Osmotic Microbial Fuel Cells for Simultaneous Wastewater Treatment, Bioelectricity Generation and Water Extraction

(OTT ID 1266)

Inventor: Dr. Zhen He, Ph.D., Professor
Department of Civil and Environmental Engineering, Virginia Polytechnic Institute and State University

For further information please contact:

Audrey Salazar, Ph.D.
Licensing Associate
1440 East North Ave.
Milwaukee, WI 53202
Tel: 414-906-4657
audrey@uwmrf.org

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Shortfalls of current wastewater treatment systems and microbial fuel cells (MFCs)

Problems/Unmet Needs:

- A relatively small amount of electricity is generated as a byproduct from wastewater treatment plants
- The effluent from current MFCs cannot meet the water reuse requirement
- Membrane processes such as microfiltration, ultrafiltration, nanofiltration, and reverse osmosis consume intensive energy due to the requirement of high hydraulic pressures

Technological Solution:

- The technology uses forward osmosis integrated into a microbial fuel cell to improve the efficiency of the fuel cell and the quality of the treated wastewater to meet water reuse requirements
- Saline water can be further processed to produce potable water
- Efficient organic contaminant removal
- Improved energy recovery compared to traditional microbial fuel cells

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Technology Specifics

Market

- The global wastewater treatment infrastructure market is estimated at nearly $91 billion by 2022 according to Research and Markets.
- Hexa Research indicates that $675 billion will be spend in the area of water and waste water treatment by 2025. A CAGR of 5.3% is expected in Asia.

Intellectual Property

- US 9527038- Osmotic bioelectrochemical systems, granted 2016

Partnering

- UWMRF has a collaborative agreement with the international engineering consulting firm Gannett Fleming, Inc. (http://www.gannettfleming.com/) to further develop a prototype for this technology.
- We are looking for an additional partners to integrate, scale up, test, and demonstrate the osmotic microbial fuel cell for water reuse applications.

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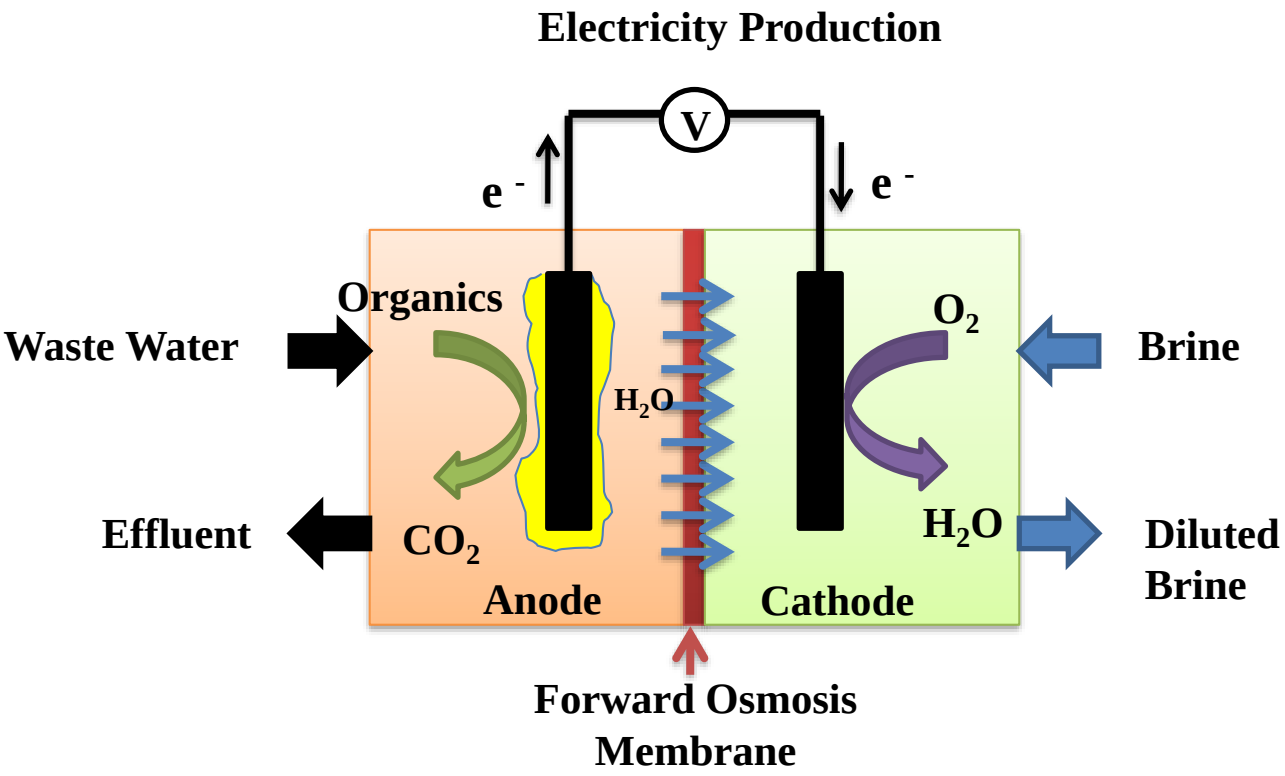
Osmotic Microbial Fuel Cells (OsMFCs)



