

Extraction of Lithium From Seawater Using Ion Exchange Chromatography

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Introduction

Over the years, Lithium has increased in interest amongst many fields of technology and science. Its applications in rechargeable batteries, laptops, and cameras have come into a high demand along with its future usage in nuclear fusion fuel. Seawater is considered one of the major sources of lithium, despite its low concentration of 0.17 mg/L. The process of extracting lithium from these seawater brines have become a large focus in terms of investigating the most efficient way to separate the element from its source. Though the biggest problem in the process is being able to fully separate the element from sodium, for seawater contains a high sodium concentration of 10.556 mg/L.

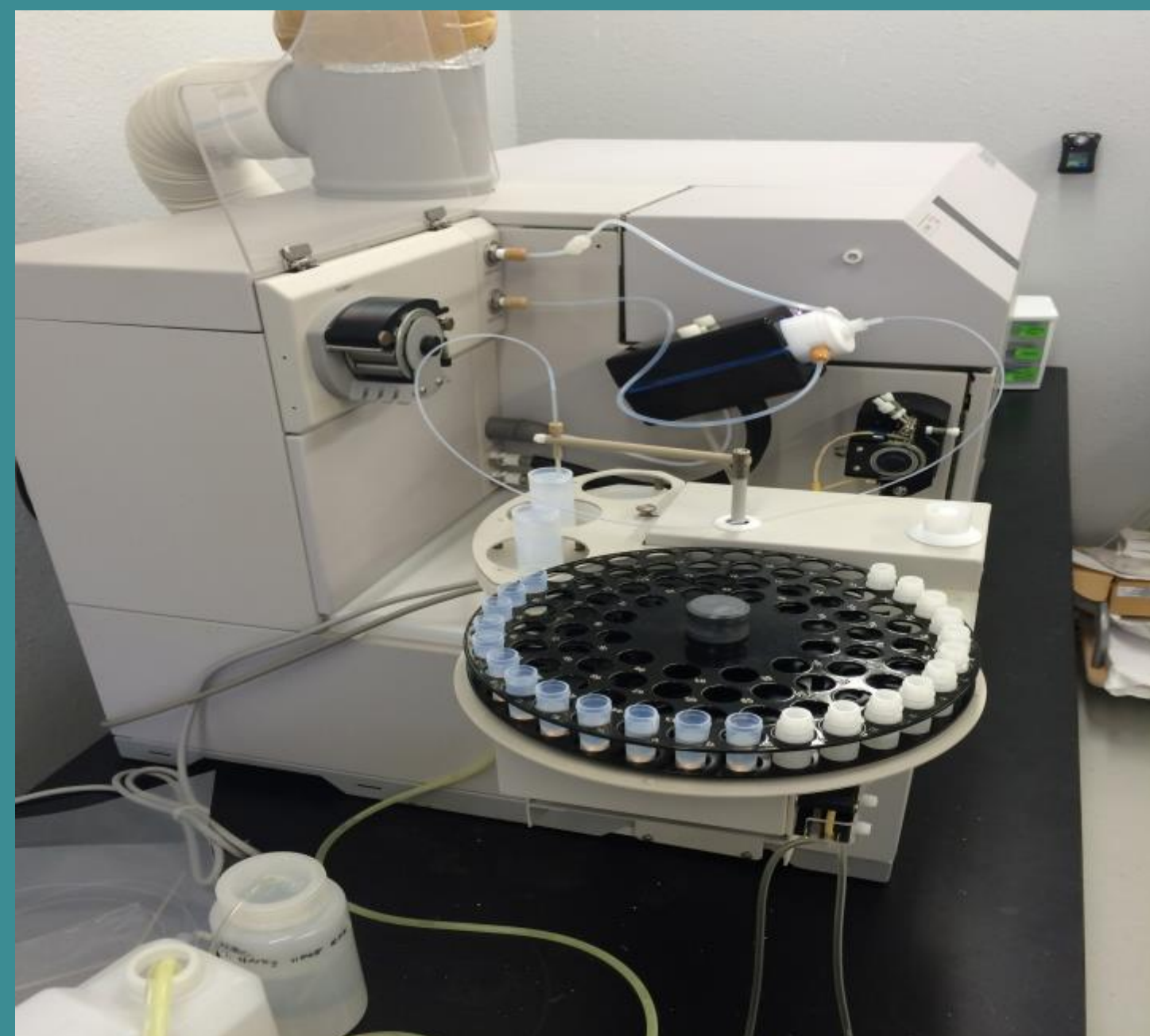


Figure 1: Mass spectrometer analysis of lithium samples

Objective

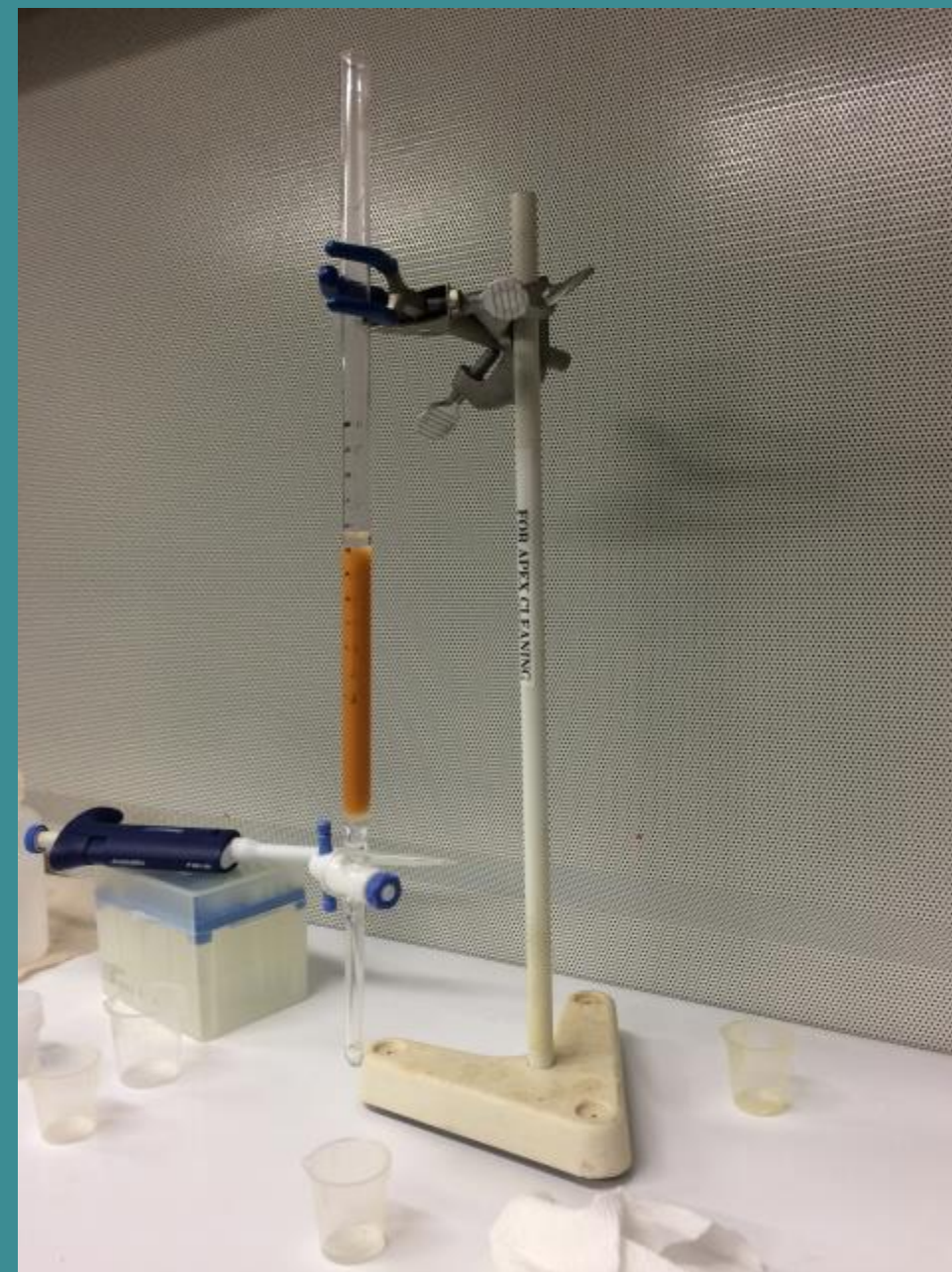
Efficiently separate lithium from sodium from a water sample using ion exchange chromatography.

