Team: TechDesal

Title: Sorption Integrated with Intensified Membrane Distillation Crystallization (SiMDC) for Direct Lithium Extraction

Topic: DLE with Integrated Sorption-Membrane Distillation

Background: Lithium (Li) has been identified as a critical element for US industries such as electric vehicles and power storage. Global Li demand is expected to increase by a factor of five by 2030 and ensuring a secure and continuous domestic supply is a top priority of the US government and a national economic security concern. In U.S., Li reserves have been estimated at about 7.9 to 13 million tons, of which a significant fraction is from non-conventional deposits such as brines (approximately 2.3 million tons), including geothermal brines. The coupling of energy and Li recovery from geothermal brines is promising for both economic and environmental reasons, such as the offsetting of energy needs and costs. However, geothermal brines pose a tremendous challenge for selective Li extraction because they also contain NaCl, $MgCl_2$, $CaCl_2$ and KCl, Fe, Mn, Zn, Pb and SiO_2 at concentrations many orders of magnitude higher than Li, which makes selective and efficient Li extraction problematic. Conventional approaches to Li extraction from geothermal brines involve a series of steps such as chemical precipitation/evaporation and/or selective adsorption which are water and land intensive and expensive.

Objectives: Team TechDesal proposes to integrate novel adsorption and membrane distillation processes to remove interfering elements, selectively extract Li, and minimize production costs. Phase 2 objectives were to:

- Design and enhanced ClO_2 process to pretreat the brine for removal of Si, Fe, Pb, Zn, and Mn)
- Design highly stable and porous sorbent polymer composites for enhanced mass transfer and reduced pressure drop in adsorption columns
- Evaluate the performance of intensified membrane distillation-crystallizer
- Conduct a coarse techno-economic and life cycle analysis of the proposed approach
- Perform thermodynamic modelling to predict the behavior of geothermal brine constituents during the proposed Li extraction process

Impacts: The DLE approach proposed by Team TechDesal will deliver a highly concentrated Li solution for further processing (~20 g/L Li carbonate) that is much higher compared to conventional methods. Our integrated process is estimated to be a more economically viable approach to Li extraction from geothermal brine due to the lower chemical consumption and reduced volume of waste produced. Additionally, our proposed field-tested desalination process can help sustain the salinity of the Salton Sea and supplement water demand, while producing green electricity.