ADVANCING MEMBRION'S CERAMIC ION EXCHANGE MEMBRANES FOR INDUSTRIAL WASTEWATER CLEANING IN ELECTRODIALYSIS

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INTRODUCTION

In an era of rapid population growth and escalating water demand, the depletion of water supplies presents an ever-growing challenge. Recognizing the need for innovative solutions, the project endeavors to test and implement revolutionary ion exchange technology that can treat wastewater, paving the way toward a future where water resources are plentiful.

This project emphasizes on treating acids such as sulfuric acid from wastewater, as it is the world's largest volume industrial chemical.[2] The removal of acids from the global water supply is critical because it is an extremely corrosive chemical.[2]

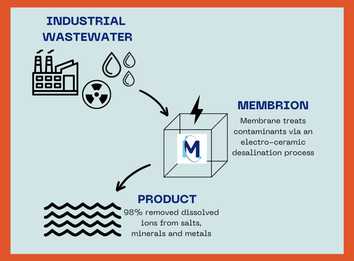


Figure 2. Overview of wastewater treatment process using ceramic desalination membrane for removal of industrial wastewater contaminants

PROJECT OBJECTIVES

- Assess membrane's performance under exposure to different acids and oxidizers.
- Perform quantitative ion exchange capacity tests to gauge the membrane's ability to capture ions.
- Compare Membrion's ceramic ion exchange membranes to Competitor's polymer ion exchange membranes to see if Membrion's product stands up to the standards of a competitive market.
- Conduct short-term and long-term exposure testing on Membrion's and Competitor's membranes to evaluate potential performance degradation over time.

Oregon State University

Cation and anion exchange capacity tests were performed on Membrion's ion exchange membrane and a Competitor's membrane to compare membrane tolerance to various acids and oxidizers.

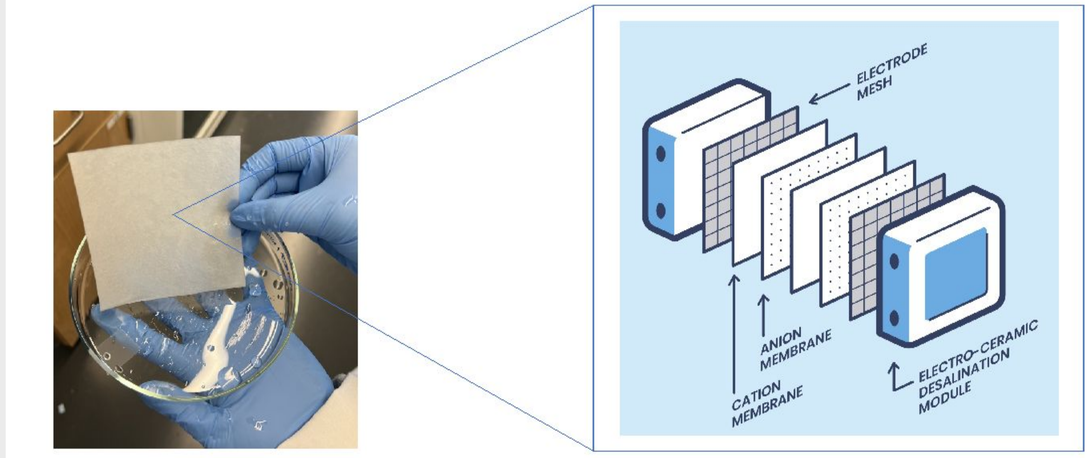


Figure 1. The components of Membrion's ceramic ion exchange membrane

PROCEDURES

Cation and anion membrane samples were exposed to four different solutions: pH 0.5 with H_2SO_4, pH 0 with H_2SO_4, pH 1 with H_2SO_4, and 0.05 M $KMnO_4$. Each sample in solution was tested over exposure times of 8 hours, 24 hours, 48 hours, 6 days without refreshed solutions, and 6 days with refreshed solutions.

CATION EXCHANGE CAPACITY TEST

Membrane samples were…
- Rinsed with DI water 3x
- Soaked in 10 mL of 1 M H_2SO_4 for 10-minutes (3x)
- Soaked in DI water for 5-minutes (3x)
- Soaked in 10 mL of 0.5 M Na_2SO_4 solution for 10-minutes (3x)
- Na_2SO_4 solutions were combined for each sample after soaking
- Soaked in DI for 5-minutes (2x)
- Left to dry overnight
- Weighed once dry

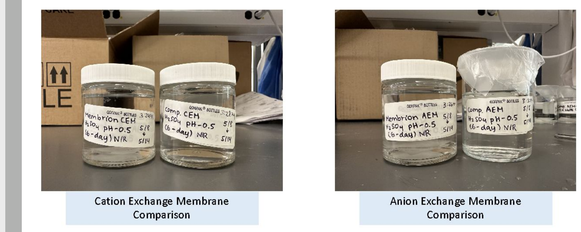
Once done…
- Bromothyl blue indicator was added to Na_2SO_4 solutions which were then titrated with 0.1 M NaOH. The volume of NaOH used in the titration was recorded

ANION EXCHANGE CAPACITY TEST

Membrane samples were…
- Rinsed with DI water 3x
- Soaked in 1.0 M KNO_3 for 10-minutes (3x)
- Soaked in DI water for 5-minutes (3x)
- Soaked in 50 mL of 0.5 M NaCl solution for 12+ hours
- Soaked in DI for 5-minutes (2x)
- Left to dry overnight
- Weighed once dry

Once done…
- UV-Vis spectrophotometer be used to measure the KNO_3 in the solution exposed to the membrane and the moles of NO_3 exchanged were calculated

MARKET COMPETITIVENESS



Cation Exchange Membrane Comparison

Anion Exchange Membrane Comparison

Figure 3. Testing perfomed on Membrion's vs the Competitor's cation exchange membranes and anion exchange membranes

PERFORMANCE LONGEVITY

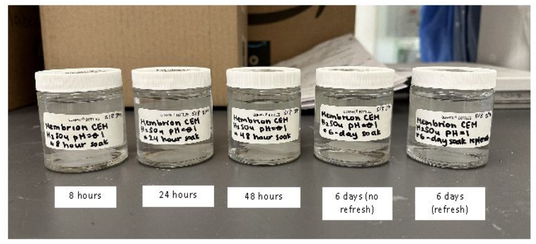


Figure 4. Membrane capacity testing conducted on long-term exposures of 6 days and 48 hours, and short-term exposures of 24 hours and 8 hours

ACKNOWLEDGEMENTS

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REFERENCES

[1] "Electro-Ceramic Desalination for Harsh Industrial Wastewater." Membrion. https://membrion.com/ (accessed April 8, 2024).

[2] "Sulfuric acid." Department of Climate Change, Energy, the Environment and Water (DCCEEW). https://www.dcceew.gov.au/environment/protection/npi/substances/fact-sheets/sulfuric-acid#:~:text=Health%20effects-,Description,the%20lungs%20(pulmonary%20oedema). (accessed May 7, 2024).