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COMPILATION OF DATA ON COMPOSITION OFBISMUTH PHOSPHATE PROCESS METAL WASTES

The available information on the ionic and radiochemical composition of current and aged bismuth phosphate process wastes is tabulated here for the convenience of those concerned with metal recovery. In addition to its application in the design of research and development experiments, this compilation may serve to suggest specific needs for additional analytical data.

For convenience in chemical calculation, molar compositions have been calculated for the ionic constituents based on the g/l values usually reported. The dates of radiochemical analyses required for decay calculations should be available from the Analytical Sections at ORNL and HW.

I. Waste Designations.

A. Current Waste

CMW-current metal waste, i.e. 8-3 WS

2. NCW-neutralized current waste, i.e. 8-3 WS plus soda ash and caustic.

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B. Aged waste - T (1945) and U (1946) cascades

1. Supernates: location; sampling date

- a. 101-T-Sp a: 1st tank, T cascade; 7/47
- b. 101-T-Sp b: 1st tank; 8/47
- c. 101-T-Sp c: 1st tank; 11/48
- d. 102-T-Sp a: 2nd tank, T cascade; 7/47
- e. 102-T-Sp b: 2nd tank; 8/47
- f. 102-T-Sp c: 2nd tank; 11/48
- g. 103-T-Sp a: 3rd tank, T cascade; 7/47
- h. 103-T-Sp b: 3rd tank; 8/47
- i. 103-T-Sp c: 3rd tank; 2/48
- j. Comp - T - Sp: calcd. composite T cascade supernate
- k. 103-U-Sp a: inlet 3rd tank, U cascade; 2/49
- l. 103-U-Sp b: outlet 3rd tank, U cascade; 2/49

2. Sludges: location; sampling date

- a. 101-T-Sl a: inlet 1st tank T cascade, depth unknown; 6/48
- b. 101-T-Sl b: inlet, depth unknown; 8/48
- c. 101-T-Sl 2: inlet, 3' from bottom; 11/48
- d. 101-T-Sl 3: inlet, 2' from bottom; 11/48
- e. 101-T-Sl 4: inlet, 1' from bottom; 11/48
- f. 101-T-Sl 5: outlet, 1' from bottom; 11/48
- g. 101-T-Sl 6: outlet, just off bottom; 11/48
- h. 101-U-Sl 13: inlet 1st tank, U cascade, 4' from bottom; 2/49
- i. 101-U-Sl 14: inlet, 3' from bottom; 2/49

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- j. 101-U-S1 15: inlet, 2'7" from bottom; 2/49
- k. 101-U-S1 16: outlet, 3' from bottom; 2/49
- l. 102-U-S1 17: inlet 2nd tank, U cascade, 1" from bottom; 2/49
- m. 102-U-S1 18: outlet, 1" from bottom, 2/49

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II. Ionic Constituents.

Waste	Reference	g/l. for Liquid Wastes; g/Kg for Sludges					Moles/l. for Liquid Wastes; Moles/Kg for Sludges				
		U	Na	PO ₄	SO ₄	CO ₃	U	Na	PO ₄	SO ₄	CO ₃
CMW	1.	122.	2.3	42.	42.	0	0.513	0.10	0.44	0.44	0
MCW, calcd.**	2.	62.	90.	24.	24.	--	0.260	3.91	0.25	0.25	--
MCW, obsd.	3.	55.5	--	28.4	27.6	42.3	0.233	--	0.299	0.288	0.705
101-T-Sp a*	2.	6.7	--	38.5	28.4	--	0.0282	--	0.405	0.296	--
101-T-Sp b	2.	5.8	--	35.1	--	--	0.0244	--	0.359	--	--
101-T-Sp c	4.	6.7	70.3	31.	23.8	27.	0.0282	3.06	0.33	0.248	0.45
102-T-Sp a*	2.	24.0	--	31.	27.1	--	0.101	--	0.33	0.282	--
102-T-Sp b	2.	21.8	--	28.9	--	--	0.0916	--	0.304	--	--
102-T-Sp c	4.	21.5	67.2	25.0	17.0	30.4	0.0903	2.92	0.263	0.177	0.507
103-T-Sp a*	2.	26.6	--	34.0	25.0	--	0.112	--	0.358	0.260	--
103-T-Sp b	2.	24.6	--	32.4	--	--	0.103	--	0.341	--	--
103-T-Sp c	5.	26.4	76.1	25.4	21.6	54.7	0.111	3.31	0.267	0.225	0.912
Comp-T-Sp	6.	19.0	78.4	33.0	26.7	42.9	0.0800	3.41	0.347	0.278	0.715
103-U-Sp a	7.	20.	34.	10.	11.	20.	0.084	1.48	0.105	0.115	0.33
103-U-Sp b	7.	20.	37.	10.	11.	18.	0.084	1.61	0.105	0.115	0.30

