Hydrothermally Produced, Spinel-$LiMn_2O_4$ Sorbent Production

Carus produced the sorbent utilizing $KMnO_4$, LiOH, 2- C_3H_8O, and C_3H_6O as follows: 13 mL of 0.1 M LiOH was reacted hydrothermally with 0.158 g of $KMnO_4$ and 1.1 eq of reducing agents inside the 24 mL polytetrafluoroethylene (PTFE) high-pressure autoclave. The autoclave was heated to 180 ^oC at a rate of 10 ^oC per minute. The autoclave was held at this temperature for five hours. The autoclave was then allowed to cool overnight.

The sorbent was next separated from the liquid through filtration. The precipitates were then washed with deionized water and then dried in an oven overnight. The precipitates were digested and analyzed for Mn, and K concentrations using a Perkin-Elmer Optimat 3800 Spectrometer and Li using a photometer. The remaining solid sorbents were mixed together and subjected to the process of the ion-sieve preparation during which the solids were soaked in a 0.5M HCl solution for 24 hours to extract the Li ions from the spinel-$LiMn_2O_4$. Following Li ion extraction, the ion-sieve was reacted with LiOH solution and the adsorption capability of the sorbent was recorded and analyzed.

Impact of pH and Temperature on Li Uptake from Solution

Figures 1 and 2 show the impact of pH and temperature on Li uptake on the sorbent in aqueous solution. The results show that pH had a large impact on Li uptake from solution. At higher pH, Li uptake approaches the maximum theoretical sorption capacity for $LiMn_2O_4$. Temperature did not have a significant impact on Li uptake.

Impact of Brine Chemistry on Li Uptake from Solution

Table 1 shows the simulated brine formula for which Li sorption was compared in the brine and in deoionized water. Results for the comparison are shown in Figure 3. The results indicate that the brine will significantly decrease Li sorption.

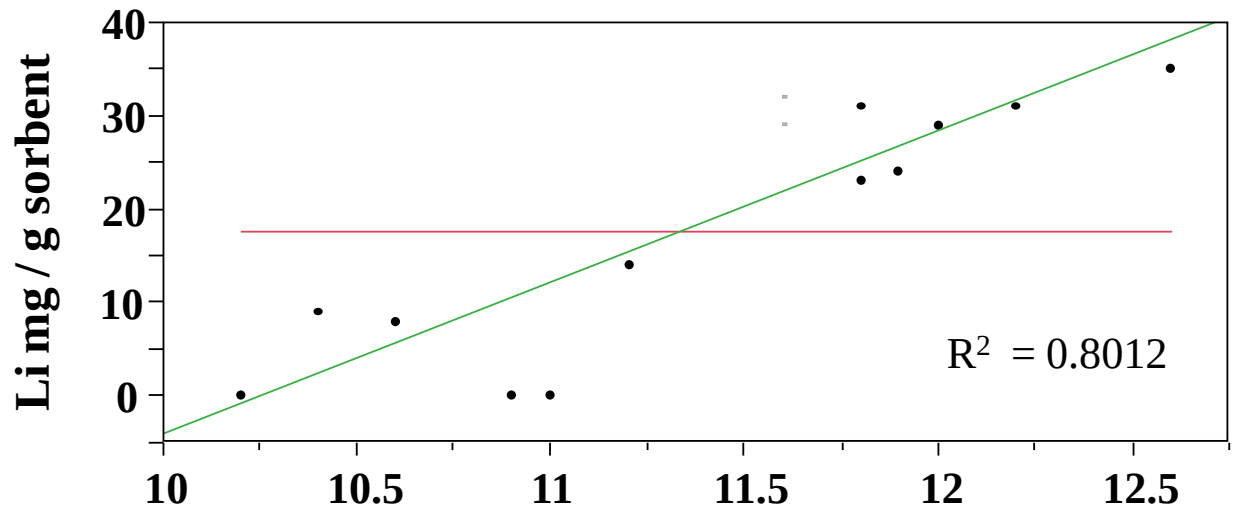

Figure 1. Impact of solution pH on Li uptake on sorbent.
Conditions – (1) deionized water matrix (2) Li concentration = 70 mg/L (3) contact time = 1 hour (4) sorbent is $LiMn_2O_4$.

