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Mixed Waste Integrated Program

Logic Diagram

November 30, 1994

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ABSTRACT

The Mixed Waste Integrated Program Logic Diagram was developed to provide technical alternative for mixed wastes projects for the Office of Technology Development's Mixed Waste Integrated Program (MWIP). Technical solutions in the areas of characterization, treatment, and disposal were matched to a select number of U.S. Department of Energy (DOE) treatability groups represented by waste streams found in the Mixed Waste Inventory Report (MWIR).

SUMMARY

The Mixed Waste Integrated Program Logic Diagram was developed to provide information to support the Mixed Waste Integrated Program (MWIP) and its technology evaluation teams during the selection of technology development activities for Fiscal Years 95, 96, and 97. In addition, the logic diagram effort:

- Identifies pressing technology development needs, addressable by the MWIP, which will enable EM-30 to meet legal deadlines imposed by the Federal Facilities Compliance Act.
- Establishes a mechanism to increase communication between EM-50 and EM-30.
- Provides those responsible with remediating Department of Energy low-level mixed waste, or low-level mixed waste similar to that found at DOE sites, a tool for evaluating characterization, treatment and disposal options.
- Addresses two Idaho National Engineering Laboratory specific waste streams representative of one or more of the MWIP Treatability Groups.

Thirteen mixed waste treatability groups and example waste streams were identified for inclusion in the Mixed Waste Integrated Program Logic Diagram. These treatability groups/waste streams were chosen in consultation with representatives from DOE HQ (EM-50, EM-30) and representatives from the MWIP. A major criteria used in selecting example waste streams for inclusion was a broad representation of the 20 matrix categories as identified in the Mixed Waste Inventory Report.

Mixed Waste Integrated Program

Logic Diagram

Fernald
Salt Sludge, Chloride
Treatment Technologies

Name: Salt Sludge, Chloride MWIR#: FM-W249 Subelement: Treatment

Matrix: Chloride Salts / 3151

Waste Stream Waste Stream Description This waste consists of a chloride salt sludge produced by a Salt-Oil Furnace. Problems Presented by this Waste Stream The eathmated density of the waste aiream (3711, kg/m²) seems high, base on the waste description (primerity sludge) and also inconsistent with other data reported (1964 kg/m²). High salt content within the waste stream may limit waste treatment technology options. Since this waste stream contains chlorides, virillication may not be an appropriate treatment because of the difficulty of place formation in the presence of chilorides. The chloride salts may also increase the volability of the chromium. constituent in the waste.

Treatability Group

Radiological Contaminants:

Site: Fernald

This waste is classified as a Beta-Gamma emitter and as a contact-handled waste with < 10 nCl/g of alpha-emitting radionuclides.

MLLW-CH U-(unspecified) U-235

Contaminants:

This waste stream is suspected to be contaminated with the toxic heavy metal, chromium, and may be corrosive, due to the salt content. The following EPA-regulated wastes are suspected to be contained in the waste stream:

D007: Chromium

Matrix:

This waste matrix is a chloride salt sludge.

Name: Salt Sludge, Chloride MWIR#: FM-W249 **Subelement:** Treatment

Matrix: Chloride Salts / 3151 Site: Fernald

Alternative/Technology

Status

Science and Technology Needs

Implementation Analysis

THERMAL TREATMENT

ALTERNATIVE - Vitrification

TECHNOLOGY +Joule Heated Melter -Refractory-lined reactor in which a pool of glass is: maintained molten by joule heating. Waste is introduced into the glass matrix. Since the waste loading is expected to be low, it may require the addition of significant volumes of glassification

Treatability studies are being performed on a similar type of waste type. Demonstration of the technology's applicability to this waste stream will be required.

Subsystems required Waste feed system Glass additive feed system Molten glass handling system Offgas collection/treatment system, including

scrubber and particulate filters

Projected performance

Need to tightly control melt chemistry complicates operation Addition of glass formers to maintain viscosity lim-

its otherwise excellent volume reduction Highly stable class final waste form

Technology must be demonstrated to assess its ... applicability to this waste stream; including the operation of required subsystems.

High power requirements. This technology will be commercially available for waste applications within 2 years, and is currently in use for highly specialized applications in the DOE system. Unit operational costs and life cycle costs fall in the mid range of this group of technologies. The large numbers of subsystems required and need to carefully control melt chemistry make this technology relatively complicated and labor-intensive. The effect of the chloride salts present in this waste stream must be investigated for this technology. There is a medium development risk, when compared to the other thermal technologies.

Input Waste Stream Characterization Information Needed

Characterization requirements will include estimates of chloride and chromium content and the composition/concentration of salts present in this waste stream (see concentration of sodium, potassium, sulfates, nitrates, chlorides, and chromium in the characterization subelement beginning on page A-5).

Waste Streams Produced

Stabilized glass can be disposed of as a RCRA LLW (but could also be classified as a RCRA alpha-contaminated LLW, or as TRU waste) (see stabilized glass disposal options beginning on page N-

Scrubber residue that requires stabilization (see scrubber residue under secondary waste streams beginning on page A-6).
Offgas particulate filters that require stabi-

lization (see offgas particulate filters under secondary waste streams beginning on page A-6).

Empty containers can be disposed of as LLW (see empty containers disposal options beginning on page N-1).

CHEMICAL TREATMENT

Although chemical treatment could be applicable to this waste stream, it was dismissed because of the inevitable generation of a large amount of secondary wastes that would also require treatment. The production of secondary wastes is due to the

Name: Salt Sludge, Chloride MWIR#: FM-W249 Subelement: Treatment

Matrix: Chloride Salts / 3151 Site: Fernald

Alternative/Technology high-salt content of the sludge Excessive dilution of the waste media would be required to enable	Status	Science and Technology Needs	Implementation Analysis
Chemically bonded Ceramics (CbC) Chemically bonded Ceramics (CbC) Chemically bonded ceramic waste forms are produced by mixing the wastes and inorganic oxide binders together. The mixture is then processed at amblent and near amblent temperatures, promoting chemical reactions that bond the waste and the inorganic oxides into a dense ceramic material.	CbC is in early stages for development by the DOE —— for usage on this type of waste streams. Subsystems required Waste feed system Ingredients feed system Shredder for combustibles and small metal pieces Projected performance Expected to produce a suitable final waste form for disposal	Technology must be demonstrated on this waste stream.	Low power requirements. Few subsystems are required and needed to make use of this technology. Low development risk. Input Waste Stream Characterization Information Needed The concentration of sodium, potassium, sulfates, nitrates, and chlorides (see concentration of sodium, potassium, sulfates, nitrates, and chlorides in the characterization subelement beginning on page A-6). Waste Streams Produced A solidified waste form that requires LLW disposal (see solid waste forms disposal options beginning on page N-1).
Polyethylene Rolyethylene is an inert thermoplastic material that can be processed at low temperatures. Polyethylene binder and dry waste material are fed through separate calibrated volumetric or loss in-weight feeders to an extruder. The materials are then thoroughly mixed, heated to a molten condition, and extruded into a suitable mold. On cooling, the mixture forms a solid monolithic waste form. No chamical reaction is required for solidill-cation.	Polyethylene is being developed by the DOE for usage on these types of waste streams. Polyethylene has been demonstrated on scrubber residues. Subsystems required Waste feed system Ingredients feed system Shredder for particulate filters Projected performance Expected to pass TCLP Expected to produce a suitable final waste form for disposal	Technology must be demonstrated on this waste stream to ensure stabilization of toxic constituents and the compatibility of the process with the actual waste streams. The technology needs development for the treatment of shredded particulate filters.	Low power requirements. Few subsystems are required and needed to make use of this technology. Low development risk. Input Waste Stream Characterization Information Needed The percent soluble salt contained in the scrubber residues (sodium, potassium, sulfates, nitrates, and chlorides) (see concentration of sodium, potassium, sulfates, nitrates, and chlorides in the characterization subelement beginning on page A-6). Waste Streams Produced A solidified waste form that requires LLW disposal (see solid waste forms disposal options beginning on page N-1).
Sulfur Polymer Cement (SPC) Sulfur Polymer Cement is composed of 95% sulfur. It melts at approximately 410 to 420, C and is particularly valuable in the immobilization combustibles and small metal pieces.	SPC is being developed by the DOE for usage within this type of waste streams at INEL. SPC has been demonstrated on ash. SPC is not compatible with waste streams containing high concentrations of nitrates. Subsystems required Waste feed system	Technology must be demonstrated on this waste stream.	, -

Name: Salt Sludge, Chloride MWIR#: <u>FM-W249</u> Subelement: Treatment

Matrix: Chloride Salts / 3151 Site: Fernald

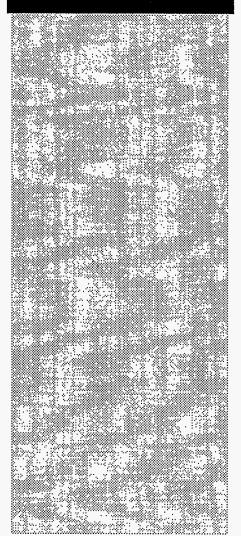
Alternative/Technology Sulfur Polymer Cement (SPC) (continued)

Status

Ingredients feed system Shredder for combustibles and small metal pieces

Projected performance
Expected to produce a suitable final waste form for

Science and Technology Needs



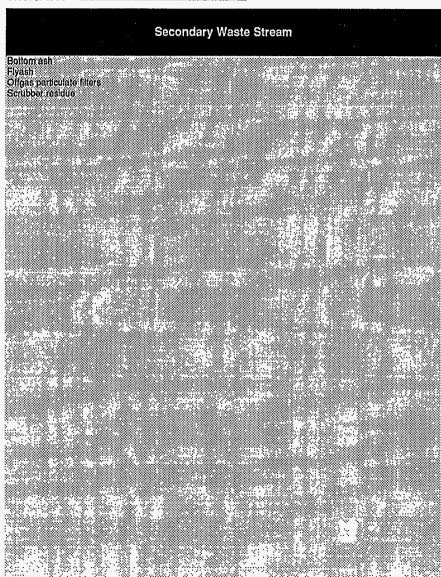
Implementation Analysis

potassium, sulfates, nitrates, and chlorides in the characterization subelement beginning on page A-6).

Waste Streams Produced
A solidified waste form that requires LLW disposal (see solid waste forms disposal options beginning on

Name: Salt Sludge, Chloride MWIR#: FM-W249 **Subelement:** Treatment

Matrix: Chloride Salts / 3151 Site: Fernald



Treatability Group

Radiological Constituents: This waste is classified as a Beta-Gamma emitter and as a contact-handled waste with < 10 nCl/g of alpha-emitting radionuclides.

Contaminants:

This waste stream is contaminated with the toxic heavy metal, chromium.

The waste consists of ash, residues, and filters.

Mixed Waste Integrated Program

Logic Diagram

Fernald
Salt Sludge, Chloride
Characterization Technologies

Diagram Logic Program Mixed Waste Integrated

Name: Salt Sludge, Chloride MWIR#: EN

MWIR#: FM-W249 Subelement: Characterization

Fernald

Site:

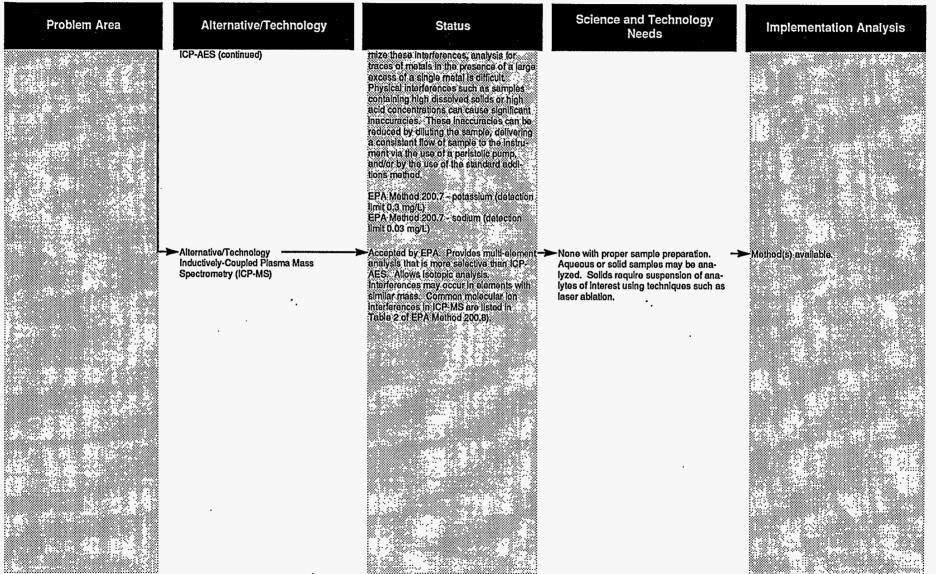
Matrix: Chloride Salts / 3151

ng sample preparation. Nonspecific absorption and fight scattering can be significant at the analytical wavelengths of these metals. Thus background correction an element in a sample for which there is Method(s) available. Care must be taken to minimize the loss of volatile metals dur spectroscopists who are knowledgeab Ical Interferences. Users must venif he absence of spectral interference from nalyte concentrations may arise - see no Instrument detection channel (false mplementation Analysis Vethod(s/Instrument(s) available U CP:AES (EPA Method 200.7) is restr Method(s)/Instrument(s) available. s required. Ā None, with proper sample preparation.
 This is a well-developed technology. None, with proper sample preparation. None, with proper sample preparation. This is a well-developed technology. Science and Technology Needs Accepted. Samples must be converted to suitable solutions for analysis (see EPA Method 200.0). EPA has approved the following methods for determining the concentration of potassium and sodium in anions in solution to ppm or pob concentrations. In order to use IC for solution an extraction method outlined in EPA Method 300,0 must be performed. Additional separation techniques may be needed to fur ccepted, ICP-AES primary advantage is The primary disadvantage of ICP-AES is trackground radiation from other elements and the plasma gases. Although all ICP-AES instruments titlize high-resolution ePA Melhod 258.3 - potassium (delacifor Accepted by EPA and industry, for —— Chromatography (EPA Method 300.0) is able to quickly and accurately determine Nethod 200,7) is applicable to all matrice However, each of these media require significant semple meparation such as acid digestion or dissolution prior to anal background correction to min EPA Method 300.0 - chloride (detection ncluding soils, sludges, and sediments. imt 0.01 mg/l) EPA Mathod 273.1 - sodium (delection that It allows simultaneous or repld sequential determination of many ele-ments in a short time. ICP (see EPA limit 0.002-0.004 mg/L) EPA Mathod 300.0 - sulfate (detection limit 0,02 ing/L) EPA Method 300.0 + nitrate (detection her separate fonts species. Status mit 0,002 ma/L) mit 0.02 mg/L) optes and Inductively-Coupled Plasma Spectroscopy Atomic Emission Spectrometry (ICP-AES) Alternative/Technology Atomic Absorption (AA), Direct Aspiration Alternative/Technology Alternative/Technology for Chromatography (IC) Alternative/Technology Concentration of soluble sodium, socials, infrates, and Problem Area

A-8

Name: Salt Sludge, Chloride MWIR#: FM-W249 Subelement: Characterization

Matrix: Chloride Salts / 3151 Site: Fernald



Mixed Waste Integrated Program

Logic Diagram

Hanford 183-H Solar Basin Waste Treatment Technologies

Name: 183-H Solar Basin Waste MWIR#: 986 Subelement: Treatment

Matrix: Pond Sludges / 3122

Waste Stream

Waste Stream Description

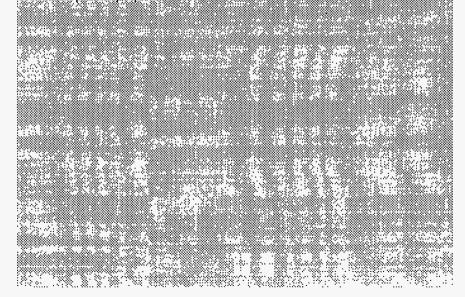
This waste stream consists of halogenated and non-halogenated solvents, cyanides, ignitable solids, and toxic heavy metals including chromium.

Problems Presented by Waste Stream

Wastes are a result of the D&D cleanup activities of the H-183 Solar Basin. Waste sludges and liquid were solidified using Sorband LPC-II (product of American Colloid Company). Sorband is a pozzalanic cement with a polymer additive. Actual physical characteristics of this waste stream are needed to determine the waste feed system requirements. LDB treatment requirements for the listed waste codes are deactivation, chemical oxidation or incineration. All must be followed by stabilization. These treatments will be sufficient to eliminate the toxic characteristic component of the wastes.

The characterization forces some assumptions in order to select technology options. It is assumed that the cyanides that were placed into the basin were not spent (due to the use of RCRA "P" waste codes). Due to the presence of chromium above 5.0 ppm in some EP Toxic Statistical Calculation Results; D007 should also be included. This waste has a very high salt content, primarily sogium salts.

The D001 waste code should be verified through analysis. The physical characterization of the solidified waste materials should be performed. Due to the RCRA "P" waste code identification, containers must be treated/rinsed prior to any disposal.



Treatability Group

Radiological Constituents:

This waste is classified as contact-handled with 10 - 100 nCl/g of alpha contamination.

Conteminante

This waste stream is suspected to be contaminated with halogenated and non-halogenated solvents, Cyanides, ignitable solids, and toxic heavy metals including: chromium. The following EPA regulated wastes are suspected to be contained within the waste stream:

D001: Unlisted hazardous waste characteristic of ignitability

Site: Hanford

P029: Copper cyanide

P030: Cvanide (soluble salts)

P098: Potassium cyanide

P106: Sodium cyanide

P120: Vanadium oxide

U123: Formic acid

Matrix:

This waste consists of pond sludges.

183-H Solar Basin Waste **Subelement:** Treatment MWIR#: 986

Matrix: Pond Sludges / 3122 Site: Hanford

Alternative/Technology

Status

Science and Technology Needs

Implementation Analysis

CHEMICAL TREATMENT

Not applicable to this waste form. The sludge has been solidified using Sorbond LPC-II. Sorbond LPC-II is a polymer used to macro-encapsulate the wastes. Because of the encapsulated nature of the contaminants within the waste matrix, it is doubtful that complete treatment via a chemical process could be performed upon this waste stream. This is due to an inability to completely decapsulate and free the contaminants within the waste matrix. If the contaminants within the waste matrix are not free to interact with chemical reagents, the required chemical reactions (and thus waste treatment) will not

➤ THERMAL TREATMENT -ALTERNATIVE + Incineration

Rotary Kiln

A cylindrical refractory-lined shell mounted on a slight incline; rotation of the kiln moves the non-containerized waste through the shell enhancing. mixing. A high-temperature secondary combus-tion chamber is also utilized to complete organiccompound destruction.

The high-temperature may volatilize certain metals (such as arsenia, mercury, selenium, cadmium, and lead) which would require the subsequent capture of these metals in the incinerator offgas. The incherator offgases would be subsequently cooled in order to allow these exidized metals (or compounds) to condense prior to being anticined via a particulate removal device. High levels of sodium within the waste may cause a condition of low-temperature melting with this waste. The refractory material will need to be carefully selected for its compatibility with the waste. The high nitrate content could result in a high NOx emission.

-Accepted by industry.

This technology has been approved by EPA as the BDAT for organics, as well as cyanide. The DOE operates a rotary kiln for treatment of liquid LLW.

Subsystems required

Feed pretreatment crusher, shredder, or slurry system (as needed based on physical characteristics) Secondary combustion chamber Large offgas treatment system, including off gas scrubber, and particulate filters Ash handling system Stabilization system for treatment residuals

Projected performance

Good organic and cyanide destruction Rotating kiln seals are questionable for performing contamination control Post-treatment stabilization of ash residuals using cement is currently in wide use Long-term leaching performance is suspect Volume reduction is moderate Alternate stabilization techniques are available for better long-term performance

-Better characterization of the waste stream is needed → Normal implementation needs. Treatment residue to determine the extent of volatilization of other waste constituents. Technology must be demonstrated to assess its applicability to this waste stream, including the operation of the required subsystems... Demonstration of the compatibility of refractory materials with this waste stream. Determination of melting point range.

Determination of NOx pas emission potential.

sector. The technology is currently in use within the DOE sector for non-cemented sludge wastes. The required subsystems as described above are currently commercially available. The moving parts and large number of subsystems required, make this technology relatively complicated and labor intensive. Since rotary kilns cannot be routinely cycled (on-off). large waste backlogs are necessary to justify implementation.

will require treatment/stabilization prior to disposal.

The rotary kiln incineration technology is commercial-

ly available and currently used within the commercial

Input waste stream characterization information needed

Characterization requirements may include the identification of volatile metals in the waste stream (see volatile metals in the characterization subelement beginning on page B-11).

Waste streams produced

Bottom ash that requires stabilization (see bottom ash under secondary waste streams beginning on page B-8).

Flyash that requires stabilization (see flyash under

Subelement: Treatment Name: 183-H Solar Basin Waste MWIR#: 986

Matrix: Pond Sludges / 3122 Site: Hanford

Science and Technology Alternative/Technology Status Needs Rotary Kiln (continued): ALTERNATIVE - Vitrification Slagging Kiln - Accepted by industry. Better characterization of the waste stream to deter. - Normal implementation needs. Slagging kiln inciner-Cylindrical refractory-lined shell mounted on a This technology has been approved by EPA as the mine the extent of volatilization of other waste conslight incline; rotation of the kiln moves the non-BDAT for organics, as well as cyanide. Slagging stituents. Technology must be demonstrated to assess its applicability to this waste stream, including containerized waste through the shell, enhancing kilns are more widely used in Europe than the US. mixing. Operation similar to rotary kiln except it is the operation of the required subsystems. Demonstration of refractory waste compatibility, operated at a higher temperature with the addition. Subsystems required Additional treatability studies to determine optimum of classification agents. A high-temperature sec-Feed pretreatment crusher, shredder, or slurry andary combustion chamber is also required to system (as needed based on physical characterisadditive/waste mix. complete the organic compound destruction. Secondary combustion chamber Large offgas treatment system, including offgas The high-temperature may volatilize certain metals (such as arsenic, mercury, selenium, cadmiscrubber, and particulate filters um, and lead) which will require the subsequent Glass additive feed system capture of the volatile metals in the incinerator off-Molten glass handling system gas. The incinerator offgases would be subse-Stabilization system for treatment residuals quently cooled in order to allow these metals (or compounds) to condense prior to being entrained Projected performance via a particulate removal device. High sodium lev-Good organic and cyanide destruction els may cause a condition of low-temperature Rotating kiln seals are questionable for reliable melting with this waste. The refractory material contamination control will need to be carefully selected to determine its Good leaching resistance performance of the glascompatibility with the waste. sified product

Implementation Analysis

secondary waste streams beginning on page B-8). Scrubber residue that requires stabilization (see scrubber residue under secondary waste streams beginning on page B-8).

Empty containers can be disposed of as LLW (see empty containers disposal options beginning on page N-1).

Offgas particulate filters that require stabilization (see offgas particulate filters under secondary waste streams beginning on page B-8).

ation technology is commercially available. The required subsystems, as described above are currently commercially available. The moving parts and the large number of subsystems required, make this technology relatively complicated and labor intensive.

Input waste stream characterization information needed

Characterization requirements may include the identification of volatile metals in the waste stream. (see volatile metals in the characterization subelement beginning on page B-11).

Waste streams produced

Siag may be disposed of as a RCRA LLW (but could also be classified as a RCRA alpha-contaminated LLW, or TRU waste) (see slag disposal options beginning on page N-1).

Flyash that requires stabilization (see flyash under secondary waste streams beginning on page B-8).

Scrubber residue that requires stabilization (see scrubber residue under secondary waste streams beginning on page B-8).

Offgas particulate filters that require stabilization (see offgas particulate filters under secondary waste streams beginning on page B-8).

Empty containers can be disposed of as LLW (see empty containers disposal options beginning on page N-1).

Subelement: Treatment Name: 183-H Solar Basin Waste MWIR#: 986

Matrix: Pond Sludges / 3122 Site: Hanford

Alternative/Technology

Status

Science and Technology Implementation Analysis Needs

Joule Heated Malter Refractory-lined reactor in which a pool of glass is maintained molten via joule heating; size-reduced waste is introduced into the glass pool and dis-

solved into the glass matrix.

High-temperatures may volatilize certain metals (such as arsenic, mercury, selenium, cadmium, and lead) require subsequent capture of the volatile metals within the incinerator offgas. The vitrifier offgases would be subsequently cooled in order to allow these metals (or compounds) to condense prior to being entrained via a particulate removal device.

Sodium and sulfate content will require the addition of significant volumes of glassification agents. DOE has developed vitrification for HLW applica- Technology must be demonstrated to assess its - High power requirements. This technology will be tions. Demonstration on LLW sludges is in progress.

Subsystems required

Waste feed pretreatment crusher, shredder or slurry system to reduce waste size (as appropriate) Waste feed system Glass additive feed system Molten glass handling system Secondary combustion chamber Small offgas treatment system, including acid gas scrubber, metal recovery system, and particulate

Projected performance

filter

Need to tightly control melt chemistry which can complicate the operation Offgas system flyash can be processed through the melter Addition of class formers necessary to maintain

Good organic destruction requires reduction pre-

treatment or extended periods in the melt

desired viscosity limits volume reduction Glass final waste form possesses good leaching applicability to the treatment of this waste stream, including the operation of the required subsystems

commercially available for waste applications within 2 years, and is currently in use for highly specialized applications in the DOE system. Unit operational costs and life cycle costs fall in the mid-range of this group of technologies. The large number of subsystems required and the need to carefully control melt chemistry make this technology relatively complicated and labor-intensive. The physical characteristics

risk compared to the other thermal technologies. Input waste stream characterization information

of this waste stream are a good match for this tech-

nology. This technology has a medium development

needed Characterization requirements include the identification of volatile metals and vitrification qualities due to salt content of this waste stream. Salts may include NaCl, KCl, along with sulfates, nitrates, and some fluorides (see volatile metals and salt content in the characterization subelement beginning on page B-11).

Waste streams produced

Stabilized glass can be disposed of as a RCRA LLW (but could also be classified as a RCRA alphacontaminated LLW, or TRU waste) (see stabilized glass disposal options beginning on page N-1).

Scrubber residue that requires stabilization (see scrubber residue under secondary waste streams beginning on page B-8).

Offgas particulate filters that require stabilization (see offgas particulate filters under secondary waste streams beginning on page B-8).

Empty containers can be disposed of as LLW (see empty containers disposal options beginning on page

Plasma Arc Furnace

Refractory-lined chamber into which unopened. containenzed waste is introduced and melted in the high-temperature arc of a plasma torch. Hightemperature volatilizes certain metals (such as arsenic, mercury, selenium, cadmium, and lead) require the subsequent capture of the metals in the offgas. The offgases would be subsequently

Large scale proof-of-principle pilot batch unit has been demonstrated. Upgrades to the pilot plant to implement a continuous waste feed system and melt removal system is currently in the design phase.

