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DOE MIXED WASTES: WHAT ARE THEY AND WHERE CAN THERMAL TECHNOLOGIES BE APPLIED?

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DOE MIXED WASTES: WHAT ARE THEY AND WHERE CAN THERMAL TECHNOLOGIES BE APPLIED?

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ABSTRACT

The Mixed Waste Treatment Project (MWTP) has collected and analyzed mixed low-level waste data to assist in developing treatment capability for the U.S. Department of Energy's (DOE) wastes. Initial data on the characteristics of mixed waste was obtained from the Waste Management Information System (WMIS) data base, and has been updated based on visits to DOE sites where most of the wastes are generated and stored. The streams of interest to the MWTP have a current inventory of about 70,000 m^3 and a generation rate of about 7,700 m^3/yr. The 12 sites with the most significant processing needs are Fernald, Hanford, K-25 (Oak Ridge), Idaho National Engineering Laboratory (INEL), Lawrence Livermore National Laboratory (LLNL), Los Alamos National Laboratory (LANL), Oak Ridge National Laboratory (ORNL), Paducah Gaseous Diffusion Plant, Portsmouth Gaseous Diffusion Plant, Rocky Flats Plant (RFP), Savannah River Site (SRS), and Y-12 (Oak Ridge). These 12 sites account for about 98% of the mixed waste volumes.

The wastes have been assigned to specific waste characterization categories and a flowsheet that identifies applicable technologies has been developed. The largest waste stream category, when considering the current inventory in storage, is inorganic solids, with sludges, filter cakes, and residues the largest specific subcategories. Aqueous liquids are the largest currently generated stream. The other large categories are solid organics, metals wastes, and heterogenous wastes. Organic liquids, which have been a major focus, are the smallest of the categories. The major thermal treatment units include evaporators, incinerators, vitrifiers, metal melters, and off-gas treatment systems.

INTRODUCTION

The DOE has generated and continues to generate a significant volume of mixed low-level wastes at 30 different sites across the country. These wastes are generally going into interim storage and need to be treated to allow their disposal. The MWTP has been established to coordinate DOE's efforts in mixed waste treatment. The primary objectives of the MWTP are to select, integrate, operate, and deploy nationally a set of technologies for mixed waste treatment. The project will identify applicable technologies and then aid in

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selecting the best set of alternatives for an initial prototype treatment facility. Multiple technologies will require the integration of various parts of the treatment system into a total overall flowsheet. The integration process will need to consider the specific problems at each site and the appropriate method to balance the various site needs into the prototype treatment facility. The initial plant will serve as a standardization facility for subsequent facilities, and will provide the opportunity to improve the design and operation of the treatment systems. The scope and status of the MWTP is described in Coleman et al (1).

An initial function of the MWTP has been to identify the characteristics and volumes of mixed low-level wastes. These data are needed to select the treatment technologies and identify the treatment sites. Several data bases and reports have been prepared during the past several years. The major DOE data base for hazardous wastes, called the Waste Management Information System (WMIS), is maintained by HAZWRAP at Oak Ridge. This data base was first developed for a report entitled the National Report on Prohibited Waste and Treatment Options, completed by DOE in 1989 in response to the Rocky Flats Federal Facilities Compliance Agreement with the U.S. Environmental Protection Agency (EPA). It was used for development of the DOE Case-By-Case Extension Application (3) that was recently submitted to the EPA. It is also the major source of information on mixed low-level wastes for the DOE's Integrated Data Base Report (4). Although these reports contain a detailed listing of the wastes, they did not contain sufficient information for the MWTP. While the sites have made substantial efforts to identify hazardous components in the wastes, information on the waste matrix is often lacking.

DATA-GATHERING ACTIVITIES

To obtain more detailed information about the wastes, the MWTP has sponsored visits to the major DOE sites to enhance and update the information in the WMIS. New information obtained from the visits is being used to update the WMIS data base. However, much of the desired information was not available for many streams. Information on waste characteristics continues to evolve as regulations governing waste generation, storage, treatment, and disposal are better understood. The quality of the data continues to improve as the sites complete characterization, classification, and treatment activities. The data also continue to be regrouped based on the definition and groupings of waste streams by the various sites. With the current state of information, it should be recognized that the information reported in this paper will change as better information becomes available.

LOCATIONS AND VOLUMES OF WASTE

The existing data have been sorted by site and aggregated as total current inventory and expected total generation rate. It is very difficult to project the future generation rate of waste streams since DOE programs are continuing to change and sites are successfully implementing waste minimization activities to reduce future waste generation.

The data for inventory and generation rate are listed by site in Table 1. Four major waste streams have been omitted from the data base since they are anticipated to be treated in dedicated facilities and the MWTP interest in waste volumes needing treatment. Two streams are at the Hanford site, where much of the single-shell and double-shell tank wastes are classified as mixed waste. These two streams are the largest DOE mixed-waste streams and amount to about 218,000 m^3 of existing inventory and 13,000 m^3/yr of annual generation. A grout treatment facility has been established at Hanford to treat these wastes and prepare them for disposal. The third waste stream of about 27,000 m^3 is composed of two types of waste, a cemented and a raw sludge, from the waste pond at the K-25 site. Under evaluation is the ability of the currently cemented materials to meet the RCRA disposal requirements without further treatment. Treatment capability will be needed for the remaining raw sludge, which has a volume of about 11,500 m^3. The fourth waste stream is the "pondcrete" at the Rocky Flats site. This stream, with a volume of about 5000 m^3, is currently being treated.

