Antimicrobial Effect of Sulfidized Silver Nanoparticles after an 18-Day Operation Period in a Reverse Osmosis Module

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Research question: Will the antimicrobial activity of sulfidized silver nanoparticles be conserved after an 18-day operation period?

Motivation

- Biofouling hinders membrane performance over time shortening life expectancy
- Silver nanoparticles (Ag-NPs) are loaded onto the membrane for biofouling mitigation
- Fast silver release from silver-coated membranes impair long-term performance of antimicrobial coatings.
- Silver nanoparticles are sulfidized to slow down silver release

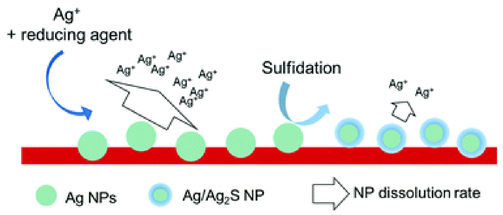


Figure 1: Illustrates the dissolution rate of functionalized silver nanoparticles versus sulfidized silver nanoparticles. Barrios_et_all

Objective

1. Quantification of the antimicrobial activity of membrane functionalized with nanoparticles of 10^{-2} sulfidation.

Obstacles faced/overcome

- Dilution factor issues
- Zero CFU mL^{-1} while plating
- Various experiments were done with different dilutions
- The different dilutions were analyzed, and the best dilution results was used

Materials and Methodology

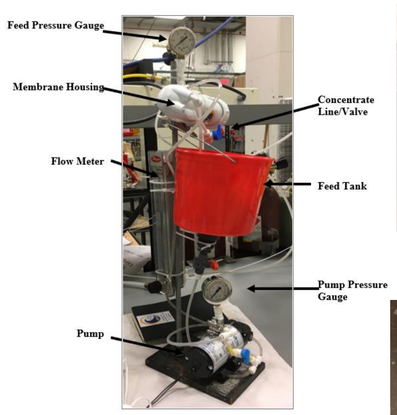


Figure 2: Recirculating Solution Support Stand Configuration. The solution is pumped up through the flow meter and the feed pressure gauge. Then it is then fed into the membrane housing and through the RO element. The solution is then fed back into the tank, where It can be recirculated.

Figure 3: Spent RO membrane samples before and after 18-day operation

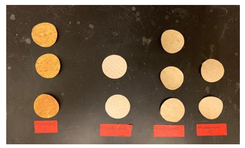
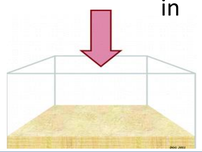


Figure 4: Illustrates coupons from RO modules with a 2.45 cm



Live bacteria in

Contacted with bacteria suspension: *P. aeruginosa* & 0.9 % NaCl for 3 hours
Concentration: $1x10^{8}$ CFU mL^{-1}

Figure 5: Plastic holders were used to hold RO membranes in place while contacted with P. aeruginosa for 3 hours.

Conclusion/ future works

- Decrease (82 %) in live bacteria on Ag-NP before the operation
- Ag-NPs after the 18-day operation is acting as the control may be due to silver leaching
- Na2S (10-2) has a decrease in live bacteria but is not keeping the same antimicrobial activity as Ag-NPs
- Quantify silver release of the testbed modules

CFU Counts: Plating

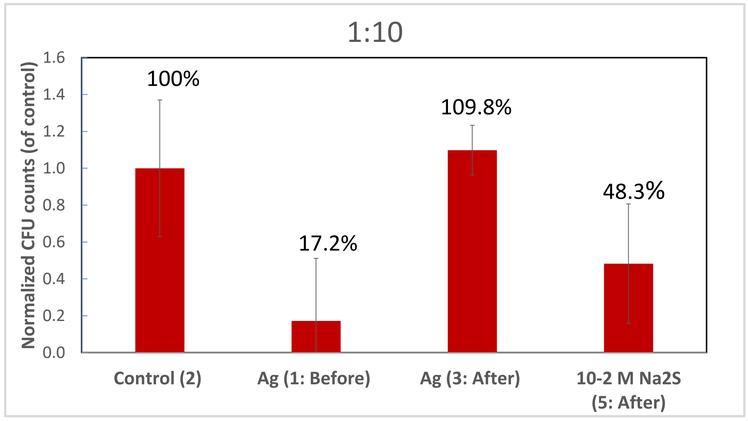


Figure 6: Several plating trials are included; all data has been normalized to respect of the control. Percent reduction included, compared to control.

References

1) Barrios, Ana C et al. "Prolonging the Antibacterial Activity of Nanosilver-Coated Membranes through Partial Sulfidation." *Environmental science. Nano* 7.9 (2020): 2607–2617. Web.

Acknowledgements

A special thanks to Dr. Perreault for providing me with all the resources needed this semester and Dr. Ana Barrios for her support and assistance.

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