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INITIALS mj DATE 10/08/2001

3. WASTE MATRIX PHYSICAL AND CHEMICAL COMPOSITION CHARACTERIZATION

The bulk of the stored wastes consist of physical mixtures of various materials and components generally in solid form, with some absorbed liquids. This section describes the stored waste inventory in terms of the relative mass fractions of the components and materials which make up the bulk waste matrix. An estimate of the chemical composition of those waste matrix materials is also provided. This information represents best estimates of the waste matrix composition to date based on engineering evaluation of previous characterization documentation and available waste generator process information. The information provided in this section is based on work by Gale (1994)^a and Raivo (1995).^b

Figure 3-1 and Table 3-1 present summary distribution of the waste matrix by component for ALLW and TRUW combined. Table 3-1 includes matrix identification codes per current DOE Waste Treatability Group Guidance.³⁻¹

Design basis estimates for chemical analysis for each constituent comprising the general waste matrix are presented in Tables 3-2, 3-3 and 3-4. Table 3-2 presents an estimate of chemical composition (elemental plus water and inert) of the constituents defined in the appendices. Table 3-3 presents an estimation of chemical composition of the inert fraction of constituents listed in Table 3-2 expressed as a fraction of the inert chemicals. Table 3-4 presents an estimation of chemical composition of the inert fraction of constituents listed in Table 3-2 expressed as a fraction of the total constituent chemicals.

Although not categorized as a stored INEL TSA waste stream, variable amounts of INEL RWMC soil may also be included for treatment as a result of retrieval efforts. Tables 3-5, 3-6, 3-7 and 3-8 present typical characterization information for RWMC soil derived from actual soil samples.³⁻² Table 3-5 presents particle size distribution and density information. Table 3-6 presents cation exchange capacity information. Table 3-7 presents a mineral content analysis, and Table 3-8 presents a chemical content analysis of RWMC soil.

Also, some soil from the Rocky Flats Plant past operations may be included as waste in the stored TSA waste. Tables 3-2, 3-3, and 3-4 present general estimated composition values for RFP soil. The detailed data in the appendices provide estimates of RFP soil content in the waste at the content code level. Tables 3-9, 3-10, 3-11, and 3-12 present additional characterization information for RFP soil derived from actual soil samples.³⁻² Table 3-9 presents particle size distribution and density information. Table 3-10 presents cation exchange capacity information. Table 3-11 presents a mineral content analysis, and Table 3-12 presents a chemical content analysis of RFP soil.

Both RWMC and RFP soil can be subjectively categorized as being very abrasive to operating (e.g., rotating) machinery.

a. L. G. Gale, Estimated Waste Matrix Compositions of ALLW for Treatment Design Basis, EDF IWPF-0047, February 1994.

b. B. D. Raivo, Estimated Waste Matrix Compositions of INEL stored waste, EDF PSPI-015546-14, December 15, 1995.