The bacterial culture on the anode and the forward osmosis membrane work together to send fresh water to the cathode. The cathode further generates clean water. The cleaning is done while electricity is also being produced.

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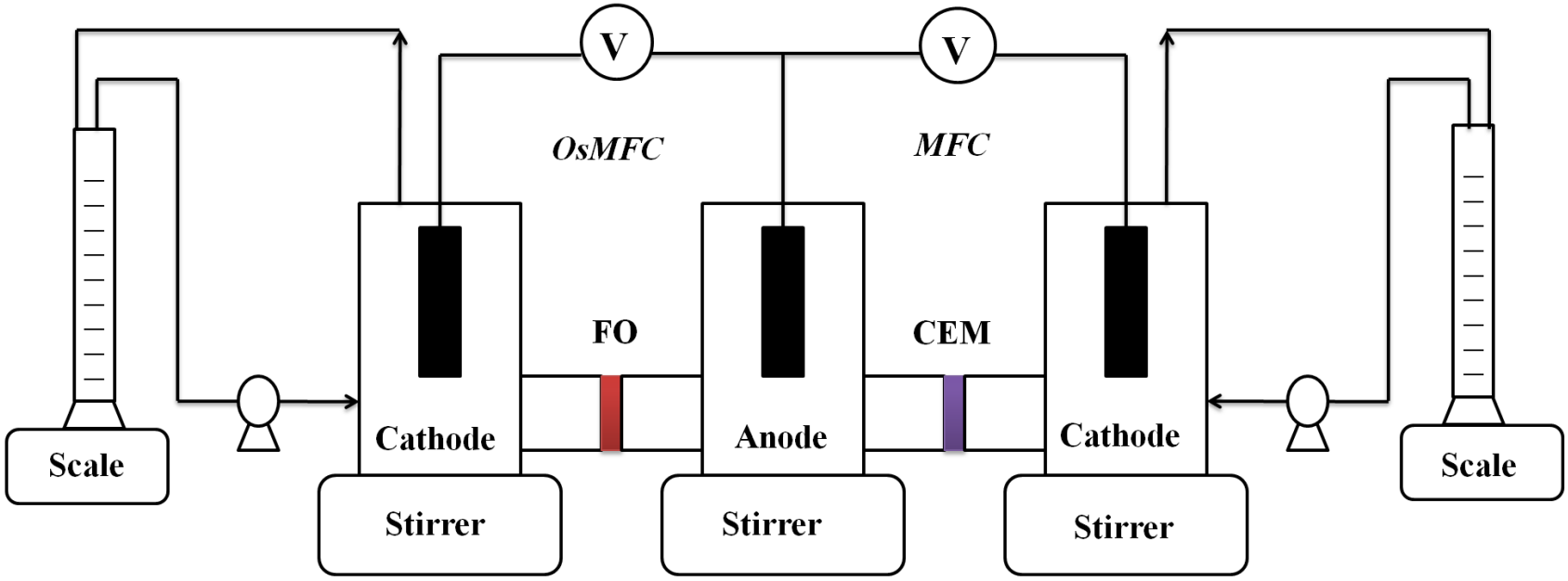
Comparison of OsMFC and MFC



A side by side comparison system was set up to compare the electric current generation, water extraction, and power production of conventional MFC with the OsMFC, sharing an anode.

