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to: Memorandum to Records

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from: Christi Leigh (6821)

subject: Waste Parameters for a Single Panel Assuming a 50/50 Volume Split Between INEEL Supercompacted Waste and Waste from Other Sites; Revision 1

This memorandum presents a calculation of waste parameters in a single panel assuming that fifty percent of the volume is occupied by supercompacted debris waste from the Idaho National Engineering and Environmental Laboratory Advanced Mixed Waste Treatment Facility (INEEL AMWTF) and fifty percent of the volume of the panel is occupied by waste from sites other than INEEL. Throughout the remainder of this document, this panel will be referred to as Panel X.

Previous calculations (Leigh 2003a, 2003b, 2003c, 2003d) give waste parameters (masses of cellulose, plastic, rubber, oxyanions, and organic ligands) for Panel X assuming varying ratios of waste from INEEL and the other sites in Panel X. The EPA has noted that there is a possibility that Panel X would be loaded with supercompacted waste and waste from sites other than INEEL without any of the AMWTF non-debris waste in the panel (EPA 2004). In this memorandum, the waste parameters for Panel X are re-calculated assuming that fifty percent of the volume is occupied by supercompacted debris waste from the INEEL AMWTF and fifty percent of the volume of the panel is occupied by waste from sites other than INEEL. Throughout the remainder of this document, this is referred to as the EPA conservative assumption.

The methodology for determining the masses of cellulose, plastic, rubber, oxyanions, and organic ligands in Panel X is given in Leigh 2003a, 2003b, and 2003c. For the EPA conservative assumption, Equations 6 through 10 of Leigh 2003a, 2003b, and 2003c change to:

$$0.208\ a = 0.379\ e \qquad (6)$$

$$b = 0.00 \qquad (7)$$

$$c = 0.00 \quad (8)$$

$$d = 0.00 \quad (9)$$

$$a/7 + e/3 = 12{,}082 \quad (10)$$

Solving Equations 6 through 10 indicates that for the EPA conservative assumption there are

a = 37,084 55-gallon drums from other sites and
e = 20,352 100-gallon drums from INEEL

in Panel X.

Tables 1 and 2 show the calculation of the masses of cellulose, plastic, and rubber for the EPA conservative assumption. Tables 3 and 4 show equivalent calculations for the masses of complexing agents, and Tables 5 and 6 show equivalent calculations for the masses of oxyanions.

For comparison, if PANEL X is filled with a homogeneous waste mix, the mass of cellulose, plastic, and rubber would be (homogeneous cellulose, plastic and rubber densities taken from "WIPP CH-TRU Waste Material Parameter Disposal Inventory" in Lott 2003):

$$12{,}098 \text{ 7-packs} \times \frac{7 \text{ drums}}{7\text{-pack}} \times \frac{0.208 \text{ m}^3}{\text{drum}} \times \frac{58 \text{ kg}}{\text{m}^3} = 1.02 \times 10^6 \text{ kg cellulose}$$

$$12{,}098 \text{ 7-packs} \times \frac{7 \text{ drums}}{7\text{-pack}} \times \frac{0.208 \text{ m}^3}{\text{drum}} \times \frac{(42+16) \text{ kg}}{\text{m}^3} = 1.02 \times 10^6 \text{ kg plastic}$$

$$12{,}098 \text{ 7-packs} \times \frac{7 \text{ drums}}{7\text{-pack}} \times \frac{0.208 \text{ m}^3}{\text{drum}} \times \frac{14 \text{ kg}}{\text{m}^3} = 2.47 \times 10^5 \text{ kg rubber}$$

For comparison, if PANEL X is filled with a homogeneous waste mix, the complexing agent masses would be (total repository complexing agent masses taken from "Total Mass of Complexing Agents In The WIPP Repository for the CRA" in Leigh and Crawford 2003):

$$12{,}098 \text{ 7-packs} \times \frac{7 \text{ drums}}{7\text{-pack}} \times \frac{0.208 \text{ m}^3}{\text{drum}} \times \frac{142 \text{ kg}}{168{,}485 \text{ m}^3} = 1.48 \times 10^1 \text{ kg acetic acid}$$

$$12{,}098 \text{ 7-packs} \times \frac{7 \text{ drums}}{7\text{-pack}} \times \frac{0.208 \text{ m}^3}{\text{drum}} \times \frac{8{,}510 \text{ kg}}{168{,}485 \text{ m}^3} = 8.90 \times 10^2 \text{ kg sodium acetate}$$

$$12{,}098 \text{ 7-packs} \times \frac{7 \text{ drums}}{7\text{-pack}} \times \frac{0.208 \text{ m}^3}{\text{drum}} \times \frac{1190.5 \text{ kg}}{168{,}485 \text{ m}^3} = 1.24 \times 10^2 \text{ kg citric acid}$$