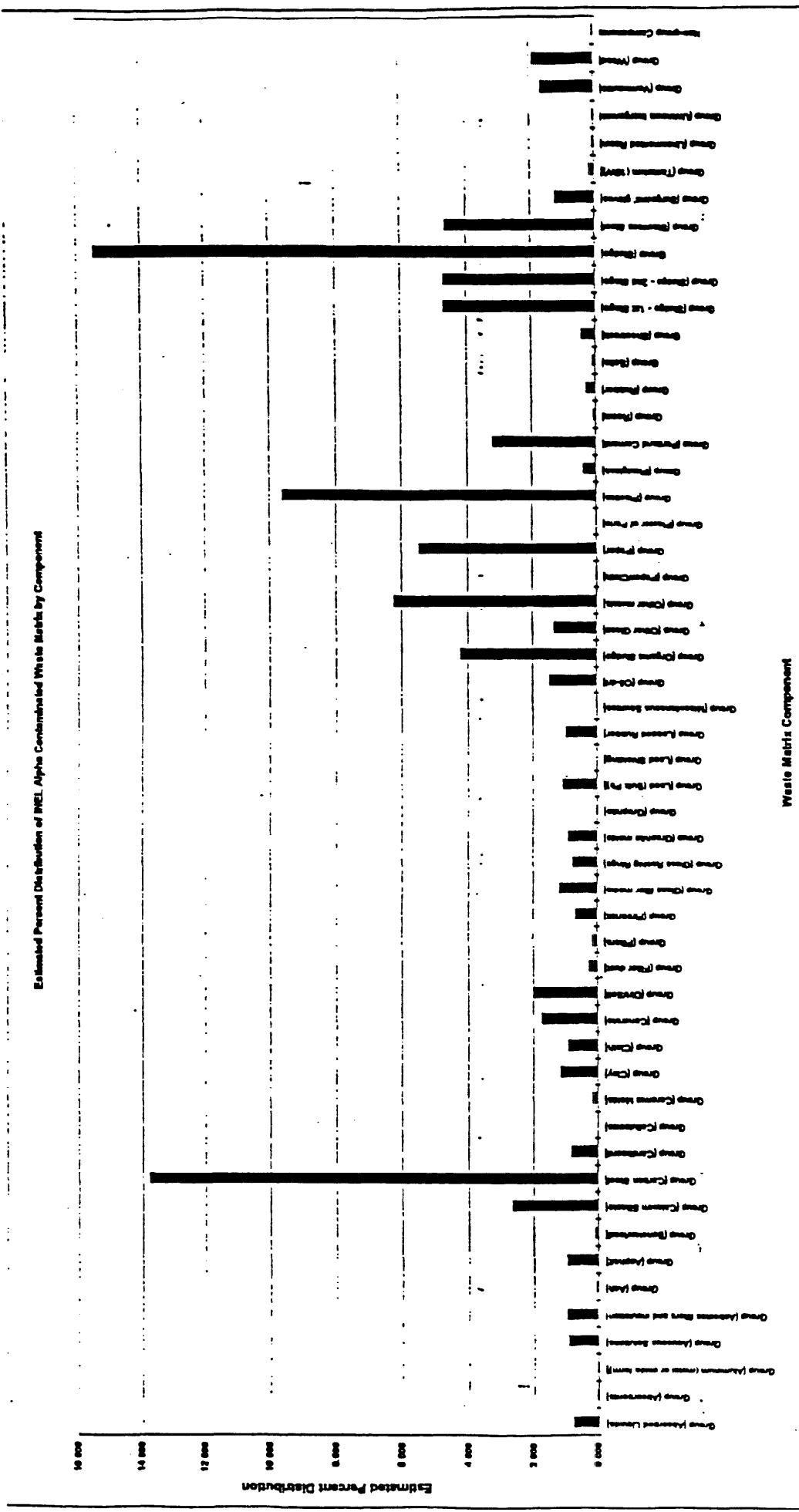


Figure 3-1. Distribution of waste matrix by component

Table 3-1. INEL alpha contaminated waste matrix composition summary by component.^a

Matrix code ^b	Waste matrix component ^c	Component mass (kg) ^d	Fraction of total identified mass	Estimated percent distribution of total estimated mass ^e
S3113	Group [Absorbed Liquids]	2.0690e+05	0.0079	0.790
S3121	Group [Absorbents]	8.5000e+03	0.00032	0.032
S3112	Group [Aluminum (metal or oxide form)]	3.6920e+03	0.00014	0.014
S3121	Group [Aqueous Solutions]	2.3800e+05	0.00909	0.909
SS410	Group [Asbestos filters and insulation]	2.5060e+05	0.00957	0.957
S3111	Group [Ash]	1.3350e+04	0.00051	0.051
SS450	Group [Asphalt]	2.5180e+05	0.00961	0.961
SS440	Group [Benelex/lead]	2.2010e+04	0.00084	0.084
S3114	Group [Calcium Silicate]	6.9140e+05	0.02639	2.639
SS111	Group [Carbon Steel]	3.6100e+06	0.13777	13.777
SS330	Group [Cardboard]	2.1140e+05	0.00807	0.807
SS330	Group [Cellulosics]	7.9800e+02	0.00003	0.003
SS123	Group [Ceramic Molds]	4.1980e+04	0.0016	0.160
S3113	Group [Clay]	2.9900e+05	0.01141	1.141
SS330	Group [Cloth]	2.3890e+05	0.00912	0.912
S3150	Group [Concrete]	4.4900e+05	0.01714	1.714
S4100	Group [Dirt/Soil]	5.2160e+05	0.01991	1.991
SS410	Group [Filter dust]	6.7750e+04	0.00259	0.259
SS320	Group [Filters]	3.7990e+04	0.00145	0.145
SS123	Group [Firebrick]	1.7270e+05	0.00659	0.659
SS410	Group [Glass filter media]	3.0600e+05	0.01168	1.168
S3117	Group [Glass Raschig Rings]	1.9650e+05	0.0075	0.750
SS126	Group [Graphite molds]	2.3340e+05	0.00891	0.891
S3110	Group [Graphite]	1.5590e+03	0.00006	0.006
X7211	Group [Lead (Bulk Pb)]	2.7510e+05	0.0105	1.050
X7210	Group [Lead Shielding]	6.2000e+02	0.00002	0.002
SS311	Group [Leaded Rubber]	2.5000e+05	0.00954	0.954
S3100	Group [Miscellaneous Sources]	0.0000e+00	0	0.000
S3113	Group [Oil-dri]	3.8100e+05	0.01454	1.454
S3114	Group [Organic Sludge]	1.1030e+06	0.04211	4.211
SS122	Group [Other Glass]	3.4320e+05	0.0131	1.310
SS110	Group [Other metals]	1.6320e+06	0.06229	6.229
SS330	Group [Paper/Cloth]	1.1370e+03	0.00004	0.004
SS330	Group [Paper]	1.4320e+06	0.05465	5.465
S3113	Group [Plaster of Paris]	8.5000e+02	0.00003	0.003
SS310	Group [Plastics]	2.5150e+06	0.096	9.600
SS313	Group [Plexiglass]	9.9160e+04	0.00378	0.378
S3121	Group [Portland Cement]	8.3660e+05	0.03193	3.193
S3211	Group [Resin]	1.4760e+04	0.00056	0.056
SS310	Group [Rubber]	7.2190e+04	0.00276	0.276
S3140	Group [Salts]	1.9430e+04	0.00074	0.074

