Zerwekh

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : Tom Keenan, H-7 Group Leader, MS-518 DATE: February 3, 1977

THRU : R. D. Baker, CMB-Division Leader, MS 756

FROM : G. R. Waterbury and Al Zerwekh, MS-740

SUBJECT: TRANSURANIC WASTE RESEARCH & DEVELOPMENT PROGRAM (A412) MONTHLY REPORT FOR JANUARY, 1977

SYMBOL : CMB-1

1521 Report

ANALYTICAL CHEMISTRY

Incinerator Feed Studies: In the determination of weight reduction factors for various waste matrices upon burning, polyvinylchloride (PVC) was previously burned at 1100°C to constant weight. The unburned residue was 6.12% of the plastic sample incinerated. Spectrochemical analysis of this residue showed it to be 50% Ti, 10% Ca, 1% each of Ba, Mg, Si, and P, and 0.1% each of Fe and Cr. The residue probably was largely due to filler and coloring materials added to the PVC. A sample of translucent, colorless sheet PVC is now being incinerated to determine if less residue will remain.

Radiolysis Studies: Laboratory studies of radiolysis effects caused by 62, 31, or 6.2 mg of ^{238}Pu as nitrate or oxide on 52.5-g quantities of various waste matrices in type-304, 300-cm^3, stainless-steel, test cylinders have shown that different waste matrices exposed to the same quantity of α-radiation generate gas at different rates. The compositions of the gas are consistently H_2, CO, CO_2, and CH_4 with occasional other hydrocarbons with masses up to 60, plus the normal constituents of the air present in the cylinders when closed. Oxygen from the included air and from degradation of cellulosics and rubbers is gradually used up in the formation of CO and CO_2, and the quantity of H_2 in the gas mixture increases.

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On the basis of the laboratory test results, ten 115-ℓ drums, that are in casks in LASL storage trenches and that contain hydrogenous waste highly contaminated with ^{238}Pu, were chosen for instrumentation and gas sampling. Drum internal gas pressure and temperature, and cask internal and external temperature are measured. Samples can be taken of the gas mixture inside the drum, in the space between the drum and the cask, and from beneath the cask. Periodic sampling and analyses showed a significant buildup of a potentially explosive gas mixture in some of the drums. The gas mixture consisted of H_2, CO, CO_2, CH_4, and occasional traces of other hydrocarbons as found in laboratory tests. Mass spectrographic analyses of the gas samples are shown in Table I. Note that the contents of drum 301 generated an explosive mixture of gases in 36 days, but in 64 days the hydrogen had increased and the oxygen decreased sufficiently to render the mixture non-explosive. In contrast, the gaseous contents of drum 330 were not in the explosive range in 23 days, but in 200 days the hydrogen-enriched gas mixture was explosible because the oxygen was not sufficiently depleted. Table II is a record of explosimeter testing of gas mixtures from laboratory cylinders and actual waste storage drums. The following conclusions may be drawn from the data: (1) If the hydrogen content of the gaseous mixture is 6 mol % or below, it probably is not explosible. (2) A gaseous mixture with relatively high hydrogen content and low oxygen content may not be explosible as shown by explosive test 9, 16, 18, and 23

Table I

Data from Selected Drums of ^{238}Pu-contaminated Waste in Covered-Trench Storage

Drum Number	^{238}Pu Content g	Waste Content Kg	Days in Storage	Temperature, °C: In-Side Drum	Temperature, °C: Out-Side Drum	Temperature, °C: Soil Under Cask	Gas Composition (Mol %) (All samples withdrawn from drums): H_2	CH_4	O_2	CO_2	CO	N_2
223	14.9	17.9	434 (Jan)	17.0	17.0	8.0	1.0	0.1	12.0	7.0	1.0	77.0
			626 (Jul)	23.5	24.0	19.0	0.9	0.1	11.2	7.5	0.8	78.6
			802 (Jan)	15.5	14.5	15.5	1.3	0.1	10.3	9.6	<0.1	77.8
224	22.1	14.5	434 (Jan)	21.0	18.0	12.0	0.2	<0.1	18.5	1.0	0.2	78.5
			805 (Jan)	25.0	20.0	15.5	0.1	<0.1	18.5	1.4	<0.1	78.[illegible]
232	29.4	10.2	434 (Jan) 76	23.5	17.5	12.0	6.0	0.3	6.6	12.0	3.0	71.0
			626 (Jul)	32.5	27.0	19.0	2.9	0.2	10.0	8.8	0.9	76.4
			802 (Jan) 77	26.0	18.5	15.5	3.2	0.1	8.6	9.8	<0.1	77.3
281	19.7	26.0	36 (Jan)		15.0	9.5	1.0	<0.1	18.0	3.0	0.7	76.0
			229 (Jul)		24.5	19.0	1.3	0.2	15.9	4.1	0.8	76.8
			400 (Jan)		17.5	15.5	3.4	0.1	13.3	7.1	<0.1	75.1
301	18.7	23.6	*36 (Jun)		15.0	11.0	11.0	0.5	10.0	11.0	4.0	62.0
			64 (Feb)				15.1	0.7	7.0	14.4	6.5	55.6
			222 (Jul)		25.0	19.0	41.9	1.4	< 0.1	23.2	10.1	22.9
			400 (Jan)		16.5	15.5	59.7	1.9	< 0.1	25.8	<0.1	12.4
330	17.4	10.9	23 (Jun)	20.5	21.0	19.0	1.7	<0.1	18.1	3.0	1.2	75.[illegible]
			*200 (Jan)	15.5	15.5	15.5	9.1	0.4	11.0	12.4	<0.1	66.3

