BNWL-1557
UC-70

QUARTERLY PROGRESS REPORT
RESEARCH AND DEVELOPMENT ACTIVITIES
FIXATION OF RADIOACTIVE RESIDUES
NOVEMBER, DECEMBER 1970
AND JANUARY 1971

February 1971

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DEVELOPMENT REPORT

BNWL-1557

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November, December 1970 and January 1971

Edited by

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QUARTERLY PROGRESS REPORT
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INTRODUCTION

This progress report is the forty-eighth in a series presenting research and development activities in the field of radioactive wastes.

Experimental work charged to programs other than those of the Division of Reactor Development and Technology is sometimes included for general interest and completeness; such work is identified in the headings.

SUMMARY

The data obtained from the 33 radioactive demonstration runs in WSEP was summarized.

The performance of the auxiliary process systems during the rising level glass run was typical of the previous pot calcination runs.

Core-drilled samples from four WSEP pots have been obtained and are undergoing testing.

SUMMARY OF WSEP RADIOACTIVE
DEMONSTRATION DATA

J. N. Hartley

The final high level radioactive waste solidification demonstration run in WSEP was completed in October 1970. A summary of the radioactive demonstration data in WSEP is shown in Table 1. Waste from a total of 40 equivalent tonnes of power

TABLE 1. Summary of WSEP Radioactive Demonstration Data

Feed to Solidifier and Receiver Pot											Filled Receiver Pot									
Run No.	Mode	Type PW	Heat Rate Density, W/liter	Volume		Avg Feed Rate, liters/hr	Process Rate, tonne/day ^(c)	Total Equiv., tonne	Total MCi	Total Ru, kCi	Diam., in.	Solidified Product			Bulk Density, kg/liter	Total Heat Rate, kW	Heat Rate Density, W/liter	Q _o to Wall ΔT, (e) °C	Q _o Temp, (e) °C	K _e , W/(m ²) (°C/m) (e)
				liters/tonne	liters							Material	liters/tonne	liters						
PC-1	A	2	0.7	400	935	13.2	0.73 ^(c)	2.2	0.09	9	12	304L	50	105 ^(d)	1.4	0.42	3.5	70	140	0.41
PC-2	B	2	1.85	400	1039	14.8	0.79	2.3	0.43	35	12	304L	45	105	1.3	1.5	12.5	235	485 ^(f)	0.35 ^(f)
PC-3	A Mod.	2	3.20	420	553	11.9	0.72	1.4	0.38	32	8	304L	47	60	1.4	1.8	30	220	410	0.35
PC-4	C	1	2.40	370	1060	14.4	0.96	2.8	0.65	47	12	304L	41	110	1.5	2.7	23.7	312	477	0.44
PC-5	C	1	8.3	410	515	13.2	0.78	1.3	1.15	18	8	304L	43	55	1.6	4.3	73	495	725	0.41
PC-6	A	2	11	390	460	9.0	0.57	1.2	1.3	36	8	304L	50	60	1.3	5.1	85	700	940	0.30
PC-7	A	1	11.2	385	500	13.7	0.64	1.3	1.4	4	8	304L	46	60	1.2	5.6	93	756	1050	0.32
PC-8	A	4m	14.2	460	340	9.4	0.49	0.74	1.2	2	6	304L	46	34	1.3	4.8	141	546	856	0.35
PC-9 (RLG)	A	4m	14.3	705	393	9.0	0.30	0.56	1.4	2	6	310	32	16	3.5	5.6	310	332	720	1.34 ^(f)
						Avg 0.65		Σ13.8	Σ8.45	Σ185	Σ31.8									
