The Use of Green Nanoparticles as a Biofouling-Resistant Agent in Reverse Osmosis Desalination

Research objective:

To develop of biofouling-resistant nanocomposite (BRN) membranes loaded with nanoparticles, from synthesis to macro scale production.

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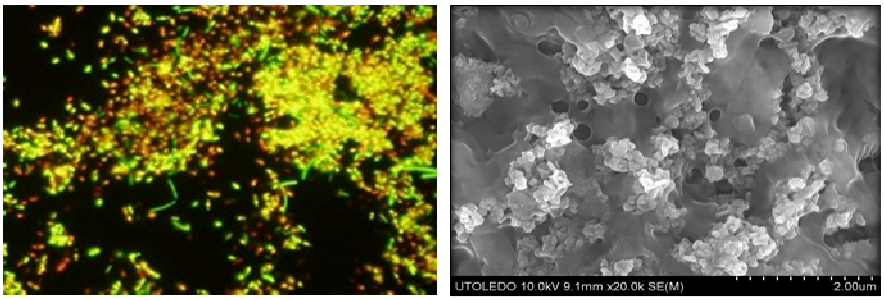

Figure 1. Cells detached from a bio fouled membrane, stained with either PI or pico-green and imaged using a fluorescent microscope (left), and imaged using scanning electron microscopy (right).

Summary:

This collaborative research project seeks to address a major technical challenge in the use of membranes for desalination and wastewater treatment: mitigation of membrane biofouling due to rejected organic matter and microbes. Most research and development in the area of biofouling prevention has focused on pretreatment of the feed water, improved cleaning solutions, and cleaning procedures. This project takes a materials approach: developing biofouling-resistant nanocomposite membranes impregnated with green silver ions, from synthesis to macro scale production, and investigating and testing membrane performance under different operational conditions. In this field of nanostructured materials, surface-structured membranes will be developed with hydrophilic properties and biofouling resistance.

The project includes two novel and complementary approaches:

First, the team proposes manufacture green silver nanoparticles. The investigators will "tune" the bioactivity of these nanoparticles by modifying their physicochemical characteristics (size, shape, and surface functionalization) to disrupt the types of microorganisms that colonize membrane surfaces and pores. Membranes will be produced by developing and processing a homogeneous polymer solution (dope) of polymers, solvents, and other additives.

The investigators will impregnate the dope solution with the "tuned" green nanoparticles.

As a result, silver will be present on the surface and within the membrane pores. The hypothesis is that these membranes will have superior biofouling control, since silver has been previously shown to interfere with the life cycle of microorganisms that cause fouling.

After refining the nanoparticle and membrane production procedures, the research team will attempt to develop scalable techniques to manufacture the membranes. This is an important step in producing membranes for bench-scale testing and demonstrating that they can be produced commercially.

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Research Partners and Budget:

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- Dr. Mahmoud Hafsi, International Institute for Water and Sanitation (ONEE).
- Dr. Abderrahim Khadir , International Institute for Water and Sanitation Water Quality Control Directorate (ONEE).
- Dr. Vinka Craver , University of Rhode Island (URI) .
- Dr. Isabel Escobar, University of Kentucky .
- Dr. Tequila Harris, Georgia Institute of Technology (Georgia Tech).

Total Budget: $ 315,000

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