Table 3-1. (continued).

Matrix code ^b	Waste matrix component ^a	Component mass (kg) ^d	Fraction of total identified mass	Estimated percent distribution of total estimated mass ^c
S5120	Group [Sheetrock]	1.1160e+05	0.00426	0.426
S3121	Group [Sludge - 1st Stage]	1.2270e+06	0.04683	4.683
S3121	Group [Sludge - 2nd Stage]	1.2270e+06	0.04683	4.683
S3121	Group [Sludge]	4.0490e+06	0.15454	15.454
S5111	Group [Stainless Steel]	1.2100e+06	0.04617	4.617
S5310	Group [Surgeons' gloves]	3.1690e+05	0.0121	1.210
S5111	Group [Tantalum (10W)]	3.8440e+04	0.00147	0.147
S3211	Group [Uncemented Resin]	9.1840e+03	0.00035	0.035
S5100	Group [Unknown Inorganics]	7.1090e+03	0.00027	0.027
S3113	Group [Vermiculite]	4.2910e+05	0.01638	1.638
S5320	Group [Wood]	4.9320e+05	0.01883	1.883
	Non-group Components ^f	3.2042e+03	0.00011	0.011
	Total	2.6173e+07	1.00	100

a. EDF PSPI-015546-14, 12/15/95.

b. Matrix codes per DOE Waste Treatability Group Guidance, DOE/LLW-217, Rev. 0, January 1995.

c. As derived from rollup of the IMWI database %wt composition splits as of 9/95, which are based on A. L. Rubert, References for Descriptions and Matrix Compositions of Corrent Code Wastes Stored at the Transuranic Storage Area, IMWI-EDF-004, June 21, 1995; L. G. Gale, B. D. Raivo, Estimated Waste Matrix Compositions of a-LL Waste for Treatment Design Bases, IWPF-EDF-0047, June 22, 1994; and current updates provided in IMWI.

d. As derived from rollup of database %wt composition splits.

e. Estimated total mass of INEL alpha-contaminated waste is 3.19E+07 kg (6.49E+04 m³).

f. Other minor matrix components similar to, but not in the group categories, may be assigned to individual waste streams; see detailed information and electronic tables.

Table 3-2. Chemical composition of waste constituents of the waste stored in the TSA.