PG-1	A, B	2	1.3, 1.3 ⁽¹⁾	480, 580 ⁽¹⁾	964, 431 ⁽¹⁾	15.7, 13.9 ⁽¹⁾	0.53	2.16	0.35	13	12	Mild Stl.	42	92	2.7	1.6	17	89	316 ^(f)	1.03 ^(f)
PG-2	A	2	3.9	586	873	18	0.38	0.89	0.40	20	8	304L	40	35	2.9 ^(j)	1.7	49	135	355	0.94
PG-3	A	2	10	458	697	11	0.21	0.69	0.60	10	8	Mild Stl.	51	35	2.8 ^(j)	3.3	95	255	655 ^(f)	0.98 ^(f)
PG-4	A	2	7	540	725	9.4	0.34	1.24	1.1	31	8	Mild Stl.	59	73	2.9 ^(j)	4.2	57	175	510 ^(f)	0.94 ^(f)
PG-5	A, B	1	13, 8 ⁽¹⁾	666, 1143 ⁽¹⁾	420, 842 ⁽¹⁾	11.1, 12.8 ⁽¹⁾	0.24	1.06	2.2	42	12	Mild Stl.	108	109	2.8	8.8	78	360	712	1.13
PG-6	A	1	16.8	889	616	12.3	0.28	0.69	2.4	8	8	304L	94	62	2.8	9.6	155	380	780	1.07
PG-7	A	2	17	644	806	18.2	0.63	1.05	2.8	13	8	310	64	67	2.7	8.5	146	418	749	1.09
PG-8	A, B	4m	14	722	660	13.3	0.42	0.84	2.3	9	8	Mild Stl.	79	67	2.9	9.8	132	350	710	0.97
PG-9	A	4m	11	1023	532	26.3	0.58	0.41	1.0	9 ^(g)	6	304L	65	27	2.9	4.8	158	204	566	1.22
PG-10	A	4m	24	1198	580	24.2	0.43	0.35	2.6	0 ^(g)	6	304L	84	29	2.9	9.5	317	369	827	1.22
PG-11	A	LMFBR	14.5	1916	813	19.3	0.22	0.38	3.3	30	8	304L	158	60	2.9	11.9	198	417	834	1.18
						Avg 0.39		Σ9.7	Σ19.1	Σ185	Σ73.7									
SS-1	A	1	0.55	455	603	16	0.84	1.3	0.08	5.7	12	304L	34	38	3.5	0.33	7.5	30	170	1.3
SS-2	B Mod.	1	2.5	455	789	14	0.72	1.7	0.42	5.3	8	304L	28	48	3.2	2.1	44	65	315	1.6
SS-3	A	2	4.8	590	357	11	0.46	0.6	0.42	26	8	304L	64	39	2.7	1.6	36	76	315	1.1
SS-4	A	2	11	560	500	12.3	0.53	0.9	1.4	15	8	Mild Stl.	63	56	2.9	5.4	91	220	505	1.1
SS-5	A	1	9.3	446	887	16.7	0.90	2.0	2.50	16	8	304L	33	66	3.2	8.3	127	278	633	1.2
SS-6	A	1	11	520	986	18	0.82	1.9	3.0	24	8	304L	34	65	3.2	11.1	168	308	767	1.4
SS-7	A	1	11.3	452	839	17.9	0.94	1.9	3.6	8	8	304L	34	62	3.2	12.7	204	450	928	1.14
SS-8	A	1	8.3	473	800	14.5	0.74	1.7	1.8	8.6	8	304L	35	59	2.9	6.5	109	210	605	1.40
SS-9	A	4m	8.0	630	792	15.2	0.58	1.3	2.0	4.4	8	310	54	68	2.9	7.2	106	240	594	1.14
SS-10	A, B	4m	11.1	611	750	13.5	0.46	1.07	2.2	6.3	8	Mild Stl.	52	56	3.1	7.2	124	260	610	1.30
SS-11	A	LMFBR	16.4	1230	670	14.9	0.29	0.54	3.1	3.6	8	304L	111	60	3.1	10.0	160	356	754	1.28
SS-12 (IPM)	A	4m	16.2	556	301	10.8	0.46	0.54	1.4	6.7	8	304L	100	54	3.0	4.86	90	197	474	1.18
SS-13 (IPM)	B Mod.	4m	33.8	352	308	15.4	1.05	0.88	2.8	10.9	8	304L	57	50	3.0	10.0	200	403	824	1.28
						Avg 0.68		Σ16.3	Σ24.7	Σ140.5	Σ 87.3									
								ΣΣ39.8	ΣΣ52.3	ΣΣ510.5	ΣΣ193									

MA Not Available
NDG No Detectable Gain
a. Ruthenium represented by ¹⁰⁶Ru.
b. Nonvolatiles represented by ¹⁴⁴CePr.
c. Based on feed time plus drying and cooling time for all pot calcine runs.

d. Product volume estimated from receiver pot temperatures and feed consumption for all pot calcine runs.
e. Receiver pot setting in furnace with cooling air on.
f. Receiver pot setting in furnace with cooling air off.
g. No radioruthenium in feed to solidifier.
h. High value due to failure of solidifier off gas filters.