$$12{,}098 \text{ 7-packs} \times \frac{7 \text{ drums}}{7\text{-pack}} \times \frac{0.208 \text{ m}^3}{\text{drum}} \times \frac{400 \text{ kg}}{168{,}485 \text{ m}^3} = 4.18 \times 10^1 \text{ kg sodium citrate}$$

$$12{,}098 \text{ 7-packs} \times \frac{7 \text{ drums}}{7\text{-pack}} \times \frac{0.208 \text{ m}^3}{\text{drum}} \times \frac{13{,}796 \text{ kg}}{168{,}485 \text{ m}^3} = 1.44 \times 10^3 \text{ kg oxalic acid}$$

$$12{,}098 \text{ 7-packs} \times \frac{7 \text{ drums}}{7\text{-pack}} \times \frac{0.208 \text{ m}^3}{\text{drum}} \times \frac{33{,}940 \text{ kg}}{168{,}485 \text{ m}^3} = 3.55 \times 10^3 \text{ kg sodium oxalate}$$

$$12{,}098 \text{ 7-packs} \times \frac{7 \text{ drums}}{7\text{-pack}} \times \frac{0.208 \text{ m}^3}{\text{drum}} \times \frac{25.6 \text{ kg}}{168{,}485 \text{ m}^3} = 2.68 \times 10^0 \text{ kg sodium EDTA}$$

For comparison, if PANEL X is filled with a homogeneous waste mix, the nitrate, sulfate, and phosphate would be (total repository masses of nitrate, sulphate and phosphate taken from "Total Mass of Constituent for WIPP Design Capacity" in Leigh and Sparks-Roybal 2003):

$$12{,}098 \text{ 7-packs} \times \frac{7 \text{ drums}}{7\text{-pack}} \times \frac{0.208 \text{ m}^3}{\text{drum}} \times \frac{2.51 \times 10^6 \text{ kg}}{168{,}485 \text{ m}^3} = 2.62 \times 10^5 \text{ kg nitrate}$$

$$12{,}098 \text{ 7-packs} \times \frac{7 \text{ drums}}{7\text{-pack}} \times \frac{0.208 \text{ m}^3}{\text{drum}} \times \frac{4.21 \times 10^5 \text{ kg}}{168{,}485 \text{ m}^3} = 4.40 \times 10^4 \text{ kg sulfate}$$

$$12{,}098 \text{ 7-packs} \times \frac{7 \text{ drums}}{7\text{-pack}} \times \frac{0.208 \text{ m}^3}{\text{drum}} \times \frac{1.05 \times 10^5 \text{ kg}}{168{,}485 \text{ m}^3} = 1.10 \times 10^4 \text{ kg phosphate}$$

Table 1. Calculation of Cellulose, Plastic, and Rubber Masses in Panel X for the EPA Conservative Assumption

Container Type	Number of Containers in Panel X	Mass of Cellulose per Container (kg)	Mass of Plastic Per Container (kg)	Mass of Rubber Per Container (kg)	Mass of Plastic Packaging Per Container (kg)	Mass of Cellulose in Panel X (kg)[e]	Mass of Plastic in Panel X (kg)[f]	Mass of Rubber in Panel X (kg)[g]	Mass of Plastic Packaging in Panel X (kg)[h]
55-Gallon Drums With Waste Mix	37,084	[a]7.00	[a]5.51	[a]1.49	3.73	2.60×10^5	2.04×10^5	5.53×10^4	1.38×10^5
TDOPs from INEEL	0	[b]12.86	[b]16.99	[b]0.04	91.55	0.00×10^0	0.00×10^0	0.00×10^0	0.00×10^0
SWBs from INEEL	0	[c]5.17	[c]6.72	[c]0.02	30.24	0.00×10^0	0.00×10^0	0.00×10^0	0.00×10^0
55-Gallon Drums from INEEL	0	[a]7.00	[a]5.51	[a]1.49	3.73	0.00×10^0	0.00×10^0	0.00×10^0	0.00×10^0
100-gallon Drums from INEEL	20,352	[d]114.71	[d]77.52	[d]30.29	0.00	2.33×10^6	1.58×10^6	6.16×10^5	0.00×10^0
Total Mass in Panel X (kg)						2.59×10^6	1.78×10^6	6.72×10^5	1.38×10^5

[a]From Section 3.2.5 Leigh 2003a; [b]From Section 3.2.2 Leigh 2003a; [c]From Section 3.2.3 Leigh 2003a; [c]From Section 3.2.1 Leigh 2003a; [e]Calculated as the number of containers from Column 2 times the mass of cellulosics per container from Column 3; [f]Calculated as the number of containers from Column 2 times the mass of plastics per container from Column 4; [g]Calculated as the number of containers from Column 2 times the mass of rubbers from Column 5, [h]Calculated as the number of containers from Column 2 times the mass of plastic packaging from Column 6.