Subsystems required

Waste feed system (with size reduction for oversized containers)

Treatability tests are needed to identify the NOx ---emission potential. Technology must be demonstrated to assess its applicability to the treatment of this waste stream; including the operation of the required subsystems Treatability tests are needed to identify if glass formers are required,

Very high power requirements. This technology is the furthest from commercial availability, but should be proven in 3-5 years. Unit operational costs are comparable to a joule melter. Minimal feed pretreatment requirements make this technology simple and non-labor intensive. This system is suited to process this waste stream without pretreatment. This has the highest development risk of all of the thermal tech-

Subelement: Treatment MWIR#: 986 183-H Solar Basin Waste Name:

Matrix: Pond Sludges / 3122 Site: Hanford

Alternative/Technology

Plasma Arc Furnace (continued)

cooled in order to allow these metals for compounds) to condense prior to being entrained via a particulate removal device. A secondary combustion chamber for treatment of organics is commonly included.

Microwave Melfer -

A process that uses microwave energy to solidify wastes within the metal container either in a batch or continuous feed mode. High-temperature melt occurs at between 1600° - 2600° F, resulting in a glassy monolithic waste material. Due to the temperatures created in this process certain metals (such as arsenic, mercury, selenium, cadmium, and lead) may volatilize. These volatilized metals need to be condensed prior to being entrained via a particulate removal device.

Typical volume reductions through this process. may be as high as 60 to 80%. Materials would require drying prior to this treatment. Stabilization additives may be required to create a final waste

Status

Glass additive feed system (as needed) Molten material handling system Secondary combustion chamber Offgas treatment system, including acid gas scrubber and particulate filters

Projected performance

Highest temperature range, good organic destruction with no pretreatment Slag and metal final waste forms are leach resis-

Offgas system particulate filters and flyash can be processed through the furnace

- A large scale non-radioactive pilot plant has been

Subsystems required

Waste feed system

Reduced handling requirements and generation of

Science and Technology Needs

lerns required. Technology must be demonstrated to

assess its applicability to this waste stream, including

Demonstration of virilication capabilities is required.

and the identification of the potential for excessive

the operation of the required subsystems.

NOx emissions generation is needed.

Implementation Analysis

nologies. The high salt content of the waste may dictate the need for class formers. NOx emissions may require additional controls.

Input waste stream characterization information needed

Characterization requirements may include the identification of volatile metals within the waste stream (see volatile metals in the characterization subelement beginning on page B-11).

Waste streams produced

Slag may be disposed of as a RCRA LLW (but could also be classified as a RCRA alpha-contaminated LLW, or TRU waste) (see slag disposal options beginning on page N-1).

Scrubber residue that requires stabilization (see scrubber residue under secondary waste streams beginning on page B-8).

Offgas particulate filters that require stabilization (see offgas particulate filters under secondary waste streams beginning on page B-8).

Study of potential container melt and corresion pro not yet commercially available, but should be proven in 2 - 4 years. Unit operational costs are high due to low throughput comparable to a joule melter or a plasma arc furnace. Minimal subsystem requirements make this technology extremely simple and non-labor intensive. This technology has a medium development risk of all of the thermal technologies.

Input waste stream characterization information needed

Characterization requirements may include the identification of volatile metals in the waste stream. (see volatile metals in the characterization subelement beginning on page B-11).

Corrosive nature of ash during micro-waving (see salt content in the characterization subelement beginning on page B-11).

Waste streams produced

Slag may be disposed of as a RCRA LLW (but could also be classified as a RCRA alpha-contami-

Molten-material handling system (as applicable) Secondary combustion chamber

Stabilization additive feed system (as needed)

Projected performance

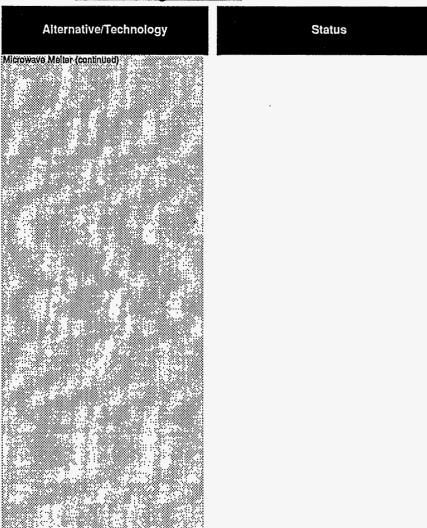
High-temperature range with good organic destruc-

Highly stable glass waste form

secondary wastes through in-drum processing

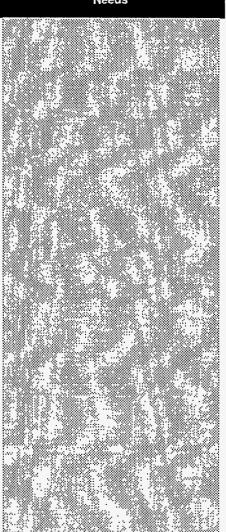
Subelement: Treatment Name: <u>183-H Solar Basin Waste</u> MWIR#: 986

Matrix: Pond Sludges / 3122



Science and Technology Needs

Site: Hanford



Implementation Analysis

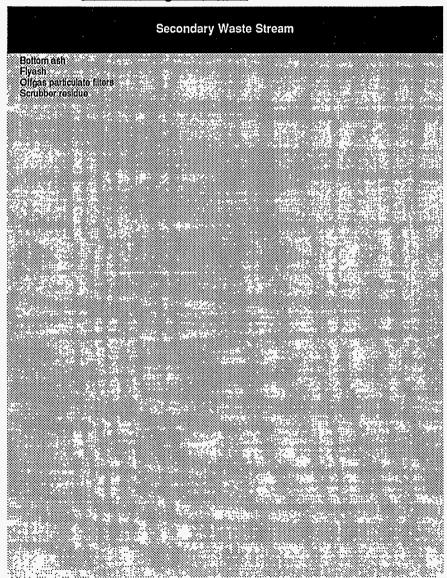
nated LLW, or TRU waste) (see slag disposal options beginning on page N-1).

Scrubber residue that requires stabilization (see scrubber residue under secondary waste streams beginning on page B-8).

Offgas particulate filters that require stabilization (see offgas particulate filters under secondary waste streams beginning on page B-8).

Subelement: Treatment Name: 183-H Solar Basin Waste MWIR#: 986

Matrix: Pond Sludges / 3122



Treatability Group

Radiological Constituents:

Site: Hanford

This waste may be classified as a waste containing 10-100 nCl/g of alpha-emitting radionuclides. However the waste may possibly be classified as TRU waste, if the radionuclides in the waste feed become concentrated within the products generated by the treatment process.

This waste stream is contaminated with toxic heavy metals including chromium. The following EPA-regulated wastes are suspected to be contained within the waste stream:

P029: Copper cyanide

P030: Cyanide (soluble salts)

P098: Potassium cyanide P106: Sodium cyanide

P120: Vanadium oxide

U123: Formic acid

Matrix:

This waste consists of filters, ash, and residues.

Name: 183-H Solar Basin Waste MWIR#: 986 Subelement: Treatment

Matrix: Pond Sludges / 3122 Site: Hanford

Science and Technology Alternative/Technology **Status** Implementation Analysis Needs ALTERNATIVE ... Solidification / Stabilization ➤ Polyethylene is being developed by DOE for use in Technology must be demonstrated on this waste Technology must be demonstrated on the Technol Low power requirements. Few subsystems are Polyethylene is an inert thermoplastic material that similar types of waste streams. Polyethylene has stream to ensure stabilization of toxic constituents required and needed to make use of this technology. can be processed at low temperatures. Polyethylene binder and dry waste material are been demonstrated on scrubber residues. and compatibility with the actual waste constituents. Low development risk. The technology needs development on the shredded fed through separate calibrated volumetric or loss-Subsystems required particulate filters. Input waste stream characterization information in-weight feeders to an extruder. The materials Waste feed system needed are then thoroughly mixed, heated to a molten Ingredients feed system The concentration of soluble salt contained in the condition, and extruded into a suitable mold. On Shredder for particulate filters scrubber residues (sodium, potassium, sulfates, cooling, the mixture forms a solid monolithic waste nitrates, and chlorides) (see concentration of soluble form. No chemical reaction is regulred for solidifi-Projected performance salt in the characterization subelement beginning on cation. Expected to pass TCLP page M-12). Expected to be a suitable final waste form for dis-Waste streams produced A solidified waste form that requires RCRA LLW disposal (but could also be classified as a RCRA alpha-contaminated LLW, or TRU waste) (see solid waste forms disposal beginning on page N-1). Sulfur Polymer Cement (SPC) ►SPC is being developed by DOE for use in these -Technology must be demonstrated on this waste -Low power requirements. Few subsystems are Sultur Polymer Cement is composed of 95% sul-fur. It melts at approximately 110 to 120°C and is particularly applicable to the immobilization of types of waste streams. SPC has been demonstratstream to ensure stabilization of toxic constituents required and needed to make use of this technology. ed on ash. SPC is not compatible with wastes conand compatibility with the actual waste constituents. Low development risk. taining a high nitrate loading. The technology needs development on the shredded toxic metals and treatment of incinerator ash, particulate filters. Input waste stream characterization information Subsystems required needed Waste feed system The concentration of soluble salt contained in the Ingredients feed system scrubber residues (sodium, potassium, sulfates, Shredder for particulate filters nitrates, and chlorides) (see concentration of soluble salt in the characterization subelement beginning on Projected performance page M-12). Expected to pass TCLP Expected to be a suitable final waste form for dis-Waste streams produced A solidified waste form that requires RCRA LLW disposal (but could also be classified as a RCRA alpha-contaminated LLW, or TRU waste) (see solid waste forms disposal beginning on page N-1).

Subelement: Treatment Name: 183-H Solar Basin Waste MWIR#: 986

Matrix: Pond Sludges / 3122

Alternative/Technology

Status

use in these types of waste streams.

Subsystems required Waste feed system Ingredients feed system Shredder for particulate filters

Projected performance Expected to pass TCLP Expected to be a sultable final waste form for dis-

Science and Technology Needs

Site: Hanford

stream to ensure stabilization of toxic constituents and compatibility with the actual constituents contained within the waste stream. The technology needs development on the shredded particulate fil-

Implementation Analysis

Low power requirements. Few subsystems are required and needed to make use of this technology. Low development risk.

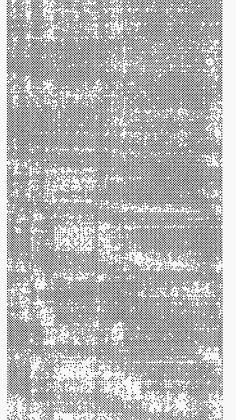
Input waste stream characterization information needed

The concentration of soluble salt contained in the scrubber residues (sodium, potassium, sulfates, nitrates, and chlorides) (see concentration of soluble salt in the characterization subelement beginning on page M-12).

Waste streams produced

A solidified waste form that requires RCRA LLW disposal (but could also be classified as a RCRA alpha-contaminated LLW, or TRU waste) (see solid waste forms disposal beginning on page N-1).





Mixed Waste Integrated Program

Logic Diagram

Hanford 183-H Solar Basin Waste Characterization Technologies

B-12

Mixed Waste Integrated Program Logic Diagram

Name: 183-H Solar Basin Waste Pond Sludges / 3122

Matrix:

Subelement: Characterization	Site: Hanford	
<u> </u>		
MWIR#:		
2		

Problem Area	Alternative/Technology	Status		Implementation Analysis
Volatile metals (süch as arsente; mer	Alternative/ Technology Atomic Absorption (AA), Furnace Technique	Accepted. Samples must be converted to — suitable solutions for analysis (sea EPA Method 200, 2). EPA has approved the following methods for determining the concentration of volatile metals in westes: EPA Method 206.2 - arsanic (detection limit 1: light) EPA Method 213.2 - castmium (detection limit 0.1:upt.)	None, with proper sample preparation.	Method(s) available. Care must be taken to minimize the loss of votatile metals during sample preparation. A featic and selection as surple preparation. A featic and selection manalysis can suifer from severe non-specific absorption and light scattering by matrix components during atomization due to their low analytical wavelengths. Simultaneous background connections must be made for all metals to avoid error neously high results.
Ţ	Alternative/Technology Atomic Absorption (AA), Direct Aspiration	EFA Method 270.2: selenjum (defection firmt 2 tog.1) Timic 2 tog.1) EFA Method 239.2: lead (detection firmt 1 tog.1) Accepted: Semples must be converted to ——None, with proper sample preparation. Sultable solutions for analysis (see EFA Method 200.2): EFA has suproved the following methods for determining the	►None, with proper sample preparation.	-Mathod(s) available. Care must be taken to mornize the loss of volatile metals during sample preparation. Nanspecific absorption, and fight scattering can be sig-
		concentration of volatile metals in wastes: EPA Method 213.1 = cadmium (detecton limit 0.005 mg/L) EPA Method 239.1 = lead (detection limit 0.1 mg/L)		inflicant at the analytical wavelengths of hese metals. Thus background corrections required. For concentrations of cachumbalow 0.02 mg/L, the funace procedure (EPA Method 2.13.2) is recommended. For concentrations of lead below 0.2 mg/L, the funace procedure (EPA Method 2.99.2) is recommended.
<u>T</u>	Aternic Absorption, Cold-Vapor	~ ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	All samples must be subject to an appropriate dissolution step prior to analysis.	Method(s) available. Potassium perman- parate is accided to aliminate possible interleative from sulfide. Wastes high in chloride require additional permangarate. Certain volatile organic absorb at the wavelength of metoury vapor (259.7-nm) A preliminary run without reagents should determine if this type of interleative is present.
	Alternative/Technology Inductively-Coupled Plasma Spectroscopy Atomic Emission Spectrometry (KP-AES)	Accepted, ICP AES's primary advantage is that it allows simultaneous or rapid sequential determination of many siles mants in a short time. ICP AES (see EPA Mahod 2007) is applicable to all marticas including soils, sludges, and sediments. However, each of these media require significant sample preparation such as	None, with proper sample preparation. This is a well-developed tachnology.	Mathod(s) available Use of ICP AES (EPA, Method 200 7) is restricted to special correction of spectral, chemical and physical inferiorisms. Users must verify the absence of spectral inferiorism of spectral inferiorism of spectral inferiorism and element in a stample for which there is no instrument detaction channel (false anner historism).

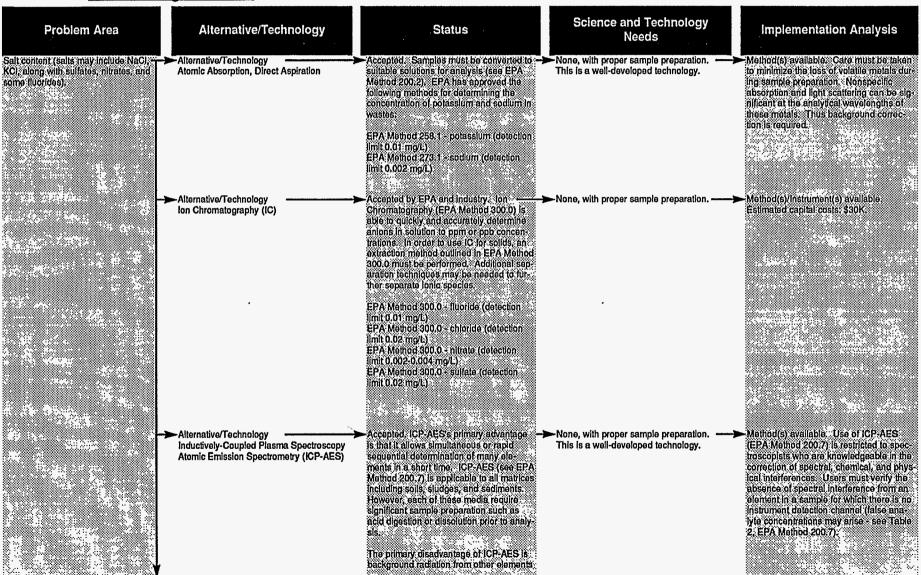
Name: 183-H Solar Basin Waste MWIR#: 986 Subelement: Characterization

Matrix: Pond Sludges / 3122 Site: Hanford

-	Problem Area	Alternative/Technology	Status	Science and Technology Needs	Implementation Analysis
	Volatile metals (continued)	Inductively-Coupled Plasma Spectroscopy Atomic Emission Spectrometry (ICP-AES) (continued)	acid digestion or dissolution prior to analysis. The primary disadvantage of ICP-AES is background radiation from other elements and the plasma gases: Although all ICP-AES instruments utilize high-resolution optics and background correction to minimize these interferences, analysis for traces of metals in the presence of a large excess of a single metal is difficult. Physical interferences such as samples containing high discolved solids or high acid concentrations can cause significant inaccuracies. These inaccuracies can be reduced by diluting the sample, delivering a consistent flow of sample to the instrument via the use of a peristolic pump, and/or by the use of the standard additions method. EPA Method 200.7 - arsenic (detection limit 0.008 mg/L) EPA Method 200.7 - cadmium (detection limit 0.001 mg/L) EPA Method 200.7 - selentum (detection limit 0.002 mg/L) EPA Method 200.7 - lead (detection limit 0.02 mg/L) EPA Method 200.7 - lead (detection limit 0.02 mg/L) EPA Method 200.7 - lead (detection limit 0.02 mg/L) EPA Method 200.7 - lead (detection limit 0.02 mg/L)		lyte concentrations may arise - see Table 2, EPA Method 200.7).
		Alternative/Technology Inductively-Coupled Plasma Mass Spectrometry (ICP-MS)	Accepted by EPA: Provides multi-element— analysis that is more selective than ICP- AES: Allows isotopid analysis Interferences may occur in elements with similar mass: Common molecular ion interferences in ICP-MS are listed in Table 2 of EPA Method 200.8). EPA Method 200.8 - arsenid (detection limit 0.9 ug/L) EPA Method 200.8 - cadmium (detection limit 0.1 ug/L) EPA Method 200.8 - selenium (detection limit 5 ug/L) EPA Method 200.8 - lead (detection limit 0.08 ug/L) EPA Method 200.8 - lead (detection limit 0.08 ug/L)	None with proper sample preparation. Aqueous or solid samples may be analyzed. Solids require suspension of analytes of interest using techniques such as laser ablation.	►Malhod(s) available

Name: 183-H Solar Basin Waste MWIR#: 986 Subelement: Characterization

Matrix: Pond Sludges / 3122 Site: Hanford



Name: <u>183-H Solar Basin Waste</u> MWIR#: <u>986</u> Subelement: Characterization

Matrix: Pond Sludges / 3122 Site: Hanford

Problem Area	Alternative/Technology	Status	Science and Technology Needs	Implementation Analysis
	Alternative/Technology Inductively-Coupled Plasma Spectroscopy Atomic Emission Spectrometry (KCP-AES) (continued)	and the plasma gases. Although all ICP-AES Instruments utilize high-resolution optics and background correction to minimize these interferences, analysis for races of metals in the presence of a large excess of a single metal is difficult. Physical Interferences such as samples containing high dissolved sollds or high acid concentrations can cause significant inaccuracies. These inaccuracies can be reduced by diluting the sample, delivering a consistent flow of sample to the instrument via the use of a peristolic pump, and/or by the use of the standard additions method. EPA Method 200.7 - potassium (detection limit 0.0 mg/L). EPA Method 200.7 - sodium (detection limit 0.03 mg/L).		
	Alternative/Technology	Accepted by EPA: Provides multi-element— analysis that is more selective than ICP: AES: Allows isotopic analysis. Interferences may occur in elements with similar mass. Common molecular ion interferences in ICP-MS are listed in Table 2 of EPA Method 200.9):	None, with proper sample preparation. Aqueous or solid samples may be analyzed. Solids require suspension of analytes of interest using techniques such as laser ablation.	Mathod(s) available

Mixed Waste Integrated Program

Logic Diagram

Hanford
TC Metal Inorganic Solid Debris
Treatment Technologies

Name: TC Metal Inorganic Solid Debris MWIR#: RL-W027 Subelement: Treatment

Matrix: Predominantly Metal Debris / 5190

Waste Stream

Waste Stream Description

This waste consists of solid debris (mainly crushed light tubes) generated from clean-up and maintenance activities of various processes and support operations within a Plutonium Finishing Plant. It is stored within a carbon-steel box

Problems Presented by Waste Stream

The waste is contaminated with cadmium, mercury, and PCB's. The PCB's within the waste have been estimated to be >500 ppm. The waste characteristics information indicates that PCBs are present in 100% of the waste stream. Therefore sorting/segregation of PCBs has been ruled out as an option. Since the concentration of the PCBs is more than 50 ppm, the waste has to be incinerated in compliance with TSCA regulations.



Treatability Group

Radiological Constituents:

Site: Hanford

This waste may be classified as a waste containing 10-100 nCl/g of alpha-emitting radionuclides. However the waste may be classified as TRU waste, if the radionuclides in the waste feed become concentrated within the products generated by the treatment process.

MLLW-CH

Alpha-emitter (10-100 nCi/g)

Cs-137

Ba-137

Sr-90

Y-90

Mixed Fission Products

H-3

Contaminants:

This waste stream is contaminated with cadmium, mercury, and PCBs. The following EPA regulated wastes are suspected to be contained within the waste stream:

D006: Cadmium

D009: Mercury

PCBs (estimated to be >500 ppm)

Matrix:

This waste matrix consists of a crushed solid (metal, glass, combustible) debris waste that is 20-30% combustible. BTU (BTUs/lb of mass) = 3000.

Name: TC Metal Inorganic Solid Debris MWIR#: RL-W027 Subelement: Treatment

Matrix: Predominantly Metal Debris / 5190 Site: Hanford

	CIAI DEDIIS / D130	one. Hamoru	
Alternative/Technology	Status	Science and Technology Needs	Implementation Analysis
Low-temperature thermal unit in which mercury is vaporized for subsequent capture within the offices. Options include desorber units (that are externally heated kilns) while other constituents are evacuated via batch waste systems. Volabilization of the other waste constituents is lower than in an inclinerator due to the lower process temperatures. The roaster offgases would be cooled to condense mercury and mercury compounds prior to capture within the offgas control device. A secondary combustion chamber is required for treatment of any volatile organics. The treated waste residue contains a large amount of carbon. The behavior of PCBs at 400°C will determine their linel form after the mercury desorption process. If all of the PCBs are volatilized as light organics and pass through the condenser, the offgas can be sent directly to a secondary combustion chamber. If there are remaining PCBs in the solid residue, they must be inclinerated (Refer to inclineration Alternative). Since the mercury retorting/roasting process is performed at a temperature considerably lower than the boilling point of cadmium, it is expected that the cadmium will remain in the solid residues after the completion of the mercury retoring/roasting process. If any cadmium escapes with the offgas, it is expected to be captured during offgas treatment. **ALTERNATIVE** Incheration Cylindrical refractory-lined shell mounted on a	Accepted by industry. The EPA has approved this—technology as the BDAT for high-mercury nonwastewaters. Subsystems required Feed pretreatment shredder for large items (as applicable) Small offgas treatment system, including offgas scrubber, mercury scrubber, and particulate filters Secondary combustion system (for treatment of volatilized organics) Solid residue handling system Mercury treatment system such as amalgamation Stabilization system for treatment residuals. Projected performance Good organic destruction in secondary combustion Post-treatment stabilization of incinerator ash residues using cement is currently in wide use Long-term leaching performance is suspect Volume reduction is moderate Residual fixed carbon may impede solidification Accepted by industry. This technology is BDAT for organics and metal contaminated nonwastewaters.	Better characterization of waste stream to determine extent of volabilization of other waste constituents and whether the waste requires mixing during treatment, (to enable the exposure of all mercury-contaminated materials to the unit's processing temperatures). Determination of solidification requirements for roasted waste materials and the appropriate solidification agent to be used. Technology must be demonstrated to assess its applicability to this waste stream, including the operation of the required subsystems. Better characterization of the waste stream to determine the extent of vegorization of other waste stream to determine the extent of vegorization of other waste stream to determine the extent of vegorization of other waste stream to determine the extent of vegorization of other waste stream to determine the extent of vegorization of other waste con-	Normal implementation needs. Captured mercury and treatment residue will require treatment/stabilization prior to disposal. This technology and its subsystems are commercially available and are currently in use in the commercial sector but the large number of subsystems required make this technology relatively complicated and labor intensive. Input waste stream characterization information needed No specific characterization requirements identified for this waste stream. Waste streams produced Bottom ash that requires stabilization (see bottom ash under secondary waste streams beginning on page C-7). Flyash that requires stabilization (see flyash under secondary waste sfreams beginning on page C-7). Scrubber residue that requires stabilization (see scrubber residue under secondary waste streams beginning on page C-7). Offgas particulate filters that require stabilization (see offgas particulate filters under secondary waste streams beginning on page C-7). Empty containers can be disposed of as LLW (see empty containers disposal beginning on page C-10). An amalgamate mercury that can be disposed of as RCRA LLW (see solidified waste forms disposal beginning on page N-1). Normal implementation needs. Captured metals and treatment residue will require treatment/stabilization
slight incline; rotation of the kiln moves the non- containerized waste through, while enhancing mixing. A high-temperature secondary combus- ition chamber is required to complete organic destruction. Cadmium that has volatilized and mercury that has not been recovered by the retort- wing/roasting unit, require subsequent capture in	The DOE is operating a rotary kiln in LLW service and post-treatment stabilization of ash residuals using cement is currently in use. Subsystems required Feed pretreatment shredder for large items (may not be necessary based on the waste stream	stituents. Demonstration of metal condensing process from the incineration offgas and subsequent capture of cadmium would be required.	prior to disposal. Rotary kiln incineration technology is commercially available, is currently in use, and planned for use within the DOE system. The required subsystems, as described above, (except for the metal condensation and collection system) are commercially available. The moving parts and large number of subsystems required, make this technolo-

Name: TC Metal Inorganic Solid Debris MWIR#: RL-W027 Subelement: Treatment

Matrix: Predominantly Metal Debris / 5190 Site: Hanford

Alternative/Technology Rotary Kiln (continued) the incinerator offgas. The offgases would be cooled to allow the cadmium in the offgas to condense out and be captured in an oligas particulate removal system (typically a HEPA filter). ALTERNATIVE - Vitrification

Status

description)

Feed system

Secondary combustion chamber

Large offgas treatment system, including acid gas scrubber, metal removal system, and particulate fil-

Ash handling system

Projected performance

Good organic destruction

Rotating kiln seals questionable for contamination

Posttreatment stabilization of ash residuals using cement is currently in wide use; long-term leaching performance is suspect; volume reduction is minimum; alternate stabilization techniques possible for better long-term performance

Plasma Arc Furnace/Centrifugal Plasma Arc Large scale pilot demonstration complete. A radioac -- Technology must be demonstrated on this waste tive waste bench scale system is under construction.