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The 12 sites with the most significant processing needs are Fernald, Hanford, K-25 (Oak Ridge), INEL, LLNL, LANL, ORNL, Paducah Gaseous Diffusion Plant, Portsmouth Gaseous Diffusion Plant, RFP, SRS, and Y-12 (Oak Ridge). These 12 sites account for about 98% of the mixed waste volumes. Figure 1 shows the relative current inventory and generation rate for the largest sites.

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INEL currently has the largest inventory of waste. The wastes requiring treatment are expected to result from the reclassification of currently stored TRU wastes that were shipped from RFP. The reclassified wastes are those with less than 100 nCi/g of TRU. Y-12, SRS, and K-25 are the other sites with significant current inventories. INEL also has the largest generation rate as the result of one large stream that they currently plan to evaporate and treat with their intermediate-level waste. Without that stream, INEL's generation rate is only 31 m^3/yr and they are one of the smaller waste generation sites. Likewise, the high generation rate at SRS is from aqueous waste streams. It is not expected that these streams will continue to be stored as high volume aqueous streams but rather that they will be treated and appear as concentrates or sludges in the future.

WASTE CHARACTERISTICS

To develop additional information about the wastes, each stream has been assigned a waste matrix category. The first digit of the code assigns the waste stream to one of seven major treatment categories: aqueous liquids, organic liquids, inorganic solids, metal wastes, organic solids, heterogenous wastes, and potential problem wastes. The division between aqueous and organic liquids is the 1% organic level in reflection of the Resource Conservation and Recovery Act (RCRA) requirements. The inorganic solids have a high residue level following thermal treatment. The metal wastes represent nearly pure metal streams that may require specific treatment technologies. The organic solids are generally those that are predominately a solid organic or combustible material. The inorganic solids and organic solids are divided between wet and dry solids since that division may be important for some process operations. The heterogenous wastes are the most difficult to treat and contain mixtures of inorganic solids, metals, and organic solids. It may be desirable or necessary to separate the heterogenous wastes into the other three types of solids for processing. The last category contains the potential problem wastes. These wastes need further evaluation to allow their incorporation into one of the other categories or to determine if specific processes are needed for them.

The relative quantities of major categories of waste are shown in Figure 2. The inorganic solids have the largest current volume. The other large streams with nearly equal amounts are the metal wastes, organic solids, and heterogenous wastes. It is interesting to note the relatively small volume of organic liquids, which have been a primary focus of much of the previous Office of Technology Development activities for mixed wastes.

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As shown in Figure 3, the seven categories have been further subdivided by the MWTP to provide additional details on the type of materials that need treatment. Each waste stream has been generally assigned to a specific subcategory. Wastes with multiple characteristics or that could not be defined within a subcategory were generally assigned to the major category. For example, if the waste is acidic (W110) and contains a toxic metal (W150), it is simply included as an aqueous liquid waste (W100). Likewise, a large metal stream exists at INEL that cannot be separated into ferrous and nonferrous streams. This stream was included in the "W400-Metal Waste" stream. These types of assignments resulted in wastes for the major categories of W100, W400, and W600, but not the other major categories. A priority was assigned to wastes with mercury, lead, or PCB content. Wastes with one of these components were grouped together in those specific categories regardless of other categories that they could potentially be assigned to. The volumes and generation rates on a national scale for each of the major categories and subcategories are shown in Table 2.

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The subcategories, as noted in Figure 3, provide additional details about the material and the relative quantities of waste. The highest volume, current inventory subcategory is W311 (sludges, filter cakes, and residues). Material in this category is generally generated from waste water treatment. The other large subcategories are cemented sludges; metal wastes; dry organic solids; and construction, cleanup, and process debris. It can be noted that aqueous acidic wastes amount to nearly half the current waste generation. Significant aqueous streams have been classified as mixed wastes at both INEL and SRS. The largest potential problem waste is also an aqueous waste with some tritium contamination. Further evaluation is needed to determine the significance of the tritium contamination. It can be noted that there are only small waste volumes for many subcategories, suggesting a need for processes that can treat several subcategories of wastes rather than specific treatments for each waste category. Also, although wastes have been assigned to a specific category, they will likely contain wastes from other categories. For example, most of the wastes are contained in plastic bags and drum liners that would be solid organics. The drums may not be readily separable from the waste, and so the waste will contain the metal from the drum. Thus, many waste drums may actually be heterogenous by nature of their packaging. It has also been reported that hardware items may have been disposed within sludge drums to minimize the volume of waste shipped. Therefore, the waste streams are not pure materials, and the processes selected for their treatment will need to accommodate various components. Characterization activities will need to identify such wastes.

The distribution of the waste types at each of the 12 major sites was also determined and is shown in Table 3 for both the current inventory and generation rate by major category of waste. Analysis of the waste stream information from each site shows that no two sites have the same distribution of wastes, and in fact certain sites dominate in different waste types. For the current inventory of wastes, aqueous wastes are of the highest inventory at ORNL and SRS; inorganic solids at Fernald, Hanford, K-25, LANL, Paducah, RFP, and Y-12; metal wastes at INEL; and heterogenous solids at Portsmouth. For generation rates, aqueous wastes represent the greatest generation rate at INEL, LLNL, and Y-12; organic liquids at Fernald, ORNL and Paducah; inorganic solids at K-25, LANL, and Rocky Flats; organic solids at Hanford; PCB wastes at Portsmouth; and tritium aqueous wastes at SRS. The variation in waste distribution among the different sites suggests that the treatment technologies selected will need to accommodate major changes in the types and relative volume of different waste streams.