Acid Preparation

With sodium being sixty times more concentrated in seawater than lithium, a sodium and lithium mix was created with sodium having sixty times more milligrams than lithium. 1 ml of the sodium and lithium mix was then evaporated on a hot plate. In order to elute the the resin bed, an acid solution of 0.50 N HCL was created with 50 ml of 2N acid and 150 ml of water. The normality of these acids were checked by multiple titrations. The HCL was then added to the evaporated sodium and and lithium solution to make a lithium chloride mix, which was flushed through the resin bed column.

Isotopic Dilution

Using the resin dowex AG 50W-X12, our goal was to bind the lithium ions from the sample with the ions from the resin and achieve complete separation from sodium. Using a column with 11ml of resin, it was eluted with 1 ml of 0.5 N HCL and ethanol acid after the lithium chloride sample was poured through the column. This was collected in 24 1ml fractions. The samples were then evaporated after being washed through the s and then diluted with nitric acid for mass spectrometry.



Mass Spectrometry

From the analyzed data, we can see that no lithium was recovered. 227 nanograms of lithium was loaded an we only recovered 1.263 nanograms.

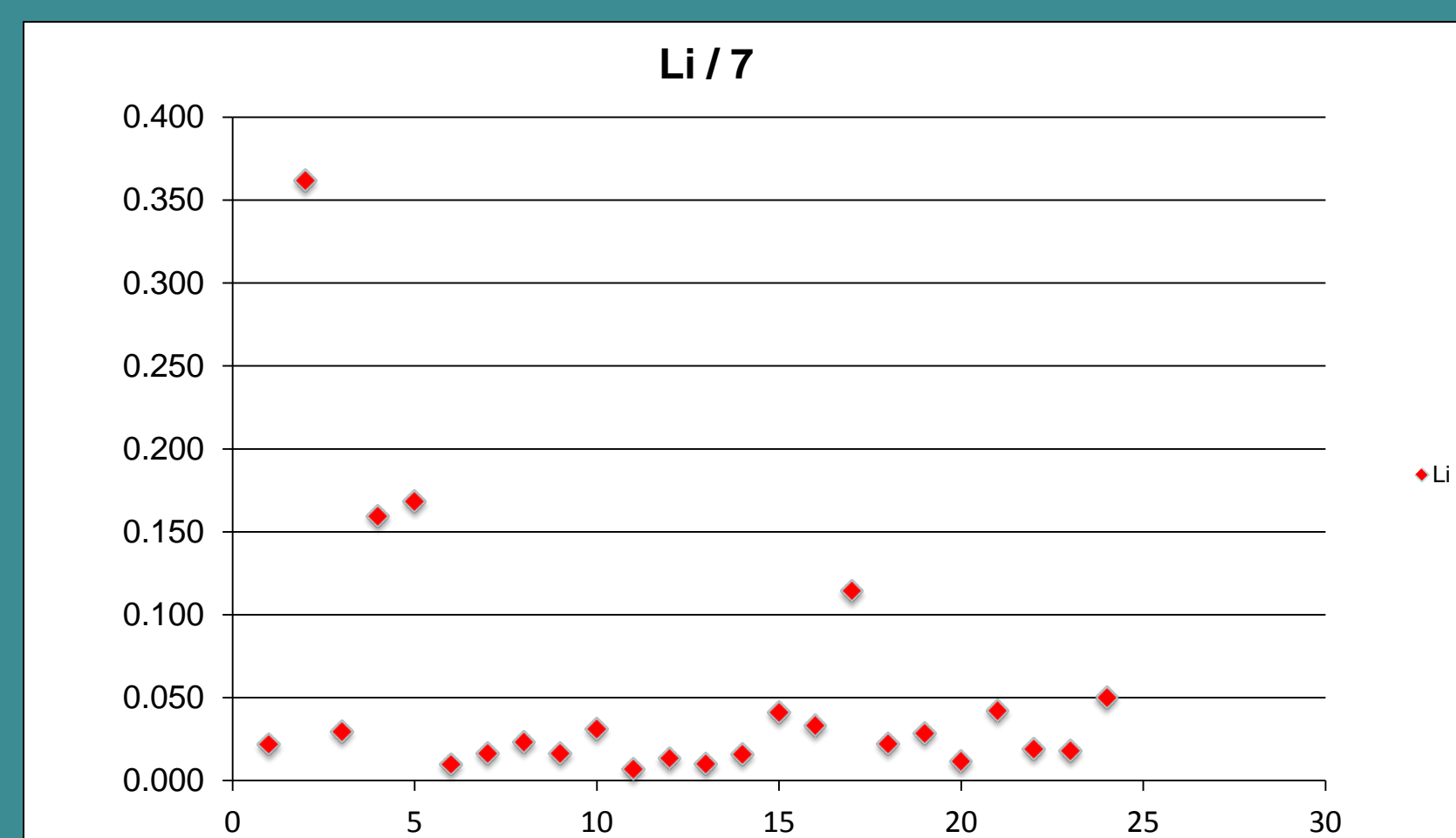


Figure 2: Lithium extraction data obtained from mass spectrometry

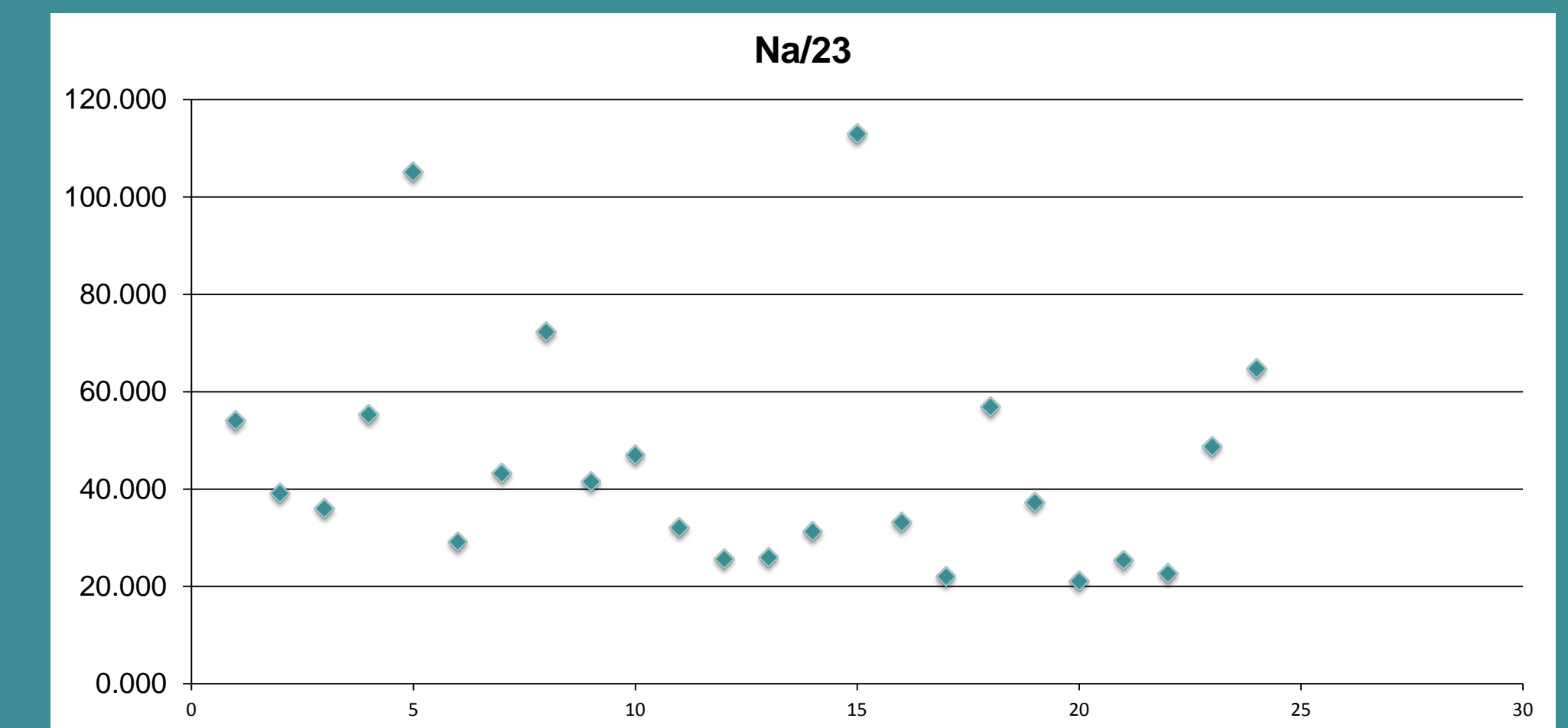


Figure 3: Sodium extraction data obtained from mass spectrometry

Standard Elution Curve

In regards to what the graph should of came out to be, this graph is representing a successful lithium separation from sodium peak, with the red bars representing the lithium ions.

