RESEARCH BRIEF
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NAWI National Alliance for Water Innovation

Omics Platform for in-operando Biological Characterization Systems Design

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Challenge

Biofouling is the uncontrolled growth of microorganisms (a biofilm) on membrane surfaces, and is a pervasive problem in desalination and other membrane-based water and wastewater treatment processes. Biofilms reduce the flux and increase the operating pressures, which significantly increases energy requirements and operational cost. Membrane elements can be cleaned (or replaced in severe instances), but must be taken offline to do so, limiting clean water production and increasing costs. Developing a fundamental understanding of how biofilms form could lead to the development of predictive tools that mitigate against biofouling, minimizing downtime and reducing costs.

Research Approach

This project will build a comprehensive "omics" platform to empower the research community to fundamentally understand biofilm formation and mitigate biofouling in water treatment and distribution systems. The term "omics" refers to the collection and analysis of DNA from the biofilm through the lenses of:

- metagenomics ("who's there?")
- meta-transcriptomics (what genes are active?)
- metaproteomics (what proteins and enzymes are active?)
- metabolomics (what is the biofilm metabolism doing, as a whole?)

Biofilms will be collected from real reverse osmosis (RO) elements in a large-scale desalination facility as well as from other RO elements in geographically diverse areas, and will be collected as single samples, or as time-series samples, to better understand how biofilms change from benign to harmful.

Impact

The resulting omics platform will provide an unprecedented opportunity to generate predictive understanding of biofilm formation and lead to more precise and efficient approaches to control membrane biofouling. The outcomes will inform materials selection and operational parameters to reduce down time, decrease energy consumption and pretreatment requirements, extend RO module cleaning cycles, and enhance treatment system resiliency.

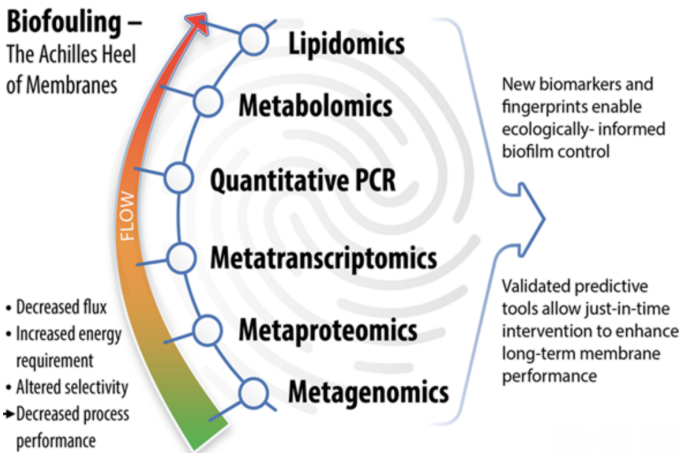

Figure 1. Proposed Omics Platform workflow to better understand the transition of biofilms from benign to destructive.

RESEARCH PARTNERS

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