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The data on RCRA categories and radioisotope contamination have also been accumulated to provide additional perspectives. The RCRA divisions are based on the EPA codes assigned to the streams. The wastes have been divided into three categories: 1) the first category includes primarily regulated organic-containing wastes, but also includes characteristic wastes such as reactive, corrosives, and ignitable; 2) wastes with heavy metals that require stabilization or immobilization; and 3) wastes that are both of the previous categories. The relative fractions are shown in Figure 4. As can be noted, over half the existing wastes require treatment for both reactives or organics and heavy metals, whereas about 60% of the current generation wastes will require treatment for characteristic or organic content. The large fraction of wastes that will require treatment for both types of content indicate a strong need for flexible treatment, stabilization, or immobilization technologies. A large fraction of the stored wastes is mixtures of the kinds of wastes described as debris in EPA's recently proposed rule (5). Here, treatment for regulated constituents is extraction, destruction, and immobilization. Specific treatments are assigned to waste categories. In cases of mixtures of waste debris categories, a series of processes or a train of treatment processes may be needed to meet the regulations.

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The majority (about 90%) of the wastes has been categorized according to the waste's radioactive content based on the content of potentially restrictive radionuclides. The content of Pu-238 is viewed as the most restrictive, then Pu-239; fission products; specific radionuclides, with tritium and technetium being the most dominant; and finally uranium, which was considered the least restrictive. Many streams have multiple nuclides. Specific activities for the nuclides in many streams were not available. Therefore, it was considered that any content of the more restrictive nuclide would put that stream into the more restrictive category. Obviously, additional characterization data will show that this approach is too conservative. The results of this categorization method for the application described here are shown in Figure 5. As can be noted, the largest category is the Pu-239 contamination, with uranium-only contamination being the next largest category. System studies will be needed to determine if separate facilities for uranium-only streams are justified.

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PLANNED IMPROVEMENTS TO DATA

The authors' reviews of the data determined that further improvements in data quality and consistency are needed. The data would be improved with uniformity in definition of waste streams and classification of specific streams. Currently there are differences with respect to classification of transuranic waste, low-level waste, and PCB waste streams. For transuranic waste, SRS and INEL have included in their estimate of mixed low-level waste volume the <100 nCi/g TRU waste, whereas at Hanford, in the absence of adequate characterization information, all retrievable stored TRU waste is still categorized as transuranic waste. PCB wastes are not necessarily RCRA wastes but are being included with mixed waste inventories at some sites. Resolution of these types of differences would further improve the data. One effort in this direction is the use of common classifications or categories for both the MWTP and the treatability grouping of wastes as in the "Case-By-Case" data. These efforts will continue to improve the quality and reliability of the mixed waste data. For many specific waste streams, additional review is needed to further increase the amount of information available and to resolve apparent inconsistencies.

Environmental restoration wastes and decontamination and decommissioning wastes from many DOE facilities, which are anticipated to be of a large volume, still need to be added to the data base. Treatment of these wastes may require a dedicated facility and unique technology because the expected volumes of these wastes will greatly exceed the volumes of currently generated and stored mixed wastes.

FLOWSHEET FOR THE MIXED WASTE TREATMENT PROJECT

An initial flowsheet for the treatment of the major waste types has been prepared to identify the types of technology that may be needed for mixed waste treatment. The flowsheet has identified preliminary treatment technologies and alternatives for processing the waste streams. The requirement to destroy the hazardous organic constituent of mixed wastes is the first objective of treatment. The second objective is the immobilization of toxic materials so they can pass the EPA's Toxic Characteristics Leach Procedure (TCLP) test. A third objective is the recycle of materials. While it is possible to recycle materials within the DOE system, it is not currently possible to release materials which have been classified as radioactive into general commerce regardless of their level of contamination. The ability to release materials from the DOE system has been identified as necessary in order to significantly reduce the volume of some materials that are classified as waste.

Based on the initial comprehensive flowsheet for the MWTP potential treatment processes have been identified by both DOE's Waste Operations (EM-30) processor designers and DOE's Office of Technology Development (EM-50) thermal treatment working group. These groups have identified and evaluated generally available technologies that could be applied to the various types of mixed waste. The alternative treatment technologies for specific waste streams are shown in Table 4. As can be noted, a wide variety of technologies are potentially applicable to the mixed wastes. Additional evaluation and testing will be needed to select the best choice and provide the data to document that choice. Much of that evaluation is expected to be a part of the EM-50's Mixed Waste Integrated Program, for which planning has been underway during most of the past year.

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SUMMARY AND CONCLUSIONS

Mixed waste data are being collected and evaluated by the MWTP with HAZWRAP and individual sites. The data have indicated several important factors:

- Most wastes are at a few of the 30 DOE sites reporting mixed low-level waste inventory or generation, thus a limited number of treatment facilities will be needed.