Ruthenium Emitted ^(a)									Nonvolatiles Emitted ^(b)								
Fraction Emitted ⁽ⁱ⁾									Fraction Emitted ⁽ⁱ⁾								
From Solidi- fier	To Fractiona- tor, to 10 ⁻³	To Fract. Distillate Receiver, to 10 ⁻⁷	To Scrubber, to 10 ⁻⁶	To Scrubber Off-Gas, to 10 ⁻⁹	To Stack, to 10 ⁻⁹	Fract. Distillate Ratio to 10CFR20	Scrubber Off-Gas Ratio to 10CFR20	Stack Off-Gas Ratio to 10CFR20, to 10 ⁻⁴	From Solidi- fier	To Fractiona- tor, to 10 ⁻⁷	To Fract. Distillate Receiver, to 10 ⁻⁹	To Scrubber, to 10 ⁻⁹	To Scrubber, Off-Gas, to 10 ⁻¹²	To Stack, to 10 ⁻¹²	Fract. Distillate Ratio to 10CFR20	Scrubber Off-Gas Ratio to 10CFR20	Stack Off-Gas Ratio to 10CFR20, to 10 ⁻⁴
0.14	0.000013	<0.1	0.88		<0.3	<16		<150	0.004 ^(k)	<0.016	<1.6	1.6		---	---		7
0.30	0.004	40	11		<2.4	6,400		<71	0.004	0.40	40	1400		<1.1	350		4.3
0.31	0.00012	1	1.7		<2.3	350		<71	0.003	0.032	3.2	100		<1.7	70		63
0.05	0.00028	2.8	0.05		<1.0	1,000		<71	---	0.096	9.6	3.1		<1.3	1,800		8.6
0.03	0.017	170	---		<1.3	40,000		<71	---	0.25	25	---		<0.7	2,200		8.2
0.13	0.00017	1.7	0.07		<0.1	1,600		<4	0.012	0.001	<0.1	10		0.6	20		8.5
0.06	2.6	4600	23	4.8	<0.6	2,000	22	<4	0.002	4.60	NDG	NDG	4600	<1.2	NDG	94	17
0.11	1.4	2800	20	52	<60	27,000	430	220	0.012	22.70	17.6	NDG	300	0.9	750	390	10
0.15	2.3	3600	740	680	<1.0	90,000	260	4.13	0.004 ^(k)	40.90	0.96	NDG	5200	0.8	190	240	10
<0.1	10.0	170	---		<0.1 ^j	15,000		<4	<0.001	NA	1,800	NDG		4.1	17,000		8.5
0.09	1.0	13	9.0		<0.1	10,000		<4	<0.001	<1.2	11	40		5.8	770		8.9
<0.1	0.39	140	9.3		<0.1	66,000		<4	<0.001	7.9	9.6	NDG		0.5	1,100		8.1
<0.02	0.85	20	0.8		<0.1	7,800		<4	0.003	3.1	2	4		2	400		23
0.11	2.1	6.7	1.3		<0.1	1,800		<4	0.003	2.8	35	0.8		1	1,800		21
0.05	1.0	29	0.7		<0.3	3,200		<4	0.002	15	3.3	NDG		1	550		26
0.14	1.6	10	<0.01	110	<0.1	2,500	4500	<4	0.004	17	28	440	710	4	55	720	<0.06
0.046	1.4	28	12.5	900	<0.3	5,600	330	<4	<0.001	NDG	0.4	163	27	4.8	89	110	2.8
0.056	0.076	6.5	<0.01	3.5	<0.3	1,600	140	<4	0.001	8.0	28	NDG	6.9	0.1	3,500	1	1.4
NA(g)	NA(g)	NA(g)	NA(g)	NA(g)	NA(g)	NA(g)	140	<4	0.0007	4.9	3.2	NDG	3.5	0.05	2,150	18	1.4
0.071	0.52	2.2	0.63	1.4	<0.9	2,200	150	<4	0.0004	13	2.6	NDG	2.3	<0.23	1,500	10	<7.7
0.75	0.82	4	0.33		<1.0	16		<150	0.0005	<10	630	290		<10	140		16
0.74	4.0	30	2.5		<0.9	45		<71	0.0002	63	2.4	<1		3.6	1.5		15
0.73	2.4	80	25		<0.1	37,000		<4	0.10 ^(h)	40	31	22		11	940		3.7
0.11	1.4	270	36		<0.2	140,000		<4	0.002	9.6	3.5	68		<1.2	870		<16
0.70	6.4	600	85		<0.3	180,000		<4	0.0006	4.8	0.3	17		<0.9	1,100		<21
0.50	6.5	200	36		<0.1	22,000		<4	0.0007	7.9	6.2	5.7		---	510		<16
0.59	12	29	51		<0.3	10,000		<4	0.001	270	0.47	NDG		<0.3	220		<11
0.35	3.6	48	29		<0.2	14,000		<4	<0.001	120	1.1	50		<0.5	180		<8.2
0.57	6.5	23	18	6.8	<0.2	4,600	50	<4	<0.0002	NDG	NDG	NDG	9.9	2.3	---	3.3	51
0.45	5.3	47	32	1.3	<0.2	41,000	850	<4	0.0008	3.9	0.1	<0.7	22	1.5	12	750	34
0.75	2.1	52	19	18	<0.2	16,000	490	<4	0.0001	3.9	0.80	7.7	14	3.0	220	38	78
0.019	1.4	19	31	10	<0.4	11,000	190	<4	0.0001	24	NDG	NDG	32	2.0	150	70	24
0.005	0.62	23	6.7	11	<0.2	8,000	390	<4	0.00001	NDG	NDG	NDG	150	<0.74	3,000	58	<18