Matrix Code (a)	Waste Matrix Component (a)	Constituent (b)	Wt% of waste constituent									
			Carbon	Hydrogen	Oxygen	Nitrogen	Sulfur	Chlorine	Fluorine	Water	Inert	References / Notes
Non-Combustible Glass												
S3117	Group [Glass Raschig Rings]	Glass Raschig rings	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	L.G. Gale, B.D. Raivo, IWPF EDF-0047, 6/22/94
S3122	Group [Other Glass]	Other glass	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	L.G. Gale, B.D. Raivo, IWPF EDF-0047, 6/22/94
Metals												
S5111	Group [Carbon Steel]	Carbon steel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	L.G. Gale, B.D. Raivo, IWPF EDF-0047, 6/22/94
S5111	Group [Stainless Steel]	Stainless steel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	L.G. Gale, B.D. Raivo, IWPF EDF-0047, 6/22/94
S3112	Group [Aluminum (metal or oxide form)]	Aluminum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	L.G. Gale, B.D. Raivo, IWPF EDF-0047, 6/22/94
S5111	Group [Tantalum (10W)]	Tantalum 10W	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	L.G. Gale, B.D. Raivo, IWPF EDF-0047, 6/22/94
X7211	Group [Lead (Bulk Pb)]	Lead	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	Group [Lead (Bulk Pb)] same inert composition as Lead from L.G. Gale, B.D. Raivo, IWPF EDF-0047, 6/22/94
X7210	Group [Lead Shielding]	Lead	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	Group [Lead Shielding] same inert composition as Lead from L.G. Gale, B.D. Raivo, IWPF EDF-0047, 6/22/94
S5110	Group [Other metals]	0.999 Misc. Metals:0.001HVP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	Ratio Group [Other Metals] to 0.999 Misc Metals:0.001 HVP based on Content Code 480 and IMWI total estimated masses for content codes and EDF 0047 for Misc. Metal to HVP splits.
		Miscellaneous metal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	L.G. Gale, B.D. Raivo, IWPF EDF-0047, 6/22/94
		HVP (Zn, Cd)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	L.G. Gale, B.D. Raivo, IWPF EDF-0047, 6/22/94
Miscellaneous Non-Combustible												
S5123	Group [Ceramic Molds]	Ceramic molds	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	L.G. Gale, B.D. Raivo, IWPF EDF-0047, 6/22/94
S5123	Group [Firebrick]	Firebrick	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	97.00	L.G. Gale, B.D. Raivo, IWPF EDF-0047, 6/22/94
S3150	Group [Concrete]	Concrete	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.72	91.28	L.G. Gale, B.D. Raivo, IWPF EDF-0047, 6/22/94
S3121	Group [Portland Cement]	Portland cement	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	95.00	L.G. Gale, B.D. Raivo, IWPF EDF-0047, 6/22/94
S4100	Group [Dirt/Soil]	Dirt/soil (RFP)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	90.00	L.G. Gale, B.D. Raivo, IWPF EDF-0047, 6/22/94
S3111	Group [Ash]	Ash	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	L.G. Gale, B.D. Raivo, IWPF EDF-0047, 6/22/94
S3113	Group [Oil-dri]	Oil-Dri	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	95.00	L.G. Gale, B.D. Raivo, IWPF EDF-0047, 6/22/94
S3113	Group [Vermiculite]	Vermiculite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	95.00	L.G. Gale, B.D. Raivo, IWPF EDF-0047, 6/22/94