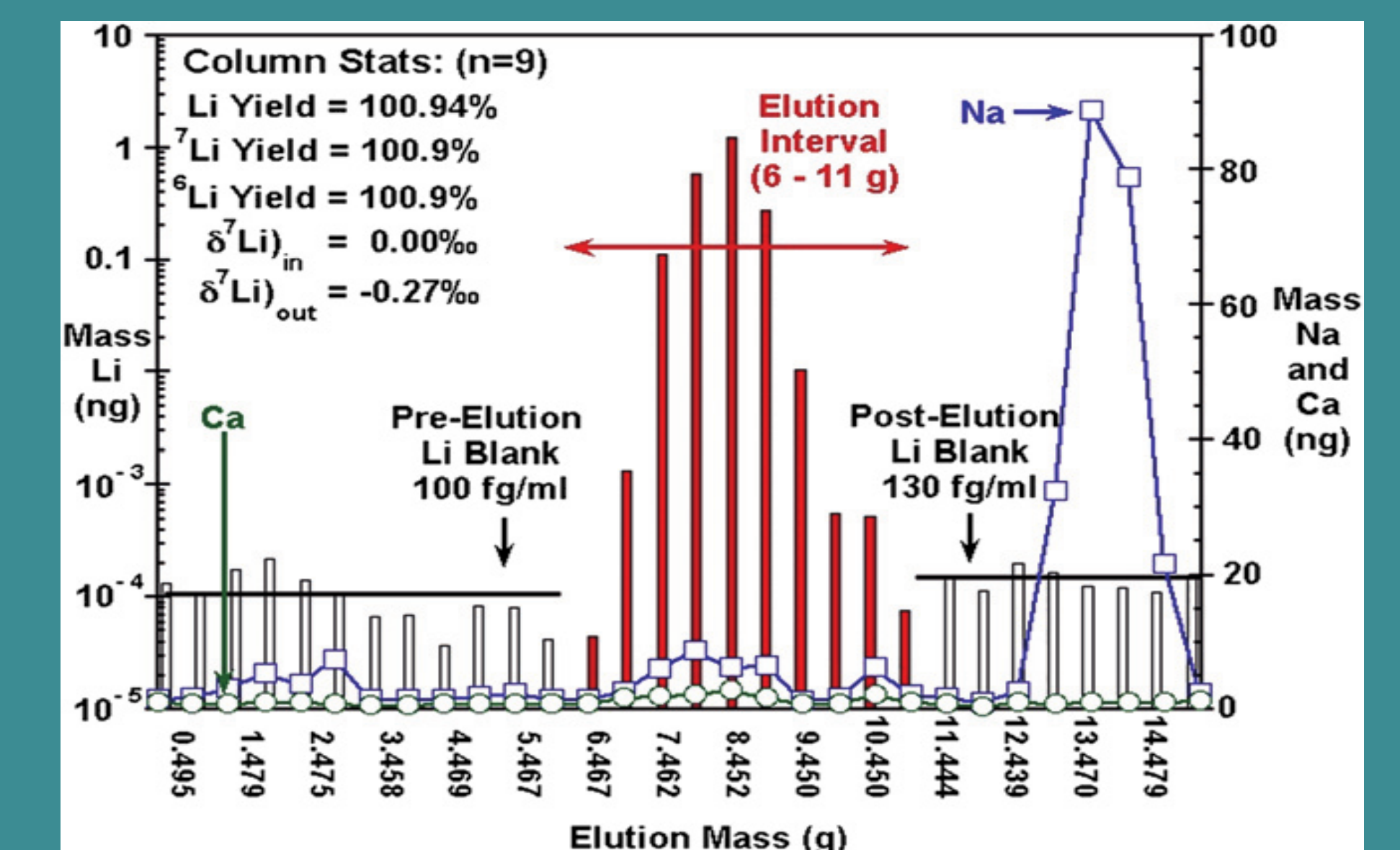


Figure 4: Lithium separation from sodium graph from the Journal of Analytical Atomic Spectrometry., 2009, Issue 11.

Discussion

It is obvious from the analysis of the elution fractions, the 227 nanograms of Li loaded on the resin column were not recovered. A number of possibilities for this were considered. This includes the possibility of a mistake in preparing the Li-Na stock solution. This was dismissed by direct mass spectrometric analysis of the solution. The possibility of the normality of the acid being incorrect could also be dismissed by multiple titrations. Finally it was discovered that the ion exchange resin made available to me was anion and not cation exchange resin.