

Case ID:M22-277P^

Published: 6/5/2023

## Side-Emitting Optical Fibers as the Next-Generation Reverse Osmosis Membrane Spacer to Mitigate Biofouling

### Inventors

**Paul Westerhoff**

**Hojung Rho**

### Contact

Physical Sciences Team

#### Background

In desalination and wastewater reuse applications, biofouling of membrane surfaces can contribute to increased operational challenges and higher costs. Ultraviolet (UV) light has been shown to control biofilms while reducing chemical usage and disinfection by-products, but in spiral or complex geometries, delivering sufficient light to the membranes has been a challenge. Reverse osmosis (RO) membranes are widely used in water treatment applications due to the requirement of filtration in removing unwanted impurities from water. These membranes only allow specific substances to pass through small pores in the membrane without allowing other contaminants to pass through.

Plastic RO feed-spacers are an important element in spirally wound membranes. The spacers provide necessary support to the membrane and allows gaps between the membrane layers to promote turbulence and minimize the deposition of particles or foulants. Most commercially available spacers are inert plastics and only help hydraulically scour membrane surfaces to limit bacterial biofouling. Over time, the membrane requires chemical cleaning or costly replacements as the foulants build up.

#### Invention Description

Researchers at Arizona State University have developed thin (0.1-1 mm), flexible side-emitting optical fibers (SEOFs) that can be used as novel reverse osmosis (RO) filaments in making RO spacers. SEOFs side emit germicidal UV-C along their length. This alternative RO spacer uses SEOFs to deliver UV-C light to minimize biofouling in the membrane element. Bundles of multiple SEOFs are formed into a mesh that can directly be used as and replace conventional plastic spacers. Light from a single light emitting diode provides the UV-C source into bundles of SEOFs. Published results verify their effectiveness in preventing microbial growth or biofilm formation on the RO polymeric membrane surfaces. SEOF mats can be used in other applications where flexible meshes are needed to control biological growth.

#### Potential Applications

- Preventing biofouling on membranes (polymeric or ceramic)
- Water treatment, wastewater reuse, cooling towers
- Food, beverage or pharmaceutical manufacturing
- Mold prevention (e.g., curtains between walls)

#### Benefits & Advantages

- Optical properties can be tuned depending on wavelength needed
- Customizable for mesh configuration
- Can be used for any size RO membranes
- Able to reach light inside the RO element that conventional spacers cannot
- Chemical-free, compact and flexible solution for bacteria, fungi, mold or other biological growth control

Related Publication: [Inhibition of Biofouling on Reverse Osmosis Membrane Surfaces by Germicidal Ultraviolet Light Side-Emitting Optical Fibers](#)