Table 2. Calculation of Cellulose, Plastic, and Rubber Masses in the Rest of Repository for the EPA Conservative Assumption

	Volume (m^3)	Mass of Cellulose (kg)	Mass of Plastic (kg)	Mass of Rubber (kg)	Mass of Plastic Packaging (kg)
All DOE Generator/Storage Sites	[a]1.69×10^5	[b]9.77×10^6	[b]7.08×10^6	[b]2.36×10^6	2.70×10^6
Panel X	[c]1.54×10^4	2.59×10^6	1.78×10^6	6.72×10^5	1.38×10^5
Rest of Repository	1.53×10^5	7.18×10^6	5.30×10^6	1.69×10^6	2.56×10^6

[a]From the definition of disposal inventory Leigh 2003a; [b]From Table 3 Section 3.2.5 Leigh 2003a, [c]Based on the number of containers and container volumes

Table 3. Calculation of Complexing Agent Masses in Panel X for the EPA Conservative Assumption

Container Type	Number of Containers in Panel X	Mass of Acetic Acid per Container (kg)	Mass of Sodium Acetate Per Container (kg)	Mass of Citric Acid Per Container (kg)	Mass of Sodium Citrate Per Container (kg)	Mass of Oxyalic Acid Per Container (kg)	Mass of Sodium Oxalate Per Container (kg)	Mass of Sodium EDTA Per Container (kg)
55-Gallon Drums With Homogeneous Mix	37,084	[a]1.98×10^{-4}	[a]1.19×10^{-2}	[a]1.66×10^{-3}	[a]5.58×10^{-4}	[a]1.92×10^{-2}	[a]4.73×10^{-2}	[a]3.57×10^{-5}
TDOPs from INEEL	0	[b]4.56×10^{-3}	[b]2.73×10^{-1}	[b]3.82×10^{-2}	[b]1.29×10^{-2}	[b]4.43×10^{-1}	[b]1.09×10^{0}	[b]8.22×10^{-4}
SWBs from INEEL	0	[c]1.80×10^{-3}	[c]1.08×10^{-1}	[c]1.51×10^{-2}	[c]5.07×10^{-3}	[c]1.75×10^{-1}	[c]4.30×10^{-1}	[c]3.25×10^{-4}
55-Gallon Drums from INEEL	0	[a]1.98×10^{-4}	[a]1.19×10^{-2}	[a]1.66×10^{-3}	[a]5.58×10^{-4}	[a]1.92×10^{-2}	[a]4.73×10^{-2}	[a]3.57×10^{-5}
100-gallon Drums from INEEL	20,352	[d]0	[d]0	[d]0	[d]0	[d]0	[d]0	[d]0
	Number of Containers in Panel X	Mass of Acetic Acid in Panel X (kg)[e]	Mass of Sodium Acetate in Panel X (kg)[f]	Mass of Citric Acid in Panel X (kg)[g]	Mass of Sodium Citrate in Panel X (kg)[h]	Mass of Oxyalic Acid in Panel X (kg)[i]	Mass of Sodium Oxalate in Panel X (kg)[j]	Mass of Sodium EDTA in Panel X (kg)[k]
55-Gallon Drums With Homogeneous Mix	37,084	7.35×10^{0}	4.40×10^{2}	6.16×10^{1}	2.07×10^{1}	7.14×10^{2}	1.76×10^{3}	1.32×10^{0}
TDOPs from INEEL	0	0.00×10^{0}	0.00×10^{0}	0.00×10^{0}	0.00×10^{0}	0.00×10^{0}	0.00×10^{0}	0.00×10^{0}
SWBs from INEEL	0	0.00×10^{0}	0.00×10^{0}	0.00×10^{0}	0.00×10^{0}	0.00×10^{0}	0.00×10^{0}	0.00×10^{0}
55-Gallon Drums from INEEL	0	0.00×10^{0}	0.00×10^{0}	0.00×10^{0}	0.00×10^{0}	0.00×10^{0}	0.00×10^{0}	0.00×10^{0}
100-gallon Drums from INEEL	20,352	0.00×10^{0}	0.00×10^{0}	0.00×10^{0}	0.00×10^{0}	0.00×10^{0}	0.00×10^{0}	0.00×10^{0}
Total Mass in Panel X (kg)		7.35×10^{0}	4.40×10^{2}	6.16×10^{1}	2.07×10^{1}	7.14×10^{2}	1.76×10^{3}	1.32×10^{0}