i. Total curies of component that accumulated in auxiliary tank/total curies of component feed to solidifier during entire run.
j. Laboratory measured density.
k. Approximately 10 to 20% additional activity can be assumed to be in the reflux drainage from the vent line.
l. Two feed batches were used.

reactor fuel was converted to solids in 33 demonstrations. Approximately 52 MCi of mixed radionuclides produced a total heat rate of 193 kW in the solid products. The heat rate density in the products varied from a low of 3.5 W/liter to a high of 317 W/liter.

POT SOLIDIFICATION

RADIOACTIVE DEMONSTRATIONS

Auxiliary Process System Performance During Run PC-9(RLG) -

J. N. Hartley

During rising level glass Run PC-9(RLG) (the solidifier performance was discussed in the previous quarterly*) the auxiliaries were operated in a Mode A arrangement as previously* used in both Runs PC-7 and PC-8 and illustrated in Figure 1. A total of 15% of the ruthenium fed to the pot volatilized and accumulated in the auxiliary evaporator. This was typical of the volatilization of ruthenium from the pot during the two previous pot calcination Runs PC-7 and PC-8. As reported previously, 0.38% of the nonvolatiles represented by $^{144}\text{CePr}$ were entrained from the pot and accumulated with the condensate (evaporator bottoms). The cesium leaving the pot and accumulating in the evaporator was higher than could be attributed entirely to entrainment, and indicated that cesium volatilization was probably about 0.6% (1.0% total accumulated). Figure 2 shows the accumulation of radionuclides in the auxiliary evaporator (volatilized and entrained radionuclides from the pot) as a function of percentage of feed fed to solidifier. The radionuclide distributions for Runs PC-7, PC-8, and PC-9(RLG) are summarized in Table 2.

The overall accumulation of radionuclides during Run PC-9 (RLG) in the auxiliaries was generally typical of previous WSEP runs. Figure 3 shows the accumulation of ruthenium in the WSEP auxiliaries for Run PC-7, PC-8, and PC-9(RLG).

* BNWL-1533, 70-3

FIGURE 1. WSEP Auxiliary Process System

FIGURE 2. Volatilization and Entrainment from the Pot During Run PC-9(RLG)

The average concentration of radionuclides in the process off-gas at various points in the auxiliary system are tabulated in Table 3. During Run PC-9(RLG), the solidifier condenser off-gas filter was by-passed and the average concentration of radionuclides in the off-gas was $3.5 \times 10^{-4} \mu\text{Ci}/\text{cm}^3$ for ^{106}Ru