- The most significant waste volumes for treatment considerations are the inorganic solids, with significant volumes of organic solids, heterogenous wastes, aqueous wastes, and metal wastes. Aqueous streams are the largest future waste stream to be generated at several sites.

- The types of waste in inventory and being generated at each site are different, and flexible processes are needed to minimize the number of treatment processes in the planned MWTP prototype facility.

- A wide variety of thermal treatment processes appears potentially applicable to the treatment of mixed wastes. The selection of effective technology will require additional testing and evaluation.

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5. EPA, "Land Disposal Restrictions for Newly Listed Wastes and Contaminated Debris," Federal Register 57(6), January 9 (1992).

<u>FIGURE CAPTIONS</u>

Fig. 1 - Distribution of Mixed Low-Level Wastes at DOE Sites

Fig. 2 - Relative Fractions of Major Waste Categories

Fig. 3 - Mixed Waste Matrix Characterization Categories

Fig. 4 - Distribution of RCRA Treatment Needs for All Wastes

Fig. 5 - Distribution of Restrictive Radionuclides in Waste Types

Table 1. Mixed Waste Volume Information for the DOE sites

	Current Inventory (m^3)[(a)]	Generation Rate (m^3/yr)
AMES LABORATORY	0.10	0.10
ARGONNE NATIONAL LABORATORY - EAST	0.00	36.24
ARGONNE NATIONAL LABORATORY - WEST	9.05	0.95
BETTIS ATOMIC POWER LABORATORY	6.56	0.35
BROOKHAVEN NATIONAL LABORATORY	15.83	10.65
COLONIE INTERIM STORAGE SITE	38.77	0.00
FERMI NATIONAL ACCELERATOR LABORATORY	2.10	0.00
FERNALD	3928.70	16.80
GRAND JUNCTION PROJECT OFFICE	0.06	0.09
HANFORD SITE	2285.98	144.20
IDAHO NATIONAL ENGINEERING LABORATORY	26716.26	2758.51
IT RESEARCH INSTITUTE	0.20	1.00
K-25 SITE	7035.50	112.00
KANSAS CITY PLANT	3.73	2.47
KNOLLS ATOMIC POWER LABORATORY	0.00	0.45
LAWRENCE BERKELEY LABORATORY	3.80	0.02
LAWRENCE LIVERMORE NATIONAL LABORATORY	134.50	102.00
LOS ALAMOS NATIONAL LABORATORY	323.93	85.34
MOUND FACILITY	40.60	2.00
NEVADA TEST SITE	0.00	48.70
OAK RIDGE NATIONAL LABORATORY	1268.16	16.28
PADUCAH GASEOUS DIFFUSION PLANT	602.96	30.62
PANTEX PLANT	95.47	5.30
PORTSMOUTH GASEOUS DIFFUSION PLANT	4900.57	311.59
PRINCETON PLASMA PHYSICS LABORATORY	0.02	0.01
ROCKY FLATS PLANT	3438.25	423.20
SANDIA NATIONAL LABORATORY ALBUQUERQUE	0.00	166.80
SANDIA NATIONAL LABORATORY LIVERMORE	0.14	0.42
SANTA SUSANA FIELD LABORATORY (ETEC)	3.32	0.00
SAVANNAH RIVER SITE	9038.51	1610.65
WELDON SPRING SITE REMEDIAL ACTIONS	56.05	0.00
WEST VALLEY	20.00	1.00
Y-12	9972.30	1801.02
TOTALS	69941.42	7688.71

(a) Note the number of significant figures shown for consistency in calculations exceeds the accuracy of the data.

Table 2. Volumes and Generation Rates for Categories of Wastes

Code Number	Mixed Waste Category	Current Inventory (m^3)[(a)]	Generation Rate (m^3/yr)
W100	Aqueous Liquids	1974.96	249.31
W110	Corrosive - Acids	102.00	3726.21
W120	Corrosive - Bases	49.80	22.20
W130	Reactives - Cyanide	2.00	0.30
W140	Reactives - Other	0.00	0.00
W150	TC -Metals	3990.89	197.02
W160	TC-Organics	64.08	68.95
W180	Hg Containing Solutions	102.08	0.02
	Subtotal	6285.80	4264.01
W200	Organic Liquids	0.00	0.00
W210	Non-Halogenated Organic	259.09	226.29
W220	Halogenated Organic	794.92	112.14
W230	Scintillation Cocktails	146.09	26.58
W280	Hg Containing Organic	4.48	0.54
	Subtotal	1204.58	365.55
W300	Inorganic Solids	0.00	0.00
W310	Wet Inorganic Solids	0.00	0.00
W311	Sludges, Filter Cakes, & Residues	11812.44	685.33
W312	Absorbed Liquids	320.71	0.06
W313	Ion Exchange Resins	0.00	0.00
W314	Salt Cakes	127.50	0.00
W320	Dry Inorganic Solids	1408.09	0.07
W321	Processing Salts	133.33	4.11
W322	Cemented Sludges	9236.20	250.20
W323	Ash, Dusts, and Particulates	1017.46	36.08
W324	Soils	363.59	38.11
W325	Glass	577.14	8.47
W326	Ceramic Crucibles, Bricks, & Media	873.46	1.00
	Subtotal	25869.92	1023.43
W400	Metal Wastes	9976.19	36.00
W410	Ferrous Metals	0.00	0.00
W420	Non-Ferrous Metals	4.80	1.00
W430	Mercury	2.76	0.68
W440	Lead Shapes	754.79	107.98
W450	Activated Lead	1.29	0.07
	Subtotal	10739.83	145.73
W500	Organic Solids	0.00	0.00
W510	Wet Organic Solids	33.34	9.52
W511	Absorbed Combustibles	113.22	31.08
W512	Paint & Residues	30.81	10.36
W513	Resins	10.00	0.00
W514	Animal Carcasses	0.00	0.02
W515	Sewage Sludges	0.00	0.00
W520	Dry Organic Solids	7731.10	115.30
W521	Wood	0.00	0.00
W522	Plastic & Rubber	74.60	1.40