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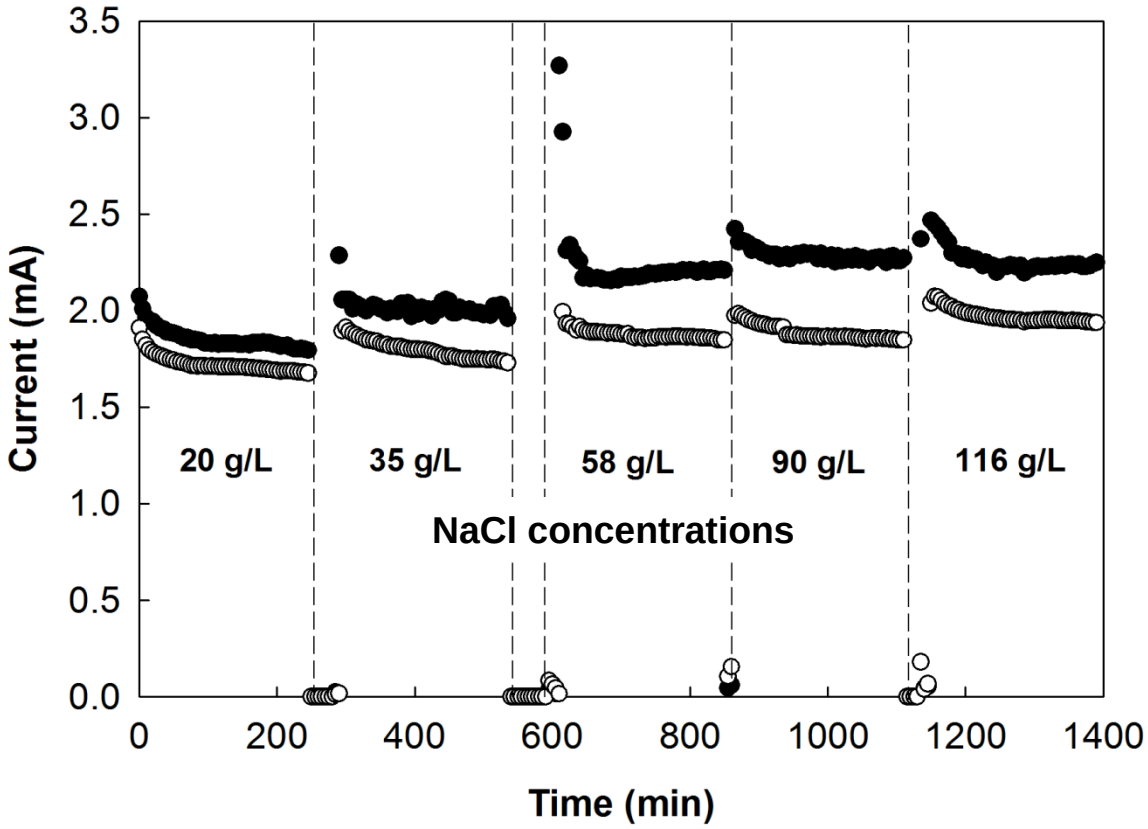
OsMFC generates more current than MFC



