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Natural flocculants from fresh and saline wastewater: comparative properties and flocculation performances

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Abstract

Natural flocculants, due to their eco-friendliness, have gained increasing attention for (waste) water treatment and are promising alternatives to oil-based synthetic flocculants. We systematically investigated simultaneous industrial wastewater treatment with the production of microbial extracellular polymeric substances (EPS) as natural flocculants. EPS were produced in two membrane bioreactors, respectively treating fresh and saline synthetic wastewater from biodiesel and (bio)ethanol industries. From each reactor, soluble and bound EPS fractions were extracted, purified and characterised for their functionalities, molecular weights and charge densities using Fourier transform infrared (FTIR), size exclusion chromatography and colloid titration, respectively. High removal of chemical oxygen demand (COD) was achieved in both reactors (93 – 95 %), with 5.8 – 7.6 % of the inlet COD recovered as EPS. FTIR spectroscopy reveals these EPS as a mixture of proteins and polysaccharides, possessing carboxyl, hydroxyl and amine groups. These functional groups, which provided a net anionic charge density (1.5 – 2.9 meq/g at neutral pH), coupled with EPS mixed molecular weight (MW) distribution: high (> 1000 kDa), medium (1000 – 100 kDa) and low (< 100 kDa) MW fractions, make them promising flocculants. Extracted EPS showed good flocculation of non-saline kaolin suspension (74 – 89 % turbidity reduction) and excellent flocculation of saline kaolin suspension (88 – 97 %), performances comparable to anionic polyacrylamide.