The Szilard-Chalmers Effect of Calcium and Tungsten Oxinates

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The enrichment of radioactive calcium or tungsten by the Szilard-Chalmers process has not been successful so far. Bruno and Belluco[1] could not find the Szilard-Chalmers effect of calcium ethylene-diaminetetraacetate complex. The present authors found enrichment of ^{45}Ca and ^{185}W during their studies on the Szilard-Chalmers effect of calcium and tungsten complexes of 8-hydroxyquinoline (oxine).

n-Butylamine is the best solvent tested for calcium oxinate, but is water-miscible. A preliminary tracer study on the cation exchange behavior of ^{45}Ca as bivalent cation in the solvent showed a very high recovery (nearly 100%) of ^{45}Ca on the resin. Accordingly the ion-exchange in n-butylamine was used in order to catch ^{45}Ca in a cationic form leaving the oxinate in the solution. In each experiment about 5.0 g. of dehydrated calcium oxinate irradiated in JRR-1 for about 15 or 60 hr. (neutron flux: 10^{11} n/cm^2·sec., about 95% thermal neutron) was dissolved in n-butylamine. The solution was passed through a cation exchange resin column (7.0 mm.ϕ $\times$100 mm. of Diaion SK-1, H-form, 100~200 mesh, 1.1 ml./min.). After washing the column with a sufficient volume of n-butylamine and water, ^{45}Ca on the resin was eluted with 6 N hydrochloric acid. Calcium was precipitated as phosphate

for the measurement of radioactivity. The results listed in Table I show that about 6~8% of ^{45}Ca is separated in a cationic form from the complex with an enrichment factor of 40~120.

To investigate the Szilard-Chalmers effect of ^{185}W, about 1.0 g. of dehydrated tungsten oxinate irradiated in JRR-1 for about 15 hr. was dissolved in 150 ml. of chloroform, and the solution was shaken with the buffer solution of various pH values. Thus ^{185}W separated from the complex by the Szilard-Chalmers effect was collected in the aqueous solution. The quantities of tungsten were determined colorimetrically. The results are listed in Table II.

TABLE II. EXTRACTION OF ^{185}W FROM TUNGSTEN OXINATE

pH	Yield	W taken***	W found in the extracted fraction	Enrich-ment factor
	%	mg.	mg.	
1.01	37.3	38.0	0.24	59
2.98	34.2	38.0	0.09	144
4.02	33.5	38.0	0.07	196
5.00	33.7	38.0	0.06	233
5.96	33.1	38.0	0.07	194
7.01	33.9	38.0	0.03	429
9.02	38.0	38.0	0.18	80
10.06	44.0	38.0	0.39	43

*** The quantity of tungsten was determined by the thiocyanate method.

High enrichment factors were obtained in the pH range between 3~7, and the maximum enrichment factor was 429 at pH 7. The extraction yield was almost constant (34%) in this pH range.

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TABLE I. SEPARATION OF ^{45}Ca BY THE SZILARD-CHALMERS EFFECT

Irrad. time	Yield**	Ca taken*	Ca found in the cationic fraction*	Enrich-ment factor
hr.	%	mg.	mg.	
15	5.9	405	0.34	70
15	8.3	405	0.28	120
60	8.3	390	5.13	63
60	7.0	399	6.75	41
60	7.4	381	4.14	68
60	8.3	376	6.61	47

* The quantity of calcium was determined by the phosphate method.
** Yield=the amount of ^{45}Ca in the cationic form/total amount of ^{45}Ca.

1) M. Bruno and U. Belluco, *Ricerca sci.*, **26**, 2985 (1956).