W523	Paper, Cloth & Rags	3647.97	2.83
W524	Heavy Sludges & Asphalt	142.60	0.83
W525	Graphite and Carbon	0.00	217.00
	Subtotal	11783.63	388.34
W600	Heterogeneous Wastes	26.62	6.20
W610	Construction, Cleanup & Process Debris	7523.94	86.36
W620	Lab Packs	84.27	26.16
W630	Equipment and Gloveboxes	2.50	3.00
W640	Filters	2058.59	60.63
W650	Reactor Equipment, Exp. Hardware & Fuel	0.22	140.81
W660	Other Toxic Metal Containing Materials	96.77	12.75
W670	Lead Containing Components and Materials	6.62	1.09
W680	Hg Contaminated Materials	109.43	31.96
	Subtotal	9908.96	368.96
W700	Potential Problem Wastes	0.00	0.00
W710	Tritium Wastes	36.71	973.87
W720	Pyrophorics	6.11	0.46
W730	Nitrated Rags and Filters	12.48	0.00
W740	Unstable Organics	0.00	0.00
W750	Compressed Gases	8.10	8.10
W760	Beryllium Wastes	1.20	0.80
W770	PCB Contaminated	4084.11	149.45
	Subtotal	4148.71	1132.68
Total all Categories		69941.43	7688.71

(a) Note the number of significant figures shown for consistency in calculations exceeds the accuracy of the data.

Table 3. Current Inventory and Generation Rates at the Twelve Major Sites for Various Waste Types

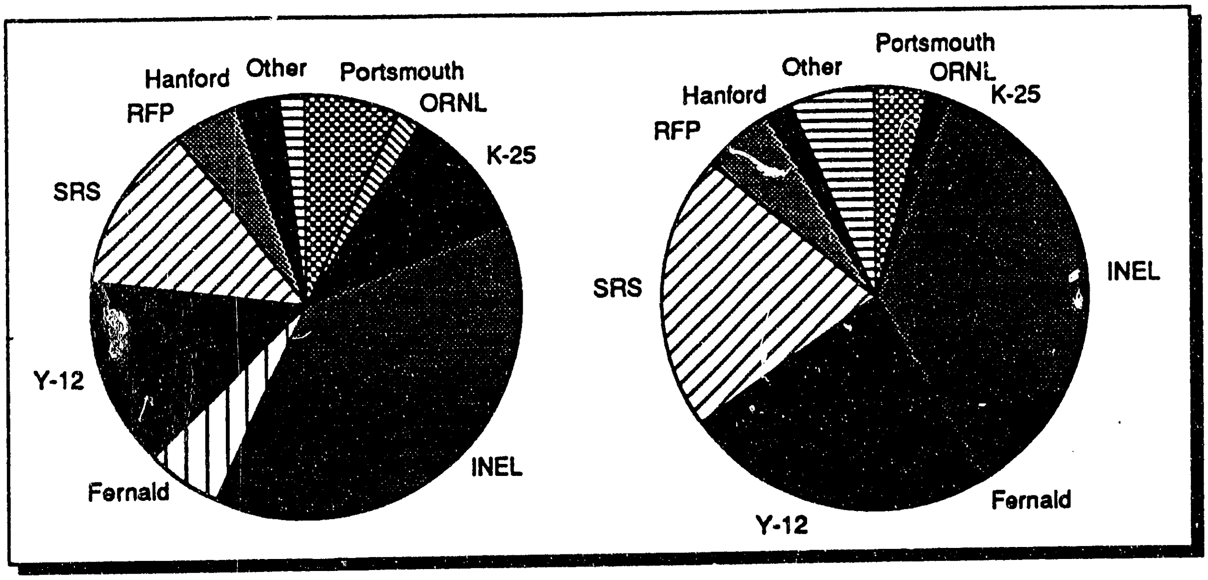
Site	Current Inventory (m^3)							Total
	W100	W200	W300	W400	W500	W600	W700	Site
FERNALD	14	418	2647	0	151	699	0	3930
HANFORD SITE	1	0	1829	116	187	119	33	2285
INEL	122	4	5052	10152	7328	4058	0	26716
K-25 SITE	112	50	6856	0	18	0	0	7036
LLNL	43	0	0	0	43	49	0	135
LANL	7	70	154	62	10	8	13	324
ORNL	1092	108	63	1	4	1	0	1268
PADUCAH	0	87	476	3	6	2	29	603
PORTSMOUTH	95	39	187	38	3	3926	613	4901
ROCKY FLATS PLANT	57	110	2749	50	351	109	12	3438
SAVANNAH RIVER SITE	4740	5	34	293	3632	291	45	9039
Y-12	0	204	5776	0	37	557	3398	9972
Total of Major Sites	6282	1095	25823	10715	11715	9819	4142	69645