S3140	Group [Salts]	Evap. salts—CC #5	0.85	0.13	0.00	0.00	0.00	0.00	0.00	0.13	98.88	L.G. Gale, B.D. Raivo, IWPF EDF-0047, 6/22/94
Filters/Insulation												
S5320	Group [Filters]	Wood	46.94	5.00	35.61	0.00	0.05	0.00	0.00	10.00	2.42	Assume inert fractions same composition as wood per IWPF EDF-0047, Content Code 30.
S5410	Group [Glass filter media]	Glass filter media	3.96	0.54	0.00	0.00	0.00	0.00	0.00	5.00	90.50	L.G. Gale, B.D. Raivo, IWPF EDF-0047, 6/22/94
S5410	Group [Asbestos filters and insulation]	Asbestos filter media	3.96	0.54	0.00	0.00	0.00	0.00	0.00	5.00	90.50	L.G. Gale, B.D. Raivo, IWPF EDF-0047, 6/22/94
S5410	Group [Filter dust]	Filter dust	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	90.00	L.G. Gale, B.D. Raivo, IWPF EDF-0047, 6/22/94
Inorganic Sludge												
S3121	Group [Sludge]	0.5 high Na2O:0.5 high CaO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.00	40.00	From IWPF EDF-0047, (CC 7), group [Sludge] is 50% 1st Stage, 50% 2nd Stage sludge.
S3121	Group [Sludge - 1st Stage]	Sludge—high Na2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.00	40.00	L.G. Gale, B.D. Raivo, IWPF EDF-0047, 6/22/94
S3121	Group [Sludge - 2nd Stage]	Sludge—high CaO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.00	40.00	L.G. Gale, B.D. Raivo, IWPF EDF-0047, 6/22/94
S3121	Group [Aqueous Solutions]	Aqueous solutions	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	0.00	L.G. Gale, B.D. Raivo, IWPF EDF-0047, 6/22/94
Partially Combustible												
S3111	Group [Leaded Rubber]	Leaded rubber	33.16	4.47	1.01	0.28	0.51	0.00	0.00	0.00	80.56	L.G. Gale, B.D. Raivo, IWPF EDF-0047, 6/22/94
S3114	Group [Organic Sludge]	Organic sludge	26.69	3.65	0.00	0.00	0.00	39.69	0.00	0.00	29.97	L.G. Gale, B.D. Raivo, IWPF EDF-0047, 6/22/94
S3211	Group [Uncemented Resin]	Uncemented resin	83.03	6.97	0.00	0.00	0.00	0.00	0.00	10.00	0.00	L.G. Gale, B.D. Raivo, IWPF EDF-0047, 6/22/94
S3211	Group [Resin]	Cemented resins	27.68	2.32	0.00	0.00	0.00	0.00	0.00	20.00	50.00	L.G. Gale, B.D. Raivo, IWPF EDF-0047, 6/22/94
EDF 0047 cemented resin consists of resin and portland cement. IMWI Group identifiers split the cemented resin into resin and portland cement. (Ex. Content Code 432). Use inert fraction for Group [Uncemented Resin] for the Group iResin].												
S3211	Group [Asphalt]	Uncemented resin	83.03	6.97	0.00	0.00	0.00	0.00	0.00	10.00	0.00	L.G. Gale, B.D. Raivo, IWPF EDF-0047, 6/22/94
S5450	Group [Benelex/lead]	Asphalt	4.29	0.49	0.05	0.05	0.12	0.00	0.00	0.00	95.01	L.G. Gale, B.D. Raivo, IWPF EDF-0047, 6/22/94
S5440	Group [Benelex/lead]	Benelex/lead	33.20	3.53	25.19	0.00	0.03	0.00	0.00	3.35	34.70	L.G. Gale, B.D. Raivo, IWPF EDF-0047, 6/22/94
S5120	Group [Sheetrock]	Sheetrock	0.41	0.06	0.42	0.00	0.00	0.00	0.00	20.77	78.34	L.G. Gale, B.D. Raivo, IWPF EDF-0047, 6/22/94
S3113	Group [Absorbed Liquids]											
Combustibles												
Plastics												
S5310	Group [Plastics]	0.800 Poly:0.199 PVC:0.001 Teflon	77.40	11.86	2.09	0.09	0.02	7.11	0.08	0.00	1.36	The plastic ratio (0.8 Poly:0.199 PVC:0.001 Teflon) From EDF 0047 is based on the narrative in EGG-WM-8503 and WM-F1-828021 (WASTDAT7.wk3).
		Poly	84.93	13.40	0.35	0.11	0.02	0.00	0.00	0.00	1.19	L.G. Gale, B.D. Raivo, IWPF EDF-0047, 6/22/94
		PVC	47.38	5.73	9.09							