Subsystems required

Waste feed system

Molten material handling system

Offgas treatment system, including acid gas scrubber and particulate filters for capture of cadmium and any mercury remaining from the mercury

bakeout process

Projected performance

Highest temperature range, good organic destruction with no pretreatment

Maximum volume reduction

Highly stable slag and metal final waste forms

Offices system particulate filters and flyash can be processed through the furnace

Science and Technology

Needs

Implementation Analysis

gy relatively complicated and labor intensive. Input Waste Stream Characterization Information Needed

Characterization requirements may include determination of the extent to which volatile metals (e.g., cadmium) are present in this waste stream (see volatile metals in the characterization subelement beginning on page C-12).

Waste Streams Produced

Bottom ash that requires stabilization (see bottom ash under secondary waste streams beginning on page C-7).

Flyash that requires stabilization (see flyash under secondary waste streams beginning on page C-7). Scrubber residue that requires stabilization (see scrubber residue under secondary waste streams beginning on page C-7).

Offgas particulate filters that require stabilization (see offgas particulate filters under secondary waste streams beginning on page C-7).

Mercury contaminated offgas (see mercury offgas under secondary waste stream beginning on page

Very high power requirements. This technology is far from commercial availability, but should be proven in 3-5 years. Unit operational costs are comparable to costs associated with a joule melter. Minimal feed preparation requirements make this the simplest of the thermal treatment options. It requires no segregation of the various components of this waste stream. Highest development risk of the thermal technologies.

Input waste stream characterization information

Characterization requirements may include the identification of volatile metals in this waste stream (see volatile metals in the characterization subelement beginning on page C-12).

Waste streams produced

Slag may be disposed of as a RCRA LLW (but could also be classified as a RCRA alpha-contaminated LLW, or TRU waste) (see slag disposal begin-

A typical plasma arc lumace uses a fixed refractory-lined chamber into which unopened, containerized waste is introduced and melted in the presence of a plasma torch. A centrifugal plasma are furnace also melts the waste with a plasma torch but uses a rotating chamber for better treatment of particulates present in the waste. If this waste stream is found to contain a significant percentage of particulates, a centrifugal plasma arc may be more suitable. High-temperature volatilization of cadmium and mercury require their subsequent capture in the incinerator offgas. A secondary combustion chamber for destruction of PCBs will be required. The incinerator offgases would be subsequently cooled in order to allow condensation of metals prior to their capture in the offgas particulate removal system.

stream, including operation of required subsystems.

Name: TC Metal Inorganic Solid Debris MWIR#: RL-W027 Subelement: Treatment

Matrix: Predominantly Metal Debris / 5190 Site: Hanford

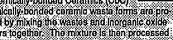
Alternative/Technology	Status	Science and Technology Needs	Implementation Analysis
Plasma Arc Furnace/Gentrifugal Plasma Arc Furnace (Continued) CHEMICAL TREATMENT No chemical technologies were found to be appropriate treatment options for the waste stream due to the inability to adequately sort/segregate the wastes. PHYSICAL TREATMENT Physical treatment via stabilization is applicable to wastes. PHYSICAL TREATMENT Physical treatment via stabilization is applicable to waste streams classified as debris per the EPA debris rule. To qualify as debris, more than 50 percent of the waste stream by volume must meet the EPA definition of debris. Since the waste stream already contains PCBs, it is possible that the stabilization of debris under the RCRA regulations may not be an adequate treatment, because the PCBs may have still have to be destroyed under TSCA regulations. ALTERNATIVE - Stabilization	••		ning on page N-1). Scrubber residue that requires stabilization (see scrubber residue under secondary waste streams beginning on page C-7). Offgas particulate filters that require stabilization (see offgas particulate filters under secondary waste streams beginning on page C-7). Mercury offgas (see mercury offgas under secondary waste streams beginning on page C-10).
Sulfur Polymer Cement (SPC) Sulfur Polymer Cement is composed of 95% sulfifur. It melts at approximately 110 to 120°C and is particularly valuable in the immobilization of combustibles and small metal pieces:	SPC is being developed by the DOE for usage within—this type of waste streams at INEL. SPC has been demonstrated on ash. SPC is not compatible with waste streams containing high nitrates. Subsystems required Waste feed system Ingredients feed system Shredder for combustibles and small metal pieces Projected performance Expected to produce a suitable final waste form for disposal	Technology must be demonstrated on this wasta stream:	Low power requirements. Few subsystems are required and needed to make use of this technology. Low development risk. Input Waste Stream Characterization Information Needed The concentration of sodium, potassium, sulfates, nitrates, and chlorides (see concentration of soluble salts in the characterization subelement beginning on page C-12). Waste Streams Produced A solidified waste form that requires RCRA LLW disposal (see solidified waste forms disposal beginning on page N-1).

Name: TC Metal Inorganic Solid Debris MWIR#: RL-W027 Subelement: Treatment

Matrix: Predominantly Metal Debris / 5190 Site: Hanford



Chemically-bonded Ceramics (CbC) Chemically-bonded caramic waste forms are produced by mixing the wastes and inorganic oxide binders together. The mixture is then processed at ambient and near ambient temperatures, proand the inorganic oxides into a dense ceramic



Status

CbC is in early stages for development by the DOE Technology must be demanstrated on this waste Low power requirements. Few subsystems are for usage on this type of waste streams.

Subsystems required

Waste feed system Ingredients feed system

Shredder for combustibles and small metal pieces

Projected performance

Expected to produce a suitable final waste form for disposal

Science and Technology Needs

stream.

Implementation Analysis

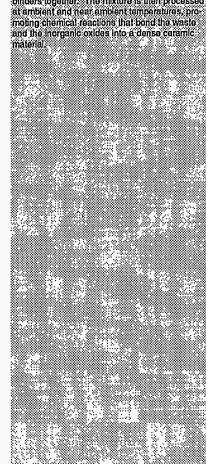
required and needed to make use of this technology. Low development risk.

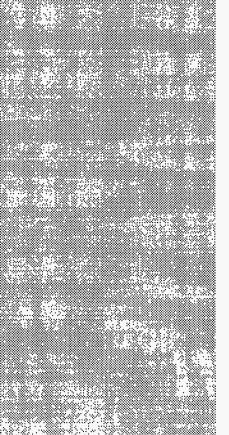
Input Waste Stream Characterization Information Needed

The concentration of sodium, potassium, sulfates, nitrates, and chlorides (see concentration of soluble salts in the characterization subelement beginning on page C-12).

Waste Streams Produced

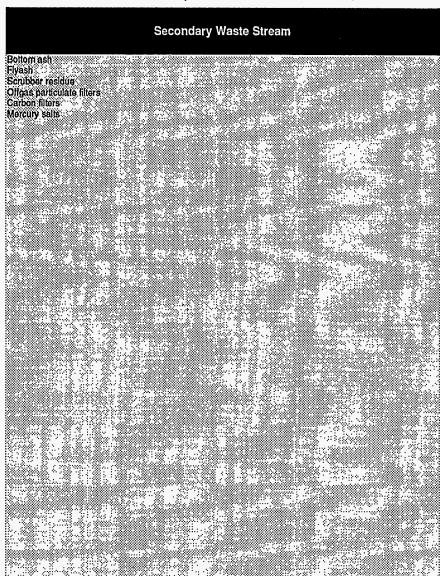
A solidified waste form that requires RCRA LLW disposal (see solidified waste forms disposal beginning on page N-1).





Name: TC Metal Inorganic Solid Debris MWIR#: RL-W027 Subelement: Treatment

Matrix: Predominantly Metal Debris / 5190



Treatability Group

Radiological Constituents:

This waste may be classified as a waste containing 10-100 nCl/g of alpha-emitting radionuclides. However the waste may be classified as TRU waste, if the radionuclides in the waste feed become concentrated within the products generated by the treatment process.

MLLW-CH

Alpha-emitter (10-100 nCi/g)

Cs-137

Ba-137

Sr-90 Y-90

Mixed Fission Products

H-3

Contaminants:

This waste stream is contaminated with toxic metals including mercury and cadmium. The following EPA-regulated wastes are suspected to be contained within the waste stream.

D009: Mercury D006: Cadmium

Matrix:

This matrix is ash, residues, filters, and mercury salts.

Site: Hanford

Name: TC Metal Inorganic Solid Debris MWIR#: RL-W027 Subelement: Treatment

Matrix: Predominantly Metal Debris / 5190 Site: Hanford

Science and Technology Alternative/Technology Status Implementation Analysis Needs ALTERNATIVE Solidification/Stabilization ➤ Polyethylene -Polyethylene is being developed by the DOE for — Technology must be demonstrated on this waste := Low power requirements. Few subsystems are Polyethylene is an inert thermoplastic material that can be processed at low temperatures. usage on these types of waste streams. stream to ensure stabilization of toxic constituents required and needed to make use of this technology. Polyethylene has been demonstrated on scrubber and the compatibility of the process with the actual Low development risk. Polyethylene binder and dry waste material are waste streams. The technology needs development. residues. fed through separate calibrated volumetric or lossfor the treatment of particulate filters. Input Waste Stream Characterization Information In-weight feeders to an extruder. The materials Subsystems required Needed are then, thoroughly mixed, heated to a molten condition; and extruded into a suitable mold. On Waste feed system The concentration of soluble salt contained in the Ingredients feed system scrubber residues (sodium, potassium, sulfates, cooling, the mixture forms a solid monolithic waste Shredder for particulate filters nitrates, and chlorides) (see concentration of soluble form. No chemical reaction is required for solidifisalts in the characterization subelement beginning on page C-12). Projected performance cation. Expected to pass TCLP Expected to produce a suitable final waste form for Waste Streams Produced disposal A solidified waste form that requires RCRA LLW disposal (see solidified waste forms disposal beginning on page N-1). Sulfur Polymer Cement (SPC). -➤ SPC is being developed by the DOE for usage within -> Technology must be demonstrated on this waste Low power requirements. Few subsystems are Sulfur Polymer Cement is composed of 95% sulstream to ensure stabilization of toxic constituents required and needed to make use of this technology. these types of waste streams. SPC has been and the processes' compatibility with the actual fur. It melts at approximately 110 to 120_C and is demonstrated on ash. SPC is not compatible with Low development risk. particularly valuable in the immobilization of toxic waste streams containing high nitrates. waste stream constituents. The technology needs metals and treatment of incinerator ash. development for treatment of particulate filters. Input Waste Stream Characterization Information Needed Subsystems required Waste feed system The concentration of soluble salt contained in the Ingredients feed system scrubber residues (sodium, potassium, sulfates, nitrates, and chlorides) (see concentration of soluble Shredder for particulate filters salts in the characterization subelement beginning on Projected performance page C-12). Expected to pass TCLP Expected to produce a suitable final waste form for Waste Streams Produced A solidified waste form that requires RCRA LLW disdisposal posal (see solidified waste forms disposal beginning on page N-1). Chemically-bonded Ceramics (CbC) - CbC is in early stages for development by the DOE - Technology must be demonstrated for this waste Low power requirements. Few subsystems are Chemically-bonded ceramic waste forms are produced by mixing the wastes and inorganic oxide for usage on these types of waste streams. stream to ensure stabilization of toxic constituents required and needed to make use of this technology. and the processes compatibility with the actual waste stream constituents. The technology needs Low development risk. binders together. The mixture is then processed Subsystems required at ambient and near ambient temperatures, prodevelopment for the treatment of particulate filters. Input Waste Stream Characterization Information Waste feed system moting chemical reactions that bond the waste. Ingredients feed system Needed and the inorganic exides into a dense ceramic Shredder for particulate filters The concentration of soluble salt contained in the scrubber residues (sodium, potassium, sulfates, nitrates, and chlorides) (see concentration of soluble Projected performance salts in the characterization subelement beginning on Expected to pass TCLP Expected to produce a suitable final waste form for page C-12).

Name: TC Metal Inorganic Solid Debris MWIR#: RL-W027 Subelement: Treatment

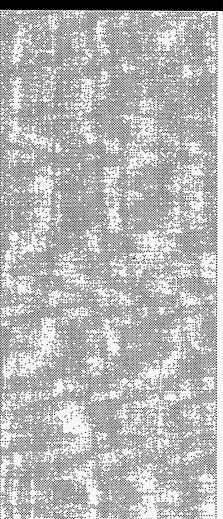
Matrix: Predominantly Metal Debris / 5190

Alternative/Technology Chemically-bonded Ceramics (CbC) (continued)

Status

Science and Technology Needs

Site: Hanford

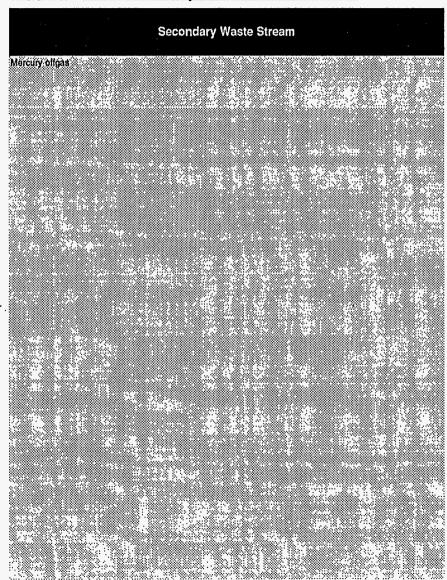


Implementation Analysis

Waste Streams Produced
A solidified waste form that requires RCRA LLW disposal (see solidified waste forms disposal beginning on page N-1).

Name: TC Metal Inorganic Solid Debris MWIR#: RL-W027 Subelement: Treatment

Matrix: Predominantly Metal Debris / 5190



Treatability Group

Radiological Constituents:

Site: Hanford

This waste may be classified as a waste containing 10-100 nCi/g of alpha-emitting radionuclides. However the waste may be classified as TRU waste, if the radionuclides in the waste feed become concentrated within the products generated by the treatment process.

MLLW-CH

Alpha-emitter (10-100 nCl/g)

Cs-137

Ba-137 Sr-90

Y-90

Mixed Fission Products

H-3

Contaminants:

This waste stream is contaminated with toxic metals including mercury and cadmium. The following EPA-regulated wastes are suspected to be contained within the waste stream.

D009: Mercury D006: Cadmium

Matrix

This waste consists of an offgas stream.

Name: TC Metal Inorganic Solid Debris MWIR#: RL-W027 Subelement: Treatment

Matrix: Predominantly Metal Debris / 5190 Site: Hanford

Alternative/Technology

ALTERNATIVE Offgas Mercury Removal

→ Wet Sodium Hypochlarite or Chelating Agent/Cupric Chloride injection; Chemical Oxidation: Chemical Reduction: Amalgamation of Mercury

The capture-rate of mercury in the offgas, utilizing only a wet caustic scrubbing process, may not be sufficient. If the concentration of the mercury in the waste is high; additional steps to remove mercury from the offgas may be necessary.

Subjecting the offgas to a wet sodium hypochlorite or chelating agent/cupic chloride injection during the wet scrubbing process and/or subjecting the offgas to a carbon absorption, following the wetscrubbing process will enable a greater capturerate of mercury.

Mercury-contaminated wet blowdown liquids will: require chemical treatments such as chemical oxidation (to destroy the chelating agent) if it is used); chemical reduction of toxic metals, and/or amalgamation of mercury (depending on the concentration of mercury and other metals contained within the blowdown). The slurry will then be dehydrated down to a sludge and treated via stabilization.



Status

Accepted by industry.

Subsystems required

Feed pretreatment in treatment of volatile mercury System for mercury removal from carbon (if encapsulation of charcoal with mercury is not acceptable

Mercury treatment system such as amalgamation or chemical oxidation

Projected performance

High mercury removal efficiency at low cost Effective at removing trace quantities of other contaminants

Simple to operate and maintain

Science and Technology Needs

mass transfer effectiveness. Demonstration of the technology on the specific thermal technology under the same flue-gas conditions. Development of a treatment for proper disposal of the residue.

Implementation Analysis

mprovements in the atomization process to improve — Normal implementation needs. The technology is simple, but control and handling of the sodium sulfide requires care to prevent emission of sulfide fumes.

Input Waste Stream Characterization Information

Concentrations levels of mercury in the waste (see volatile metals in the characterization subelement beginning on page C-12).

Waste Streams Produced

Mercury contaminated carbon filters that require stabilization (see carbon filters under secondary waste stream beginning on page C-7).

Mercury salts contaminated with radionuclides that require stabilization (see mercury salts under secondary waste stream beginning on page C-7).



Mixed Waste Integrated Program

Logic Diagram

Hanford TC Metal Inorganic Solid Debris Characterization Technologies

Diagram **Program Logic** Mixed Waste Integrated

Subelement: Characterization Name: TC Metal Inorganic Solid Debris MWIR#: RL-W027

Site: Hanford

Matrix: Predominantly Metal Debris / 5190

specific absorption and light scattering by nainx components during atomization due lificant at the snatytical wavelengths of hisse matals. Thus background correction is required. For concentrations of cadmit-A preliminary run without reagents should defermine if this type of interference is Simultaneous background corrections must be made for all metals to avoid erro Aethod(s) avallable. Care must be taken o minimize the loss of volatile metals dur ng sample preparation. Nonspecific absorption and light scattering can be sig Im below 0.02 mg/L, the furnace procedure (EPA Melhod 219.2) is recommended. For concentrations of lead below 0.2 g/L, the furnace procedure (EPA Metho dethod(s) avallable. Care must be taker ilum analysis can suffer from severe non /lethod(s) available. Potassium perman Implementation Analysis panate is added to eliminate possible o their low analytical wavelengths. eously high resuits Accepted. Samples must be converted to — None. All samples must be subject to an suitable solutions for analysis. EPA has appropriate dissolution step prior to analystopayed the following methods for debries sis. ccepted. Samples must be converted to - None, with proper sample preparation. ccapted. Samples must be converted to 👉 None, with proper sample preparation. — Technology is applicable as is. Benefit would be derived from faster chromatography to shorten analysis time. Science and Technology mass specromery (GC-MS) is a tech-nique which provides separation of volallie and semi-volalile organic molecules by concentration of volatile metals in wastes EPA Method 213.2 + cadmium (detection following methods for determining the concentration of volatile metals in westes gas chromatography and detection by mass spectrometry. Utilizes the separation characteristics of various chromato-EPA Method 213.1 + cadmium (detection EPA Method 680 + PCBs in soll/sedimen rasses defected with the elution times. Suffable solutions Wethough 200.0) EPA has approved the ic columns, qualitative and Status fable solutions Imit 0.005 mg/L lethod 200.0). imit 0.1 ug/L) GCMS ■ Atomic Absorption (AA), Direct Aspiration - ■ Gas Chromatography/Mass Spectrometry Alternative/Technology → Atomic Absorption (AA), Furnace Atomic Absorption, Cold-Vapor Technique (GC/MS) folatile metals (such as mercury and Problem Area

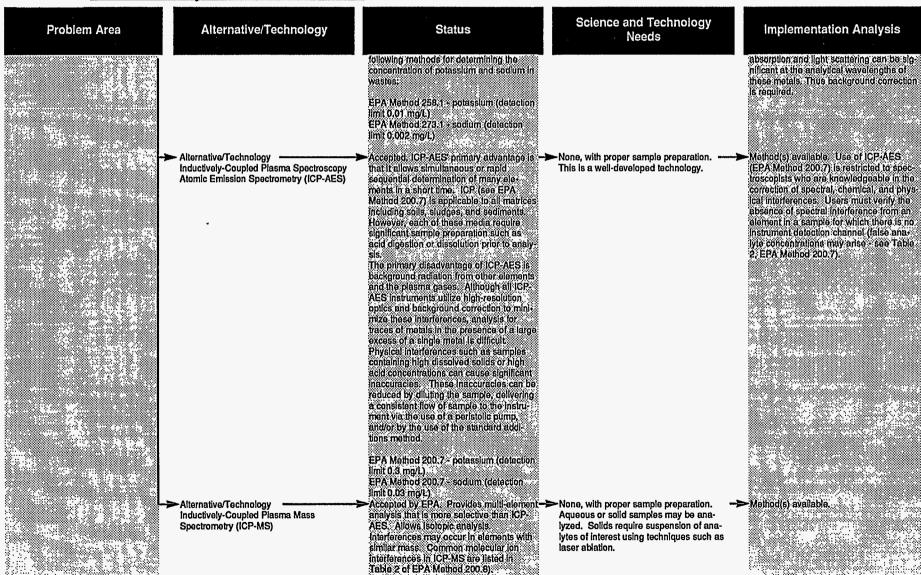
Name: TC Metal Inorganic Solid Debris MWIR#: RL-W027 Subelement: Characterization

Matrix: Predominantly Metal Debris / 5190 Site: Hanford

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Problem Area	Alternative/Technology	Status	Science and Technology Needs	Implementation Analysis
	→ Inductively-Coupled Plasma Spectroscopy — Atomic Emission Spectrometry (ICP-AES)	Accepted: ICP-AES primary advantage is that it allows simultaneous or rapid sequential determination of many elements in a short time. ICP-AES (see EPA Method 200.7) is applicable to all matrices including soils, studges, and sediments. However, each of these media require significant sample preparation such as acid digestion or dissolution prior to analysis. The primary disadvantage of ICP-AES is background radiation from other elements and the plasma gases. Although all ICP-AES instruments utilize high-resolution optics and background correction to minimize these interferences, analysis for traces of metals in the presence of a large excess of a single metal is difficult. Physical interferences such as samples containing high dissolved solids or high acid concentrations can cause significant inaccuracies. These inaccuracies can be reduced by diluting the sample, dalivering a consistent flow of sample to the instrument via the use of a peristolic pump, and/or by the use of the standard additions method. EPA Method 200.7 - mercury (detection limit 0.001 mg/L).	None, with proper sample preparation. This is a well-developed technology.	Method(s) available. Use of ICP-AES. (EPA Method 200.7) is restricted to spectroscopists who are knowledgeable in the correction of spectral, chemical, and physical interferences. Users must verify the absence of spectral interference from an alement in a sample for which there is no instrument detection channel (false analyte concentrations may arise * see Table 2, EPA Method 200.7)
	Spectrometry (ICP-MS)	Accepted by EPA. Provides multi-element—) analysis that is more selective than ICP- AES. Allows isotopic analysis, interferences may occur in elements with similar mass. Common molecular for interferences in ICP-MS are listed in Table 2 of EPA Method 200.8). EPA Method 200.8 - cadmium (detaction limit 0.1 ug/L).	Aqueous or solid samples may be analyzed. Solids require suspension of analytes of interest using techniques such as laser ablation.	► Method(s) avallable.
Concentration of soluble salt con- lained in the scrubber residues (sodi- um; potassium; sulfates, nitrates, and chiordes)	Alternative/Technology Atomic Absorption (AA), Direct Aspiration	► Accepted. Samples must be converted to → sultable solutions for analysis (see EPA Method 200.0). EPA has approved the	➤ None, with proper sample preparation. ——— This is a well-developed technology.	➤ Method(s) avaliable. Care must be taken to minimize the loss of volable metals during sample preparation. Nonspecific. C-1

Name: TC Metal Inorganic Solid Debris MWIR#: RL-W027 Subelement: Characterization

Matrix: Predominantly Metal Debris / 5190 Site: Hanford



Mixed Waste Integrated Program

Logic Diagram

Idaho National Engineering Laboratory
Cemented Sludge
Treatment Technologies

Name: Cemented Sludge **MWIR#: IN-W157**

Matrix: Solidified Process Residues / 3150

Waste Stream

Waste Stream Description

Comented Sludges at the Idaho National Engineering Laboratory.

This waste stream consists of comented liquid wastes from paint shippers, degreesers, and cleaning sol-Yents. This waste is generated by removal from processing tanks that collected liquid efficients from floor drains. Waste stream is no longer generated. Problems Presented by Waste Stream

LDA treatment regulirements for contaminants with listed wasts codes are inclineration followed by stabilizajion. This treatment will also be sufficient for the treatment of the toxic characteristic components. Waste ition. This treatment will also be sufficient for the treatment of the toxic characteristic components, waste information defines three, separate waste streams; a special equips waste (1237 drums); high-level causite (1486 drums). This does not account for the current total number of drums) listed (4497), nor the 20 * 112th3 boxes (possibly 4x4x7). Two types of the current total number of drums listed (4497), nor the 20 * 112th3 boxes (possibly 4x4x7). Two types of solidification agents have been identified as having been used; portland cerrent and Florico absorbent (aluminium magnesium-iron silicate clay). The material is packaged in plastic bags and inserted into sleel drums containing plastic liners. External to the waste materials themselves Oil-Dry or Vermiculitie were used within the drum to absorb any liquide that might not solidly and could potentially leak.

The soliditied nature of the waste presents a significant problem for treatment. To destroy the organics by inclineration would require size reduction by shredding or grinding to expose all of the organics to the required temperatures. Because the waste has been cemented inside droms, it will be very difficult to separate the waste from the metal container, plastic liner, and plastic tragging for reatment. Healthing of the unsolidified portion of this waste material may be the safest method for handling this waste stream. To further complicate treatment, the waste was sometimes comented inside 1/2 gallon wide mouth pollysthylene bottles then placed inside the drum liner of a 55 gallon drum. The presence of plastics impedes the process of shredding or grinding for separation. Even then, sintening of the extendr of targer waste chunks may traporganics inside without destruction and heavy metals without complete stabilization. Insuring complete destruction would probably require melling of all material to release and destroy all of the organics and to stabilize all of the heavy metals. Separation of the metal from the rest of the materials, required for some thermal processes, will be difficult after streeding with the plastics. It is questionable, based on current information whether or not the waste contained within any of these drums is actually classified as TRU.

Subelement: Treatment

Site: Idaho National Engineering Laboratory

Treatability Group

Radiological Constituents:

This waste is classified as contact-handled with 10-100 nCl/g of alpha-contamination.

Contaminants:

This waste stream is contaminated with toxic organics and metals. The following EPA-regulated wastes are suspected to be contained within the waste stream:

D002:Unlisted hazardous waste characteristic of corrositivity

D007:Chromium

D008:Lead

F001:Halogenated solvents used for degreasing

F002:Halogenated solvents and mixtures

F003:Non-halogenated solvents

Matrix:

This waste consists of solidified sludges and particulates.

Subelement: Treatment Cemented Sludge MWIR#: <u>IN-W157</u> Name:

Matrix: Solidified Process Residues / 3150

Site: Idaho National Engineering Laboratory

Alternative/Technology

CHEMICAL TREATMENT

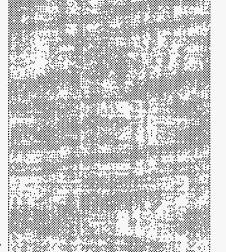
Not applicable to this waste stream, because of the encepsulated nature of the contaminants with-In the waste stream. It is doubtful that complete treatment via: a chemical process could be performed upon this waste stream, due to inability to completely de-capsulate and free the contaminants within the waste matrix. If the contaminants within the waste matrix are not free to interact with chemical reagents, the required chemical reac: tions (and thus waste treatment) will not occur.

THERMAL TREATMENT

ALTERNATIVE - Incineration

- Rotary Kiin -

Cylindrical refractory-lined shell mounted on a slight incline; rotation of the kiln moves the noncontainerized, size-reduced waste and container through while enhancing mixing. A secondary combustion chamber commonly follows the kiln to ensure complete organic destruction. The presence of portland cement used in solidification of some of this waste stream may cause calcination. resulting in high dust formation.