Site	Annual Generation Rates (m^3/year)							
	W100	W200	W300	W400	W500	W600	W700	Site
FERNALD	1	9	0	0	7	0	0	17
HANFORD SITE	0	0	14	33	53	34	9	144
INEL	2735	3	4	10	0	6	0	2758
K-25 SITE	17	25	65	0	5	0	0	112
LLNL	80	6	2	0	0	14	0	102
LANL	1	17	50	12	3	2	0	85
ORNL	1	13	0	1	1	1	0	16
PADUCAH	0	25	3	1	1	0	0	31
PORTSMOUTH	38	11	59	15	33	56	100	312
ROCKY FLATS PLANT	1	18	300	29	56	18	1	423
SAVANNAH RIVER SITE	389	191	1	6	0	43	981	1611
Y-12	983	30	501	0	227	20	40	1801
Total of Major Sites	4246	349	999	106	386	195	1131	7412

(a) Note the number of significant figures shown for consistency in calculations exceeds the accuracy of the data.

Table 4 - Potential Thermal Treatment Technologies for Mixed Waste Treatment

Waste Stream	Alternative Treatment Technologies
Aqueous Wastes with Trace Organics	Wet Air Oxidization, UV-Ozone, Peroxide-Heat, Air/Steam Stripping, Thermal Incineration, Electrochemical Oxidization, Supercritical Water Oxidization
Organic Liquids	Controlled Air Incinerator, Fluid Bed Incinerator, Liquid Injection, Cyclone Incinerator, Plasma Torch, Molten Salt, Combined treatment with Inorganic Solids
Heavy Organics	Car Bottom Furnace, Pyrolysis Units, Treat with Organic Solids
Organic Solids	Rotary Kiln Agitated Hearth, Controlled Air, Multiple Hearth, Excess Air, Indirect Fired Pyrolysis, Plasma Furnaces, Vitrification, Slagging Incinerators
Inorganic Solids	Vitrification, Rotary Kiln, Fluid Bed Incinerator, Slagging Incinerators, Plasma Torch Furnaces, Arc Plasma Furnace
Metal Wastes	Chemical, Mechanical, or Slag Decontamination, Supercompaction, Direct Melting
Mercury Wastes	Thermal Bakeout Hg absorber or collection in off-gas train.
RCRA Off-Gas Treatment	Secondary Combustion Unit, Indirect Heated, Catalytic Units, Plasma Destruction, Molten Salt Oxidization, Microwave Induced Plasma, Carbon Absorption

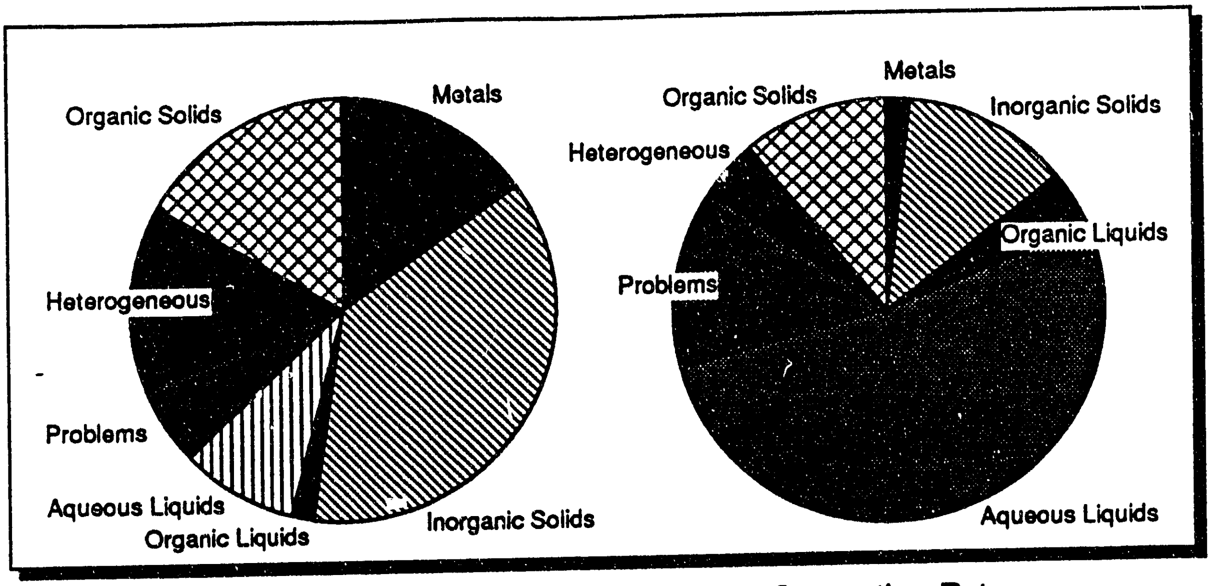


Current Inventory
70,000 (M3)

Generation Rate
7,700 (M3/Y)