[a]From Section 3.2.5 Leigh 2003b; [b]From Section 3.2.2 Leigh 2003b; [c]From Section 3.2.3 Leigh 2003b; [d]From Section 3.2.1 Leigh 2003b; [e]Calculated as the number of containers from Column 2 times the mass of acetic acid per container from Column 3; [f]Calculated as the number of containers from Column 2 times the mass of sodium acetate per container from Column 4; [g]Calculated as the number of containers from Column 2 times the mass of citric acid per container from Column 5. [h]Calculated as the number of containers from Column 2 times the mass of sodium citrate per container from Column 6; [i]Calculated as the number of containers from Column 2 times the mass of sodium oxalate per container from Column 7; [j]Calculated as the number of containers from Column 2 times the mass of oxalic acid per container from Column 8; [k]Calculated as the number of containers from Column 2 times the mass of sodium EDTA per container from Column 9.

Table 4. Calculation of Complexing Agent Masses in the Rest of Repository for the EPA Conservative Assumption

Panel Type	Volume (m^3)	Mass of Acetic Acid (kg)	Mass of Sodium Acetate (kg)	Mass of Citric Acid (kg)	Mass of Sodium Citrate (kg)	Mass of Oxalic Acid (kg)	Mass of Sodium Oxalate (kg)	Mass of Sodium EDTA (kg)
All DOE Generator/Storage Sites	[a]1.69×10^5	[b]142	[b]8510	[b]1190.5	[b]400	[b]13,796	[b]33,940	[b]25.6
Panel X	[c]1.54×10^4	7.35×10^0	4.40×10^2	6.16×10^1	2.07×10^1	7.14×10^2	1.76×10^3	1.32×10^0
Rest of Repository	1.53×10^5	1.35×10^2	8.07×10^3	1.13×10^3	3.79×10^2	1.31×10^4	3.22×10^4	2.43×10^1

[a]From the definition of disposal inventory Leigh 2003b, [b]Crawford and Leigh 2003, [c]Based on the number of containers and container volumes

Table 5. Calculation of Nitrate, Sulfate, and Phosphate Masses in Panel X for the EPA Conservative Assumption

Container Type	Number of Containers in Panel X	Mass of Nitrate per Container (kg)	Mass of Sulfate Per Container (kg)	Mass of Phosphate Per Container (kg)	Mass of Nitrate in Panel X (kg)[e]	Mass of Sulfate in Panel X (kg)[f]	Mass of Phosphate in Panel X (kg)[g]
55-Gallon Drums With Waste Mix	37,084	[a]3.31	[a]0.71	[a]2.02	1.23×10^5	2.63×10^4	7.49×10^4
TDOPs from INEEL	0	[b]91.16	[b]1.22	[b]0	0.00×10^0	0.00×10^0	0.00×10^0
SWBs from INEEL	0	[c]36.08	[c]0.60	[c]0	0.00×10^0	0.00×10^0	0.00×10^0
55-Gallon Drums from INEEL	0	[a]3.31	[a]0.71	[a]2.02	0.00×10^0	0.00×10^0	0.00×10^0
100-gallon Drums from INEEL	20,352	[d]0	[d]0	[d]0	0.00×10^0	0.00×10^0	0.00×10^0
Total Mass in Panel X (kg)					1.23×10^5	2.63×10^4	7.49×10^4

[a]From Section 3.2.5 Leigh 2003c; [b]From Section 3.2.2 Leigh 2003c; [c]From Section 3.2.3 Leigh 2003c; [d]From Section 3.2.1 Leigh 2003c; [e]Calculated as the number of containers from Column 2 times the mass of nitrate per container from Column 3; [f]Calculated as the number of containers from Column 2 times the mass of sulfate per container from Column 4; [g]Calculated as the number of containers from Column 2 times the mass of phosphate from Column 5.

Table 6. Calculation of Nitrate, Sulfate, and Phosphate Masses in the Rest of Repository for the EPA Conservative Assumption

Panel Type	Volume (m^3)	Mass of Nitrate (kg)	Mass of Sulfate (kg)	Mass of Phosphate (kg)
All DOE Generator/Storage Sites	[a]1.69×10^5	[b]2.50×10^6	[b]4.21×10^5	[b]1.05×10^6
Panel X	[a]1.54×10^4	1.23×10^5	2.63×10^4	7.49×10^4
Rest of Repository	1.53×10^5	2.38×10^6	3.95×10^5	9.75×10^5

[a]From the definition of disposal inventory Leigh 2003c; [b]Leigh and Sparks-Roybal 2003, [c]Based on the number of containers and container volumes

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