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II. Ionic Constituents. (concluded)

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Waste •	Reference	g/l. for Liquid Wastes; g/kg for Sludges						Moles/l. for Liquid Wastes; Moles/Kg for Sludges						
		U	Na	PO ₄	SO ₄	CO ₃	NO ₃	U	Na	PO ₄	SO ₄	CO ₃	NO ₃	U/PO ₄
101-T-S1 a	4.	112.	116.	111.	24.	3.	51.	0.471	5.04	1.17	0.25	0.05	0.82	0.406
101-T-S1 b	4.	134.	85.	134.	22.	1.	16.	0.563	3.70	1.41	0.23	0.02	0.26	0.399
101-T-S1 2	8.	162.	104.	128.	19.	15.8	--	0.681	4.52	1.35	0.20	0.263	--	0.50
101-T-S1 3	8.	204.	116.	102.	12.	25.6	--	0.857	5.04	1.07	0.125	0.427	--	0.801
101-T-S1 4	8.	363.	137.	48.	8.	115.	--	1.53	5.96	0.505	0.08	1.92	--	3.03
101-T-S1 5	8.	346.	151.	16.	8.	255.	--	1.45	6.57	0.17	0.08	4.25	--	8.5
101-T-S1 6	8.	365.	146.	15.	6.	263.	--	1.53	6.35	0.16	0.06	4.38	--	9.6
101-U-S1 13	7.	329.	127.	61.	2.80	181.	2.	1.38	5.52	0.64	0.0292	3.02	0.03	2.16
101-U-S1 14	7.	263.	94.	49.	2.05	166.	3.	1.11	4.09	0.52	0.0214	2.77	0.05	2.13
101-U-S1 15	7.	273.	123.	53.	2.54	162.	3.5	1.15	5.35	0.56	0.0265	2.70	0.056	2.05
101-U-S1 16	7.	266.	108.	52.	3.03	41.	2.	1.12	4.70	0.55	0.0316	0.68	0.03	2.04
101-U-S1 17	7.	106.	109.	136.	5.08	69.	3.	0.445	4.74	1.43	0.0529	1.15	0.05	0.311
101-U-S1 18	7.	152.	85.	105.	9.26	90.	2.	0.639	3.70	1.11	0.0965	1.50	0.03	0.576

* Bi analysis: $< 0.02 \text{ g/l} \approx < 10^{-4} \text{ M Bi}^{\text{III}}$

* Bi analysis: $0.06 \text{ g/l} \approx 3 \times 10^{-4} \text{ M Bi}^{\text{III}}$

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III. Radiochemical Constituents.

A. ORNL Analyses

<u>Radiation</u>	<u>Geometry</u>	<u>Microcuries = cts./m.x.</u>	<u>Counting details</u>
Beta	10.2%	4.45×10^{-6}	Mica end-window G-M
Gamma	2nd Shelf	--	Al-Pb-Al sandwich on 1st shelf
Alpha	52%	8.7×10^{-7}	Simpson proportional counter

Activities given in cts./m./ml. for supernates, cts./m./mg. U for sludges.