S9203003.3

Figure 1

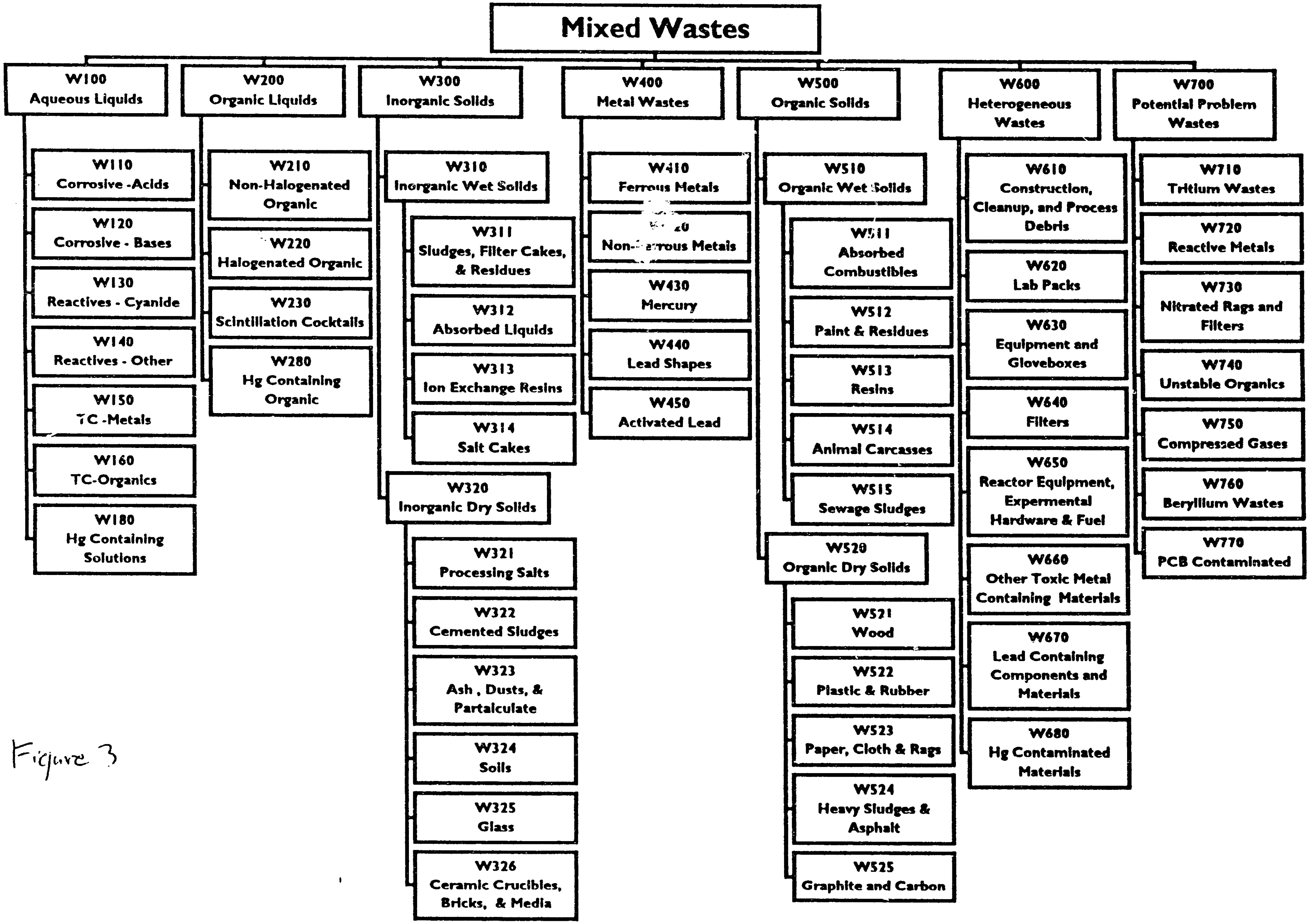


Current Inventory
70,000 (M3)

Generation Rate
7,700 (M3/Y)

