Comparison of alternative additives used for the mitigation of membrane fouling in membrane bioreactors

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ABSTRACT
This work examined the impact of three natural minerals (zeolite, bentonite and perlite), three coagulants [ferric chloride, alum and polymeric aluminium chloride (PACl)] and a cationic polymer (MPE50) on the reduction in membrane fouling in membrane bioreactors (MBRs). The experiments were conducted using an ultrafiltration (UF) membrane module that was submerged in a reactor. Mixed liquor taken from an MBR was spiked with specific additive concentrations and was filtered through the UF membranes. Membrane fouling was assessed by determining the increase in the normalized membrane permeability \( L_{60}/L_0 \) when the additive was added compared to the \( L_{60}/L_0 \) obtained when sludge was filtered without any additive (i.e. control experiment). The use of additives resulted in a net increase in membrane permeability compared to the control experiment. Fouling mitigation followed the order MPE50 > PACl > FeCl3 > Al2(SO4)3 > zeolite > bentonite, with perlite increasing fouling. The addition of 400 mg/L MPE50 resulted in an increase in \( L_{60}/L_0 \) by 229%, while the addition of 200 mg/L PACl resulted in a respective increase by 158%. The economic evaluation showed that a more feasible solution was the use of 200 mg/L PACl, which incurs a cost of 0.601 cents/m³ treated wastewater. Additive use also resulted in a significant decrease in the colloidal substances in sludge which was in accordance with the fouling reduction.

Keywords: Membrane bioreactors; Fouling mitigation; Coagulants; Minerals; Cationic polymer

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