Antifouling properties and mechanisms of bismuth-modified membrane in wastewater membrane bioreactors

Abstract

Membrane bioreactors (MBRs) combine membrane filtration with conventional activated sludge processes, providing better effluent quality and lower sludge production for wastewater treatment. Biofouling refers to the deposition, growth and metabolism of bacteria cells on the membranes, and is a significant concern to the operation of MBRs. Biofouling is highly related to membrane surface features, including pore size, porosity, biocide property, material composition, and hydrophobicity. Traditional antifouling methods involve chemical (by adding hypochlorite or week acids) or physical cleaning (by air scouring or backwashing) of the membrane surface. In recent years, chemical membrane modification has been developed as a novel approach to reduce biofouling. The surface-coated materials, e.g. silver nanoparticles or zwitterionic monomers, could improve the hydrophilicity and biocide properties of regular membranes. Bismuth dimercaptopropanol (BisBAL) nanoparticles (NP) has been proved to effectively suppress microbial extracellular polymeric substances (EPS) secretion, and therefore is a potential antifouling regent in surface modification. Additionally, BisBAL-NPs are non-carcinogenic, less bioaccumulative and cytotoxic than many other heavy metal NPs. In this project, regular and BisBAL-modified polysulfone (PSF) membranes will be compared in the cross-flow filtration tests in a lab-scale nitrification reactor. Several parameters being analyzed now including filtration flux, fouling layer morphology, microbial communities, EPS distribution. Results from this study will provide the insights into biofouling mechanisms of BisBAL modified PSF membranes, potentially leading to its broader applications in biofouling control for wastewater MBRs.