**TABLE 2. Radionuclide Distribution in the WSEP Auxiliaries
for Runs PC-7, PC-8, and PC-9(RLG)**

	Fraction of Equivalent Feed Radioactivity for Total Run in Effluent Streams						
	PC-7 Mode A		PC-8 Mode A		PC-9 Mode A		
	¹⁰⁶ Ru	¹⁴⁴ CePr	¹⁰⁶ Ru	¹⁴⁴ CePr	¹⁰⁶ Ru	¹³⁷ Cs	¹⁴⁴ CePr
Evaporator (TK-113)	6.1×10^{-2}	1.5×10^{-3}	1.1×10^{-1}	1.2×10^{-2}	1.5×10^{-1}	1.0×10^{-2}	3.8×10^{-3}
Fractionator (TK-115)	2.6×10^{-3}	4.6×10^{-7}	1.4×10^{-3}	2.2×10^{-6}	2.2×10^{-3}	4.3×10^{-4}	4.1×10^{-6}
Fractionator Distillate Receiver (TK-116)	4.6×10^{-4}	NDG	2.8×10^{-4}	1.7×10^{-8}	3.6×10^{-4}	7.7×10^{-7}	9.7×10^{-10}
Off-Gas Scrubber (TK-118)	2.3×10^{-5}	NDG	2.0×10^{-5}	NDG	7.4×10^{-4}	8.1×10^{-7}	---
Off-Gas from Scrubber	4.8×10^{-8}	4.6×10^{-10}	5.2×10^{-7}	3.0×10^{-9}	6.8×10^{-8}	5.2×10^{-9}	1.7×10^{-10}
Off-Gas to Stack	$<6.0 \times 10^{-10}$	$<1.0 \times 10^{-12}$	$<6.0 \times 10^{-8}$	$<9.0 \times 10^{-13}$	$<1 \times 10^{-9}$	---	8×10^{-13}
Ratio (Fractionator Distillate Radioactivity to 10CFR20)	2.0×10^3	---	2.7×10^4	7.5×10^2	9×10^4	1.1×10^2	1.9×10^2
Ratio (Scrubber Off-Gas Radioactivity to 10CFR20)	22	94	3.9×10^2	4.3×10^2	3×10^2	1.2	2×10^2
Ratio (Stack Off-Gas Radioactivity to 10CFR20)	$<4.0 \times 10^4$	2.0×10^{-3}	$<1.0 \times 10^{-3}$	$<2.0 \times 10^{-2}$	$<4 \times 10^{-4}$	---	$<1 \times 10^{-3}$

NDG - No detectable gain in radioactivity

FIGURE 3. Accumulation of Ruthenium in the WSEP Auxiliaries During Runs PC-7, PC-8, and PC-9(RLG)

TABLE 3. Average Concentration of Radionuclides in the Process Off-Gas During Runs PC-7, PC-8, and PC-9(RLG)

PC Run Number	Solidifier Condenser Off-Gas, $\mu\text{Ci}/\text{cm}^3$		Off-Gas from Condenser Filter, $\mu\text{Ci}/\text{cm}^3$		Evaporator Condenser Off-Gas, $\mu\text{Ci}/\text{cm}^3$		Fractionator Condenser Off-Gas, $\mu\text{Ci}/\text{cm}^3$	
	^{106}Ru	$^{144}\text{CePr}$	^{106}Ru	$^{144}\text{CePr}$	^{106}Ru	$^{144}\text{CePr}$	^{106}Ru	$^{144}\text{CePr}$
7	1.4×10^{-4}	7.5×10^{-5}	---	---	1.3×10^{-5}	2.8×10^{-5}	1.9×10^{-5}	3.6×10^{-8}
8	1.0×10^{-3}	6.1×10^{-3}	4.8×10^{-6}	8.3×10^{-6}	3.6×10^{-7}	1.6×10^{-5}	6.8×10^{-6}	4.6×10^{-8}
9(RLG)	3.5×10^{-4}	1.3×10^{-3}	---(b)	---(b)	5.0×10^{-6}	1.5×10^{-5}	2.1×10^{-6}	1.4×10^{-7}