Black circles = OsMFC
White circles = MFC

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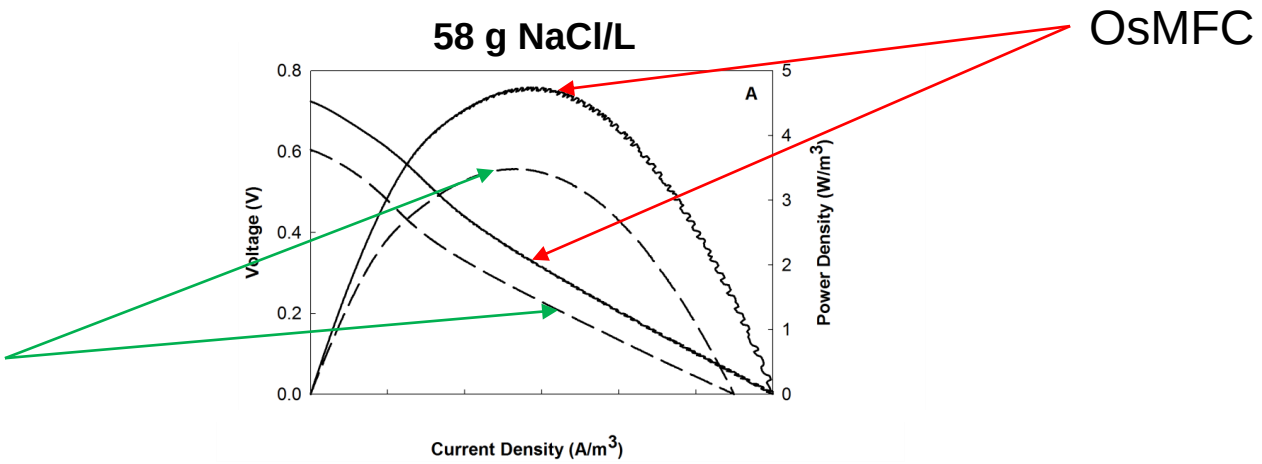
OsMFC produces 26% more power than MFC



Maximum power: 4.7 W/m^3

OsMFC had 26% greater power generation than MFC

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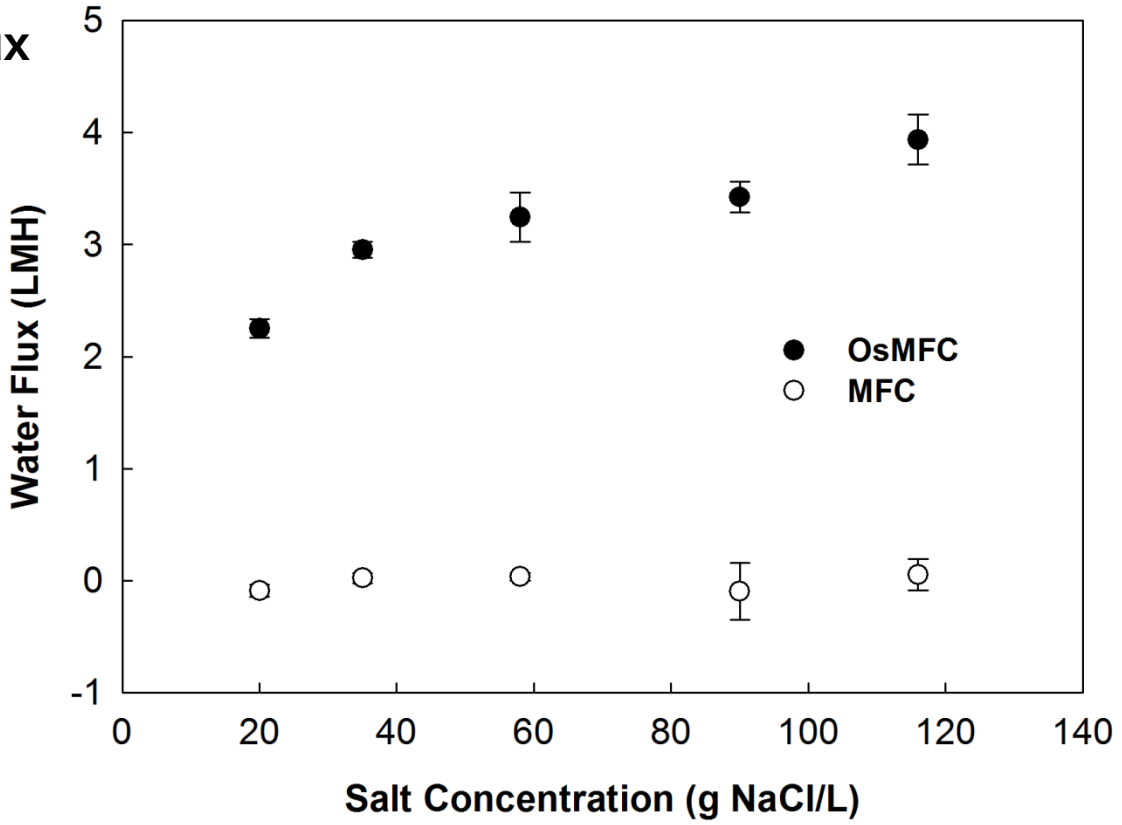
OsMFC results in significant H_2O extraction