Table 3-4. Chemical composition of the inert fraction of waste constituents stored in the TSA (expressed as a fraction of the total constituent chemicals).

Matrix Code (a)	Waste Matrix Component (b)	Constituent (b)	Wt % of Inert fraction																				Total	Reference / Notes																
			Metals Form (b,c)			Aluminum	Boron	Barium	Cadmium	Carbon	Chromium	Copper	Gallium	Iron	Lead	Magnesium	Manganese	Nickel	Phosphorus	Potassium	KNO3	Silicon	Sodium	NaNO3	Tantalum	Tin	Titanium	Tungsten	Vanadium	Zinc	SO3	Cl	CO2							
Non-Combustible																																								
85117	Group [Glass Rasching Rings]	Glass Rasching rings	2	0.00	12.80	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	62.20	20.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	LG. Gale, B.D. Raive, IWPF EDF-0047, 6/22/94							
85122	Group [Other Glass]	Other glass	2	0.00	5.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	70.00	20.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	LG. Gale, B.D. Raive, IWPF EDF-0047, 6/22/94							
85111	Group [Carbon Steel]	Carbon steel	1	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	39.10	0.00	0.00	0.45	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	LG. Gale, B.D. Raive, IWPF EDF-0047, 6/22/94							
85111	Group [Stainless Steel]	Stainless steel	1	0.00	0.00	0.00	0.00	0.00	0.00	0.03	19.00	0.00	0.00	71.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	LG. Gale, B.D. Raive, IWPF EDF-0047, 6/22/94							
85112	Group [Aluminum (metal or oxide form)]	Aluminum	1	98.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	LG. Gale, B.D. Raive, IWPF EDF-0047, 6/22/94							
85111	Group [Tantalum (10W)]	Tantalum 10W	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	90.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	LG. Gale, B.D. Raive, IWPF EDF-0047, 6/22/94						
<i>Group [Lead (Bulk Pb)] same inert composition as Lead from LG. Gale, B.D. Raive, IWPF EDF-0047,</i>																																								
X7211	Group [Lead (Bulk Pb)]	Lead	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	99.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	LG. Gale, B.D. Raive, IWPF EDF-0047, 6/22/94								
X7210	Group [Lead Shielding]	Lead	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	99.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	LG. Gale, B.D. Raive, IWPF EDF-0047, 6/22/94								
85110	Group [Other metals]	0.999 Misc. Metals:0.001 HVPM	1	29.97	0.00	0.00	0.00	0.00	0.00	1.05	0.00	1.00	0.99	0.00	49.85	1.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	2.05	0.00	0.00	0.00	0.00	0.00	100.00	LG. Gale, B.D. Raive, IWPF EDF-0047, 6/22/94					
		Miscellaneous metal	1	30.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	10.00	0.00	50.00	1.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	100.00	LG. Gale, B.D. Raive, IWPF EDF-0047, 6/22/94					
		HVPM (Zn, Cd)	1	0.00	0.00	0.00	0.00	0.00	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	LG. Gale, B.D. Raive, IWPF EDF-0047, 6/22/94						
Miscellaneous Non-Combustible																																								
85123	Group [Ceramic Molds]	Ceramic molds	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	38.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	LG. Gale, B.D. Raive, IWPF EDF-0047, 6/22/94	
85123	Group [Firebrick]	Firebrick	2	41.71	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	97.00	LG. Gale, B.D. Raive, IWPF EDF-0047, 6/22/94	
85120	Group [Concrete]	Concrete	2	0.39	0.00	0.00	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	80.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	91.29	LG. Gale, B.D. Raive, IWPF EDF-0047, 6/22/94	
85121	Group [Portland Cement]	Portland cement	2	0.56	0.00	0.00	59.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.03	95.00	LG. Gale, B.D. Raive, IWPF EDF-0047, 6/22/94
84100	Group [Dirt/Silt]	Dirt/silt (RFF)	2	11.43	0.00	0.00	3.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	90.00	LG. Gale, B.D. Raive, IWPF EDF-0047, 6/22/94	
83111	Group [Ash]	Ash	2	15.22	0.00	0.12	7.74	0.00	0.51	0.00</td																														

Table 3-5. Particle size distribution and mean density of RWMC soil.*

Particle size distribution of as received RWMC soil

Particle size (mm)	Wt%	Cumulative Wt%
-0.075	10.98	10.98
0.075-0.15	15.35	26.33
0.15-0.3	5.63	31.96
0.3-0.6	6.64	38.60
0.6-1	5.98	44.58
1-2.36	12.98	57.56
2.36-25.0	42.44	100

Particle size and density distribution of RWMC soil. Portion <1 mm blended (44.5% <1 mm).

Particle size (mm)	Wt%	Cumulative Wt%	Mean density (g/cm ³)
-0.075	24.64	24.64	2.55
0.075-0.15	34.43	59.07	2.48
0.15-0.3	12.62	71.69	2.58
0.3-0.6	14.89	86.58	2.66
0.6-1	13.42	100	2.54
Mass fraction ave density			2.55

a. Sample (one ten gallon drum, 35 kg) collected from the Lost River Spreading Area A adjacent to the RWMC which is commonly used as a source of soil fill for the RWMC, EGG-WTD-9749, June 1991.

Table 3-6. Cation exchange capacity of RWMC soil.

Particle size (mm)	Cation exchange capacity ^a (milliequivalent/100 grams)	
	Ashed	Unashed
0.6-1	17.7	17.2
0.3-0.6	13.9	15.5
0.15-0.3	15.0	16.0
0.075-0.15	13.3	15.0
-0.075	13.3	13.3
Unclassified	11.6	15.0

a. Sample (one ten gallon drum, 35 kg) collected from the Lost River Spreading Area A adjacent to the RWMC which is commonly used as a source of soil fill for the RWMC. Portion of sample <1 mm blended (44.5% <1 mm), EGG-WTD-9749, June 1991.

Table 3-7. Mineral content of RWMC soil.

Typical breakdown: 37 wt% quartz, 48 wt% clay minerals, 10 wt% calcite, and 5 wt% minor constituents.