PC Run Number	Off-Gas from High Efficiency Filter, $\mu\text{Ci}/\text{cm}^3$		Final Off-Gas from Scrubber			
	^{106}Ru	$^{144}\text{CePr}$	$\mu\text{Ci}/\text{cm}^3$		Ratio to 10CFR20	
	^{106}Ru	$^{144}\text{CePr}$	^{106}Ru	$^{144}\text{CePr}$	^{106}Ru	$^{144}\text{CePr}$
7	3.1×10^{-6}	2.7×10^{-5}	1.1×10^{-8}	3.8×10^{-8}	55	95
8	1.5×10^{-5}	1.2×10^{-5}	7.9×10^{-8}	1.7×10^{-7}	4.0×10^2	4.3×10^2
9(RLG)	5.6×10^{-6}	3.9×10^{-6}	5.2×10^{-8}	9.5×10^{-8}	2.6×10^2	2.4×10^2

- a. The high concentration of radionuclides in the off-gas from the process filter is probably due to internal contamination of sampling line.
- b. The solidifier condenser off-gas filter was bypassed after about 15 minutes of elapsed run time.

and $1.3 \times 10^{-3} \mu\text{Ci}/\text{cm}^3$ for $^{144}\text{CePr}$. Again, as in the previous two pot calciner runs, there was very little ruthenium carried through the off-gas system in the gas phase.

During Run PC-9(RLG), the auxiliary evaporator and acid fractionator were successfully operated automatically using the GE-412 process computer. The auxiliary process control during Run PC-9(RLG) was discussed in the previous quarterly.*

The auxiliary evaporator operated with an average bottoms acidity of 5M HNO_3 and ranged from 4 to 6M HNO_3 . Instantaneous DF's across the evaporator varied from less than 10^2 to greater than 10^4 and were typically greater than 10^3 for ^{106}Ru and 10^3 to 10^4 for $^{144}\text{CePr}$. Again there was no apparent correlation between instantaneous ruthenium DF's and the evaporator overhead acidity. This is primarily attributed to internal contamination of the auxiliary system. The fraction of equivalent feed radioactivity that accumulated in the acid fractionator was 2.2×10^{-3} for ^{106}Ru , 4.2×10^{-4} for ^{137}Cs , and 4.1×10^{-6} for $^{144}\text{CePr}$. These values were in general agreement with those of Run PC-8,* except that the fraction of equivalent ^{137}Cs that accumulated in the fractionator during Run PC-9(RLG) indicated that some cesium volatilization occurred. These values indicated cumulative DF's across the evaporator of 59 for ^{106}Ru , 24 for ^{137}Cs , and 8.4×10^2 for $^{144}\text{CePr}$.

Instantaneous DF's across the fractionator ranged from less than 10 to 5.4×10^2 for ^{106}Ru and from 10^3 to 10^4 for $^{144}\text{CePr}$. The concentration of radionuclides in the final aqueous effluent (fractionator distillate) was above 10CFR20 release limits by factors of 9×10^4 for ^{106}Ru , 1.1×10^2 for ^{137}Cs , and 1.9×10^2 for $^{144}\text{CePr}$.

* BNWL-1533, 70-3

The fraction of equivalent ruthenium that accumulated in the off-gas scrubber was 7.4×10^{-4} , while 6.8×10^{-8} escaped in the scrubber off-gas. There was no detectable accumulation of $^{144}\text{CePr}$ in the off-gas scrubber; however, an equivalent fraction of 1.7×10^{-10} escaped in the scrubber off-gas. An equivalent fraction of 8.1×10^{-7} of the ^{137}Cs accumulated in the off-gas scrubber while 5.2×10^{-9} escaped in the scrubber off-gas. The concentration of radionuclides in the scrubber off-gas was above 10CFR20 release limits by factors of 3×10^2 for ^{106}Ru , 1.2 for ^{137}Cs , and 2×10^2 for $^{144}\text{CePr}$. The radionuclide concentration in the final off-gas to the stack after being filtered twice more and combined with the building ventilation air was well below 10CFR20 release limits.

LABORATORY STUDIES

CORROSION RATES IN BOILING WASTE SOLUTIONS - R. F. Maness

Corrosion rates of 304L, titanium, and Zircaloy-2 were determined in boiling simulated PW-4m and LMFBR waste solutions containing spray solidifier melt-forming additives and PW-4m waste solutions containing phosphate glass additives. The nitric acid content of the PW-4m waste solution containing phosphate glass additives was reduced from 6.0 to 2.0M via reaction with formaldehyde. The solutions containing spray solidifier additives were not treated with formaldehyde. All solutions were adjusted to 378 liters/tonne. After four weeks exposure none of the titanium or Zircaloy-2 specimens showed appreciable corrosion (rates less than 0.001 in./yr). Corrosion rates of 304L were about 0.12 in./yr in both the PW-4m and LMFBR waste solutions containing spray solidifier additives and about 0.06 in./yr in the low acid PW-4m waste solution containing phosphate glass additives. The attack was predominately intergranular.