Status

in LLW services.

Subsystems required

Waste shredder or grinder

Waste and container fines feed system

Slurry feed system

Secondary combustion chamber

Large offgas treatment system, including dry offgas scrubber and particulate filter

Ash handling system

Stabilization system for final waste form

Projected performance

Good organic destruction

Rotating kiln seals questionable for contamination

Stabilization posttreatment using cement is currently in wide use; volume reduction is not expect-

ed to occur with this waste.

Science and Technology Needs

Implementation Analysis

Accepted by industry. DOE is operating a rotary kiln - Technology must be demonstrated to assess its - Difficult implementation needs due to the combined applicability to this waste stream, including the operation of the required subsystems. Determination of physical waste characteristics will be needed. Immobilization techniques must be selected and demonstrated. The long-term leaching performance of this stabilized waste would need to be demonstrat-



waste types. Treatment residue will require stabilization prior to disposal. The rotary kiln incineration technology is commercially available and currently used within the commercial sector. The technology is currently in use within the DOE sector for noncemented sludge wastes. The required subsystems as mentioned above are currently commercially available. Operational cost per unit throughput is lowest of all the technologies, but life cycle costs are high. The moving parts and large number of subsystems required make this technology relatively complicated and labor intensive. The solidified, non-combustible nature of this waste stream is not a good match for this technology. Lowest development risk of all of the thermal technologies. The varied composition of the wastes are expected to present materials of construction and design problems.

Input waste stream characterization information needed

Heat of combustion and alkali metal (sodium and potassium) content (see alkali metal in the characterization subelement beginning on page D-9).

Waste streams produced

Bottom ash that requires stabilization (see bottom ash under secondary waste streams beginning on

Flyash that requires stabilization (see flyash under secondary waste streams beginning on page D-6).

Scrubber residue that requires stabilization (see scrubber residue under secondary waste streams beginning on page D-6).

Subelement: Treatment Name: Cemented Sludge MWIR#: IN-W157 Matrix: Solidified Process Residues / 3150 Site: Idaho National Engineering Laboratory Science and Technology Alternative/Technology Status Implementation Analysis Needs Offgas particulate filters that require stabilization Rotary Kiln (continued) (see offgas particulate filters under secondary waste streams beginning on page D-6). Empty containers can be disposed of as LLW (see empty containers disposal beginning on page N-1). ► ALTERNATIVE - Vitrilication Joule Heated Melter ➤ The DOE has demonstrated melters on specific Technology must be demonstrated to assess its: ----→ High power requirements. This technology will be Refractory-lined reactor in which a pool of glass applicability to this waste stream, including the operacommercially available for waste applications within 2 wastes tion of the required subsystems and the durability of the system's materials of construction. is maintained molten by joule heating; sizeyears, and is currently in use for highly specialized reduced waste is introduced into the glass pool applications in the DOE system. Unit operational Subsystems required and absorbed into the class matrix; metal contain-Demonstration should include combined wastes. costs and life cycle costs fall in the mid range of the Waste shredder or grinder and system to separate er must be managed separately. waste and plastic from metal container group of thermal technologies. Large number of subsystems required and need to carefully control melt Waste feed system Metal waste container treatment system chemistry make this technology relatively complicat-Glass additive feed system ed and labor-intensive. The mixed composition of Molten glass handling system this waste stream is not a good match for this tech-Secondary combustion chamber nology. Medium development risk compared to the Small offgas treatment system, including acid gas other thermal technologies. scrubber and particulate filter Input waste stream characterization information Projected performance needed The need to tightly control melt chemistry may Chemical composition of sludge, specific sodium, complicate operation calcium, chloride, sulfate, phosphate, and silica con-Addition of glass formers to maintain desired viscentrations for glass development (see chemical cosity may limit the volume reduction composition in the characterization subelement Highly stable glass final waste form beginning on page D-9). Waste streams produced Stabilized glass can be disposed of as a RCRA LLW (but could also be classified as a RCRA alphacontaminated LLW, or TRU waste) (see stabilized glass disposal beginning on page N-1). Empty containers can be disposed of as LLW (see empty containers disposal beginning on page N-1). Scrubber residue that requires stabilization (see scrubber residue under secondary waste streams beginning on page D-6). Offgas particulate filters that require stabilization (see offgas particulate filters under secondary waste streams beginning on page D-6). Plasma Arc Furnace ➤ A large scale proof-of-principle pilot batch unit has — Tachnology must be demonstrated to assess its — Very high power requirements. This technology is far Hetraciony-lined chamber into which unopened, containenized waste is introduced and melted in been demonstrated. A pilot system with a continuous applicability to this waste stream, including the operafrom commercial availability, but should be proven in feed system and melt removal system is currently tion of the required subsystems. 3-5 years. Unit operational costs are comparable to the high-temperature arc of a plasma torch. Highjoule melter, but life cycle costs are low, due to volbeing designed.

temperature volabilities of certain metals (such as

arsenic, cadmium, lead, and selenium) may

ume reduction effects on disposal costs. Minimal

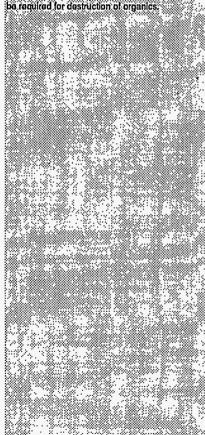
subsystem requirements make this technology

Name: Cemented Sludge MWIR#: IN-W157 Subelement: Treatment

Matrix: Solidified Process Residues / 3150

Alternative/Technology

require the subsequent capture of the metals in the offgas. The offgases would be subsequently cooled in order to allow any metals (or compounds) to condense out to low levels prior to being entrained via a particulate removal device. Since this material has already been incinerated it is unlikely that high levels of volatile metals are present. A secondary combustion chamber will



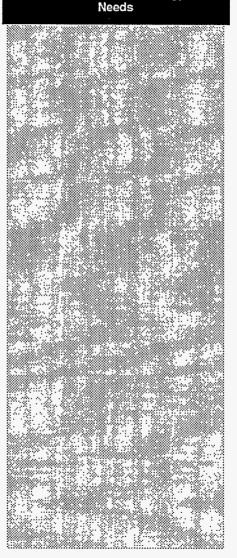
Status

Subsystems required
Waste feed system
Molten material handling system
Offgas treatment system, including acid gas scrubber and particulate filters
Glass former addition may be required, although testing on sludge has not shown a need for glass formers

Projected performance

Highest temperature range, good organic destruction with no pretreatment
Maximum volume reduction
Highly stable slag and metal final waste forms
Offgas system particulate filters and flyash can be
processed through the furnace

Science and Technology



Implementation Analysis

extremely simple and non-labor intensive. Ideally suited to process this waste stream with no pretreatment. Highest development risk of all of the thermal technologies.

Input waste stream characterization information needed

No specific characterization requirements for this waste stream.

Waste streams produced

Site: Idaho National Engineering Laboratory

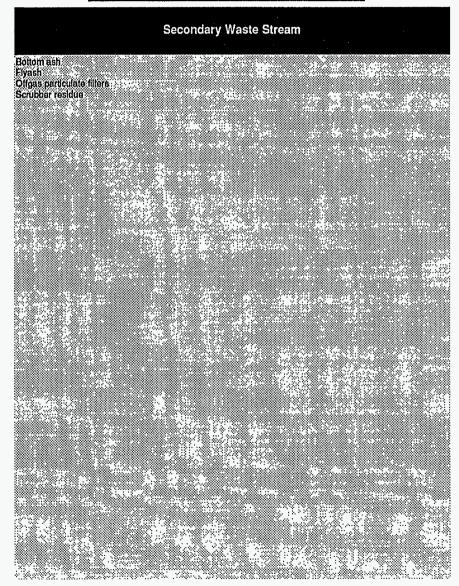
Slag may be disposed of as a RCRA LLW (but could also be classified as a RCRA alpha-contaminated LLW, or TRU waste) (see slag disposal beginning on page N-1).

Scrubber residue that requires stabilization (see scrubber residue under secondary waste streams beginning on page D-6).

Offgas particulate filters that require stabilization (see offgas particulate filters under secondary waste streams beginning on page D-6).

Name: Cemented Sludge **MWIR#: IN-W157**

Matrix: Solidified Process Residues / 3150



Subelement: Treatment

Site: Idaho National Engineering Laboratory

Treatability Group

Radiological Constituents:

This waste may be classified as a waste containing 10-100 nCl/g of alpha-emitting radionuclides. However the waste may possibly be classified as TRU waste, if the radionuclides in the waste feed become concentrated within the products generated by the treatment process.

Contaminants:

Toxic heavy metals including chromium and lead. The following EPA regulated wastes are suspected to be contained within the waste stream:

F001:Halogenated solvents used for degreasing F002:Halogenated solvents and mixtures F003:Non-halogenated solvents

This waste consists of ash, residues, and filters.

Name: Cemented Sludge MWIR#: IN-W157 Subelement: Treatment

Matrix: Solidified Process Residues / 3150
Site: Idaho National Engineering Laboratory

Science and Technology Alternative/Technology **Status** Implementation Analysis Needs Alternative Solidification/Stabilization Polyethylene Polyethylene is being developed by DOE for use in — Technology must be demonstrated on this waste — Low power requirements. Few subsystems are stream to ensure stabilization of toxic constituents Polyethylene is an inert thermoplastic these types of waste streams. Polyethylene has required and needed to make use of this technology. and compatibility with the actual constituents conbeen demonstrated on scrubber residues. material that can be processed at low tempera-Low development risk. tures. Polyethylene binder and dry waste material tained within the waste stream. The technology are fed through separate calibrated volumetric or Subsystems required needs development on the treatment of particulate fil-Input waste stream characterization information loss-in-weight feeders to an extruder. The materi-Waste feed system needed als are then: thoroughly mixed, heated to a molten condition; and extruded into a suitable mold. On Ingredients feed system The percent of soluble salts contained in the Shredder for particulate filters scrubber residues (sodium, potassium, sulfates, cooling, the mixture forms a solid monolithic waste form. No chemical reaction is required for solidifinitrates, and chlorides) (see process residue salt Projected performance content in the characterization subelement beginning Expected to pass TCLP on page M-12). Expected to produce a suitable final waste form for Waste streams produced A solidified waste form that requires RCRA LLW disposal (but could also be classified as a RCRA alpha-contaminated LLW, or TRU waste) (see solidified waste forms disposal beginning on page N-1). Sulfur Polymer Cement (SPC) SPC is being developed by the DOE for usage within -> Technology must be demonstrated on this waster-Low power requirements. Few subsystems are Sulfur Polymer Cement is composed of 95% sulfur. It melts at approximately 110 to 120°C and is these types of waste streams. SPC has been stream to ensure stabilization of toxic constituents required and needed to make use of this technology. and compatibility with the actual constituents condemonstrated on waste ash. SPC is not compatible Low development risk. particularly applicable to the immobilization of with waste streams that contain high nitrates. tained within the waste stream. The technology. toxic metals and treatment of incinerator ash. needs development on the treatment of shredded Input waste stream characterization information Subsystems required particulate filters. needed Waste feed system The percent of soluble salts contained in the Ingredients feed system scrubber residues (sodium, potassium, sulfates, Shredder for particulate filters nitrates, and chlorides) (see process residue salt content in the characterization subelement beginning Projected performance on page M-12). Expected to pass TCLP Expected to produce a suitable final waste form for Waste streams produced A solidified waste form that requires RCRA LLW disposal (but could also be classified as a RCRA alpha-contaminated LLW, or TRU waste) (see solidified waste forms disposal beginning on page N-1).

Subelement: Treatment Name: Cemented Sludge **MWIR#: IN-W157**

Matrix: Solidified Process Residues / 3150

Alternative/Technology

Chamically-bonded ceramic waste forms are produced by mixing the wastes and inorganic oxide binders together. The mixture is then processed at ambient and near ambient temperatures, pro-

Status

for use in these types of waste streams.

Subsystems required Waste feed system Ingredients feed system Shredder for particulate filters

Projected performance Expected to pass TCLP Expected to produce a suitable final waste form for disposal

Science and Technology Needs

stream to ensure stabilization of toxic constituents and compatibility with the actual constituents contained within the waste stream. The technology needs development on the treatment of particulate fil-

Implementation Analysis

Chemically-bonded Ceramics (CbC). Low power requirements. Few subsystems are required and needed to make use of this technology. Low development risk.

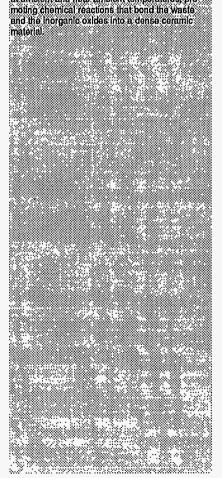
Input waste stream characterization information needed

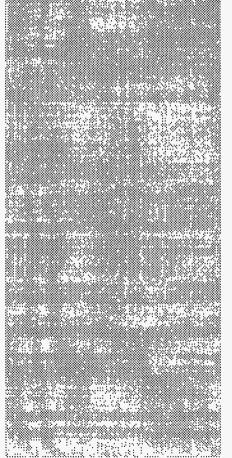
The percent of soluble salts contained in the scrubber residues (sodium, potassium, sulfates, nitrates, and chlorides) (see process residue salt content in the characterization subelement beginning on page M-12).

Waste streams produced

Site: Idaho National Engineering Laboratory

A solidified waste form that requires RCRA LLW disposal (but could also be classified as a RCRA alpha-contaminated LLW, or TRU waste) (see solidified waste forms disposal beginning on page N-1).





Mixed Waste Integrated Program

Logic Diagram

Idaho National Engineering Laboratory
Cemented Sludge
Characterization Technologies

P-10

Mixed Waste Integrated Program Logic Diagram

Subelement: Characterization MWIR#: IN-W157 Name: Cemented Sludge

Solidified Process Residues / 3150

Matrix:

Site: Idaho National Engineering Laboratory

Implementation Analysis	Method(s) available. Care must be taken to minimize the loss of volatile metals during sample preparation. Nanspecific absorption and light scattering can be significant at the analytical werdengths of these metals. Thus background correction is required.	Method(s)/Instrument(s) available	Mathod(s) available. Use of ICP-AES. (EPA Method 2007) Is restricted to spectorection of spectral management in the contection of spectral channel and physical interferences. Users must verify the absence of spectral interference from an element in a sample for which there is no instrument delection channel (false and instrument delection).
Science and Technology Needs	None, with proper sample preparation. This is a well-developed technology.	None, with proper sample preparation. ——	None, with proper sample preparation. —— This is a well-developed tachnology.
Status	Accepted. Samples must be cativered to suitable solutions for analysis (see EPA Methic 2002). EPA has approved the following methods for determining the concentration of polassium and sodum in wastes. EPA Method 258 1 - potassium (detection limits 0.1 mg/L) EPA Method 273.1 - sodum (detection limits 0.002 mg/L)	Accepted by EPA and industry (in Chromatography (EPA Mattend 300.0) is able to quickly and accilirately deformine arithms in cultically deformine arithms in solution to ppin or pub concernitations. In order to use IC for solids, an extraction method coultined in EPA Mathod 300.0 must be performed. Additional separation techniques may be needed to further separate tonic species. EPA Method 300.0 - fluoride (detection limit 0.01 mg/L). EPA Method 300.0 - chloride (detection limit 0.02 mg/L). EPA Method 300.0 - nitrate (detection limit 0.02 mg/L). EPA Method 300.0 - nitrate (detection limit 0.02 mg/L). EPA Method 300.0 - sulfate (detection limit 0.02 mg/L). EPA Method 300.0 - sulfate (detection limit 0.02 mg/L).	Accepted ICP AES's primary advantage is that it allows simultaneous or rapid advantage and until distermination of many elements in a short time. ICP AES (see EPA Method 2007.) is applicable to all matrices including soils, sludges, and sediments. However, sach of these media require significant sample preparation such as each digeston or dissolution prior to analy, significant digeston or dissolution prior to analy, significant to a segmentation of the control of the primary dissolution group.
Alternative/Technology	Atornic Absorption, Direct Aspiration	Ion Chromatography (IC)	Alternative/Technology Inductively-Coupled Plasma Spectroscopy Atomic Emission Spectrometry (KP-AES)
Problem Area	Alkali metal (such tis sodium and potassium) content		

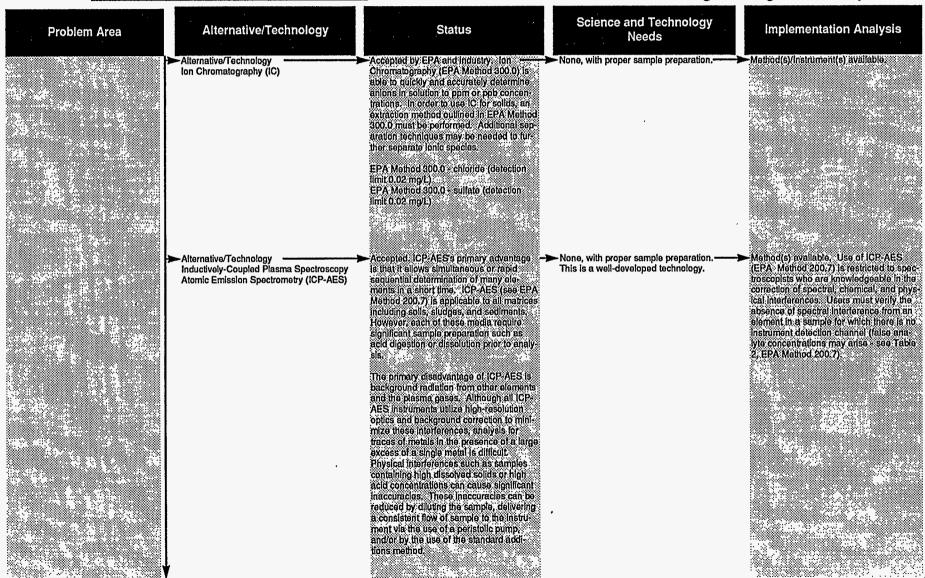
Subelement: Characterization Name: Cemented Sludge MWIR#: <u>IN-W157</u>

Matrix: Solidified Process Residues / 3150 Site: Idaho National Engineering Laboratory

Problem Area	Alternative/Technology	Status	Science and Technology Needs	Implementation Analysis
	Inductively-Coupled Plasma Spectroscopy Atomic Emission Spectrometry (contin- ued)	background radiation from other elements and the plasma gases: Although all ICP-AES Instruments utilize high-resolution optics and background correction to minimize these interferences; analysis for traces of metals in the presence of a large excess of a single metal is difficult. Physical interferences such as samples containing high dissolved solids or high acid concentrations can cause significant inaccuracies. These inaccuracies can be reduced by diluting the sample, delivering a consistent flow of sample to the instrument via the use of a peristolic pump, and/or by the use of the standard additions method. EPA Method 200,7 - potassium (detection limit 0.3 mg/L) EPA Method 200.7 - sodium (detection limit 0.03 mg/L)		
Ļ	Inductively-Coupled Plasma Mass Spectrometry (ICP-MS)	Accepted by EPA. Provides multi-element— analysis that is more selective than ICP- AES. Allows isotopic analysis. Interferences may occur in elements with similar mass. Common molecular ion interferences in: ICP-MS are listed in Table: 2 of EPA Method 200.8).	None, with proper sample preparation. Aqueous or solid samples may be analyzed. Solids require suspension of analytes of interest using techniques such as laser ablation.	➤ Method(s) available.
Chemical composition of sludge, spe- citic sodium, calcium chloride, sul- fate, and silica concentrations for glass development.	Alternative/Technology Atomic Absorption, Direct Aspiration	Accepted. Samples must be converted to sultable solutions for analysis (see EPA Method 200.2). EPA has approved the following methods for determining the concentration of potassium and sodium in wastes: EPA Method 215.1 - calcium (detection limit 0.01 mg/L) EPA Method 273.1 - sodium (detection limit 0.002 mg/L)	None, with proper sample preparation. This is a well-developed technology	Method(s) available. Care must be taken to minimize the loss of volatila metals during sample preparation. Nonspecific absorption and light scattering can be significant at the analytical wavelengths of these metals. Thus background correction is required.

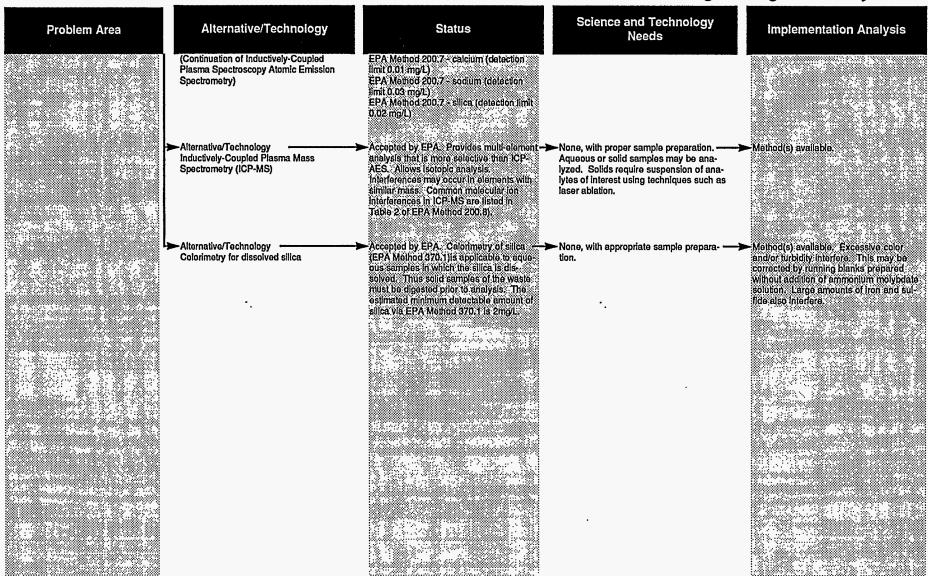
Name: Cemented Sludge MWIR#: IN-W157 Subelement: Characterization

Matrix: Solidified Process Residues / 3150 Site: Idaho National Engineering Laboratory



Name: Cemented Sludge MWIR#: IN-W157 Subelement: Characterization

Matrix: Solidified Process Residues / 3150
Site: Idaho National Engineering Laboratory



Mixed Waste Integrated Program

Logic Diagram

Idaho National Engineering Laboratory
Particulate Wastes (a-LLW)
Treatment Technologies

Name: Particulate Wastes (a-LLW) MWIR#: IN-W264 Subelement: Treatment

Matrix: Predominantly Inorganic Non-Metal Debris / 5430 Site: Idaho National Engineering Laboratory

Waste Stream

Waste Stream Description

This waste stream consists of dirt, soll, etc. from floor sweepings; blacktop and concrete from clean-up efforts; grif from grif-blasting operations; and sludge from incineration activities:

The characterization information for this waste stream is limited, and some of the data presented are inconsistent. In the MWIR waste profile sheet, the waste is designated with the RCRA characteristic of corrosivity (EPA Code D002). However, the waste form evaluation for IDC 374 states that there are no toxic or corresive materials present in the waste stream. Based on the description of the waste it has been assumed for selecting technology aptions that the waste is not corrosive because no liquids are present in the waste form:

The wastes are stored in carbon-steel 55-gallon drums and 4x4x7 wooden boxes.

Problems Presented by Waste Stream

Since the waste stream contains alpha emitters between 10 to 100 nC/g, it is possible that it is also contain nated with TRU radionuclides that could present potential problems during handling, containment; and treatment

The presence of spent solvents requires LDR treatment using an organic destruction technology followed by slabilization of the residues. However, the presence of lead (10008) and its high-temperature volability may present problems in an offgas treatment system and will therefore require special treatment. The lead captured in the offgas will require that the offgas be subsequently cooled to condense the lead prior to the lead's removal in an offgas treatment device.



Treatability Group

Radiological Constituents:

This waste may be classified as a waste containing 10-100 nCi/g of alpha-emitting radionuclides. However the waste may be classified as TRU waste, if the radionuclides in the waste feed become concentrated within the products generated by the treatment process.

Low-level (10-100 nCl/g) alpha-emitting radionuclides (contact-handled)

Am-241 Pu-52

Beta-gamma emitter (<200 mR/hr at the surface)

Contaminant

This waste stream is contaminated with spent solvents. The following EPA-regulated wastes are suspected to be contained within the waste stream.

D002: Unlisted hazardous waste characteristic of corrosivity

D008: Lead

D019: Carbon Tetrachloride

D040: Trichloroethylene

F001: Spent halogenated solvents used in degreasing

F002: Spent halogenated solvents and mixtures

F003: Spent nonhalogenated solvents

F004: Spent nonhalogenated solvents

Matrix:

This matrix consists of inorganic non-metal debris, particulate material, and sludges.

