

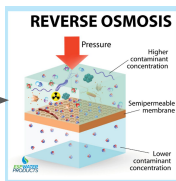
Application of Non-Oxidizing Biocides to Mitigate Biofouling in Reverse Osmosis Membrane Systems

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Background

The Problem: Over 25% of the global population lack clean drinking water.

The Solution: Reverse Osmosis (RO), a water treatment process that removes contaminants from water through a semipermeable membrane.



Reverse Osmosis

Limitations of RO:

- Biofouling: the accumulation of microorganisms on the membrane, forming biofilms

Preventing Biofouling:

- Chemical treatment; however, this can pose serious risks to the environment and human health

Objective

To provide safer methods of biofouling prevention, reducing the impact of biofouling and improving membrane performance in RO systems.

More specifically, the goal of these experiments was to identify the effective concentrations (MBIC and MBEC) at which biocides were able to prevent and inhibit bacterial growth.

Biocides

The following biocides were studied:

- Phenoxyethanol (PE)
- Sodium benzoate (SB)
- Methylisothiazolinone (MIT)
- 2, 2-dibromo-3-nitropropionamide (DBNPA)
- Sodium bisulfite (SBS)
- Ethyl Lauroyl arginate (LAE)

Methods

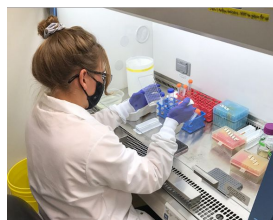
Biofilm Prevention (MBIC)

To determine the biocides ability to prevent biofilm growth, a three day experiment was conducted using 96-well plates.

Day 1: Overnight culture inoculation

Day 2: Biocide addition and plate inoculation

Day 3: Plate staining and reading



Biofilm Removal (MBEC)

To determine the biocides ability to remove existing biofilms, a four day experiment was conducted using 96-well plates.

Day 1: Overnight culture inoculation

Day 2: Plate inoculation

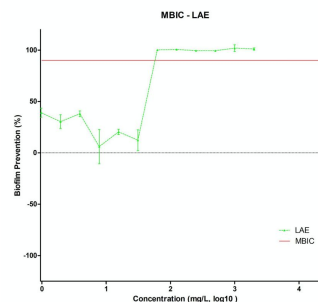
Day 3: Biocide addition

Day 4: Plate staining and reading

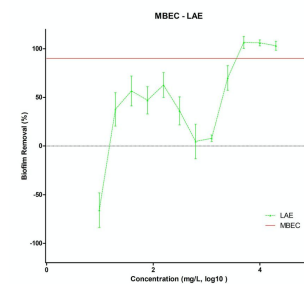
Results

The results of this study indicated that LAE was the best candidate for mitigating biofouling on RO membranes.

The concentration at which LAE can effectively prevent biofilm growth is 63 mg/L.



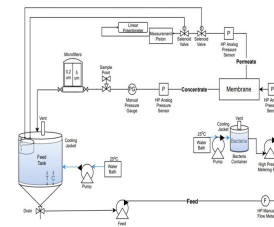
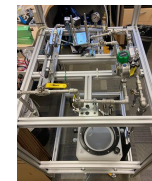
The concentration at which LAE can effectively remove biofilm growth is 5000 mg/L.



Next Steps

Given the results from this study, further studies may be required to further validate the applicability of LAE in RO systems.

- Testing LAE's ability to prevent and remove biofilms from RO membranes
- Testing LAE's compatibility with RO membranes
- Perform anti-biofouling tests on laboratory, pilot and full-scale RO treatment systems



References

L. H. Da-Silva-Correa, K. Aasen, N. E. Gamm, R. Godoy, N. Rahmati, and H. L. Buckley, "Efficacy testing of non-oxidizing biocides for Polyamide membrane biofouling prevention using a modified CDC biofilm reactor," *Journal of Water Supply: Research and Technology-Aqua*, Feb. 2023.

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