EVALUATION OF SOLIDIFIED WASTE PRODUCTSNONRADIOACTIVE LABORATORY STUDIESStrontium Leach Rates - F. P. Roberts

The strontium leach rates of four typical simulated WSEP products have been determined. The measurements were carried out using the leach test procedure below.

Phosphate glass product samples were prepared from simulated PW-1 and PW-4m wastes. The melts were formed at 1000 °C and cooled at 30 °C/min to storage temperatures of 600 and 100 °C. The samples were held at the storage temperature for 12 weeks. The specimens for the leach test were cut from the solid samples with an abrasive wheel and the geometric surface area was measured. Similarly, samples of spray solidifier products were prepared from simulated PW-1 and PW-4m wastes. The specimens were placed in the leach test apparatus. The leach solution (distilled water) was removed and replaced at 1- or 2-week intervals. The strontium concentration of the leach solution was determined by a flame spectrometric technique after a carrier precipitation on lanthanum carbonate which served to remove interferences and to concentrate the strontium.

Figure 4 shows the data obtained with the phosphate glass samples. Sodium leach rates are included in these figures for comparison. The phosphate glass samples stored at 600 °C exhibit strontium leach rates which are nearly four orders of magnitude higher initially than the samples stored at 100 °C. The samples stored at 600 °C also show strontium leach rates which are somewhat lower than the sodium leach rates, while the samples stored at 100 °C have strontium leach rates which are slightly higher than the corresponding sodium leach rates.

Figure 5 shows the data obtained for the spray solidifier product samples. The effect of the higher storage temperature is similar to the phosphate glass product but is much less pronounced.

FIGURE 4. Strontium and Sodium Leach Rates of Phosphate Glass Products

FIGURE 5. Strontium and Sodium Leach Rates of Spray Solidifier Products

High Temperature Studies - F. P. Roberts and C. Hampton, Jr.

A part of the product characterization task is the evaluation of the behavior of the solidified wastes when subjected to elevated temperatures which might occur in the event that a pot would be immersed in a fire. The initial work on this study is the determination of the rate of volatilization of the constituents of the solidified wastes.

A technique for evaluating the volatility of the solidified waste based on direct gamma counting and weight loss is being developed in the laboratory. The procedure being used is to melt 2 to 3 grams of the solidified waste in a small alumina crucible. The crucible and its contents are cooled, weighed, and the gamma emitting constituents analyzed by gamma energy spectrometry. The specimen is then heated to a given temperature for a given time period and again cooled, weighed, and gamma counted. This procedure will give the rate of total weight loss as well as the rate of loss of specific gamma emitting constituents as a function of temperature and surface area. In the cold laboratory studies the specimens are tagged with tracers of sodium, cesium, strontium, and cerium.

This technique appears quite promising for use with actual WSEP products, and the procedure can be carried out in the hot cell.

RADIOACTIVE LABORATORY STUDIESEvaluation of WSEP Products - F. P. Roberts and C. Hampton, Jr.

Satisfactory core-drilled samples from four WSEP pots have been obtained which are now undergoing testing. The tests include cesium and cerium leach rates, dispersibility, and fission product segregation. The fission product segregation is being evaluated by direct gamma counting and by calorimetric measurements.

The status of the testing is shown in Table 4.

TABLE 4. Status of Core Drill Sample Testing

<u>WSEP Run Number</u>	<u>Number of Cores Obtained</u>	<u>Tests in Progress</u>	<u>Tests Completed</u>
PG-7	4	5 leach rates	2 dispersibility 3 calorimetry 7 direct gamma counts
PG-10	3	2 leach rates	2 dispersibility 3 calorimetry 5 direct gamma counts
SS-6	2	2 leach rates	2 dispersibility 2 calorimetry 6 direct gamma counts
SS-10	2	1 leach rate 1 dispersibility	2 calorimetry 5 direct gamma counts

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