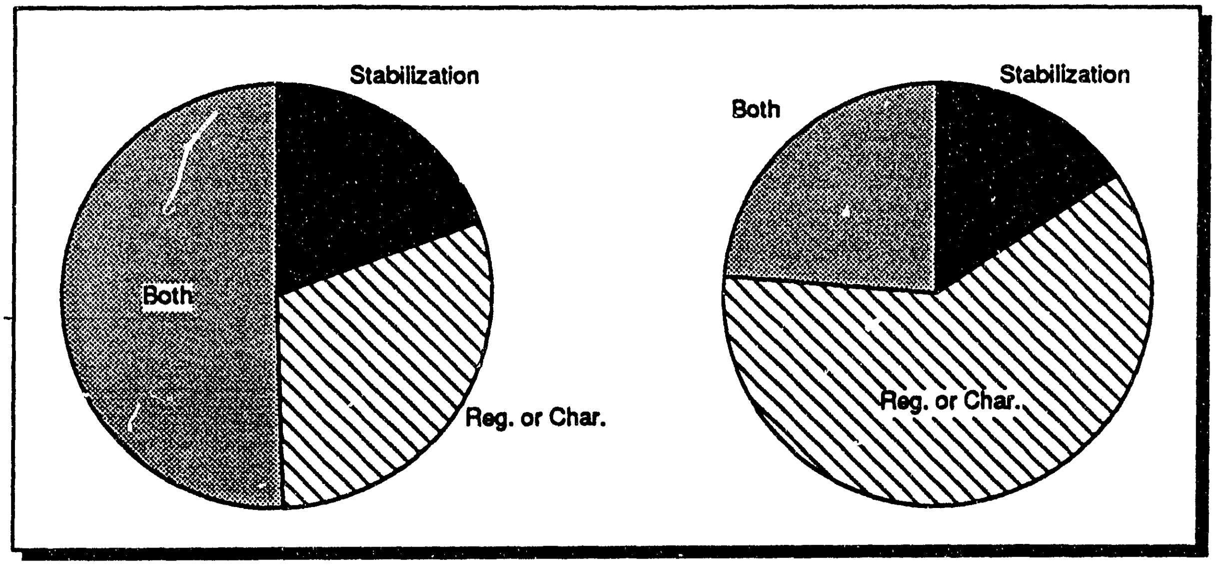
S9203003.4

Figure 2



Mixed Wastes
W100 Aqueous Liquids
W110 Corrosive -Acids
W120 Corrosive - Bases
W130 Reactives - Cyanide
W140 Reactives - Other
W150 TC -Metals
W160 TC-Organics
W180 Hg Containing Solutions
W200 Organic Liquids
W210 Non-Halogenated Organic
W220 Halogenated Organic
W230 Scintillation Cocktails
W280 Hg Containing Organic
W300 Inorganic Solids
W310 Inorganic Wet Solids
W311 Sludges, Filter Cakes, & Residues
W312 Absorbed Liquids
W313 Ion Exchange Resins
W314 Salt Cakes
W320 Inorganic Dry Solids
W321 Processing Salts
W322 Cemented Sludges
W323 Ash , Dusts, & Partalculate
W324 Soils
W325 Glass
W326 Ceramic Crucibles, Bricks, & Media
W400 Metal Wastes
W410 Ferrous Metals
Non-Ferrous Metals
W430 Mercury
W440 Lead Shapes
W450 Activated Lead
W500 Organic Solids
W510 Organic Wet Solids
W511 Absorbed Combustibles
W512 Paint & Residues
W513 Resins
W514 Animal Carcasses
W515 Sewage Sludges
W520 Organic Dry Solids
W521 Wood
W522 Plastic & Rubber
W523 Paper, Cloth & Rags
W524 Heavy Sludges & Asphalt
W525 Graphite and Carbon
W600 Heterogeneous Wastes
W610 Construction, Cleanup, and Process Debris
W620 Lab Packs
W630 Equipment and Gloveboxes
W640 Filters
W650 Reactor Equipment, Expermental Hardware & Fuel
W660 Other Toxic Metal Containing Materials
W670 Lead Containing Components and Materials
W680 Hg Contaminated Materials
W700 Potential Problem Wastes
W710 Tritium Wastes
W720 Reactive Metals
W730 Nitrated Rags and Filters
W740 Unstable Organics
W750 Compressed Gases
W760 Beryllium Wastes
W770 PCB Contaminated

Figure 3



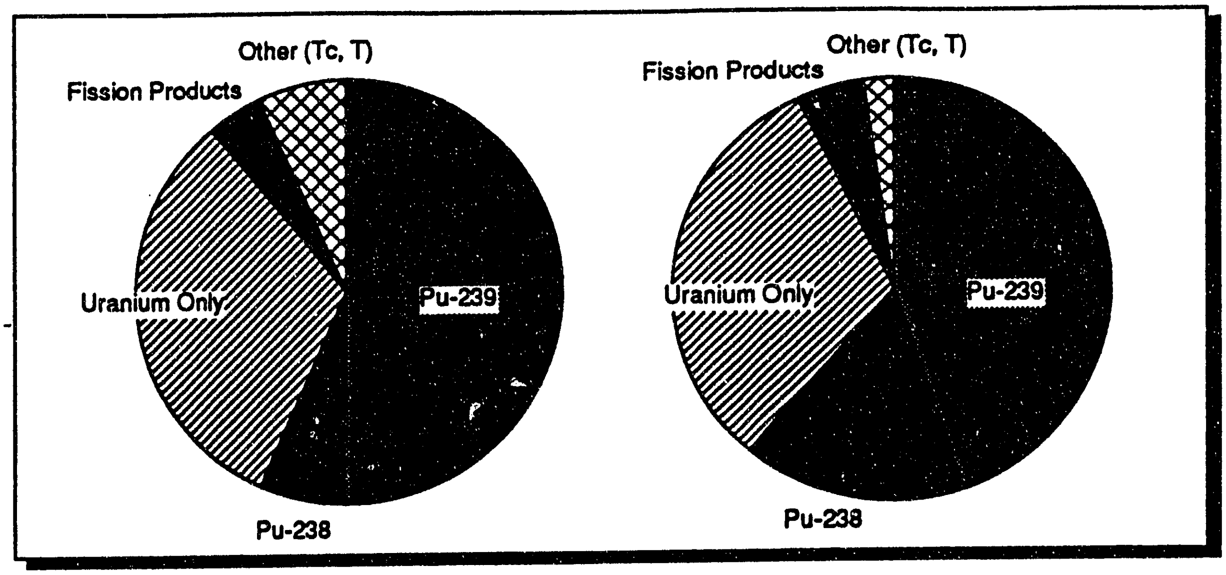
Current Inventory

Generation Rate

Stabilization = Stabilization or Immobilization
Reg. & Char. = Regulated Organic or Characteristic

S9203003.12

Figure 4



Current Inventory

Generation Rate

S9203003.13

Figure 5

END

DATE
FILMED
7/13/93