4 hour water flux test results



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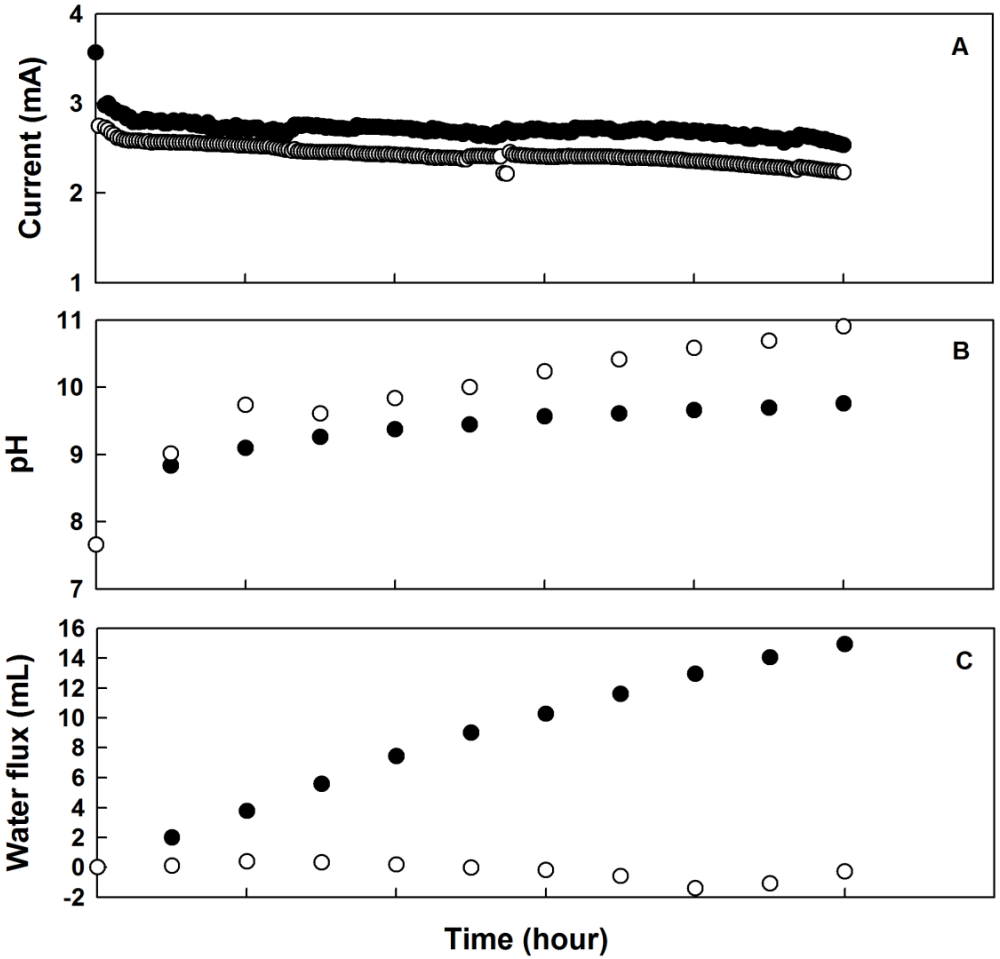
10 hour test of the osMFC versus the MFC



OsMFC has similar electricity generation to MFC

MFC has a higher overpotential than OsMFC

OsMFC generates water. MFC generates minimal water.

