RESEARCH BRIEF
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NAWI National Alliance for Water Innovation

Engineering Robust Antiscalants for Silica Scale Mitigation for High Recovery Brine Concentrators

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Challenge

High salinity wastewaters and brines contain high levels of sparingly soluble, scale-forming species, which significantly limit the water recovery and efficiency of brine concentrators. The most common approach to mitigating inorganic scaling is the addition of antiscalants to the feedwater. Commercial antiscalants are generally effective in disrupting the formation of crystalline scale (e.g., gypsum and barite), but are ineffective in preventing the formation of amorphous silica scale. The chemistry and mechanisms of silica scale formation are complex and not well understood, which is one of the main reasons for the lack of effective silica antiscalants. Hence, there is a critical need to better understand the interaction of antiscalants with dissolved silica in high salinity environments and to develop polymeric antiscalants that are highly effective in hindering silica scaling.

Research Approach

The overall goal of the project is to develop robust polymeric antiscalants for silica scale mitigation that are effective at high salinities. To achieve this goal, the project will involve the following specific objectives:

1. Identify functional groups and molecular structures that inhibit silica polymerization through molecular simulations and machine learning

2. Synthesize antiscalants informed by the obtained molecular design principles

3. Test antiscalant performance in bench-scale experiments to provide feedback to molecular design and synthesis

Impact

The project addresses a major gap in our ability to design effective antiscalants for high recovery desalination and brine concentration technologies. Development of an effective silica antiscalants that functions at high salinities would enable low-cost, efficient brine concentration, and would unlock non-traditional waters as a source of freshwater for industrial and municipal use.

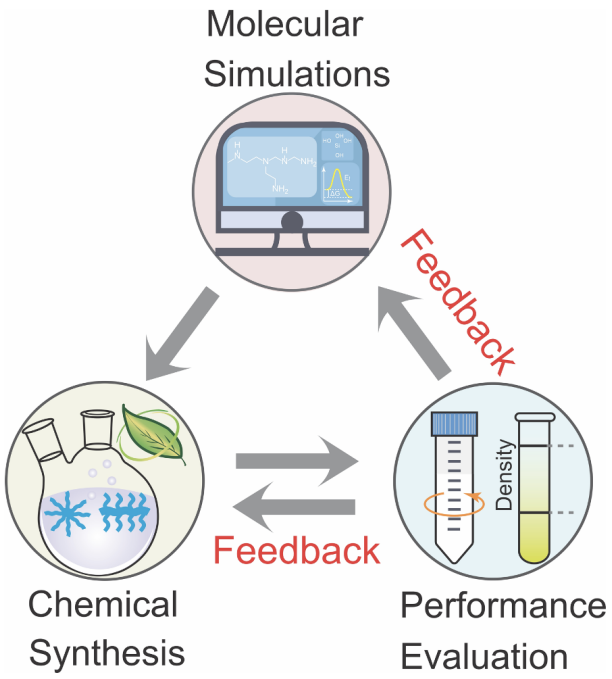

Figure 1. Overview of research strategy: molecular simulations to identify functional groups and molecular structures of antiscalants, chemical synthesis of the antiscalants informed by the molecular design principles, and systematic bench-scale performance testing of the synthesized antiscalants.

RESEARCH PARTNERS

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