Direct Li Extraction to LiOH with Ion Conducting Ceramic Membranes

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The basic goal of this project is to use a class of ceramic ion-conducting materials called LiSICON (Lithium Super Ion CONductors) as a membrane between a hot brine containing a mixture of salt ions and hot water. An applied voltage will selectively transport lithium ions across the membrane creating a concentrated product stream of LiOH and leaving the remaining salt brine to be reinjected into the ground. The characteristics are:

1. Selectively removes lithium, increasing efficiency.
2. Extracted lithium is a concentrated solution of LiOH without extra processing.
3. No evaporation pools.
4. No added chemicals, e.g., acids to recharge ion exchange resins.
5. Inputs: hot water and electricity.
6. Brine without lithium can go through existing power generation or be re-injected.
7. Membrane material need is small to process a large amount of brine.
8. Valuable hydrogen and chlorine gas biproducts are produced.
9. The ceramic membrane works better at high temperatures: doesn't degrade.

For this project we have:

1. Tested several potential materials in batch mode.
2. Found compositions that selectively transfer the Li while leaving sodium behind, enhancing the Li/Na ratio by more than 3000.
3. Found an electrode material that is both inexpensive and is inert to salt brines.
4. Modeled the Li transport for batch and continuous systems.
    a. Found the electric energy needed is less than $1/kg LiOH produced.
    b. Found the membrane cost will be less than $100,000 for a 6000 gal/min flow.

For the next phase of the project, we plan to:

1. Continue small scale batch testing at elevated temperatures.
2. Continue small scale testing with other interfering ions.
3. Build and test a small-scale continuous flow system (preliminary designs done)
4. Acquire actual brines
5. Test systems with actual brines
6. Continue to improve cost and performance models as new data is obtained.