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Mitigating Biofouling on Reverse Osmosis Membranes: Applying Greener Preservatives to Biofilm Treatment

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Abstract : Water scarcity is characterized by a lack of access to clean and affordable drinking water, as well as water for hygienic and economic needs. The amount of people effected by water scarcity is expected to increase in the coming years due to climate change, population growth, and pollution, amongst other things. In response, scientists are pursuing cost effective drinking water treatment methods, often with a focus on alternative water sources. Desalination of seawater via reverse osmosis is one promising alternative method. Desalination of seawater via reverse osmosis, however, is limited significantly by biofouling of the filtration membrane. Biofouling is the buildup of microorganisms in a biofilm at the water-membrane interface. It clogs the membrane, decreasing the efficiency of filtration, consequently increasing operational and maintenance costs. Although effective, existing chemical treatment methods can damage the membrane, decreasing the lifespan of the membrane; create antibiotic resistance; and cause harm to humans and the environment if they pass through the membrane into the permeate. The current project focuses on applying safer preservatives used in home and personal care products to RO membranes to investigate the biofouling treatment efficacy. Currently, many of these safer preservatives have only been tested on cells in planktonic phase in suspension cultures, not on cells in biofilms. The results of suspension culture tests are not applicable to biofouling scenarios because organisms in planktonic phase in suspension cultures exhibit different morphological, chemical, and metabolic characteristics than those in a biofilm. Testing antifoulant efficacy of safer preservatives on biofilms will provide more applicable results to biofouling on RO membranes. To do this, biofilms will be grown on 96-well-plates and minimum inhibitory concentrations (MIC90) and log-reductions will be calculated for various safer preservatives. Results from these tests will be used to guide doses for tests of safer preservatives in a bench-scale RO system.

Keywords : reverse osmosis, biofouling, preservatives, antimicrobial, safer alternative, green chemistry
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