Name: Particulate Wastes (a-LLW) MWIR#: IN-W264 Subelement: Treatment

Matrix: Predominantly Inorganic Non-Metal Debris / 5430 Site: Idaho National Engineering Laboratory

Alternative/Technology	Status	Science and Technology Needs	Implementation Analysis
Low-temperature thermal unit-in which volatile and semivolatile organics will be vaporized for subsequent centure in the offgas. Volatilization of constituents is less likely to occur than in an incinerator due to lower operating temperatures. At the lower operating temperatures, the load present in the waste will not volatilize into the offgas, and therefore will stay with the residues. The lead will need to be subsequently stabilized. A secondary combustion chamber will be required for destruction of the organics captured in the offgas.	Accepted by industry. This technology is BDAT for high-mercury contaminated nonwastewaters. Subsystems required Feed pretreatment shredder for large items (may not be necessary for this waste stream based on the waste description) Feed system Moderate offgas treatment system, including acid gas scrubber, and particulate filters Secondary combustion system Ash handling system Projected performance Good organic destruction in secondary combustor Post-treatment stabilization of ash residues Long-term leaching performance is suspect especially because of the presence of lead in the residues Volume reduction is minimal	of waste constituents, determination of solidification requirements for reasted waste materials including the selection of an appropriate solidification agent, and determination of whether the waste will require mixing to expose all of the contaminants to the processing temperatures. Demonstration of the residuals passing TCLP tests will be required after stabilization.	will require treatment/stabilization prior to disposal. This technology and its subsystems are commercially available and are currently in use in the commercial sector for this waste type. Few moving parts, but large number of subsystems required make this technology relatively complicated and labor intensive. Input Waste Stream Characterization Information Needed Better characterization of waste stream to determine nature and extent of alpha- contamination, especially the presence of TRU radionuclides, and also the presence or absence of corrosives needs to be verified (see TRU radionuclides in the characterization subelement beginning on page E-10). Waste Streams Produced Bottom ash, that requires stabilization (see bottom ash under secondary waste stream treatment beginning on page E-7). Flyash that requires stabilization (see flyash under secondary waste stream treatment beginning on page E-7). Scrubber residue under secondary waste stream treatment beginning on page E-7). Offgas particulate filters that require stabilization (see offgas particulate filters under secondary waste stream treatment beginning on page E-7).
Rotary Klin Cylindrical refrectory-lined shell mounted on a slight incline; rotation of the kiln moves the non-containenzed waste through while enhancing mixing. A high-temperature secondary-combustion chember is required to complete organic destruc-	Accepted by Industry. This technology is BDAT for organics and metal-contaminated nonwastewaters. The DOE is operating a rotary kiin in LLW service. Subsystems required Feed pretreatment shredder for large items as well	■ Better characterization of the waste stream to deter——) mine the extent of vaporization of other waste constituents: Demonstration of metal condensing process from the incineration offgas would be required.	Normal implementation needs. Captured metals and treatment residue will require treatment/stabilization prior to disposal. Rotary kiln incineration technology is commercially available and is currently in use and planned in the DOE system. The required subsystems, except for the metal condensation and collections.
			g

Name: Particulate Wastes (a-LLW) MWIR#: IN-W264 Subelement: Treatment

Matrix: Predominantly Inorganic Non-Metal Debris / 5430 Site: Idaho National Engineering Laboratory

Science and Technology Alternative/Technology Status Implementation Analysis Needs Rotary Kild (continued) as concrete and blacktop tion system, as described above are commercially tion. The high-temperature volatility of lead-Feed system available. The moving parts and large number of Secondary-combustion chamber requires its subsequent capture in the incinerator. subsystems required make this technology relatively Large offgas treatment system, including acid gas offgas. The incinerator offgases would be subsecomplicated and labor intensive. quently cooled to allow the lead in the offgas to scrubber, metal removal system, and particulate filcondense out prior to the final offgas treatment-Input Waste Stream Characterization Information Ash handling system device. Needed Characterization requirements may include volatile Projected performance metals for this waste stream in this technology (see Good organic destruction TRU radionuclides in the characterization subelement Rotating kiln seals questionable for contamination beginning on page E-10) Better characterization of waste stream to determine nature and extent of alpha contamination especially the presence of TRU radionuclides (see volatile metals in the characterization subelement beginning on page E-10) The presence/absence of corrosive compounds needs to be verified (The acid and salt content will be used to correlate the corrosivity of the waste material) (see pH in the characterization subelement beginning on page M-12 and salt content in the characterization subelement beginning on page B-11). Waste Streams Produced Bottom ash, that requires stabilization (see bottom ash under secondary waste stream treatment beginning on page E-7). Flyash that requires stabilization (see flyash under secondary waste stream treatment beginning on page E-7). Scrubber residue that requires stabilization (see scrubber residues under secondary waste stream treatment beginning on page E-7). Offgas particulate filters that require stabilization (see offgas particulate filters under secondary waste ►ALTERNATIVE - Vitrification stream treatment beginning on page E-7). Joule Heated Melter: • Ready for demonstration. echnology must be demonstrated on this waste 🖛 ➤ High-power requirements. This technology will be Refractory-lined reactor in which a pool of glass is stream, including operation of required subsystems. commercially available for waste applications within 2 maintained molten by Joule heating, size-reduced waste is introduced into the glass pool and disyears, and is currently in use for highly specialized Subsystems required Waste shredder or grinder and system to reduce applications in the DOE system. Unit operational solved into the glass matrix. High temperature volatility of lead will require the subsequent capwaste size (may not be required based on waste costs and life cycle costs fall in the mid range of this description) group of technologies. Large number of subsystems ture in the offgas. The offgases would be subse-Waste feed system required and need to carefully control melt chemistry quently cooled in order to allow it to condense out Glass additive feed system make this technology relatively complicated and to low levels prior to the final removal device. If labor-intensive. The limited characterization data for Molten glass handling system any salts are present, which seems unlikely from Small offgas treatment system, including acid gas this waste stream must be updated in order to deterthe waste description, the process may require scrubber, metal removal system, and particulate mine applicability of this technology. Medium devel-

Name: Particulate Wastes (a-LLW) MWIR#: IN-W264 Subelement: Treatment

Matrix: Predominantly Inorganic Non-Metal Debris / 5430 Site: Idaho National Engineering Laboratory

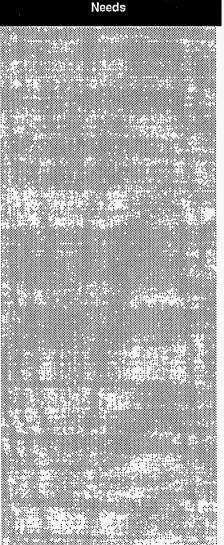
Science and Technology Alternative/Technology **Status** Implementation Analysis Needs Joule Heated Melter(continued) filter opment risk compared to the other thermal technolothe addition of significant volumes of plassification: Projected performance Input Waste Stream Characterization Information Good organic destruction requires reduction pretreatment or extended periods in the melt Characterization requirements include better charac-Need to tightly control melt chemistry complicates terization of waste stream to determine nature and operation extent of alpha contamination especially the pres-Offgas system flyash can be processed through ence of TRU radionuclides (see volatile metals in the the melter characterization subelement beginning on page E-10) Addition of glass formers to maintain viscosity lim-The salt content of the waste stream needs to be its otherwise excellent volume reduction verified (see salt content in the characterization Highly stable glass final waste form subelement beginning on page E-10). Waste streams produced Stabilized glass can be disposed of as a RCRA LLW (but could also be classified as a RCRA alphacontaminated LLW, or TRU waste) (see stabilized glass disposal beginning on page N-1). Scrubber residue that requires stabilization (see scrubber residue under secondary waste streams beginning on page E-7). Offgas particulate filters that require stabilization (see offgas particulate filters under secondary waste streams beginning on page E-7). Empty containers can be disposed of as LLW (see empty containers disposal beginning on page N-1). ► Plasma Arc Furnace: --Large-scale pilot demonstration complete. A radioac- Technology must be demonstrated on this waste → Very high power requirements. This technology is Refractory-lined chamber into which unopened, tive-waste bench scale system is under construction. stream, including operation of required subsystems. farthest from commercial availability, but should be containenzed waste is introduced and melted in proven in 3-5 years. Unit operational costs are comthe high-temperature arc of a plasma torch. The Subsystems required parable to Joule melter. Minimal subsystem requirehigh-temperature volatilization of lead in the waste Waste feed system ments make this technology operationally simple. would require its subsequent capture in the incin-Molten material handling system Ideally suited to process this waste stream with little erator offgas. A secondary combustion chamber Offgas treatment system, including acid gas scrubto no pretreatment. Highest development risk of the for treatment of organics will be required. The ber and particulate filters thermal technologies. Incinerator offgases would be subsequently cooled in order to allow condensation of metals Projected performance Input waste stream characterization information prior to the final offgas treatment device. Highest temperature range, good organic destrucneeded tion with no pretreatment Characterization requirements may include the Maximum volume reduction identification of volatile metals within the waste Highly stable slag and metal final waste forms stream (see volatile metals in the characterization Offcas system particulate filters and flyash can be subelement beginning on page E-10). processed through the furnace Waste streams produced Slag may be disposed of as a RCRA LLW (but could also be classified as a RCRA alpha-contaminated LLW, or TRU waste) (see slag disposal begin-

Name: Particulate Wastes (a-LLW) MWIR#: IN-W264 Subelement: Treatment

Matrix: Predominantly Inorganic Non-Metal Debris / 5430 Site: Idaho National Engineering Laboratory

Alternative/Technology Plasma Arc Furnace (continued)

Science and Technology Status Needs



Implementation Analysis

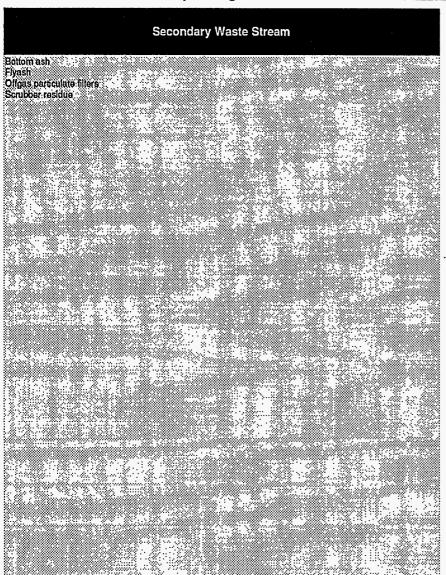
ning on page N-1). Scrubber residue that requires stabilization (see scrubber residue under secondary waste streams

Deginning on page E-7).

Offgas particulate filters that require stabilization (see offgas particulate filters under secondary waste streams beginning on page E-7).

Name: Particulate Wastes (a-LLW) MWIR#: IN-W264 Subelement: Treatment

Matrix: Predominantly Inorganic Non-Metal Debris / 5430 Site: Idaho National Engineering Laboratory



Treatability Group

Radiological Constituents:

This waste may be classified as a waste containing 10-100 nCl/g of alpha-emitting radionuclides. However the waste may be classified as TRU waste, if the radionuclides in the waste feed become concentrated within the products generated by the treatment process.

Low-level (10-100 nCl/g) alpha-emitting radionuclides (contact-handled)

Am-241 Pu-52

Beta-gamma emitter

Contaminants:

This waste stream is contaminated with spent solvents. The following EPA-regulated wastes are suspected to be contained within the waste stream.

F001: Spent halogenated solvents used in degreasing

F002: Spent halogenated solvents and mixtures

F003: Spent nonhalogenated solvents

F004: Spent nonhalogenated solvents

Matrix:

This waste matrix consists of ash, residues, and filters.

Name: Particulate Wastes (a-LLW) MWIR#: IN-W264 Subelement: Treatment

Matrix: Predominantly Inorganic Non-Metal Debris / 5430 Site: Idaho National Engineering Laboratory

Science and Technology Alternative/Technology Status Implementation Analysis Needs ► ALTERNATIVE → Solidification/Stabilization Polyethylene --Technology must be demonstrated on this waste. Polyethylene is being developed by the DOE for — Low power requirements. Few subsystems are Polyethylene is an inert thermoplastic material that usage on these types of waste streams. stream to ensure stabilization of toxic constituents required and needed to make use of this technology. and the compatibility of the process with the actual waste streams. The technology needs development can be processed at low temperatures. Polyethylene has been demonstrated on scrubber Low development risk. Polyethylene binder and dry waste material are residues. for the treatment of particulate filters. fed through separate calibrated volumetric or loss-Input Waste Stream Characterization Information in-weight feeders to an extruder. The materials Subsystems required Needed are then thoroughly mixed, heated to a moltan Waste feed system The concentration of soluble salt contained in the condition, and extruded into a suitable mold. On Ingredients feed system scrubber residues (sodium, potassium, sulfates, nitrates, and chlorides) (see concentration of soluble cooling, the mixture forms a solid monolithic waste Shredder for particulate filters form. No chemical reaction is required for solidifisalts in the characterization subelement starting on Projected performance page E-10). Expected to pass TCLP Expected to produce a suitable final waste form for Waste Streams Produced Solidified waste form that requires RCRA LLW disposal (but could also be classified as RCRA LLW alpha-contaminated waste) (see solidified waste forms disposal beginning on page N-1). Sulfur Polymer Cement (SPC) + SPC is being developed by the DOE and has been ——Technology must be demonstrated on this waste.... Low power requirements. Few subsystems are stream to ensure stabilization of toxic constituents Sulfur Polymer Cement is composed of 95% suldemonstrated on ash and many other substances. It required and needed to make use of this technology. fur. It melts at approximately 110 to 120°C and is is not compatible with waste streams containing high and the processes' compatibility with the actual Low development risk. particularly valuable in the immobilization of toxic concentrations of nitrates. waste stream constituents. metals and treatment of incinerator ash. Input Waste Stream Characterization Information Subsystems required Needed Waste feed system The concentration of soluble salt contained in the Ingredients feed system scrubber residues (sodium, potassium, sulfates, nitrates, and chlorides) (see concentration of soluble Projected performance salts in the characterization subelement starting on Expected to pass TCLP page E-10). Expected to produce a suitable final waste form for Waste Streams Produced Solidified waste form that requires RCRA LLW disposal (but could also be classified as RCRA LLW alpha-contaminated waste) (see solidified waste forms disposal beginning on page N-1).

Particulate Wastes (a-LLW) MWIR#: IN-W264 **Subelement:** Treatment

Matrix: Predominantly Inorganic Non-Metal Debris / 5430 Site: Idaho National Engineering Laboratory

Alternative/Technology

Status

Science and Technology Needs

Implementation Analysis

Chemically-bonded Ceramics (CbC) Chemically-bonded caramic wasta forms are produced by mixing the wastes and inorganic oxide binders together. The mixture is then processed at ambient and near ambient temperatures, promoting chemical reactions that bond the waste and the inorganic oxides into a dense ceramic

Waste feed system Ingredients feed system Projected performance

Subsystems required

Expected to pass TCLP Expected to produce a suitable final waste form for disposal

➤ CbC is in early stages for development by the DOE. - Technology must be demonstrated on this waste..... stream to ensure stabilization of toxic constituents and the processes' compatibility with the actual waste stream constituents. The technology needs development for the treatment of particulate fillers.

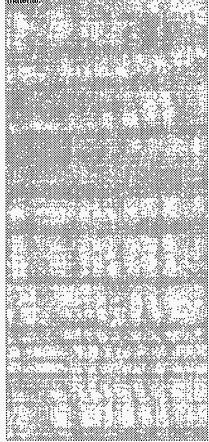
Low power requirements. Few subsystems are required and needed to make use of this technology. Low development risk.

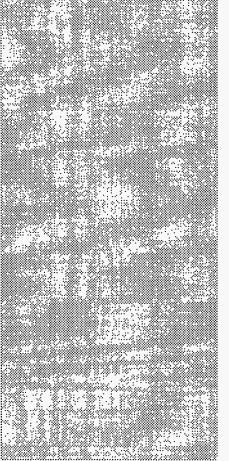
Input Waste Stream Characterization Information Needed

The concentration of soluble salt contained in the scrubber residues (sodium, potassium, sulfates, nitrates, and chlorides) (see concentration of soluble salts in the characterization subelement starting on page E-10).

Waste Streams Produced

Solidified waste form that requires RCRA LLW disposal (but could also be classified as RCRA LLW alpha-contaminated waste) (see solidified waste forms disposal beginning on page N-1).





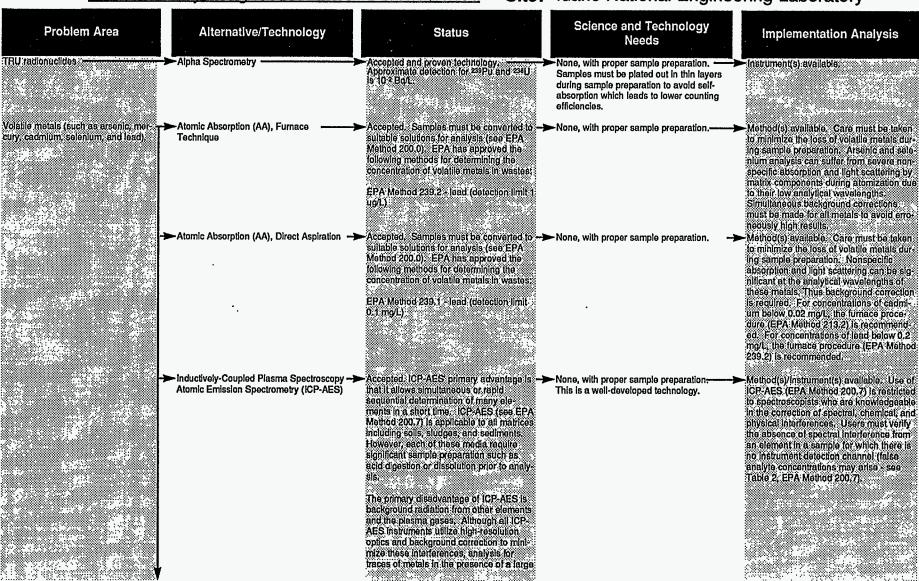
Mixed Waste Integrated Program

Logic Diagram

Idaho National Engineering Laboratory
Particulate Wastes (a-LLW)
Characterization Technologies

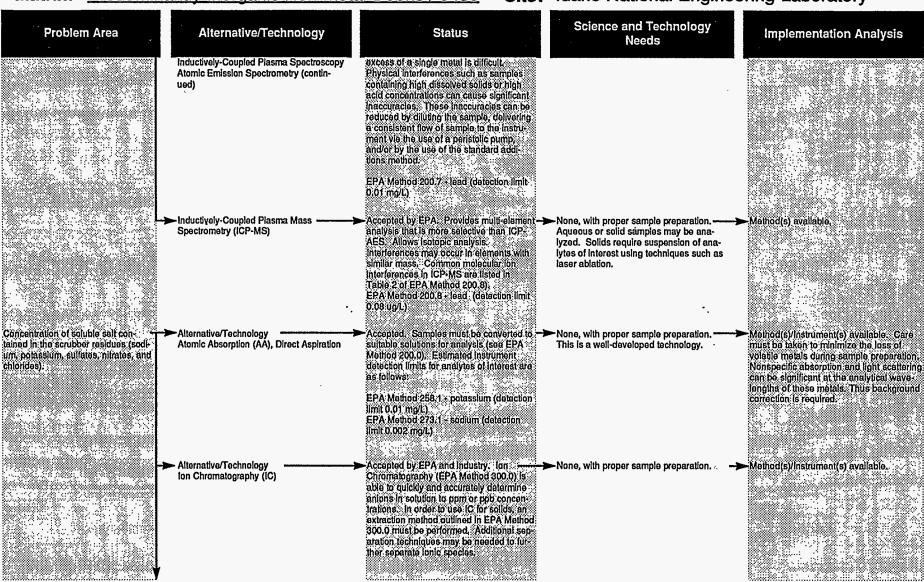
Name: Particulate Wastes (a-LLW) MWIR#: IN-W264 Subelement: Characterization

Matrix: Predominantly Inorganic Non-Metal Debris / 5430 Site: Idaho National Engineering Laboratory



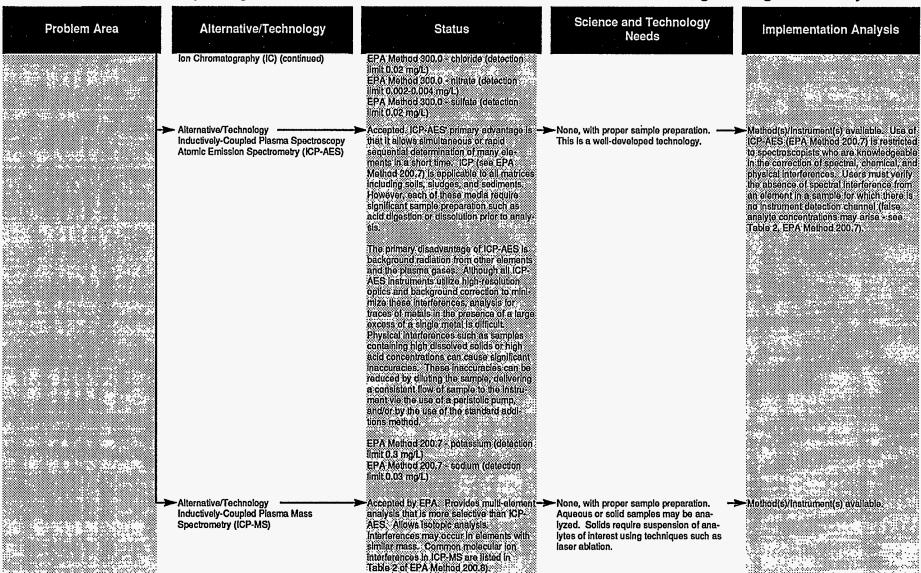
Name: Particulate Wastes (a-LLW) MWIR#: IN-W264 Subelement: Characterization

Matrix: Predominantly Inorganic Non-Metal Debris / 5430 Site: Idaho National Engineering Laboratory



Name: Particulate Wastes (a-LLW) MWIR#: IN-W264 Subelement: Characterization

Matrix: Predominantly Inorganic Non-Metal Debris / 5430 Site: Idaho National Engineering Laboratory



Mixed Waste Integrated Program

Logic Diagram

Los Alamos National Laboratory
Spent Solvents
Treatment Technologies

Name: Spent Solvents MWIR#: LA-W024 Subelement: Treatment

Matrix: Aqueous - Halogenated Organic Liquid / 2110

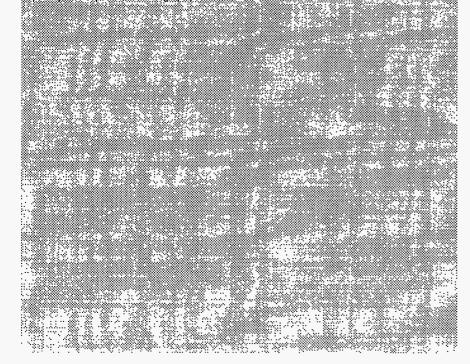
Waste Stream

Waste Stream Description

This waste stream consists of spent halogenated solvents.

Problems Presented by Waste Stream

The LDR treatment for this waste stream is organic destruction followed by stabilization of residues. This waste stream is very small in volume (8.9 cubic maters) and therefore will not justify the construction of a new facility for organic destruction. Since the radiologic characteristics for this waste stream are not known it is difficult to match this stream to an existing DOE incheration facility. If TRU radionuclides are present, the Controlled Air incherator at LANL is the only facility that may be able to treat this waste stream. If TRU nuclides are not present in the waste stream if may be treated at either the TSCA incherator at Cak Ridge or at the SEG incherator, which is a commercial facility. The extent of the effect of fluorides present in the waste stream must be determined to ensure that are no problems arising from reactions with the refractory lining of the incherator. In general, additional characterization data on this waste stream will be required, especially with respect to its radiologic properties.



Treatability Group

Site: Los Alamos National Laboratory

Radiological Constituents:

This waste is classified as a Beta-Gamma emitter and as a contact-handled waste with < 10 nCi/g of alpha-emitting radionuclides.

MLLW-CH

Pu-239 U-238

Contaminants

This waste stream is contaminated with spent solvents. The following EPA-regulated wastes are suspected to be contained within the waste stream.

F001: Spent halogenated solvents used in degreasing

1,1,1-trichloroethane

Trichloroethylene

Methylene chloride

Chlorinated fluorocarbons

Matrix:

This waste matrix consists of aqueous halogenated liquids.

Name: Spent Solvents MWIR#: LA-W024 **Subelement:** Treatment

Matrix: Aqueous - Halogenated Organic Liquid / 2110 Site: Los Alamos National Laboratory

Science and Technology Alternative/Technology Status Implementation Analysis Needs CHEMICAL TREATMENT ALTERNATIVE - Dehalogenation Chemical definition using alkaline poly. — Chemical dehalogenation technology has been used — Technology integration must be demonstrated on this — Higher than normal implementation needs. ethylene glycol (APEG) of potassium hydroxida on many chlorinated organics but its effectiveness on waste stream especially concerning treatment of fluo. Treatment residues consisting of filtered sa Treatment residues consisting of filtered salts and with polyethylene glycol (KPEG). other halogens, especially fluorine, needs to be evalrides. Characterization of both of the output streams dehalogenated organic liquids will require stabilizawould be required to determine if they are RCRA reguated. tion. The required subsystems are commercially Chemical dehalogenation systems mix wastes with a dehalogenation reagent such as APEG or KPEG and heat them in a reactor vessel. The available and the subsystems are not complicated or Subsystems required numerous. Centrifuge system to separate precipitated salts dehalogenation reaction replaces halogens with Filtration system Input Waste Stream Characterization Information colyethylene glycol, rendering the compound non-hazardous and generating a chlomated-liquid secondary waste stream. The technology is most effective for wastes contaminated with halogenat-Organic solidification Needed Identification of any TRU levels in the waste Projected performance because the radiation level is either unknown or Good dechlorination uncompiled (see identification of TRU waste levels in ed-semivolatile organic compounds and is best Uncertainty about treatment of fluorocarbons the characterization subelement beginning on page suited for small volume waste streams. The Chlorinated waste stream contains RCRA-listed KPEG process involves the catalytic reaction of a compounds that would continue to characterize the phase transfer catalyst with the halogenated com-pound to promote the reaction. The feaction is effective with a temperature of 70 O and a duratreated waste as RCRA-regulated Waste Streams Produced Chloride salts produced from the treatment of the Chloride salts (see chloride salts under secondary RCRA-listed wastes would also be RCRA-regulatwaste streams beginning on page F-5). tion of 15 minutes to 1 hour. If a large amount of Organic liquids without chlorides (see thermal water (>20% by volume) or other reactants are treatment alternatives in this section). present, the reaction times can be as high as 12 →THERMAL TREATMENT ALTERNATIVE - Organic Destruction Liquid Injection Incinerator Post-treatment stabilization of ash residuals using — Technology, must be demonstrated on this waste 😹 ➤ Normal implementation needs. The first implementa-Liquid waste material is introduced into the comcement is accepted by industry and commercially stream, but the technology is well established. tion issue is determination of the TRU level in the bustion chamber by specially designed nozzles. available. waste. The result will impact the treatment alterna-Different nozzle designs result in various droplet tive selection. The large number of subsystems sizes which mix with air and fuel as needed. Subsystems required required make this technology relatively complicated Following combustion, the resulting gases are Large offgas treatment system, including acid gas and labor intensive, however the modular design of cooled and treated to remove particulates and to scrubber, particulate filters, and ash-handling systhe incinerator and use of a wide variety of secneutralize acid gases. Operating temperatures

Stabilization system for treatment residuals such as flyash and spent scrubber solution

Projected performance

range from 2000'F. The stream could also be

any of several varieties of incinerators.

injected into the second combustion chamber of

Good organic destruction

Reaction of hydrogen fluoride (HF) with refractory materials may be a problem

Post-treatment stabilization of ash residuals using

ondary fuels lower operational costs.

Input Waste Stream Characterization Information Needed

Identification of any TRU waste because the radiation level is either unknown or uncompiled (see identification of TRU waste levels in the characterization subelement beginning on page F-6).

Name: Spent Solvents **MWIR#:** LA-W024 **Subelement:** Treatment

Matrix: Aqueous - Halogenated Organic Liquid / 2110 Site: Los Alamos National Laboratory

Alternative/Technology

Liquid Injection Incinerator (continued)

Steam Reforming .-

Hazardous organic chemicals are destroyed by reaction with super-heated steam resulting in volatilization of organics to the vapor phase with some thermal decomposition and fragmentation of organic molecules. In catalytic steam reforming, the volatilized organics are adsorbed on a rhodium catalyst and oxidized by high-temperature steam. A noncatalytic version of this technology is also available where the volatilized organics are first passed through a moving bed of ceramic spheres that have been coated with an alkeli base In order to react any inorganic acids that may have been released during the volatilization step. The volatilized organics are subsequently reduced to CO and H2 in a high-temperature steam reformer that operates at 1200°C.