Mineral species	Wt% of species ^a					
	Unclassified	1-0.6 mm	0.6-0.3 mm	0.3-0.15 mm	0.15-.075 mm	-0.075 mm
Quartz	37.46	35.98	34.67	34.68	39.24	37.77
Ill/Mont-Random	25.77	23.08	28.22	26.26	25.04	27.09
Fe-Illite/Nontronite	10.71	13.76	14.12	11.88	9.08	9.59
Calcite	9.92	10.34	9.68	10.07	8.86	10.50
Illite	8.35	4.70	6.37	7.16	6.70	8.94
Chlorite-Mg	3.33	4.57	2.41	4.49	4.54	3.31
Rutile	0.74	0.78	0.76	0.81	0.66	0.70
Andesine	1.33	4.64	2.41	0	0	0
Hydrous Phosphate	0.37	0.40	0.38	0.43	0.34	0.39
Microcline	1.98	1.79	0.94	1.15	2.85	1.42
Oligoclase	0	0	0	3.16	2.63	0.24

a. Sample (one ten gallon drum, 35 kg) collected from the Lost River Spreading Area A adjacent to the RWMC which is commonly used as a source of soil fill for the RWMC. Mineral Content as a function of particle size for RWMC soil. Portion of sample <1 mm blended (44.5% < 1 mm), EGG-WTD-9749, June 1991.

Table 3-8. Chemical composition of RWMC soil.

Typical composition: SiO₂ 64.0 wt%, Al₂O₃ 11.0 wt%, Fe₂O₃ 4.0 wt%, FeO 0.7 wt%, CaO 7.0 wt%, K₂O 2.0 wt%, MgO 2.0 wt%, Organic 0.5 wt%, TiO₂ 0.7 wt%, Na₂O 0.3 wt%.

Compound	Wt% of compound ^a					
	Unclassified	1-0.6 mm	0.6-0.3 mm	0.3-0.15 mm	0.15-.075 mm	-0.075 mm
SiO ₂	64.81	63.57	64.20	63.17	66.37	64.92
Al ₂ O ₃	11.15	11.09	11.46	11.67	10.91	11.05
Fe ₂ O ₃	3.70	3.97	3.78	3.85	3.17	3.40
CaO	6.84	7.22	6.87	7.00	6.09	7.13
K ₂ O	2.26	2.21	2.14	2.24	2.25	2.20
MgO	2.14	2.41	2.13	2.46	2.39	2.20
H ₂ O ⁻	3.50	3.28	4.90	5.29	4.12	5.05
H ₂ O ⁺	2.51	2.51	2.54	2.64	2.48	2.52
CO ₂	4.36	4.54	4.25	4.42	3.90	4.61
TiO ₂	0.735	0.780	0.756	0.805	0.657	0.699
FeO	0.698	0.738	0.806	0.810	0.798	0.753
FeS ₂	0.019	0.019	0.019	0.019	0.019	0.019
Na ₂ O	0.252	0.423	0.454	0.382	0.409	0.205
BaO	0.094	0.093	0.088	0.094	0.092	0.089
P ₂ O ₅	0.192	0.206	0.198	0.222	0.179	0.202
Organic	0.54	0.56	0.76	0.87	0.64	0.68

a. Sample (one ten gallon drum, 35 kg) collected from the Lost River Spreading Area A adjacent to the RWMC which is commonly used as a source of soil fill for the RWMC. Chemical composition as a function of particle size for RWMC soil. Portion of sample <1 mm blended (44.5% <1 mm), EGG-WTD-9749, June 1991.

Table 3-9. Particle size distribution and mean density of Rocky Flats Plant soil.^a

Particle size distribution of as received RFP soil

Particle size (mm)	Wt%	Cumulative Wt%
-0.075	5.2	5.2
0.075-0.15	16.3	21.5
0.15-0.3	18.7	40.2
0.3-0.6	16.8	57.0
0.6-1	7.5	64.5
1-2.36	6.9	71.4
2.36-37.5	28.6	100

Particle size and density distribution of RFP soil. Portion <1 mm blended (64.5% <1mm)

Particle size (mm)	Wt%	Cumulative Wt%	Mean density (g/cm ³)
-0.075	8.0	8.0	2.51
0.075-0.15	25.2	33.2	2.47
0.15-0.3	28.9	62.1	2.41
0.3-0.6	26.1	88.3	2.54
0.6-1	11.7	100	2.63
Mass fraction ave density			2.49

a. Sample (18 one gallon cans) collected about 150 yards southeast of 903 Pad, EGG-WTD-9749, June 1991.

Table 3-10. Cation exchange capacity of RFP soil.

Particle size (mm)	Cation exchange capacity ^a (milliequivalent/100 grams)	
	Ashed	Unashed
0.6-1	5.5	9.4
0.3-0.6	7.8	32.7
0.15-0.3	15.5	37.7
0.075-0.15	16.1	35.5
-0.075	12.8	27.2
Unclassified	13.3	34.4

a. Sample (18 one gallon cans) collected about 150 yards southeast of 903 Pad. Portion of sample <1 mm blended (64.5% < 1 mm) EGG-WTD-9749, June 1991.

