Investigating Aeration and Filtration as Pre-Treatment Methods for Flowback and Produced Water Prior to Ion Exchange for Lithium Extraction

Bennett Braun, Karthik R. Shivakumar, Daniel Alessi
University of Alberta, Edmonton, AB, Canada

Lithium is crucial for battery production, utilized in electric vehicles and portable electronics. In many cases, Li-bearing flowback and produced water (FPW) requires pre-treatment before entering the ion-exchange process for Li extraction using a highly Li-selective Mn (IV) oxide sorbent. The main obstacle is the reductive dissolution of the Mn (IV) oxide by dissolved organics (DOC) and loss of Mn (IV) as more soluble Mn (II/III). An approach of aeration and filtration can remove DOC to prevent mass loss of the sorbent and improve the Li extraction performance. In Canada, significant concentrations (>75 ppm) of lithium are present in petrobrines near Fox Creek, AB. The FPW samples used for this study have a TDS >157,000 ppm and lithium values from 64-72 ppm. The four aeration experiments used 800 ml of brine, which was aerated with compressed air for 24 hrs at 0.3 L/min and filtered after 24 hours to remove precipitates. Two experiments used raw brine samples and the other two were pH-adjusted to pH 6 and 7. Li extractions were completed on the raw brine, aerated raw brine, and aerated pH-adjusted brine using the Mn (IV) oxide sorbent, and an ICP-MS to measure Li recovery and Mn loss. The pH-adjusted brine displayed a decline in Fe^{2+} concentrations, evidencing the formation of Fe (III) solids, with a concomitant 10-24% decrease in the solution TOC concentrations. Elevated Li uptake of up to 10.8 mg/g was observed in the pH-adjusted brine extractions, compared to 4.5 mg/g in the raw brine extraction. The above trends are proposed to be caused by organics sorbing to iron oxyhydroxides produced through of the oxidation of Fe^{2+} during aeration. These colloids are large enough to be removed by microfiltration. If the pre-treatment methods above are scalable, ion-exchange technology could be feasible for lithium production from petrobrines.