Status

cement is in use; long-term leaching performance is suspect; volume reduction is minimal; alternate stabilization techniques are possible for better long-term performance

It is a common industrial process that is used to ... make hydrogen gas from methane. The technology is currently undergoing demonstration for destruction of hazardous organic contaminants commonly found in DOE mixed wastes. A demonstration of the use of a commercial one ton per day noncatalytic steam reforming system is being planned for destruction of organic materials and inorganic salts. Full-scale application of this process is likely to take 2 to 3 vears.

Subsystems required

Liquid feed system

Moving bed evaporator or alternative for vaporization of feed and halogen capture Steam reforming system (including a high-temper-

ature steam generator)

Oxidizer system for CO and H2

Projected performance

Greater than 99.99% destruction efficiencies have been achieved for many organic solvents commonly found in mixed wastes by both catalytic (800°C) and noncatalytic (1200°C) methods

Science and Technology Needs

Implementation Analysis

Waste Streams Produced

Flyash (see flyash under secondary waste streams beginning on page F-5).

Scrubber residue (see scrubber residue under secondary waste streams beginning on page F-5).

Offgas particulate filters (see offgas particulate filters under secondary waste streams beginning on page F-5).

taining high concentrations of chlorides, including operation of the required subsystems. Also, based on the demonstration, additional data must be obtained about the secondary waste streams to determine if they will pass TCLP tests.

▶ Technology:must be demonstrated on wastes con: ▶ Potential high cost of utilities for generation of high temperature steam. However, since steam reforming is not a combustion process, it does not require supplemental fuel and products of incomplete combustion are not generated as offgas contaminants. Therefore, if the technology can be demonstrated on this waste stream, overall system costs should be comparable to other thermal treatment processes and may be cheaper than incineration. This technology is not yet commercially available for chlorinated waste applications and may take 2 to 3 years for commercial-scale applications within the DOE svstem. The liquid form of this waste stream is a good match for this technology. Low development risk compared to the other thermal technologies.

Input Waste Stream Characterization Information Needed

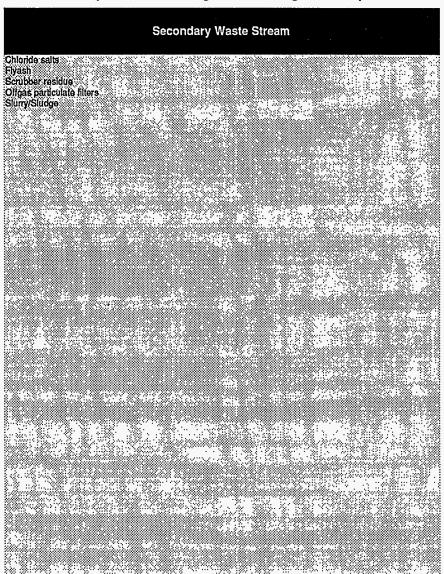
Apart from radiological characterization, data requirements will include details of the hazardous constituents in the waste stream to determine the effectiveness, applicability, and appropriate process conditions for this stream and this technology (see organic contaminants in characterization subelement beginning on page F-6).

Waste Streams Produced

A residual slurry/sludge (see slurry/sludge under secondary waste streams beginning on page F-5).

Name: Spent Solvents MWIR#: LA-W024 Subelement: Treatment

Matrix: Aqueous - Halogenated Organic Liquid / 2110



Treatability Group

Radiological Constituents:

This waste is classified as a Beta-Gamma emitter and as a contact-handled waste with < 10 nCi/g of alpha-emitting radionuclides.

MLLW-CH Pu-239 U-238

Contaminants:

The following EPA regulated wastes are suspected to be contained within the waste stream:

Site: Los Alamos National Laboratory

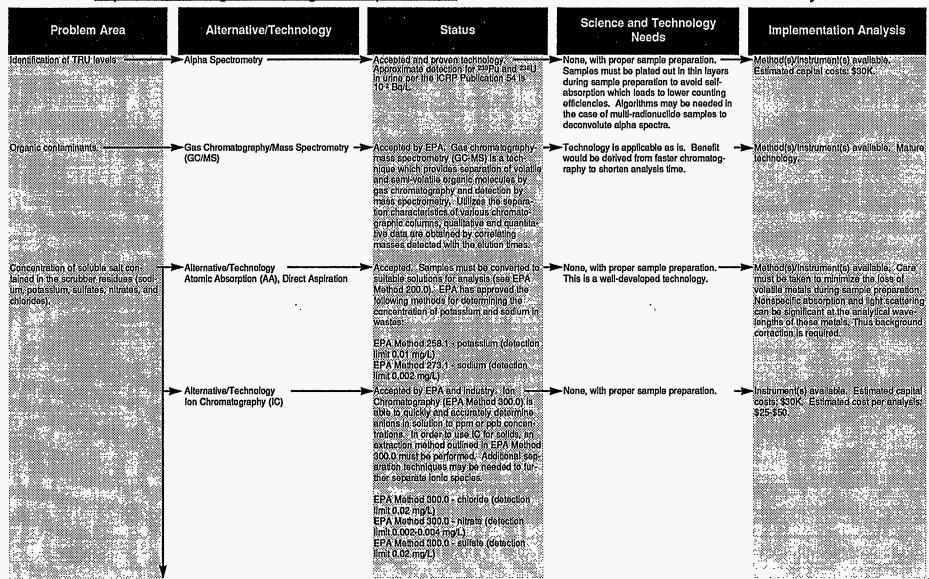
F001: Spent halogenated solvents used in degreasing

Matrix

This waste matrix consists of salts, ash, residue, filters, and slurry/sludge.

Name: Spent Solvents MWIR#: LA-W024 Subelement: Characterization

Matrix: Aqueous - Halogenated Organic Liquid / 2110 Site: Los Alamos National Laboratory



Name: Spent Solvents MWIR#: LA-W024 Subelement: Characterization

Matrix: Aqueous - Halogenated Organic Liquid / 2110 Site: Los Alamos National Laboratory

			Colones and Technology	
Problem Area	Alternative/Technology	Status	Science and Technology Needs	Implementation Analysis
	Alternative/Technology Inductively-Coupled Plasma Spectroscopy Atomic Emission Spectrometry (ICP-AES)	Accepted, ICP-AES primary advantage is that it allows simultaneous or rapid sequential determination of many elements in a short time. ICP (see EPA Method 200.7) is applicable to all matrices including soils, sludges, and sediments. However, each of these media require significant sample preparation such as acid digestion or dissolution prior to analysis. The primary disadvantage of ICP-AES is background radiation from other elements and the plasma gases. Although all ICP-AES instruments utilize high-resolution optics and background correction to minimize these interferences, analysis for traces of metals in the presence of a large excess of a single metal is difficult. Physical interferences such as samples containing high dissolved soilds or high acid concentrations can cause significant inaccuracies. These inaccuracies can be reduced by diffuging the sample; delivering a consistent flow of sample to the instrument via the use of a perisolic pump, and/or by the use of the standard additions method. EPA Method 200.7 - potassium (detection limit 0.3 mg/L).	None, with proper sample preparation. This is a well-developed technology.	Method(s)/instrument(s) available; Use of ICP-AES (EPA Method 200.7) is restricted to spectroscopists who are knowledgeable in the correction of spectral, chemical, and physical interferences. Users must verify the absence of spectral interference from an element in a sample for which there is no instrument detection channel (felse analyte concentrations may arise - see Table 2, EPA Method 200.7). Estimated capital cost: \$150K. Estimated cost per analysis: \$50-\$100.
	→ Alternative/Technology Inductively-Coupled Plasma Mass Spectrometry (ICP-MS)	Accepted by EPA. Provides multi-alement— analysis that is more selective than ICP- AES. Allows isotopia analysis. Interferences may occur in elements with similar mass. Common molecular ion interferences in ICP-MS are listed in Table 2 of EPA Method 200.8).	➤ None, with proper sample preparation. Aqueous or solid samples may be analyzed. Solids require suspension of analytes of interest using techniques such as laser ablation.	→ Method(s)/Instrument(s) available; Estimated capital costs: \$170K: Costs per multi-element analysis: \$50-\$100

Mixed Waste Integrated Program

Logic Diagram

Oak Ridge
TSCA Incinerator Ash
Treatment Technologies

Name: TSCA Incinerator Ash MWIR#: 2480 Subelement: Treatment

Matrix: <u>Ash / 3111</u>

Waste Stream

Waste Stream Description

TSCA incinerator Ash was generated from a waste feed that contained halogenated and non-halogenated solvents, toxic heavy metals including; arsenic, cadmium, chromium, lead, selenium, and silver and wastewater treatment sludges from electropiating operations.

Although the incinerator waste feed had contained EPA-listed volatile organic compounds, these compounds are assumed to have been destroyed while being subjected to the previously performed incineration treatment process. Even though this waste stream is not expected to be contaminated with the volatile-organics, the respective codes continue to be attributed to the waste stream, because the VOC's have been treated/destroyed but have not been de-listed by the EPA.

Problems Presented by Waste Stream

Since the waste material has been incinerated; no further treatment is required to destroy the organic constituents. The concentration of sulfur and residual carbon that are present in the ash may a solidification problem. LDR treatment requirement for the listed waste codes is incineration followed by stabilization (understanding that incineration is already done). This treatment will also be sufficient for the toxic characteristic components. Volume reduction of waste materials (and thus the concentration of the radionuclides) could change this low-level mixed waste into a TRU-classified waste.

The LDR treatment standard for incinerator ash prior to land disposal is treatment via a stabilization technology, such as macro/micro-encapsulation.

The lack of TCLP characterization forces some assumptions in order to select technology options. The presence of metals may complicate the treatment strategy if the concentrations are very high, since stabilization may not be acceptable for greater than trace quantities of some metals. Currently identified EPA waste codes include: F001, F002, F003, and F006. However, based on analytical results for wastes generated from 3/27/91 to 6/11/92 the following additional waste codes are considered to also be applicable. D004, D006, D007, D008, D010, and D011. Characterization of wastes through process knowledge has been performed without actual verification via a TCLP analysis.

Treatability Group

Radilogical Constituents:

This waste is classified as contact-handled with 10-100 nCl/g of alpha contamination.

Contaminants:

This waste is contaminated with toxic heavy metals and sludges. The following EPA-regulated wastes are suspected to be contained within the waste stream. It is assumed that the volatile organic compounds have previously been destroyed via the incineration treatment process,

F001: Halogenated solvents used for degreasing

Site: Oak Ridge

F002: Halogenated solvents and mixtures

F003: Non-halogenated solvents

F006: Wastewater treatment sludges from electroplating

D004: Arsenic

D006: Cadmium

D007: Chromium

D008: Lead

D010: Selenium

D011: Silver

Matrix:

This waste stream consists of ash.

ITTE / dsA **WMIH#: 2480** TSCA Incinerator Ash Иате: Subelement: Treatment

Site: Oak Ridge

Needs

Science and Technology

ametayadua berlupet ett fo not

Status

Alternative/Technology

bated for treatment via a stabilization process. containing metal and sait perticulate is now preincineration process and the residual ash/sludge combonuda pave been previonaly destroyed by an pinsgro edT , maette etasw aidt nogu fnemfaert potring can be gained by performing chemical Not applicable to this waste stream, because CHEMICAL TREATMENT

► ALTERNATIVE - Vitrification THERMAL TREATMENT

Matrix:

material has already been inclnerated it is unlikely quant capture of metals in the offgas. Since this mium, lead, and selenium) may require the cubsesolved within the glass matrix. High-temperature, volabilities of certain matals (such as areanic, cadwaste is introduced into the glass pool and diswsipralned molten by Joule healing; size-reduced Refrectory-lined reactor in which a pool of glass is TetleM betted Melter

Aneserg ere elsiem elbelov to alevel right feit The edit editore yem has ert to nobscillritv erff enges nobscilleasig to semulov tracillingis to nob

Heady for demonstration. The DOE has developed the second for usage on HLW. Demonstration applications will be the population of the popul

scrubber, and particulate filter Small offgas treatment system, including offgas Secondary combustion chamber Molten glass handling system

.(01-D egsq tent in the characterization subelement beginning on

LLW (but could also be classified as a RCRA alpha-Stabilized glass can be disposed of as a HCRA Waste streams produced

and sodium saits (see volatile metals and sait con-Salts are primarily aluminum, calcium, phosphorus ties due to the salt content in this waste stream.

identification of volatile metals and vitrification quali-

Characterization requirements may include the

Input waste stream characterization information

neous nature of this waste stream is a good match

complicated and labor-intensive. The dry-homoge-

required and the need to carefully control the chem-

group of technologies. Large number of subsystems

costs and ille cycle costs fall in the mid-range of this

applications within the DOE system. Unit operational

commercially available for waste applications within 2

lmplementation Analysis

years, and is currently in use for highly specialized

istry of the melt makes this technology relatively

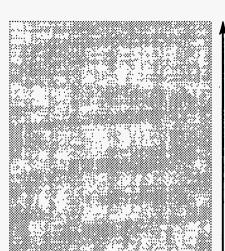
pared to the other thermal technologies. for this technology. Medium development risk com-

beginning on page G-7). scrubber residue under secondary waste streams Scrubber residue that requires stabilization (see glass disposal beginning on page N-1). contaminated LLW, or TRU waste) (see stabilized

streams beginning on page G-7). (see offgas particulate filters under secondary waste Offgas particulate filters that require stabilization empty containers disposal beginning on page N-1). Empty containers can be disposed of as LLW (see

> Glass additive feed system metays beet etseW Subsystems required on LLW is proceeding.

Highly stable glass final waste form is produced. cosity limits volume reduction -siv beriseb nistnism of eremot easig to notibbA melt complicates the operation of the process The need to tightly control the chemistry of the Projected performance



Name: TSCA Incinerator Ash **Subelement:** Treatment MWIR#: 2480

Matrix: Ash / 3111 Site: Oak Ridge

Alternative/Technology

Status

Science and Technology Needs

Implementation Analysis

Plasma Arc Furnace Refractory-lined chamber into which unopened, containerized waste is introduced and melted in the high-temperature arc of a plasma torch. Hightemperature volatilities of certain metals (such as arsenic, cadmium, lead, and selenium) may require the subsequent capture of metals in the offgas. The offgases would be subsequently cooled in order to allow any metals (or compounds) to condense and be entrained via a particulate removal device.

Since this material has already been incinerated it is unlikely that high levels of volatile metals are present. A secondary combustion chamber for treatment of organics should not be required due to previous incineration;

been demonstrated. A pilot system with a continuous feed system and melt removal is currently in design.

Subsystems required Waste feed system Molten material handling system Offgas treatment system, including acid gas scrubber and particulate filters

Projected performance

processed through the furnace.

Highest temperature range, good organic destruction with no pretreatment Maximum volume reduction Highly stable slag and metal final waste forms Offgas system particulate filters and flyash can be

A large scale proof-of-principle pilot batch unit has — Demonstration of a continuous process is scheduled — Very high power requirements. This technology is for late 1994. Technology must be demonstrated to assess its applicability to this waste stream, including the operation of the required subsystems. Treatability tests will be required to determine if glass formers are necessary.

furthest from commercial availability, but should be proven in 3-5 years. Unit operational costs are comparable to the operational costs of a joule melter. Minimal feed pretreatment simplifies operations. Suited to process this waste stream with no pretreatment of the waste stream. Highest development risk of the thermal technologies.

Input waste stream characterization information needed

Characterization requirements may include the identification of volatile metals within this waste stream (see volatile metals in the characterization subelement beginning on page G-10).

Waste streams produced

Scrubber residue that requires stabilization (see scrubber residue under secondary waste streams beginning on page G-7).

Slag may be disposed of as a RCRA LLW (but could also be classified as a RCRA alpha-contaminated LLW, or TRU waste) (see slag disposal beginning on page N-1).

Offgas particulate filters that require stabilization (see offgas particulate filters under secondary waste streams beginning on page G-7).

Microwaye Melter

A process that uses microwave energy to malt wastes within a metal container, either via a batch or continuous feed mode. High-temperature melt occurs at 1800°+2600°F, resulting in a glassymonolithic waste material. Due to the temperatures utilized in this process, certain metals (such as arsenic, mercury, selenium, cadmium, and lead) may volatilize. Typical waste volume reductions resulting from this process may be as high as 60 to 80%. Depending on ash composition, glass formers may have to be added to the melt to produce a vitrified product.

A full-scale non-radioactive waste pilot plant has been demonstrated. Small-scale radioactive systems have demonstrated performance on the DOE wastes.

Subsystems required

Waste feed system

Glass former addition system (probable addition)

Projected performance

Good organic destruction

High volume reduction

Stable glass waste form

Reduced handling requirements and generation of secondary wastes through in-drum processing

Technology must be demonstrated to assess its applicability to this waste stream, including the operation of the required subsystems. Preliminary testing at PNL indicates a need for glass formers.

Very high power requirements. This technology is not yet commercially available, but should be proven in 2-4 years. Unit operational costs are high due to low throughput when compared to a joule melter or plasma arc furnace, but life cycle costs on the microwave melter are low, due to volume reduction effects on disposal costs. Minimal subsystem requirements make this technology extremely simple and non-labor intensive. Suited to process this waste stream with no pretreatment of the waste stream. Medium development risk of the thermal technoloales.

Input waste stream characterization information needed

Characterization requirements may include the identification of volatile metals within this waste stream (see volatile metals in the characterization

Name: TSCA Incinerator Ash MWIR#: 2480 Subelement: Treatment

Matrix: Ash / 3111 Site: Oak Ridge

Science and Technology Alternative/Technology Status Implementation Analysis Needs Microwave Melter (continued) subelement beginning on page G-10). Waste streams produced Scrubber residue that require stabilization (see scrubber residue under secondary waste streams beginning on page G-7). Slag may be disposed of as a RCRA LLW (but could also be classified as a RCRA alpha-contaminated LLW, or TRU waste) (see slag disposal beginning on page N-1). Offgas particulate filters that require stabilization PHYSICAL TREATMENT (see offcas particulate filters under secondary waste ➤ ALTERNATIVE - Solidification/Stabilization. streams beginning on page G-7). Polyethylene is being developed by the DOE for — Technology must be demonstrated on this waste. Low power requirements. Few subsystems are Polyethylene is an inert thermoplastic material that usage within these types of waste streams. stream to ensure stabilization of toxic constituents required and needed to make use of this technology. can be processed at low temperatures. Polyethylene binder and dry Waste material are Polyethylene has been demonstrated on scrubber and compatibility with the actual constituents con-Low development risk, tained in the waste stream. fed through separate calibrated volumetric or loss-Input waste stream characterization information in-weight feeders to an extruder. The materials Subsystems required needed are then thoroughly mixed, heated to a molten Waste feed system The percent soluble salt contained in the scrubber condition, and extruded into a suitable mold. On Ingredients feed system residues (sodium, potassium, sulfates, nitrates, and cooling, the mixture forms a solid monolithic waste chlorides) (see concentration of soluble salt in the form. No chemical reaction is required for solidifi-Projected performance characterization subelement beginning on page Mcallon. Sulfur Polymer Cement (SPC) Expected to pass TCLP Expected to produce a suitable final waste form for disposal. Waste streams produced A solidified waste form that requires RCRA LLW disposal (but could also be classified as a RCRA alpha-contaminated LLW waste) (see solidified waste forms disposal beginning on page N-1). ►SPC is being developed by the DOE for usage within -- Technology must be damonstrated on this waste. Low power requirements. Few subsystems are Sulfur Polymer Cement is composed of 95% sulfur. It melts at approximately 110 - 120°C, and is these types of waste streams. SPC has been stream to ensure stabilization of toxic constituents required and needed to make use of this technology. demonstrated on ash. SPC is not compatible with and compatibility with the actual constituents con-Low development risk. particularly applicable to the immobilization of toxic metals and treatment of incinerator ash. tained in the waste stream: high nitrates. Input waste stream characterization information Subsystems required needed Waste feed system The percent soluble salt contained in the scrubber ingredients feed system residues (sodium, potassium, sulfates, nitrates, and chlorides) (see concentration of soluble sait in the Projected performance characterization subelement beginning on page M-Expected to pass TCLP Expected to produce a suitable final waste form for Waste streams produced A solidified waste form that requires RCRA LLW disposal (but could also be classified as a RCRA alpha-contaminated LLW waste) (see solidified waste forms disposal beginning on page N-1).

Subelement: Treatment Name: TSCA Incinerator Ash MWIR#: 2480

Matrix: Ash / 3111 Site: Oak Ridge

Alternative/Technology

Chemically-bonded Ceramics (CbC)
Chemically-bonded ceramic waste forms are produced by mixing the wastes and inorganic oxide binders together. The mixture is then processed at ambient and near ambient temperatures, promoting chemical reactions that bond the waste

Status

CbC is in early stages for development by the DOE - Technology must be demonstrated on this waste - Low power requirements. Few subsystems are for usage within these types of waste streams.

Subsystems required Waste feed system Ingredients feed system

Projected performance Expected to pass TCLP Expected to produce a suitable final waste form for disposal.

Science and Technology Needs

stream to ensure stabilization of toxic constituents and compatibility with the actual constituents contained in the waste stream.

Implementation Analysis

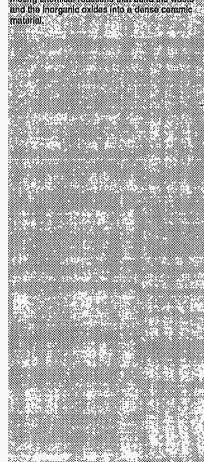
required and needed to make use of this technology. Low development risk.

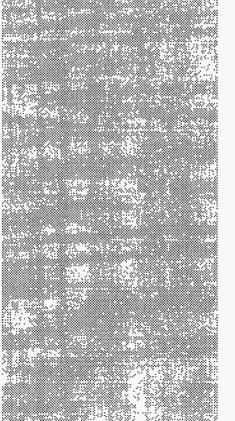
Input waste stream characterization information needed

The percent soluble salt contained in the scrubber residues (sodium, potassium, sulfates, nitrates, and chlorides) (see concentration of soluble salt in the characterization subelement beginning on page M-12).

Waste streams produced

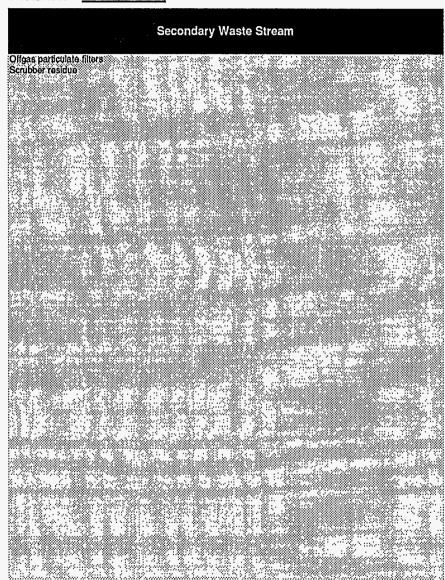
A solidified waste form that requires RCRA LLW disposal (but could also be classified as a RCRA alpha-contaminated LLW waste) (see solidified waste forms disposal beginning on page N-1).





Subelement: Treatment Name: TSCA Incinerator Ash MWIR#: 2480

Matrix: Ash / 3111



Site: Oak Ridge

Treatability Group

Radiological Constituents:

This waste may be classified as a waste containing 10-100 nCl/g of alpha-emitting radionuclides. However the waste may be classified as TRU waste, if the radionucides in the waste feed become concentrated within the products generated by the treatment process.

This waste is contaminated with toxic heavy metals including arsenic, cadmium, chromium, lead, selenjum, and

F001: Halogenated solvents used for degreasing F002: Halogenated solvents and mixtures

F003: Non-halogenated solvents

F006: Wastewater treatment sludges from electroplating

Matrix:

This waste consists of filters and scrubber residue.

Diagram Logic Program Integrated Mixed Waste

Subelement: Treatment MWIR#: 2480 TSCA Incinerator Ash Ash / 3111 Matrix: Name:

Site: Oak Ridge

Science and Technology

Implementation Analysis

· PHYSICAL TREATMENT ALTERNATIVE · Solidification/Stabilization Alternative/Technology

In weight teaders to an extruder. The materials are then, thoroughly mixed, heated to a mollen condition, and extruded into a suitable mold. On cooling, the mixture forms a solid monolithic wasteform. No chamical reaction is required for solidiffic Polyethylene is an inert thermoplastic material the can be processed at low temperatures.
Polyethytene binder and dry waste material are led through separate calibrated volumetric or loss

➤ Sulfut Polymer Cement (SPC)
Sulfut Polymer Cement is compased of 95% sulfur. It melts at approximately 110 = 120°C, and is particularly applicable to the immobilization of

toxic metals and treatment of incinerator ash.

Chamically, Windox ceramic waste forms are pro-duced by mixing the wastes and incipanic exide binders together. The mixin is their processed at ambient and near ambient temperatures, pro-moting chemical reactions that bond the waste-and the inorganic exides into a dense ceramic. Chemically-bonded Ceramics (CbC) -

Polyethylene has been demonstrated on scrubber Polyethylene is being developed by the DOE for usage within these types of waste streams. esidues.

tream to ensure stabilization of toxic constituents and compatibility with the actual constituents con-

ained in the waste stream.

echnology must be demonstrated on this waste.

Ingredients feed system Waste feed system Subsystems required

Expected to pass TCLP Expected to produce a suitable final waste form for Projected performance

SPC is being developed by the DOE for usage within these types of waste streams. SPC has been demonstrated on ash. SPC is not compatible with high nitrates.

stream to ensure stabilization of toxic constituents and compatibility with the actual constituents contained in the waste stream.

achidogy must be demonstrated on this waste.

Ingredients feed system Waste feed system Subsystems required

Projected performance Expected to pass TCLP Expected to produce a sultable final waste form for

CbC is in early stages for development by the DOE for usage within these types of waste streams.

Waste feed system Ingredients feed system Subsystems required

Low power requirements. Few subsystems are required and needed to make use of this technology. Low development risk.

The percent soluble salt contained in the scrubber residues (sodium, potassium, sulfates, nitrates, and Input waste stream characterization information

characterization subelement beginning on page Mchlorides) (see concentration of soluble salt in the A solidified waste form that requires RCRA LLW disposal (but could also be classified as a RCRA Waste streams produced

alpha-contaminated LLW waste) (see solidified waste forms disposal beginning on page N-1).

required and needed to make use of this technology Low power requirements. Few subsystems are Low development risk.

Input waste stream characterization information

The percent soluble salt contained in the scrubber residues (sodium, potassium, sulfates, nitrates, and chlorides) (see concentration of soluble salt in the characterization subelement beginning on page M-

Waste streams produced

A solidified waste form that requires RCRA LLW disposal (but could also be classified as a RCRA alpha-contaminated LLW waste) (see solidified waste forms disposal beginning on page N-1).

required and needed to make use of this technology. Low power requirements. Few subsystems are Low development risk.