*These samples were tested and found to be explosive.

TABLE II

SELECTED EXPLOSIMETER TESTS ON VARIOUS GAS MIXTURES

EXPL Test No.	Gas Composition H_2	CH_4	O_2	CO_2	CO	N_2	EXPLOSIBLE	MATRIX
53	4.1	0.2	19.2	2.5	1.5	71.6	NO	Cellulosics
52	4.3	0.1	9.8	0.1	0.2	36.6	NO	Duoseal on Vermiculite
59	4.5	0.2	19.1	2.8	1.4	71.1	NO	Cellulosics
49	5.0	<0.1	11.7	2.0	0.9	43.3	NO	Water-soaked Cellulosics
62	5.0	0.1	19.7	0.1	0.2	73.5	NO	Duoseal on Vermiculite
50	5.2	0.2	14.8	2.5	0.8	55.4	NO	Cellulosics, Plastics, Rubbers
70	5.3	0.1	15.3	0.1	0.2	58.4	NO	Duoseal on Vermiculite
67	5.4	<0.1	5.4	2.5	1.0	20.1	NO	Water-soaked Cellulosics
66	5.5	0.2	5.7	2.8	1.9	21.1	NO	Cellulosics
68	5.5	0.2	7.1	3.2	1.5	27.0	NO	Cellulosics
51	5.5	0.2	19.6	0.1	0.3	73.5	NO	Duoseal on Vermiculite
48	5.6	<0.1	6.8	1.9	0.9	24.4	NO	Water-soaked Cellulosics
58	5.9	0.2	4.8	3.0	2.0	18.0	NO	Cellulosics
69	5.9	<0.1	9.9	<0.1	0.3	37.0	NO	Polyethylene
57	6.0	<0.1	5.0	2.0	1.0	18.0	NO	Water-soaked Cellulosics
60	6.0	<0.1	9.8	2.5	1.1	36.9	NO	Water-soaked Cellulosics
42	6.1	0.2	6.5	3.6	1.9	23.6	YES	Cellulosics
72	6.1	0.2	7.4	3.6	2.0	27.0	YES	Cellulosics
44	6.2	<0.1	6.0	2.1	0.9	21.0	NO	Water-soaked Cellulosics
46	6.3	<0.1	6.7	<0.1	0.3	24.3	NO	Polyethylene
74	6.3	0.2	7.3	<0.1	0.1	27.8	NO	Duoseal on Vermiculite
71	6.4	<0.1	18.7	2.9	1.0	70.0	NO	Water-soaked Cellulosics
75	6.5	0.2	7.4	3.0	0.7	27.0	YES	Cellulosics, Plastics, Rubbers
45	6.6	0.2	6.5	<0.1	0.2	24.1	NO	Duoseal on Vermiculite
61	6.7	<0.1	14.3	<0.1	0.2	54.8	NO	Polyethylene
55	6.8	<0.1	6.2	0.1	0.3	24.0	YES	Polyethylene
76	6.8	0.3	7.0	4.6	0.1	26.3	YES	Cellulosics
43	6.8	0.2	7.9	0.1	0.2	29.2	YES	Duoseal on Vermiculite
73	6.9	<0.1	7.4	3.2	1.2	26.5	YES	Water-Soaked Cellulosics
40	6.9	0.3	9.0	6.0	2.0	34.0	YES	Cellulosics
56	7.0	<0.1	6.4	3.0	1.0	24.0	YES	Water-Soaked Cellulosics

TABLE II
(cont'd)