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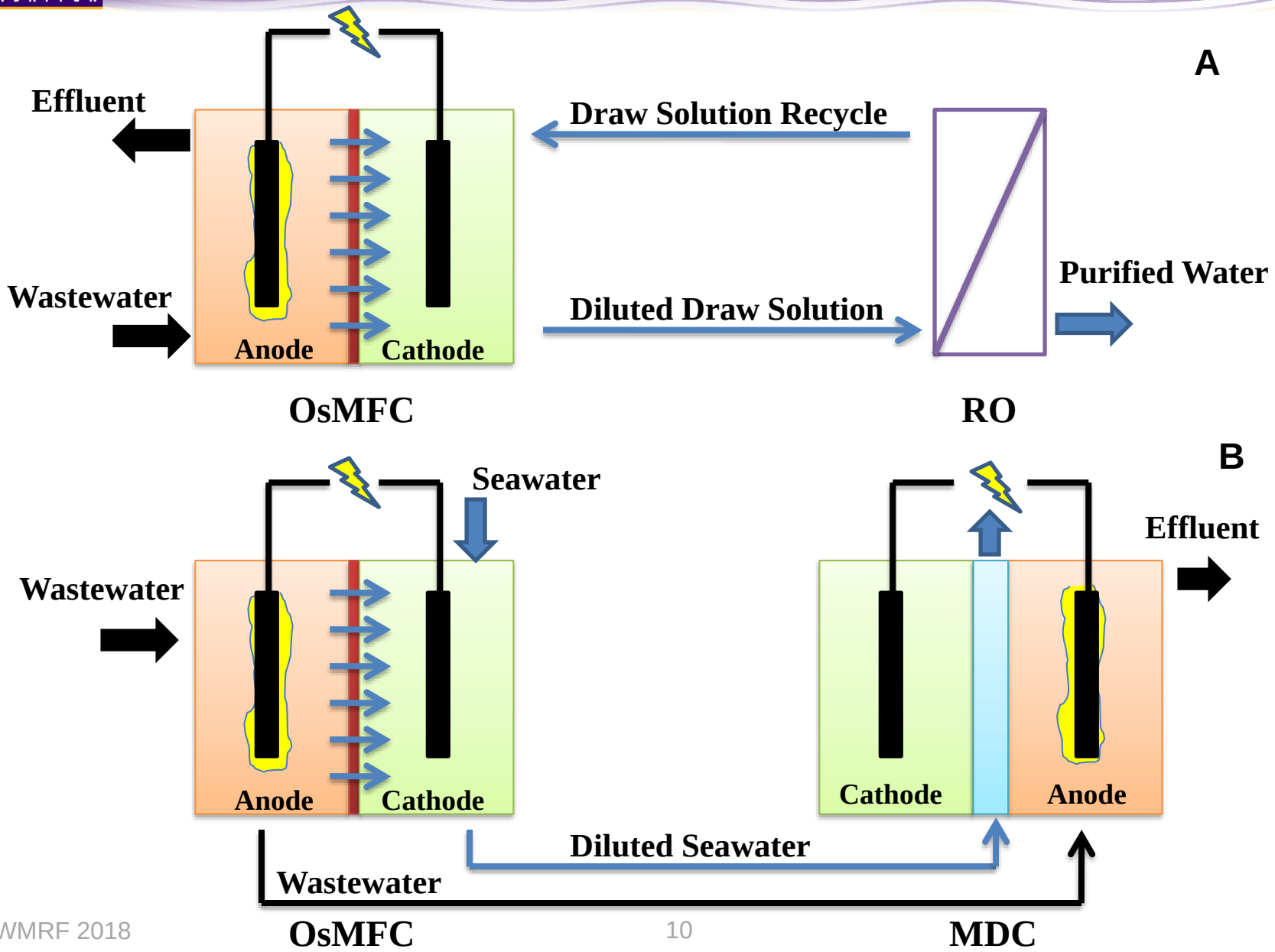
Potential Applications



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Next Steps

Further investigations and Development

- Long-term performance with actual wastewater
- Long-term stability of the system performance
- Fouling of FO membrane and related cleaning methods (in situ vs. ex situ)
- System scaling up to a transitional or pilot scale for technological demonstration
- Economic analysis of capital investment and operational expense

- Industrial partners can help with improving the design and manufacturing of the systems
- Financial and technical support to long-term test of the system
- Market discovery and analysis

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