Technology must be demonstrated on this waste stream to ensure stabilization of toxic constituents and compatibility with the actual constituents contained in the waste stream.

input waste stream characterization information

needed The percent soluble salt contained in the scrubber

Diagram Program Logic Mixed Waste Integrated

MWIR#: 2480 TSCA Incinerator Ash Name:

Ash / 3111 Matrix:

Subelement: Treatment

Site: Oak Ridge

residues (sodium, potassium, sulfates, nitrates, and chlorides) (see concentration of soluble salt in the characterization subelement beginning on page M-

Projected performance Expected to pass TCLP Expected to produce a sultable final waste form for

Status

Alternative/Technology

Implementation Analysis Science and Technology

Waste streams produced
A solidified waste form that requires RCRA LLW
disposal (but could also be classified as a RCRA waste forms disposal beginning on page N-1).

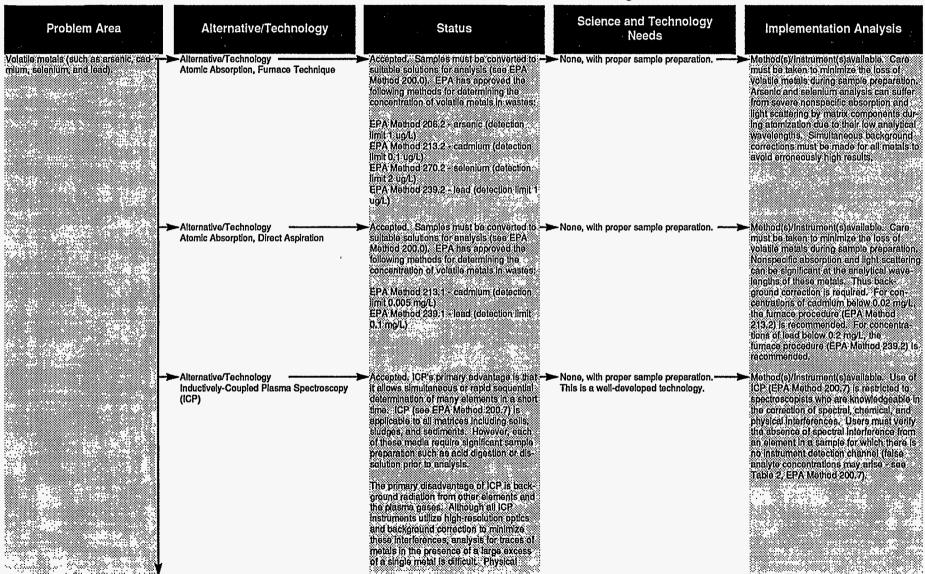
Mixed Waste Integrated Program

Logic Diagram

Oak Ridge TSCA Incinerator Ash Characterization Technologies

Name: TSCA Incinerator Ash MWIR#: 2480 Subelement: Characterization

Matrix: Ash / 3111 Site: Oak Ridge



Name: TSCA Incinerator Ash MWIR#: 2480 Subelement: Characterization

Matrix: Ash / 3111 Site: Oak Ridge

		:		
Problem Area	Alternative/Technology	Status	Science and Technology Needs	Implementation Analysis
	Inductively-Coupled Plasma Spectroscopy (ICP) (continued)	interferences such as samples containing high dissolved sollds or high acid concens trations can cause significant inaccure		
		clas. Thase inaccuracies can be reduced by diluting the sample, delivering a con- sistent flow of sample to the instrument		
		via the use of a peristolic pump, and/or by the use of the standard additions method:		
		EPA Method 200.7 * arsenic (detection limit 0.008 mg/L) EPA Method 200.7 * cadmium (detection		
		limit 0.001 mg/L) EPA Method 200.7 - selenium (detection limit 0.02 mg/L)		
	AlbanationTaskanlass	EPA Method 200.7 - lead (detection limit 0.01 mg/L)	Mana with assessment assessment	
	➤ Alternative/Technology Inductively-Coupled Plasma Mass Spectrometry (ICP-MS)	 Accepted by EPA. Provides multi-alement— analysis that is more selective than ICP, Allows isolopic analysis, interferences may occur in elements with similar mass. 	Aqueous or solid samples may be ana- lyzed. Solids require suspension of ana- lytes of interest using techniques such as	► Method(s)/instrument(s)available
	·.	Common molecular lon interferences in ICP-MS are listed in:Table 2 of EPA Method 200,8)	laser ablation.	
		EPA Method 200.8 - arsenia (detection limit 0.9 ug/L)		
		EPA Melhod 200.8 - cadmlum (detection limit 0.1 ug/L) EPA Method 200.8 - selenium (detection		
		ilmit 5 ug/L) EPA Method 200.8 + lead : (detection limit 0.08 ug/L)		
Salt contant (salts are primarily alu- minum, calcium, phosphorus, and sodium salts).	Alternative/Technology Atomic Absorption, Direct Aspiration.	sultable solutions for analysis (see EPA Method 200.0). EPA has approved the	None, with proper sample preparation. ——) This is a well-developed technology.	must be taken to minimize the loss of volatile metals during sample preparation.
		following methods for determining the concentration of potassium and sodium in wastes:		Nonspecific absorption and light scattering can be significant at the analytical wave- lengths of these metals. Thus back-
		EPA Method 202.1 - aluminum (detection limit 0.1 mg/L) EPA Method 215.1 - calcium (detection		graund correction is required.
X				

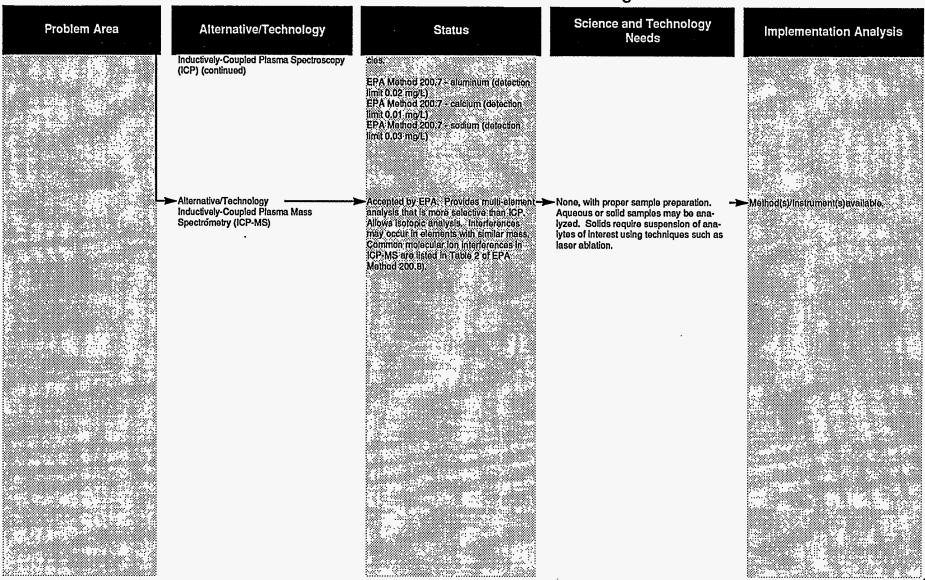
Subelement: Characterization MWIR#: 2480 Name: TSCA Incinerator Ash Matrix: Ash / 3111

Site: Oak Ridge

	Implementation Analysis		→ İnstrument(3) available.		◆ Method(sylhstrument(stavellable, Use of CP (EPA Method 2007) is restricted to spectroscopists who are knowledgable in the correction at spectra; chemical, and physical interferences. Users must yearly	the absence of spectral interference from an element in a sample for which there is no instrument detection channel (talse analyte concentrations may arise - see Table 2: EPA Method 2007).	
. Can muye	Science and Technology Needs		None, with proper sample preparation.		►None, with proper sample preparation. This is a well-developed technology.		
, J. C.	Status	fimit 0.01 mg/L) EPA Method 272:1 * socium (detection fimit 0.002 mg/L)	Accepted by EPA and industry, for Chromatography (EPA Method 300.0) is able to quickly and accumately determine anients in solution to pain or pob soncertrations. In order to use (C by solids, an extraction method outlined in EPA Method 300.0 must be performed. Additional separation sechniques may be resided to further separatial onic species.	EPA Metrod 300.0 - chloride (detection limit 0.02 mg/L) EPA Method 300.0 - nilrete (detection limit 0.002-0.004 mg/L) EPA Method 300.0 - sulfate (detection limit 0.02 mg/L) EPA Method 300.0 - sulfate (detection limit 0.02 mg/L)	Accepted, ICP's primary advantage is that that allows similismed is or repid sequential determination of many elements in a short time. I/OP (see EPA Metidos 200,7) is applicable to all mathos including soils.	studges, and sediments. However, each of these media require significant sample preparation such as acid digestion or dissolution prior to analysis. The primary disapvantage of ICP is back ground radiation from other elements and	The plasma gases. Although all ICA- instruments utilize high-vesidution optics and background correction to mainfize these interfereds, analysis for traces of metals fit the presence of a large excess of a singla metal is difficult. Physical ittelforates such as samples containing fight dissolved solids or holy acid concen- trations can cause significant inaccure.
	Alternative/Technology	Atomic Absorption, Direct Aspiration (continued)	Alternative/Technology lon Chromatography (IC)		Alternative/Technology Inductively-Coupled Plasma Spectroscopy (ICP)		
Mathix. Asil/311	Problem Area						

Name: TSCA Incinerator Ash MWIR#: 2480 Subelement: Characterization

Matrix: Ash / 3111 Site: Oak Ridge



Mixed Waste Integrated Program

Logic Diagram

Oak Ridge TSCA Incinerator Sludge Treatment Technologies

TSCA Incinerator Sludge MWIR#: 2508 Name:

Offgas Treatment Sludges / 3123 Matrix:

Waste Stream

Waste Stream Description

TSCA incinerator studge waste feed stream consisted of halogenated and non-halogenated solvents, toxic heavy metals including; arsenic, cadmium, chromium, lead, selenium, and sliver and wastewater treatment sludges from electroplating operations.

Although the incinerator waste feed had contained EPA-listed volatile organic compounds: these compounds are assumed to have been destroyed while being subjected to the previously performed incineration treatment process. Even though this waste stream is not expected to be contaminated with volatile organics, the respective codes continue to be attributed to the waste stream, because the VOC's have been treated/destroyed but have not be de-listed by the EPA.

Problems Presented by Waste Stream

LDR treatment requirement for the listed waste codes is inclineration followed by stabilization: This treatment will also be sufficient for the toxic characteristic components. The LDR treatment standard for incinerator ash after frealment but prior to land disposal is stabilization via a treatment technology such as macro/microencapsulation.

The lack of TCLP characterization forces some assumptions in order to select technology options. The presence of metals may complicate the treatment strategy. If the concentrations are very high, since stabilization may not be acceptable for greater than trace quantities of some metals. Currently identified EPA waste codes include: F001, F002; F003; and F006. However based on analytical results for wastes generated from 3/27/91 to 8/11/92 for the TSCA ash, the following additional waste codes are also considered to be applicabie: D004, D006, D007, D008, D010, and D011. Characterization of wastes through process knowledge has been done without actual verification via TCLP analysis. It is assumed that PBCs thought to have been previously contained in the waste stream have been destroyed by the TSCA incinerator.

Subelement: Treatment

Site: Oak Ridge

Treatability Group

Radiological Constituents:

This waste is classified as contact-handled with 10 -100 nCl/o of alpha contamination.

Contaminants:

This waste stream is contaminated with solvent, heavy metals, and sludges. It is assumed that the volatile organic compounds have previously been destroyed via the incineration treatment process:

F001: Halogenated solvents used for degreasing

F002: Halogenated solvents and mixtures

F003: Non-halogenated solvents

F006: Wastewater treatment sludges from electroplating

D004: Arsenic D006: Cadmium D007: Chromium D008: Lead D010: Selenium D011: Silver

This waste consists of offgas treatment sludges.

TSCA Incinerator Sludge MWIR#: 2508

Matrix: Offgas Treatment Sludges / 3123

Subelement: Treatment

Site: Oak Ridge

Alternative/Technology

CHEMICAL TREATMENT
Not applicable to this waste form, because nothing can be gained by performing chemical treatment upon this waste stream. The organic com-pounds have been previously destroyed by an incineration process and the residual ash/sludge containing metal and salt particulate is now prepared for treatment via a stabilization process..

THERMAL TREATMENT ALTERNATIVE - Virification

cation of the waste.

Joule Heated Melter • Refractory-lined reactor in which a pool of plass is maintained molten by joule heating; waste is introduced within the glass pool and dissolved into the glase matrix. High-temperatures can volatilize certain metals (such as arsenic, mercury, selenium, cadmium, and lead) and may require the subsequent capture of the metals in the offgas. Sludge may require the addition of significant volumes of glassification agents to ensure the vitrili-

Status

The DOE has demonstrated vitrification systems using HLW. Vitrification on several LLW matrices is under way. Pacific National Laboratory (PNL) has conducted bench scale testing of TSCA sludge vitrification.

Subsystems required

Waste feed system Glass additive feed system Molten glass handling system Secondary combustion chamber Small offgas treatment system, including acid-gas scrubber, metal-recovery system, and particulate Scrub solution treatment system

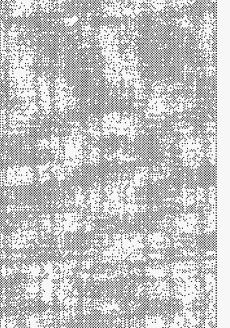
Projected performance

The need to tightly control the chemistry of the melt complicates operation of the process Addition of class formers to maintain desired viscosity limits volume reduction Highly stable glass final waste form is produced.

Science and Technology Needs

Technology must be demonstrated to assess its applicability to this waste stream, including the opera-

tion of the required subsystems.



Implementation Analysis

High power requirements. This technology will be commercially available for waste applications within 2 years, and is currently in use for highly specialized applications within the DOE system. Unit operational costs and life cycle costs fall in the mid-range of this group of technologies. Large number of subsystems required and the need to carefully control the chemistry of the melt, make this technology relatively complicated and labor-intensive. The homogeneous nature of this waste stream is a good match for this technology. Medium development risk compared to the other thermal technologies.

Input waste stream characterization information needed

Characterization requirements may include the identification of volatile metals and vitrification qualities due to potential sait content in this waste stream (see volatile metals in the characterization subelement beginning on page H-10).

Waste streams produced

Stabilized glass can be disposed of as a RCRA LLW (but could also be classified as a RCRA alphacontaminated LLW, or TRU waste) (see stabilized glass disposal beginning on page N-1).

Scrubber residue that requires stabilization (see scrubber residue under secondary waste streams beginning on page H-7).

Empty containers can be disposed of as LLW (see empty container disposal beginning on page N-1).

Offgas particulate filters that require stabilization (see offgas particulate filters under secondary waste streams beginning on page H-7).

Name: TSCA Incinerator Sludge MWIR#: 2508

Matrix: Offgas Treatment Sludges / 3123

Alternative/Technology

Plasma Arc Furnace Refractory-lined chamber into which unopened, containerized waste is introduced and melted in the high-temperature arc of a plasma torch. Hightemperatures can volatilize certain metals (such as arsenic, mercury, selenium, cadmium, and lead) requiring the subsequent capture of the metals in the offgas. The offgases would be subsequently cooled in order to allow any metals (or compounds) to condense and be entrained in a particulate removal device.

A secondary combustion chamber for treatment of organics is commonly included (in this case should not be required).

Microwave Melter --

A process that uses microwave energy to solidify wastes within the metal container, either via a batch or continuous feed mode. High-temperature melt occurs at between 1800°-2600°F resulting in a glassy-monolithic waste material. Due to the temperatures utilized in this process, certain metals (such as arsenic, mercury, selenium, cadmium, and lead) may volatilize. Glass formers are commonly added to produce a stable waste form.

Status

been demonstrated. An upgraded pilot plant with a continuous feed system and melt removal is currently in design

Subsystems required

Waste feed system

Molten material handling system for slag and metal phases.

Offgas treatment system, including acid gas scrubber and particulate filters.

Projected performance

Highest temperature range, good organic destruction with no pretreatment.

Maximum volume reduction.

Highly stable slag and metal final waste forms.

operated.

Subsystems required

Waste feed system

Offgas system

Glass former addition system

Projected performance

Highly stable glass waste form

Reduced handling requirements and generation of secondary wastes through in-drum processing.

Science and Technology Needs

Site: Oak Ridge

Subelement: Treatment

applicability to this waste stream, including the operation of the required subsystems... Analytical information is required. Glass formers may be necessary. although they have not been needed in any testing performed thus far.

applicability to this waste stream, including the opera-

tion of the required subsystems. Treatability tests

would identify any stabilization additives that may be

Implementation Analysis

A large scale proof-of-principle pilot batch unit has - Technology must be demonstrated to assess its - Very high power requirements. This technology is furthest from commercial availability, but should be proven in 3-5 years. Unit operational costs are comparable to the operational costs of a joule melter. Minimized feed preparation requirements make this the simplest of the thermal technology options. Highest development risk of the thermal technologies.

> Input waste stream characterization information needed

Characterization requirements may include the identification of volatile metals within this waste stream (see volatile metals in the characterization subelement beginning on page H-10).

Waste streams produced

Scrubber residue that requires stabilization (see scrubber residue under secondary waste streams beginning on page H-7).

Slag may be disposed of as a RCRA LLW (but could also be classified as a RCRA alpha-contaminated LLW, or TRU waste) (see slag disposal beginning on page N-1).

Offgas particulate filters that require stabilization (see offgas particulate filters under secondary waste streams beginning on page H-7).

not yet commercial availability, but should be proven in 2-4 years. Unit operational costs are high due to low throughput comparable to joule melter or plasma arc furnace. Minimal subsystem requirements make this technology extremely simple and non-labor intensive. Suited to process this waste stream with no pretreatment. The corrosive nature of the sludge during microwaving may be a problem. Medium development risk of the thermal technologies.

Input waste stream characterization information

Characterization requirements may include the identification of volatile metals within this waste stream (see volatile metals in the characterization

H-4

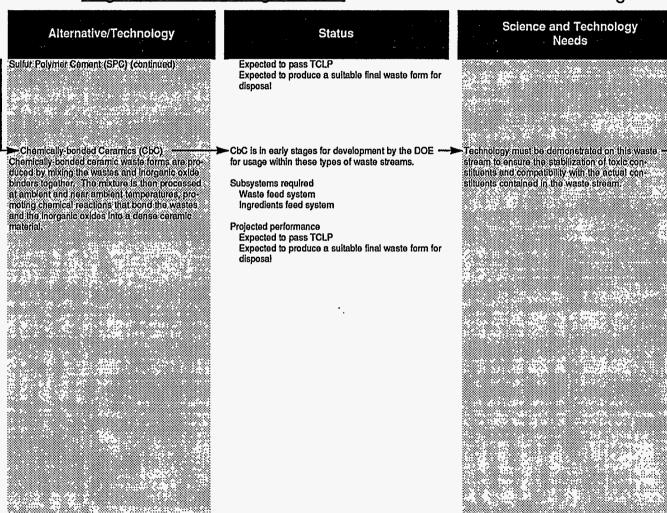
Name: TSCA Incinerator Sludge MWIR#: 2508 Subelement: Treatment

Matrix: Offgas Treatment Sludges / 3123 Site: Oak Ridge

Alternative/Technology	Status	Science and Technology Needs	Implementation Analysis
Microwave Melter (continued) PHYSICAL TREATMENT: Solidification/Stabilization.			Waste streams produced Slag may be disposed of as a RCRA LLW (but could also be classified as a RCRA alpha-contaminated LLW, or TRU waste) (see slag disposal beginning on page N-1). Scrubber residue that requires stabilization (see scrubber residue under secondary waste streams beginning on page H-7). Offgas particulate filters that require stabilization (see offgas particulate filters under secondary waste streams beginning on page H-7).
Polyethylene Is an inert thermoplastic material that can be processed at low temperatures. Polyethylene binders and dry waste materials are fed through separate calibrated volumetric or loss in-weight feeders to an extruder. The materials are then thoroughly mixed, friested to a molten condition, and extruded into a suitable mold. On cooling, the mixture forms a solid monalithic waste form. No chemical reaction is required for solidilication.	Polyethylene is being developed by the DOE for usage on these types of waste streams. Polyethylene has been demonstrated on scrubber residues. Subsystems required Waste feed system Ingredients feed system Projected performance Expected to pass TCLP Expected to produce a suitable final waste form for disposal.	Technology must be demonstrated on this waste stream to ensure the stabilization of the toxic constituents and the compatibility of the process with actual constituents contained in the waste stream.	Low power requirements. Few subsystems are required and needed to make use of this technology. Low development risk. Input waste stream characterization information needed The percent soluble salt contained in the scrubber residues (sodium, potassium, sulfates, nitrates, and chlorides) (see concentration of soluble salt in the characterization subelement beginning on page M-12). Waste streams produced A solidified waste form that requires RCRA LLW disposal (but could also be classified as a RCRA alpha-contaminated LLW waste) (see solidified waste forms disposal beginning on page N-1).
Sulfur Polymer Cement (SPC) Sulfur Polymer Cement is composed of 95% sulfur. It melts at approximately: 110 to 120°C and is particularly applicable to the immobilization of toxic metals and treatment of incinerator ash.	SPC is being developed by the DOE for usage within — these types of waste streams. SPC has been demonstrated on waste ash. SPC is not compatible with waste streams that contain high nitrates. Subsystems required Waste feed system Ingredients feed system Projected performance	- 1861 Paris 1906-2-190-2000 Control Contr	Low power requirements. Few subsystems are required and needed to make use of this technology. Low development risk. Input waste stream characterization information needed The percent soluble salt contained in the scrubber residues (sodium, potassium, sulfates, nitrates, and chlorides) (see concentration of soluble salt in the characterization subelement beginning on page M-

Name: TSCA Incinerator Sludge MWIR#: 2508 **Subelement:** Treatment

Matrix: Offgas Treatment Sludges / 3123



Science and Technology Needs

Site: Oak Ridge

12).

Waste streams produced A solidified waste form that requires RCRA LLW disposal (but could also be classified as a RCRA alpha-contaminated LLW waste) (see solidified waste forms disposal beginning on page N-1).

Implementation Analysis

Low power requirements. Few subsystems are required and needed to make use of this technology. Low development risk.

Input waste stream characterization information

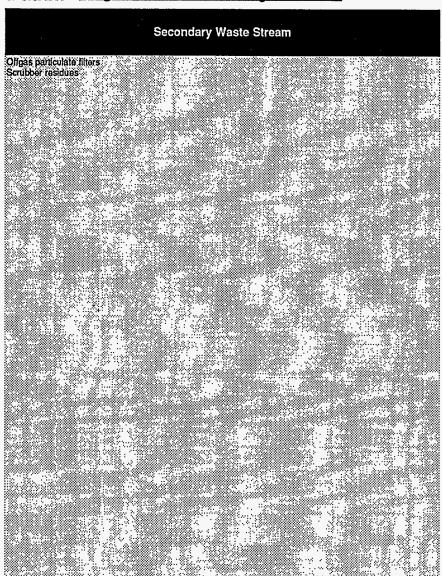
The percent soluble salt contained in the scrubber residues (sodium, potassium, sulfates, nitrates, and chlorides) (see concentration of soluble salt in the characterization subelement beginning on page M-

Waste streams produced

A solidified waste form that requires RCRA LLW disposal (but could also be classified as a RCRA alpha-contaminated LLW waste) (see solidified waste forms disposal beginning on page N-1).

Name: TSCA Incinerator Sludge MWIR#: 2508

Matrix: Offgas Treatment Sludges / 3123



Subelement: Treatment

Site: Oak Ridge

Treatability Group

Radiological Constituents:

This waste may be classified as waste containing 10-100 nCl/g of alpha-emitting radionuclides. However the waste may possibly be classified as TRU waste, if the radionuclides in the waste feed become concentrated within the products generated by the treatment process.

Contaminants:

This waste stream is contaminated with toxic heavy metals including; arsenic, cadmium, chromium, lead, selenium, and silver. The following EPA-regulated wastes are suspected to be contained within the waste stream. It is assumed that the volatile organic compounds have previously been destroyed via the incineration treatment process:

F001: Halogenated solvents used for degreasing

F002: Halogenated solvents and mixtures

F003: Non-halogenated solvents

F006: Wastewater treatment sludges from electroplating

Matrix:

This waste consists of scrubber residues and offgas particulate filters.

