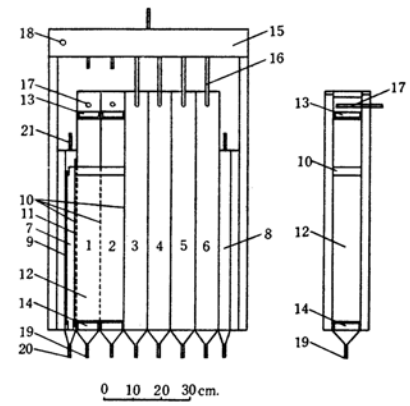

Fig. 1. Essential part of enrichment apparatus.

1—6: Resin compartments
7: Cathode compartment
8: Anode compartment
9: Pt electrode
10: Cation exchange membrane
11: Supporter
12: Cation exchange resin
13: Perforated plate
14: Resin holder
15: Feed conduit
16: P. V. C. tube
17: Solution distributor
18: Feed solution inlet
19: Discharge solution outlet
20: Electrode solution inlet
21: Electrode solution outlet

Continuous Isotope Enrichment by a Simultaneous Use of Ion Exchange and Electromigration

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For a continuous isotope enrichment a new type of apparatus (Fig. 1) was devised on the basis of a simultaneous use of ion exchange and electromigration. The principle of the continuous enrichment is schematized in Fig. 2.

If an ion of isotope I moving down through an ion exchange bed with velocity of v_1 is placed under the horizontal supply of an electric field, the movement of the ion should be the addition of vectors v_1, the vertical velocity, and h_1, the horizontal velocity caused by the electric field. Similarly the movement of isotope II ion is the addition of vectors v_2, and h_2. If $v_1 > v_2$ and $h_1 < h_2$, the movement of the two ions can be expressed by the vectors R_1 and R_2. As R_1 and R_2 are different each other not only in their magnitude but also in their direction, the continuous enrichment of the isotopes should be possible by the continuous feed of the isotope solution from the top (Fig. 2).

After the compartments (1, 2, 3, 4, 5 and 6 in Fig. 1) had been filled with ion exchange resin, a lithium solution was introduced at the top and drawn from the bottom, and at the same time a electric current was horizontally passed through the apparatus. To the electrode compartments electrolyte solutions were circulated.

To find whether any isotopic enrichment can be experimentally detected, a number of runs were carried out. Data for a run are given in Table I. In 35 hr. the run reached the stationary state, where the potential gradient

TABLE I. OPERATING CONDITIONS

Ion exchange resin: 50~60 mesh Diaion SK 1
Potential across resin: 60~140 V., D. C.
Current through resin: 9.0~12.0 amp.
Temperature of solution at the bottom: 40.0~50.0°C
Feed solution: 0.043 N Li_2CO_3 aq. solution
Feed rate: 60 ml./cm²/hr.
Electrode solution: 0.5 N $(NH_4)_2SO_4$ aq. solution
Flow rate: 10 l./hr.

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TABLE II. RESULTS OF ANALYSIS

Position	Samples of $38^{hr}10^{min}$ after the start				Samples of $43^{hr}40^{min}$ after the start			
	L. concn. γ/cc. samp. solution	$^7Li/^6Li$	Li flow rate g./hr.	Li distribution, %	Li concn. γ/cc. samp solution	$^7Li/^6Li$	Li flow rate g./hr.	Li distribution, %
Cathode	189	12.10	0.58	8.0	205	12.11	0.29	4.6
1	646	12.16	3.23	44.7	428	12.14	2.14	33.6
2	311	12.22	1.56	21.6	369	12.23	1.85	29.0
3	252	12.20	1.26	17.4	291	12.21	1.42	22.3
4	90.4	12.19	0.47	6.5	97.2	12.17	0.49	7.7
5	16.3	12.31	0.08	1.1	28.7	12.27	0.14	2.2
6	4.9	12.26	0.03	0.4	6.1	12.43	0.03	0.5
Anode	3.3		0.02	0.3	2.6		0.01	0.2
Feed	300.0	12.20	7.23	100.0	300.0	12.20	6.37	100.1

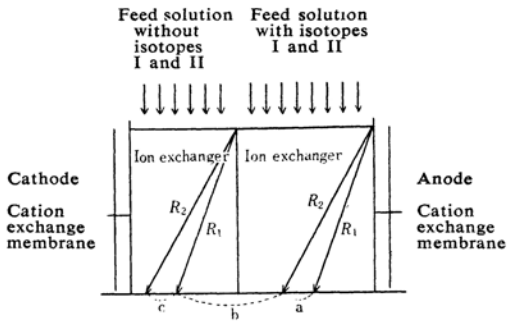

Fig. 2. Principle of the continuous isotope enrichment.

a: Pure isotope I comes out
b: The solution same as feed solution comes out
c: Pure isotope II comes out

was 2V./cm., the current density was 18 mamp./cm^2 and the thermal convection and gas evolution were effectively reduced. The samples of solution drawn off from each bottom of the six compartments were analyzed. Lithium concentration in the samples was determined by colorimetry with thoron[1]. Another portion of the sample solutions was evaporated to dryness, and sulfate ion was separated with anion exchange resin column in the hydroxide form. Then the lithium was converted to iodide by the addition of hydroiodic acid and evaporation to dryness, the lithium in the feed solution was also converted to lithium iodide in the similar manner. Isotopic ratios of the lithium iodide samples were determined with a Nier-type 60 degree mass spectrometer, Atlas CH-4 using the thermionic method[2].

The analytical results are given in Table II. The ratios $^7Li/^6Li$ were decreased in the solutions from the compartment 1 and the cathode, and increased in the solutions from the compartment 5 and 6. At the stationary state about 38.2 per cent of the lithium came out continuously from the compartment 1 to the cathode compartment and the bottom of the compartment, while 2.7 per cent of the lithium could be continuously collected in the outputs from the compartments 5 and 6. The values for the ratio of $^7Li/^6Li$ in both products are estimated 12.14 and 12.30 respectively.

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