRACT
The membrane bioreactor (MBR) process is characterized by its high efficiency in contaminant removal and its broad applicability in wastewater treatment. Despite these advantages, the MBR process is still hindered by persistent challenges, particularly membrane fouling and limited phosphorus removal. Membrane fouling not only shortens the operational lifespan of the system but also increases maintenance and energy costs. In addition, the treated effluent from conventional MBRs frequently contains elevated concentrations of total phosphorus (T-P), as the system lacks a dedicated biological phosphorus removal mechanism. To overcome these limitations, novel approaches are required to enhance the stability and sustainability of MBR performance. This study introduces quorum quenching cell entrapping beads (QQ-CEB) to address membrane fouling and phosphorus removal, which are critical challenges in membrane bioreactors. An experimental investigation was conducted to evaluate the immobilized QQ-CEB. Under conditions of the immobilized QQ-CEB, the effluent total phosphorus removal was maintained at approximately 50%. In the same condition, the operational period of the system increased by approximately 2.2 times compared to conventional MBRs. Analysis of microbial products on the membrane surface revealed that their levels were reduced to approximately 28.1–47.0% respectively by QQ mechanism. Additionally, the analysis of signal molecule confirmed that the QQ mechanism mitigated biofouling by inhibiting microbial quorum sensing. The Fe^{3+} QQ-CEB demonstrated a 1.53-fold longer operational lifespan than the Ca^{2+} QQ-CEB (control). Microbial community analysis of the Fe^{3+} QQ-CEB further indicated that the internal microbial population within the media was stably maintained, while the intrusion of external microorganisms was effectively suppressed.

Keywords: Biofouling mitigation; Membrane bioreactor; Phosphorus removal; QQ-CEB

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