SELECTED EXPLOSIMETER TESTS ON VARIOUS GAS MIXTURES

EXPL Test No.	Gas Composition H_2	CH_4	O_2	CO_2	CO	N_2	EXPLOSIBLE	MATRIX
64	7.0	0.2	6.6	3.0	1.0	25.0	YES	Cellulosics, Plastics, Rubbers
47	7.1	0.3	6.9	5.4	2.0	25.2	YES	Cellulosics
41	7.3	0.2	7.0	4.0	1.0	26.0	YES	Cellulosics, Plastics, Rubbers
78	7.6	<0.1	6.1	<0.1	0.1	22.2	NO	Polyethylene
79	7.9	<0.1	6.5	3.0	<0.1	23.5	YES	Water-soaked Cellulosics
77	8.0	0.3	7.2	4.5	0.3	26.9	YES	Cellulosics
65	8.1	<0.1	7.9	3.0	1.0	29.0	YES	Water-soaked Cellulosics
54	8.2	3.0	5.5	5.0	<0.1	18.0	NO	Cellulosics
63	8.2	0.2	5.9	0.1	0.2	22.0	YES	Duoseal on Vermiculite
27	8.7	0.2	10.7	0.1	0.2	40.0	YES	Duoseal on Vermiculite
39	8.8	<0.1	9.0	3.0	1.0	32.0	YES	Water-soaked Cellulosics
38	8.9	<0.1	9.1	0.2	0.2	33.0	YES	Polyethylene
1	9.0	0.5	6.0	17.0	6.0	61.0	NO	Hydrogenous Solid Trash
81	9.1	0.4	11.0	12.4	<0.1	66.3	YES	Hydrogenous Solid Trash Drum 232 Drum 330
35	9.2	0.4	9.2	5.4	2.9	34.0	YES	Cellulosics
32	9.8	0.2	9.4	0.1	0.2	36.0	YES	Duoseal on Vermiculite
29	9.9	0.4	10.2	6.6	2.2	38.1	YES	Cellulosics, Plastics, Rubbers
37	10.1	<0.1	8.8	2.9	1.4	32.5	YES	Water-soaked Cellulosics
30	10.2	<0.1	9.8	0.2	0.2	37.5	YES	Polyethylene
28	11.0	0.5	10.2	10.9	4.2	62.4	YES	Hydrogenous Solid Trash (Drum 301)
36	11.1	0.4	9.1	7.0	3.3	33.6	YES	Cellulosics
31	13.5	<0.1	9.3	4.0	2.0	35.0	YES	Water-soaked Cellulosics
34	15.1	0.7	7.0	14.4	6.5	55.6	NO	Hydrogenous Solid Trash (Drum 301)
23	24.9	1.0	9.9	16.8	7.4	37.3	NO	Cellulosics
8	25.8	0.8	11.1	15.8	4.1	41.5	YES	Cellulosics, Plastics, Rubbers
9	26.0	1.0	10.0	19.0	8.0	36.0	NO	Cellulosics
18	27.1	0.8	8.8	21.3	7.9	33.5	NO	Cellulosics
22	29.0	1.0	9.0	18.0	8.0	34.0	NO	Cellulosics

TABLE II
(cont'd)

SELECTED EXPLOSIMETER TESTS ON VARIOUS GAS MIXTURES

EXPL Test No.	Gas Composition						EXPLOSIBLE	MATRIX
	H_2	CH_4	O_2	CO_2	CO	N_2		
16	36.4	0.1	7.9	7.6	3.33	29.2	NO	Water-soaked Cellulosics
4	40.5	0.1	10.6	6.0	3.0	39.0	YES	Water-soaked Cellulosics
12	42.8	1.0	11.6	0.3	0.2	43.6	NO*	Duoseal on Vermiculite
13	47.2	0.3	10.0	0.6	0.3	40.2	YES	Polyethylene
19	48.7	0.2	10.4	0.5	0.4	39.1	YES	Polyethylene

*Apparently Anomalous Behavior

in Table II. (3) Because of the possibility of air diffusion into any storage drum, all drums of ^{238}Pu-contaminated hydrogenous waste in interim storage must be considered potentially explosive until their gaseous contents have been analyzed and/or replaced with inert gas. The last conclusion must also be considered when recovering or reprocessing interim storage waste. The LASL has developed a drum sampling device which permits sampling the gaseous contents of a drum without exposure to the air.

✓ Meetings: On January 5, 1977, waste incineration and radiolytic attack of TRU-contaminated hydrogenous waste in interim storage were discussed with Mike J. Klem of ARHCO.
✓ On January 18, 1977, the third quarterly meeting of the Waste Isolation Pilot Plant Federal-State-Local Review Group was attended at the Albuquerque Convention Center.

G. R. Waterbury

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