Table 3-11. Mineral content of Rocky Flats Plant soil.

Typical breakdown: 47 wt% quartz, 38 wt% clay minerals, 13 wt% feldspars, and 2 wt% minor constituents.

Mineral species	Wt% of species*					
	Unclassified	1-0.6 mm	0.6-0.3 mm	0.3-0.15 mm	0.15-0.075 mm	-0.075 mm
Quartz	47.23	68.51	48.48	41.70	39.07	39.86
Illite-Ca	20.76	13.99	16.57	17.77	20.88	20.84
Microcline	7.68	6.12	11.36	4.42	4.00	1.21
Ill/Mont-Random	12.45	9.09	9.94	25.39	18.79	18.76
Chlorite-Fe	4.23	0.46	1.68	0.23	2.34	1.96
Labradorite	4.92	0	5.64	3.86	0	0
Fe-Illite/Nontronite	0.04	0	4.97	2.38	3.51	4.20
Andesine	0	0.68	0	0	7.98	10.32
Rutile	0.56	0.26	0.45	0.62	0.68	0.70
Calcite	0.42	0.60	0.38	0.11	0	0
Hydrous Phosphate	0	0.26	0	0	0.46	0.46
Pyrite	0.09	0.02	0.02	0	0.11	0.09
Apatite	0.40	0	0.43	0.50	0	0
Pyroxene	1.04	0	0	1.71	1.43	0.95
Mg-Siderite (Mg 15)	0	0	0	1.01	0	0
Dolomite	0	0	0	0	0.49	0.53

a. Sample (18 one gallon cans) collected about 150 yards southeast of 903 Pad. Mineral content as a function of particle size for RFP soil. Portion of sample <1 mm blended (64.5% <1mm), EGG-WTD-9749, June 1991.

Table 3-12. Chemical composition of Rocky Flats Plant soil.

Typical composition: SiO₂ 75.0 wt%, Al₂O₃ 11.0 wt%, Fe₂O₃ 2.0 wt%, FeO 2.0 wt%, CaO 2.0 wt%, K₂O 3.0 wt%, MgO 1.7 wt%, Organic 6.0 wt%, TiO₂ 0.7 wt%, Na₂O 0.5 wt%.

Compound	Wt% of compound ^a					
	Unclassified	1-0.6 mm	0.6-0.3 mm	0.3-0.15 mm	0.15-0.075 mm	-0.075 mm
SiO ₂	74.14	85.00	76.15	72.24	70.69	70.88
Al ₂ O ₃	11.29	6.78	10.83	12.40	13.02	12.97
Fe ₂ O ₃	1.90	1.32	2.49	2.78	2.90	3.01
FeO	1.87	0.63	0.79	1.58	1.71	1.61
CaO	1.90	0.99	1.76	2.10	2.10	2.03
K ₂ O	3.16	2.32	3.37	3.30	3.20	3.17
MgO	1.78	0.64	1.35	1.60	1.83	1.73
H ₂ O ⁻	12.83	5.29	9.54	17.23	12.79	12.11
H ₂ O ⁺	2.05	1.12	1.68	2.15	2.25	2.22
CO ₂	0.19	0.30	0.17	0.54	0.40	0.27
TiO ₂	0.54	0.758	0.452	0.615	0.677	0.698
FeS ₂	0.094	0.019	0.019	0.019	0.112	0.094
Na ₂ O	0.467	0.224	0.686	0.438	0.741	0.811
BaO	0.066	0.044	0.066	0.072	0.071	0.069
P ₂ O ₅	0.204	0.133	0.184	0.217	0.239	0.238
Organic	5.87	3.50	5.83	10.55	6.32	5.50

a. Sample (18 one gallon cans) collected about 150 yards southeast of 903 Pad. Chemical composition as a function of particle size for RFP soil. Portion of sample <1 mm blended (64.5% < 1 mm), EGG-WTD-9749, June 1991.

3.1 References

- 3-1. Radioactive Waste Technical Support Program, *Department of Energy Waste Treatability Group Guidance*, DOE/LLW-217, Rev. 0, January 1995.
- 3-2. J. H. Lee, G. P. Martins, J. R. Weidner, *Characterization Studies on: a) Contaminated Batch of Rocky Flats Soil, b) Uncontaminated Batch of INEL Soil*, EG&G-WTD-9749, June 1991.