<u>Activity</u>	<u>101-T-Sp c</u>	<u>103-T-Sp c</u>	<u>103-U-Sp a</u>	<u>103-U-Sp b</u>
Reference	4.	5.	7.	7.
Date of analysis	⊙			
Gross β ⊙	1.45×10^7	2.82×10^7	7.40×10^6	6.42×10^6
Gross γ	4.93×10^4	4.03×10^4	1.61×10^4	1.76×10^4
Gross α ⊙	7.85×10^3	5.2×10^3	--	--
Pu α	--	--	1.56×10^3	1.63×10^3
β -Cb	8.97×10^4	3.67×10^4	7.12×10^3	⊙ 8.48×10^3 ⊙
⊙ Ce	2.35×10^6	1.37×10^7	1.10×10^6	1.04×10^6
Cs	8.59×10^6	7.39×10^6	3.54×10^6	3.76×10^6
Ru	3.53×10^6	5.08×10^6	1.35×10^6	1.40×10^6
Sr	1.85×10^5	3.04×10^5	9.90×10^4	2.70×10^4
Zr	1.95×10^3	1.49×10^4	1.47×10^3	1.38×10^3
61	--	5.2×10^5	--	--
Other R.E.*	5.2×10^5	7×10^5	2.6×10^5	2.3×10^5
Other*	-8×10^5	4×10^5	1.0×10^6	-5×10^4

* By difference ⊙

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Activity	101-T-S1a	101-T-S1b	101-U-S1 13	101-U-S1 14
Reference	4.	4.	7.	7.
Date of analysis				
Gross β	1.70×10^6	2.15×10^6	3.13×10^6	5.10×10^5
Gross γ	5.80×10^4	3.68×10^2	8.60×10^2	1.49×10^2
Gross α	1.44×10^2	1.51×10^2	--	--
Pu α	--	--	94.4	56.2
β -Cb	5.05×10^2	1.46×10^3	1.78×10^3	2.88×10^2
Ce	9.1×10^5	7.22×10^5	2.11×10^6	2.46×10^5
Cs	8.24×10^4	3.59×10^4	7.74×10^4	1.39×10^4
Ru	4.25×10^4	3.09×10^4	8.48×10^4	1.62×10^4
Sr	2.24×10^5	3.92×10^5	8.80×10^4	4.26×10^4
Zr	3.56×10^3	4.75×10^3	3.25×10^3	4.98×10^2
61	1.49×10^5	--	--	--
Other R.E.*	2.2×10^5	5.1×10^5	4.1×10^5	1.78×10^3
Other*	7×10^4	4.5×10^5	3.5×10^5	1.3×10^4
Activity	101-U-S1 15	101-U-S1 16	102-U-S1 17	102-U-S1 18
Reference	7.	7.	7.	7.
Date of analysis				
Gross β	1.35×10^6	2.93×10^6	1.75×10^6	4.07×10^5
Gross γ	4.35×10^2	9.58×10^2	5.42×10^2	1.64×10^2
Gross α	--	--	--	--
Pu α	89	112	198	50
β -Cb	1.26×10^3	4.07×10^3	1.38×10^4	2.85×10^2
Ce	9.35×10^5	2.26×10^6	1.16×10^6	2.74×10^5
Cs	5.38×10^4	9.48×10^4	5.00×10^4	2.42×10^4

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III. Radiochemical Constituents. (concluded)

Activity	101-U-S1 15	101-U-S1 16	102-U-S1 17	102-U-S1 18
Ru	3.61×10^4	8.97×10^4	4.66×10^4	1.83×10^4
Sr	7.74×10^4	1.16×10^5	1.56×10^5	4.88×10^4
Zr	1.46×10^3	4.03×10^3	1.46×10^3	1.70×10^2
61	--	--	--	--
Other R.E.*	1.2×10^5	3.9×10^5	3.2×10^5	7.7×10^4
Other*	1.2×10^5	-3×10^4	0×10^4	$-4. \times 10^4$

B. HW Analyses. Reference: 2.

Activities given in cts./m./ml.

Waste	Gross α	Gross β	Gross γ
Geometry	--	8%	0.1%
CNW	5×10^3	4×10^8 (calcd.)	2×10^6
101-T-Sp a	5.2×10^3 *	1.9×10^7	4.6×10^4
102-T-Sp a	8.8×10^3 *	2.2×10^7	3.3×10^4
103-T-Sp a	8.9×10^3 *	2.6×10^7	3.5×10^4

* Evaporation analyses, thought to be about factor of 2 high for Pu alphas.

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