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AUTHOR

H. L. Brandt
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RECUPLEX PROCESS WASTE

By

H. L. Brandt and A. E. Reisenauer

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PRELIMINARY STUDY OF THE REMOVAL AND RECOVERY OF PLUTONIUM FROM
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INTRODUCTION

Recent experiments show that soil uptake of plutonium by cation exchange from Recuplex process waste is practically negligible. Additional experiments with synthetic cation exchangers also produced negative results. The plutonium occurs in the form of an anion nitrate complex, precluding the possibility of plutonium removal by cation exchange.

As a result, a laboratory investigation was started to determine the effectiveness of synthetic anion exchange resins for removing plutonium from these wastes. The initial results of this investigation indicate that a fixed bed ion exchanger may be utilized to remove a large part of the plutonium from CAW waste. Laboratory work is continuing to define the optimum resin and operating conditions.

SUMMARY AND CONCLUSIONS

The Recuplex process (CAW) waste, which is discharged to the 216-Z-9 crib, contains about 5.5 mg Pu/liter and is generated at a rate of about 60,000 liters/month. Laboratory experiments indicate that a fixed bed of synthetic anion exchange resin is effective for removing more than 95% of the Pu from this stream. In these tests the feed was introduced into the bed up to a flow rate of 554 liters/ft²/day. The Amberlite IRA-400 resin column has received 222 column volumes to date and has adsorbed the equivalent of 45.6 g/ft³ of Pu²³⁹.

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Removal of 95% of the plutonium from the resin can be accomplished with about 25 column volumes of 0.35 M nitric acid. The eluted plutonium nitrate may then be simply introduced into the Recuplex process for recovery.

Experimental Results

Batch equilibrium tests and column tests of anion exchange resins were performed. Plutonium in acid CAW waste has an equilibrium distribution coefficient of 1200 with Amberlite IRA-400 anion exchange resin. Diluting this waste with an equal volume of water reduces the distribution coefficient to 276.

Three resin column tests were performed at 28° C -- two with Amberlite IRA-400 resin and one with Permutit-SK resin, both anion exchangers. Column 1 contained 11.3 cc of IRA-400 resin in a 1.2 cm bed 10 cm long and operated at a flow rate equivalent to 398 liters/ft²/day. Column 2 contained 14.1 cc of IRA-400 resin in a 0.6 bed 50 cm long and operated at a flow rate equivalent to 554 liters/ft²/day. Column 3 contained 14.1 cc of Permutit-SK resin in a 0.6 cm bed 50 cm long and operated at a flow rate equivalent to 554 liters/ft²/day. The results of these three column tests are shown in Tables I, II, and III.

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TABLE I

Column 1 performance data, Amberlite IRA-400

Influent concentration: 4.9 mg Pu/l

<u>Accumulated total flow (column volumes)</u>	<u>% Pu Removed by resin</u>	<u>Pu concentration in effluent (mg/l)</u>
81	97	0.17
114	99	0.08
149	98	0.12
156	96	0.21
172	96	0.20
181	96	0.18
207	93	0.37
216	90	0.52

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TABLE II

Column 2 performance data, Amberlite IRA-400

Influent concentration: 7.4 mg Pu/l

<u>Accumulated total flow (column volumes)</u>	<u>% Pu Removed by resin</u>	<u>Pu concentration in effluent (mg/l)</u>
8	99	0.05
17	98	0.15
26	98	0.12
35	98	0.19
43	99	0.09
56	99	0.10
67	99	0.06
79	99	0.08
83	100	0.02
109	98	0.13
129	99	0.11
130	98	0.13
144	98	0.19
159	96	0.34
180	96	0.29
203	98	0.17
222	97	0.24

TABLE III

Column 3 performance data, Permutit-SK

Influent concentration: 7.4 mg Pu/l

<u>Accumulated total flow (column volumes)</u>	<u>% Pu Removed by resin</u>	<u>Pu concentration in effluent (mg/l)</u>
8	98	0.12
18	99	0.11
28	97	0.23
38	90	0.79
48	75	1.9
60	59	3.1
73	32	5.1
85	8	6.9
89	0	7.6
116	0	8.0
136	0	8.2

A mechanical failure required stopping the flow through column 1 prematurely, but the data confirm the capacity indicated by column 2. Testing of column 2 will continue until breakthrough. It is evident that Permutit-SK has a much lower efficiency for removing Pu from CAW waste than does Amberlite IRA-400 under the conditions of these tests.

The CAW waste has an approximate chemical composition of:

<u>Component</u>	<u>Molarity</u>	<u>Savannah River Gen. Paper</u>
Mg ⁺²	0.5	1.3 M
H ⁺	2.2	5.5 M
Al ⁺³	0.8	0.4 M
AlF ₃	0.1	0.6 M F ₃ ⁻
Ca ⁺²	0.2	0.2 M
NO ₃ ⁻	6.0	9.0 M

In addition, the waste contains small concentrations of plutonium-239 and

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americium-241. The determination of plutonium in these solutions is complicated by the presence of Am^{241} , which is also an alpha emitter. The Am^{241} concentration in CAW waste samples studied ranged from 0.012 mg/l (0.037 $\mu\text{c}/\text{ml}$) to 0.045 mg/l (0.14 $\mu\text{c}/\text{ml}$). Americium is not appreciably removed from solution by anion exchange resins.

A single elution test was performed on column 1 after it was loaded with plutonium. Dilute nitric acid (0.35 M) was used for elution. The data are shown in Table IV.

TABLE IV

Elution data - Column 1

Amberlite IRA-400 resin, about 1.0 mg Pu/cc.

<u>Accumulated leachate flow (column volumes)</u>	<u>% Pu eluted</u>	<u>Accumulated % Pu eluted</u>
1.9	21.4	21.4
3.7	15.7	37.0
5.6	8.1	45.2
7.4	5.5	50.7
9.8	5.5	56.1
12.5	6.3	62.4
14.9	5.5	67.9
17.5	15.2	83.1
19.9	5.3	88.3
22.5	4.2	92.5
24.9	2.1	94.6
27.4	1.9	96.5
30.3	1.3	97.8
33.2	2.0	99.7
35.7	0.03	99.8

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