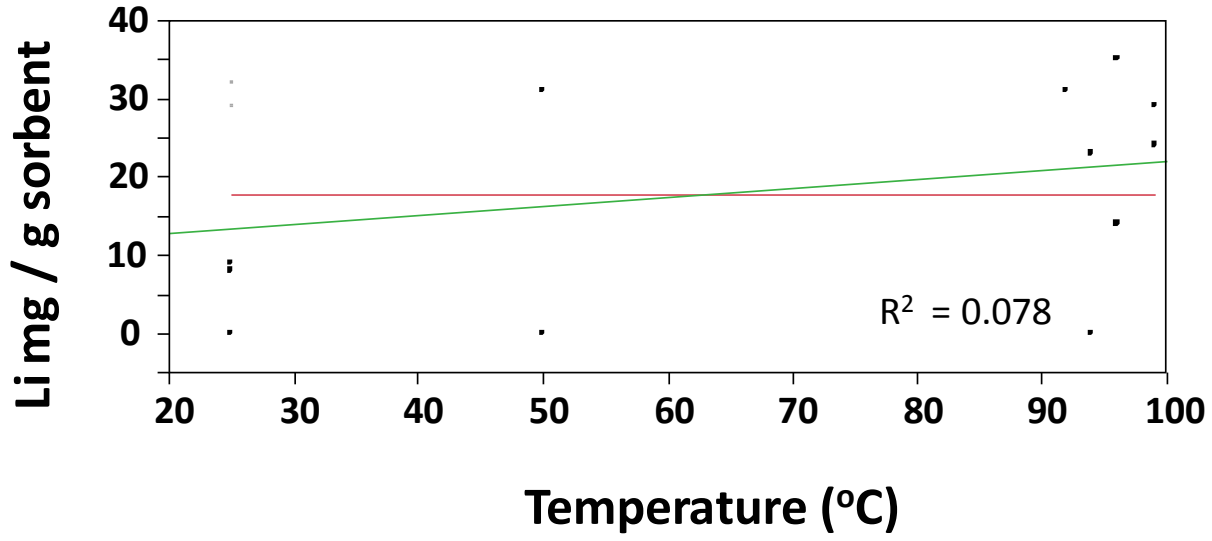

Figure 2. Impact of solution temperature on Li uptake on sorbent.
Conditions – (1) deionized water matrix (2) Li concentration = 70 mg/L (3) contact time = 1 hour (4) sorbent is $LiMn_2O_4$.

Table 1. Composition of Brine A in sorption experiment.

Component	Brine A (mg/L)
Ca	**60**
Li	**20**
Mg	**60**
Si	**10**
Na	**11,392**
Cl	**19,094**
SO_4	**750**

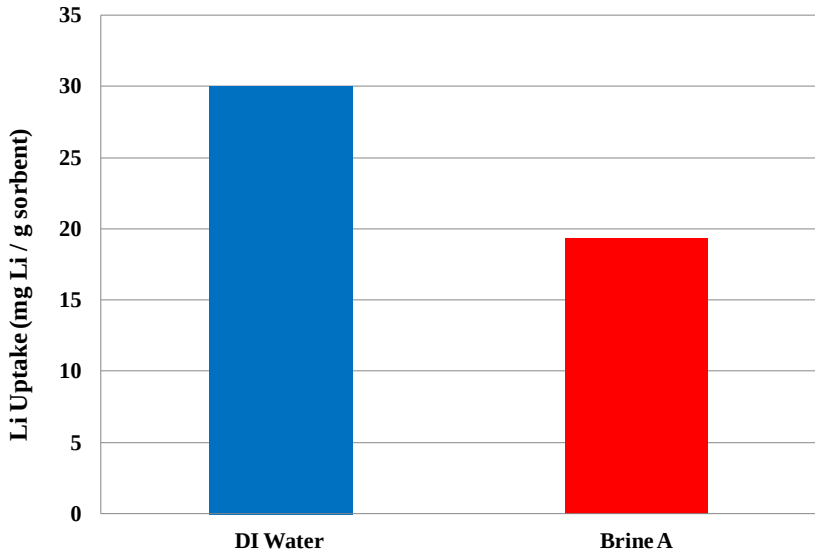

Figure 3. Impact of brine chemistry on Li uptake on sorbent.
Conditions – (1) deionized water versus Brine A (2) Li concentration = 20 mg/L (3) sorbent: spinel – $LiMn_2O_4$.