Optimizations on Lithium ion exchange separation and isotopic measurements

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Introduction: The Lithium-7 is of interest for nuclear application, being used for primary cooling of PWR (Pressurized Water Reactor) reactors [1]. An environmentally friendly technique is required to replace the Mercury amalgam technique used worldwide [1,2]. This work aims to present the preliminary results of the development of ^{7}Li separation by ion exchange.

Methods: A 120 mm x1.0 cm i.d. glass column filled with Dowex 50W-x16 resin was used. A total of 3.0 liters of 0.2 M CH_3COOLi solution percolated the column in order to saturate and displace the formed band of ^{6}Li and ^{7}Li. Fractions were collected every 50 mL, then the resin was washed with 5M HNO_3 and ultrapure water. The fractions were filtered and evaporated at 80°C, finally taken up with HNO_3 1%. Samples were analyzed by ICP-OES – SPECTRO ARCOS. The fractions were analyzed by ICP-MS, model ELAN 6000 – SCIEX. For isotopic ratio measurement, with the parameters of gas flow of approximately 1.1 L min^{-1}, RF 600 W, gas flow rate 1.2 L min^{-1}, Peak Hopping mode, dwell time 80 and 480 for ^{6}Li and ^{7}Li (respectively), 50 sweeps per reading, 1 read per replicate and 10 replicates.

Results: A total of 63 samples were collected from the separation experiment. The Li isotopic ratio measured for each fraction was assessed by ANOVA one-way considering the differences among fractions. A statistical significant difference was observed between the fraction 1 and the remainder fractions and the load solution. The remaining fractions showed an isotopic ratio around the natural abundance ($^{6}Li/^{7}Li$: 7.59%/92.41% = 0.082). The isotopic ratio of this sample indicated enrichment of ^{7}Li of 0.92% in the fraction number 30.

Conclusions: The method of ion exchange with Dowex 50W-x16 resin was efficient on ^{7}Li separation and through ICP-MS method was able to measure the δ 84‰ enrichment of the ^{7}Li. The isotopic separation procedure via ion exchange is still being studied, however the results are promising.

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