RESEARCH BRIEF
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NAWI
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Solvent-Driven Zero Liquid Discharge for Production of Synthetic Gypsum

Aaron Wilson | Idaho National Laboratory (INL)
aaron.wilson@inl.gov

Challenge

Highly saline brine streams (TDS > 80,000 mg/L) are expensive to dispose of and could also be an important water resource in the future. Today, thermal concentration is the only commercially-available method to further concentrate these brines, but thermal processes are energy-intense and cost-prohibitive in most situations. They also do not easily scale down in size.

Solvent-based extraction is another method distinct from membrane- and thermal-based processes to concentrate brine. Solvent-based extraction uses an organic liquid that selectively "pulls" water out of a brine leaving behind a solid salt. This approach avoids evaporating water (high energy) and protect active surfaces from solute precipitation (scaling). However, due to the nature of the separation process, the loss of solvent is difficult to avoid, and the inability to fully regenerate the solvents has rendered the process economically and environmentally unviable.

Research Approach

This project pioneers the use of dimethyl ether (DME) as a solvent to concentrate brines for zero-liquid discharge (ZLD). The research objectives are to:

1. develop a deep understanding of how the solvent-water-salt mixture behaves and construct a general model.
2. design and test a DME recovery system for recovering 99.999% of the solvent.

Impact

The goal of this project is to advance DME-Driven ZLD desalination for treating water associated with brine management. By addressing the challenge of fugitive solvent loss, the DME-based process can bring significant improvements to brine concentration, including increased water recovery, reduced capital and energy costs, reduced land requirements, and reduced environmental impacts. Initial models of the DME-driven ZLD process suggest a 50% decrease in energy use, relative to state-of-the-art crystallizers.

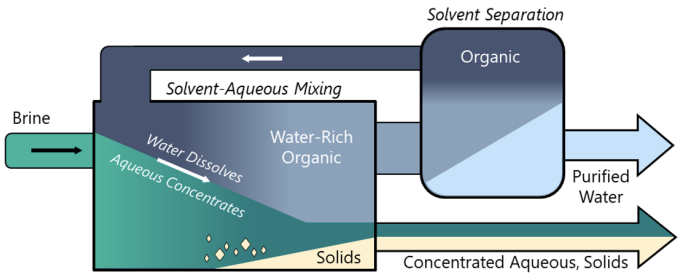

Figure 1. Conceptual design of DME-driven water selective solvent extraction.

RESEARCH PARTNERS

Idaho National Laboratory (INL): Aaron Wilson, Caleb Stetson, Hyeonseok Lee; Massachusetts Institute of Technology (MIT): Askshay Deshmukh, John H. Lienhard, Zi Hao Foo; Trevi Systems: Igor Kiryakin, James Hrovat, John Webley; USG Corporation: Ashish Dubey

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