Name: TSCA Incinerator Sludge MWIR#: 2508 Subelement: Treatment

Matrix: Offgas Treatment Sludges / 3123 Site: Oak Ridge

	Alternative/Technology	Status	Science and Technology Needs	Implementation Analysis
	Polyethylene Polyethylene is an inert thermoplastic material that can be processed at low temperatures. Polyethylene binders and dry waste materials are fed through separate calibrated volumetric or loss in-weight feeders to an extruder. The materials are then thoroughly mixed, heated to a molten cording, the mixture forms a solid propolithic waste form. No chemical reaction is required for solidification.	Polyethylene is being developed by the DOE for usage on these types of waste streams. Polyethylene has been demonstrated on scrubber residues. Subsystems required Waste feed system Ingredients feed system Projected performance Expected to pass TCLP Expected to produce a suitable final waste form for disposal.	Technology must be demanstrated on this waste, stream to ensure the stabilization of the toxic constituents and the competibility of the process with actual constituents contained in the waste stream	Low power requirements. Few subsystems are required and needed to make use of this technology. Low development risk. Input waste_stream characterization information needed The percent soluble salt contained in the scrubber residues (sodium, potassium, sulfates, nitrates, and chlorides) (see concentration of soluble salt in the characterization subelement beginning on page M-12). Waste_streams_produced A solidified waste form that requires RCRA LLW disposal (but could also be classified as a RCRA alpha-contaminated LLW waste) (see solidified waste forms disposal beginning on page N-1).
	Sulfur Polymer Cement (SPC) Sulfur Polymer Cement is composed of 95% sulfur. If melts at approximately 110 to 120°C and is particularly applicable to the immobilization of toxic metals and treatment of incinerator ash.	SPC is being developed by the DOE for usage within— these types of waste streams. SPC has been demonstrated on waste ash. SPC is not compatible with waste streams that contain high nitrates. Subsystems required Waste feed system Ingredients feed system Projected performance Expected to pass TCLP Expected to produce a suitable final waste form for disposal	Technology must be demonstrated on this waste ——stream to ensure the stabilization of toxic constituents and compatibility with the actual constituents contained in the waste stream. The technology needs development on the treatment of shredded particulate filters.	Low power requirements. Few subsystems are required and needed to make use of this technology. Low development risk. Input waste stream characterization information needed The percent soluble salt contained in the scrubber residues (sodium, potassium, sulfates, nitrates, and chlorides) (see concentration of soluble salt in the characterization subelement beginning on page M-12). Waste streams produced A solidified waste form that requires RCRA LLW disposal (but could also be classified as a RCRA alpha-contaminated LLW waste) (see solidified waste forms disposal beginning on page N-1).
L	Chemically-bonded Ceramics (CbC) Chemically-bonded ceramic waste forms are produced by mixing the wastes and inorganic oxide binders together. The mixture is then processed at ambient and near ambient temperatures, promoting chemical reactions that bond the wastes and the inorganic oxides into a dense ceramic material.	CbC is in early stages for development by the DOE — for usage within these types of waste streams. Subsystems required Waste feed system Ingredients feed system Projected performance Expected to pass TCLP	Technology must be demonstrated on this waste stream to ensure the stabilization of toxic consistents and compatibility with the actual consultants contained in the waste stream.	Low power requirements. Few subsystems are required and needed to make use of this technology. Low development risk. Input waste stream characterization information needed The percent soluble salt contained in the scrubber residues (sodium, potassium, sulfates, nitrates, and chlorides) (see concentration of soluble salt in the

Diagram Program Logic Mixed Waste Integrated

MWIR#: 2508 TSCA Incinerator Sludge Matrix: Name:

Offgas Treatment Sludges / 3123

Subelement: Treatment

Site: Oak Ridge

Waste streams produced
A solidified waste form that requires RCRA LLW disposal (but could also be classified as a RCRA-alpha-contaminated LLW waste) (see solidified waste forms disposal beginning on page N-1). characterization subelement beginning on page M-12). Science and Technology Expected to produce a suitable final waste form for disposal Status Alternative/Technology

Mixed Waste Integrated Program

Logic Diagram

Oak Ridge TSCA Incinerator Sludge Characterization Technologies

Diagram Logic Program Mixed Waste Integrated

Subelement: Characterization MWIR#: 2508 TSCA Incinerator Sludge Name:

Offgas Treatment Sludges / 3123

Matrix:

Site: Oak Ridge

the furnice procedure (EPA Method 213.2), is recommended. For concentrations of lead below 0.2 mg/L, the furnice procedure (EPA Method 239.2) is recommended. Method(s/Instruments) avallable. Use of ICP-AES (EPA Method 200.7) is restricted in spectroscopists who are knowledgeable Wavelengths. Simultaneous background corrections must be made for all metals to cury vapor (253,7,mm). A preliminary run without reagents should determine if this type of interference is present. physical interferences. Users must verify the absence of spectral interference from an element in a sample for which there is no instrument defection channel (false from severe nonspecific absorption and light scattering by matry components during abmization due to their low analytical Mathodis/Instrumon(s) available
Polassium permanganate is adoled to
alimnate possible inbeference from sulfide. Wastes high in chloride require adol tional permanganate. Certain volatile organic absorb at the wavelength of mer-Method(s)/Instrument(s) available. Care must be taken to minimize the loss of volatile metals during sample preparation Method(s)/instrument(s) available, Care must be taken to minimize the loss of ground correction is required. For con-centrations of cadmium below 0.02 mg/L. volatile metals during sample preparation Arsenic and selentum analysis can suffe Nonspecific absorption and light scatterin can be significant at the analytical wave-lengths of these metals. Thus back Implementation Analysis avoid erroneously high results None. All samples must be subject to an appropriate dissolution step prior to analy-sis. must be converted to - None, with proper sample preparation. -None, with proper sample preparation. Science and Technology None, with proper sample preparation. This is a well-developed tachnology. Accepted: ICP-AES's primary advantage—
is that it allows simultaneous or rapid
sequential determination of many elements in a short time. ICP-AES (see EPA
Nethod 200.7) is applicable to all matrices
including soils, sludges, and sediments
However, each of these needs require
significant termine preparation such as Accepted. Samples must be converted to suitable solutions for analysis (see EPA Method 2020). EPA task approved the Ollowing methods for determining the concentration of volidile metals; in wastes: ccepted. Samples must be converted to EPA Method 239,2 - lead (detection limit 1 concentration of volatile metals in wastes: ilmit 1 tigt.) EPA Mothod 213.2 - cadmium (detection EPA Method 213.1 - cadmium (detection EPA Method 239.1 - lead (detection limit sultable solutions for analysis. EPA has approved the following methods for determining the topal mercury (morganic and od 270.2 - selenium (detection EPA Method 245.5 - mercury (detection limit, 0002 mg/L) sultable solutions for analysis (see EPA Method 200.2). EPA has approved the EPA Method 206.2 + arsanic (detection lowing methods for determining the Status organic) in solid wastes: Alternative/Technology Inductively-Coupled Plasma Spectroscopy Atomic Emission Spectrometry (KP-AES) Atomic Absorption (AA), Direct Aspiration Alternative/Technology Alternative/Technology ——
Atomic Absorption (AA), Furnace
Technique Atomic Absorption, Cold-Vapor Alternative/Technology -Alternative/Technology Volatile metals (such as arsente, mer cury, cadmium, selentum, and lead) Problem Area

Subelement: Characterization Name: TSCA Incinerator Sludge MWIR#: 2508

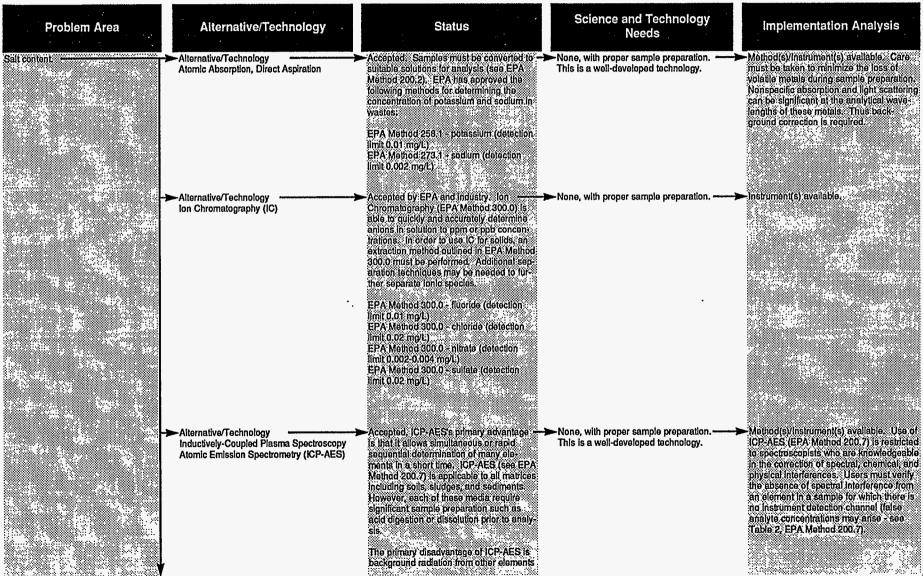
Matrix: Offgas Treatment Sludges / 3123

Site: Oak Ridge

Implementation Analysis	analyle concentrations may arise see	
Science and Technology Needs	None, with proper sample preparation. Aqueous or solid samples may be analyzed. Solids require suspension of analyzes of interest using bechniques such as laser ablation.	
Status	acid digastion or dissolution prior to analysis. The primary disadvantage of 1CP-AES is background radiation from other dements and the plasma gases. Although all 1CP-AES instruments utilize high-resolution optics and background correction to minimize these interferences such as samples occases of a single matal is difficult. Physical interferences such as samples containing high dissolved solids of high acid contentrations. These inaccuracies can be reduced by diluting the samples containing high dissolved solids of high acid contentrations. These inaccuracies can be reduced by diluting the sample, delivering a constant flow to the Instrument via the use of the paradard additions method. EPA Method 200.7 - areant (detection limit 0.02 mg/L) EPA Method 200.7 - areant (detection limit 0.02 mg/L) EPA Method 200.7 - selentium (detection limit 0.02 mg/L) EPA Method 200.7 - selentium (detection limit 0.02 mg/L) EPA Method 200.7 - selentium (detection limit 0.02 mg/L) EPA Method 200.7 - selentium (detection limit 0.02 mg/L) EPA Method 200.8 - selentium (detection limit 0.01 mg/L) EPA Method 200.8 - selentium (detection limit 0.9 ug/L) EPA Method 200.8 - selentium (detection limit 0.9 ug/L) EPA Method 200.8 - selentium (detection limit 0.1 ug/L) EPA Method 200.8 - selentium (detection limit 0.1 ug/L) EPA Method 200.8 - selentium (detection limit 0.1 ug/L) EPA Method 200.8 - selentium (detection limit 0.1 ug/L)	0.08 ug/L)
Alternative/Technology	Inductively-Coupled Plasma Spectroscopy Atomic Emission Spectrometry (continued) Inductively-Coupled Plasma Mass Spectrometry (ICP-MS)	
	Atomic ued) Alterni	

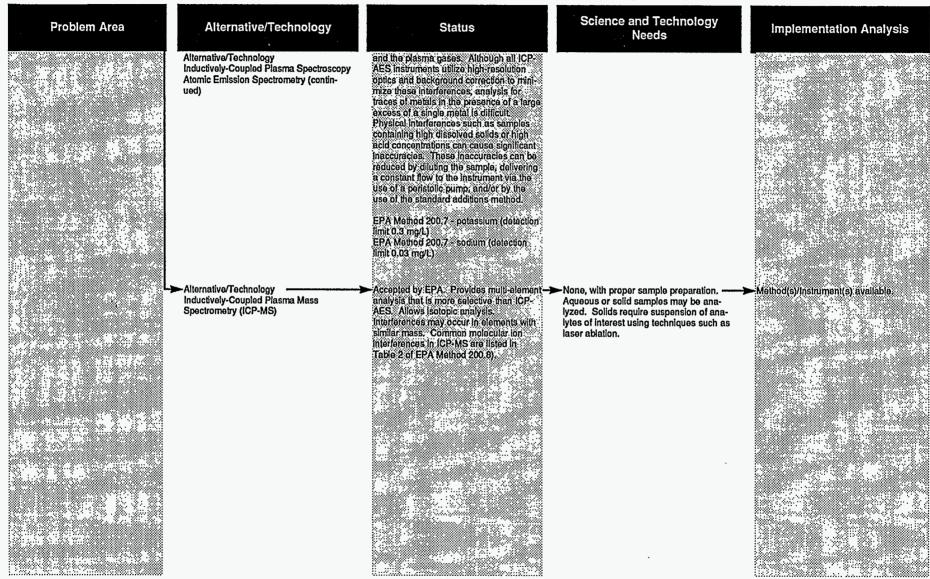
Name: TSCA Incinerator Sludge MWIR#: 2508 Subelement: Characterization

Matrix: Offgas Treatment Sludges / 3123 Site: Oak Ridge



Name: TSCA Incinerator Sludge MWIR#: 2508 Subelement: Characterization

Matrix: Offgas Treatment Sludges / 3123 Site: Oak Ridge



Mixed Waste Integrated Program

Logic Diagram

Oak Ridge Y-12 Hazardous Solid Waste Treatment Technologies

Name: Y-12 Hazardous Solid Waste MWIR#: 919 Subelement: Treatment

Matrix: <u>Inorganic Debris / 5430</u>

Waste Stream

Waste Stream Description:

Hazardous waste solid generated during plant operations at ORNL Y-12 facility.

Y-12 solid wasts contains hazardous chlorinated solvents, inorganic debris, toxic organics and metals. The Resource Conservation and Recovery Act (RCRA) Best Demonstrated Available Technology (BDAT) for treatment of the hazardous solvents in this waste is incineration. Thermal treatment is the preferred treatment for the organic components. Stabilization at the Mixed Waste Treatment Facility is the preferred treatment for process residuals and inorganic solids remaining after incineration/thermal treatment is complete. Stabilized wastes requiring disposal will include aqueous salts from off-gas treatment systems, dry solid residuals to which stabilizers may be added; discarded metal drums and other waste containers. The alternate LDR treatment standard for debris (it is not obvious that this stream meets the debris rule criteria) is treatment prior to land disposal using any of the following technologies: extraction (physical, chemical or thermal); destruction (biological, chemical, or thermal), macro/microencapsulation or sealing. The debris rules are not applied in this analysis.

Problems Presented by Waste Stream:

The characterization data concerning the physical and chemical form is not available for the waste. The F006 waste code is listed; however, the volume and physical state of the electropiating sludge is not stated.

If the electroplating sludge is separate or well defined and not mixed in with the other general debris, it may be able to be solidified for disposal. It is assumed that the waste form is predominantly solid depris contamnated with metal residues and organics.

LDR treatments required for the listed waste codes are incineration, recovery, chemical reduction, acid leaching, or high-temperature metal recovery; all followed by stabilization:

The alternate LDR treatment standard for debris is treatment prior to land disposal using any of the following technologies; extraction (physical, chemical, thermal), destruction (biological, chemical, or thermal), macro/microencapsulation or sealing.

Treatability Group

Radiological Constituents:

This waste is classified as contact-handled with 10 -100 nCl/g of alpha contamination.

Contaminants:

This waste is contaminated with toxic organics and mercury. The following EPA regulated wastes are suspected to be contained within the waste stream:

D001:Unlisted hazardous waste characteristic of ignitability

Site: Oak Ridge

D006:Cadmium

D007:Chromium

D008:Lead

D009:Mercury

F001:Halogenated solvents used in degreasing

F002:Halogenated solvents and mixtures

F006:Wastewater treatment sludges from electroplating

PCBs

Matrix:

The waste matrix consists of inorganic debris including the following:

Carbon filter used for crushing

Crushed fluorescent bulbs

Crushed fluorescent light tubes

Crushed fluorescent lamps

Filter

Filter cartridges

Fluorescent lamps

HCL & Soda Ash concrete and gravel

Lab instruments

Lab trash

Manometers and sweepings

Mercury contaminated asbestos

Mercury contaminated filter

Mercury contaminated hose

Mercury contaminated lead

Mercury contaminated paper

Mercury contaminated piping

Mercury contaminated polystyrene

Mercury contaminate pump parts

Mercury contaminated rags

Mercury contaminated solids

Mercury contaminated trash

Mercury contaminated tiles

Mercury contaminated waste

Mercury fluorescent lamps

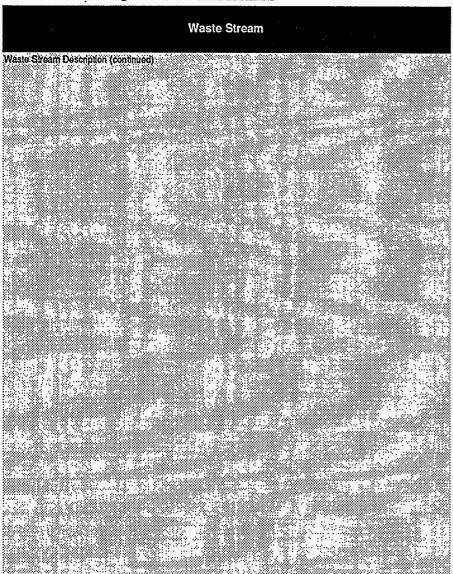
Mercury vapor lamps from hot cell

Mersorb filter

PCB plastic drum 7

Name: Y-12 Hazardous Solid Waste MWIR#: 919 Subelement: Treatment

Matrix: Inorganic Debris / 5430



Treatability Group

PCB solids (diapers)
PCB solids paper, plastic
Rad filter
Respirator cartridges
Rubber lining (PCB HO)
Sorball clean up material
Trash
T.S wipes
Tube machine
Stokes gauge
U-contaminated trash
W a s t e paper and plastic

Site: Oak Ridge

Subelement: Treatment Y-12 Hazardous Solid Waste MWIR#: 919 Name:

Matrix: Inorganic Debris / 5430 Site: Oak Ridge

Alternative/Technology

CHEMICAL TREATMENT

Oxidation: Chemical Reduction (Note: Although only a few chemical oxidation reagents have been identified here, various reagents that could be utilized to perform chemical exidation include exene, permanganate, hydrogen peroxide, hypochlorite, and sulfur dioxide. Various oxidation techniques utilized could include wet air oxidation, electrolytic exidation, or ozonation via an ultraviolet light.) Wastes will be sorted into categories of combustibles, liquid mercury, mercury-contaminated asbestos, and metals,

Chemical treatment technologies are only applicable to the liquid mercury and large portions of this

Combustibles (including combustibles contaminated with PCBs) and small metal pieces will be treated via incineration or stabilization(see thermal treatment or physical freatment).

Mercury-contaminated asbestos will be treated as debris via stabilization (see physical treatment).

Liquid mercury that has been drained from waste instrumentation and plumbing will be treated via amalgamation. Zing metal powder (or copper): will be mixed with the liquid mercury and allowed. to react, forming a zinc-mercury alloy (see secondary waste stream treatment).

Large Metal objects will be treated via decontamination, chemical oxidation, chemical reduction. and dehydration/evaporation. Chemical immobilization of contaminants adhering to the surfaces of waste metals can be accomplished via an acidic spray or dip system. Acids utilized could include EDTA or cliric acid combined with surfactants. Il rigorous treatment was required, nitric acid could be utilized. Organics contained in the acidic rinse can be destroyed via chemical oxidation (utilizing hydrogen peroxide or permanganate as the oxidizer under conditions in the pH range of 1-4). If PCBs are contained within the waste

Status

chemical oxidation; chemical reduction; and dehydration/evaporation technologies have been previously used in industry on similar waste types.

Subsystems required Manual sorting system Amalgamation system Acidic rinse system Chemical oxidation system Caustic addition system Chemical reduction system Dehydration/evaporation system

Projected performance Expected to pass TCLP Expected to produce a suitable final waste form for disposal

Science and Technology Needs

🕳 Deconfamination, via an Acidic Rinse; Chemical -— Amalgamation; decontamination via an acidic rinse; -— Demonstration of this acidic rinse; -- Demonstration of this waste treatment of these specific contaminants within this specific waste matrix is needed.

Implementation Analysis

stream labor intensive. Acid utilization within the presence of alpha contamination may cause safety concerns.

Input waste stream characterization information needed

Waste stream:

Concentration and form of mercury contaminants. (see concentration and chemical form of mercury in the characterization subelement beginning on page I-19).

Liquid Mercury:

Chemical form and concentration of the mercury (see concentration and chemical form of mercury in the characterization subelement beginning on page i-19).

Solution pH (see pH in the characterization subelement beginning on page I-19).

Presence of interfering materials, such as oils and greases (see presence and concentration of oil and grease in the characterization subelement beginning on page M-12).

Presence of suspended particles (see presence and concentration of suspended solids in the characterization subelement beginning on page M-12).

Presence of dissolved salts (see presence of dissolved salts in the characterization subelement beginning on page I-19).

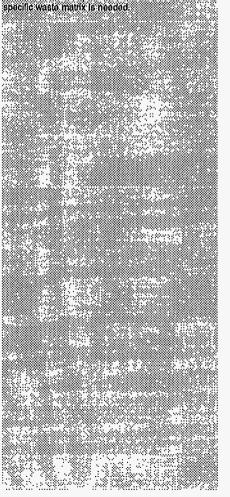
Acidic rinsate:

An accurate COD analysis of the waste is required to determine the reagents necessary to promote oxidation of the organics within the waste (see Chemical-Oxygen Demand analysis in the characterization subelement beginning on page I-19).

Concentration of metal salts. Metal salts, especially silver salts, will react with the oxidizing agents to form metal oxides which can interfere with the effectiveness of the treatment process (see metal salts in the characterization subelement beginning on page I-19).

pH of the waste (see pH in the characterization subelement beginning on page I-19).

The presence and concentration of cyanide and



Name: Y-12 Hazardous Solid Waste Subelement: Treatment MWIR#: 919

Matrix: Inorganic Debris / 5430 Site: Oak Ridge

Alternative/Technology

solution, an exidation technique utilizing hydrogen peroxide in combination with an ultraviolet light will destroy them.

After the destruction of the organics, the acidic rinse can be raised to a pH of 4-5, and ferrous sulfate added to precipitate the metal contaminants. The slurry is then dehydrated/evaporated down to a sludge (~ 60-80 wt. %) to enable the physical treatment of the heavy metal contaminants via stabilization (see physical treatment stabilization).

The required concentrations of the reagents will... be based on the Chemical-Oxygen Demand(COD) analysis of the solution. Temperature control and Oxidation-Reduction Potential (ORP) monitoring are standard control technologies utilized for COD analysis. The process can be monitored via the COD analysis to determine when the organics are completely destroyed. For accurate COD analysis, the hydrogen peroxide (if utilized as the oxidizer) must be neutralized prior to the performance of the analysis.

Decontamination via CO2 Blasting: Chemical Decontamination via CO2 Blasting; Chemical Oxidation: Chemical Reduction (Note: Although only a few chemical oxidation reagents have been identified here, various reagents that could be utilized to perform chemical oxidation include ozone, permanganate; hydrogen peroxide, hypochlorite; and sulfur diox-Ide. Various exidation techniques utilized could Include wet air oxidation, electrolytic oxidation, or ozonation via an ultraviolet light.)

Wastes will be sorted into categories of combustibles, liquid mercury, mercury-contaminated asbestos, and metals,

Chemical treatment technologies are only applica-ble to the liquid mercury and large metals portions of this waste stream.

Combustbles (including combustibles contaminated with PCBs) and small metal pleces will be treated via incineration (see thermal treatment or physical treatment).

Status

Science and Technology Needs

Implementation Analysis

PCBs within the waste rinsate will be necessary to select the appropriate oxidation treatment method (see cyanide and PCBs in the characterization subelement beginning on page I-19).

Waste streams produced

Empty containers can be disposed of as LLW (see empty containers disposal beginning on page N-1),

Sludge that requires stabilization (see sludge under secondary waste streams beginning on page I-

14).
Decontaminated metal debris can be disposed of as a LLW (see metal debris disposal beginning on page N-1).

Mercury zinc alloy can be disposed of as LLW (but could be classified as alpha-contaminated or TRU waste) (see solidified waste forms disposal beginning on page N-1).

Oxidation; Chemical Reduction; and Dehydration/Evaporation technologies have been previously used in industry on similar waste types.

Subsystems required

Manual sorting system Amalgamation system CO2 blasting system Chemical oxidation system Acid addition system Chemical reduction system Dehydration/evaporation system

Projected performance

Expected to produce a suitable product that can be stabilized into a final waste form for disposal

treatment of these specific contaminants within this specific waste matrix is needed.

stream labor intensive. A pressurized spray within the presence of alpha contamination may cause safety concerns.

> Input waste stream characterization information bebeen

Waste stream:

Concentration and form of mercury contaminants (see concentration and chemical form of mercury in the characterization subelement beginning on page I-

Llauid Mercury:

Chemical form and concentration of the mercury (see concentration and chemical form of mercury in the characterization subelement beginning on page I-

Solution pH (see pH in the characterization subelement beginning on page I-19).

Presence of interfering materials, such as oils and greases (see presence and concentration of oil and

Name: Y-12 Hazardous Solid Waste MWIR#: 919 Subelement: Treatment

Matrix: Inorganic Debris / 5430

Alternative/Technology

Decontamination via CO2 Blasting (continued)

Mercury-contaminated asbestos will be treated as debris via stabilization (see physical treatment).

Liquid mercury that has been drained from waste instrumentation and plumbing will be treated via amalgamation. Zinc metal powder (or copper) will be mixed with the liquid mercury at ambient 50°C temperatures; and allowed to react; forming a zinc-mercury alloy (see secondary waste stream treatment).

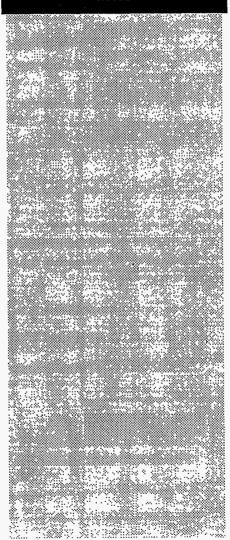
Large metal objects will be treated via decontamination, chemical oxidation, chemical reduction, and dehydration/evaporation. Chemical immobilization of contaminants adhering to the surfaces of waste metals can be accomplished via CO2 Blasting (CO2 Blasting is the removal of contamination via a pressurized spray of frozen carbon dioxide pellets). The trozen CO2 evaporates and the contaminants will be swept up off of the floor and treated via a caustic (hydrogen peroxide or permanganate) chemical oxidation process. If PCBs are contained within the waste solution, an oxidation technique utilizing hydrogen peroxide in combination with an ultraviolet light will destroy them. After the destruction of the organics, the solution can be lowered to a pH of 4-5, and ferrous sulfate added to precipitate the metal contaminants. The slurry is then dehydrated/evaporated down to a sludge (~ 60-80 wt. %) to enable the physical treatment of the heavy metal contaminants via stabilization (see physical treatment stabilization).

The required concentrations of the reagents will be based on the Chemical-Oxygen Demand (COD) analysis of the solution. Temperature control and Oxidation-Reduction Potential (ORP) monitoring are slandard control technologies utilized for COD analysis. The process can be monitored via the COD analysis to determine when the organics are completely destroyed. For accurate COD analysis, the hydrogen peroxide (if utilized as the oxidizer) must be neutralized prior to the partormance of the analysis.

Status

Science and Technology Needs

Site: Oak Ridge



Implementation Analysis

grease in the characterization subelement beginning on page M-12).

Presence of suspended particles (see presence and concentration of suspended solids in the characterization subelement beginning on page M-12).

Presence of dissolved salts. Copper salts can react with zinc prior to the mercury-zinc reaction (see dissolved salts in the characterization subelement beginning on page I-19).

Oxidation process solution:

An accurate COD analysis of the waste is required to determine the reagents necessary to promote oxidation of the organics within the waste (see Chemical-Oxygen Demand analysis in the characterization subelement beginning on page 1-19).

Concentration of metal salts. Metal salts, especially silver salts, will react with the oxidizing agents to form metal oxides which can interfere with the effectiveness of the treatment process (see metal salts in the characterization subelement beginning on page 1-19).

pH of the waste (see pH in the characterization subelement beginning on page 1-19).

The presence and concentration of cyanide and PCBs within the waste process solution will be necessary to select the appropriate oxidation treatment method (see cyanide and PCBs in the characterization subelement beginning on page I-19).

Waste streams produced

Empty containers can be disposed of as LLW (see empty containers disposal beginning on page N-1),

Studge that requires stabilization (see sludge under secondary waste streams beginning on page 1-14).

Decontaminated metal debris can be disposed of as a LLW (see metal debris disposal beginning on page N-1).

Mercury zinc alloy can be disposed of as LLW (but could be classified as alpha-contaminated or TRU waste) (see solldified waste forms disposal beginning on page N-1).

Subelement: Treatment Name: Y-12 Hazardous Solid Waste MWIR#: 919

Matrix: Inorganic Debris / 5430 Site: Oak Ridge

Alternative/Technology

Decontamination via Polyethylene-Bead Decontamination via polyethylene-bead blasting; Demonstration of this technology with respect to the Many subsystems make the treatment of this waste Blasting: Chemical Oxidation; Chemical Reduction (Note: Although only a few chemical oxidation reagents have been identified here, various reagents that could be utilized to perform chemical oxidation include ozone, permanganate, hydrogen peroxide, hypochlorite, and sulfur dioxide. Various oxidation techniques utilized could include wet air oxidation, electrolytic oxidation, or ozonation via an ultraviolet light.)

Wastes will be sorted into categories of combustibles, liquid mercury, mercury-contaminated asbestos, and metals.

Chemical treatment technologies are only applicable to the liquid mercury and large metals portions of this waste stream.

Combustibles (including combustibles contaminated with PCBs) and small metal pieces will be treated via incineration (see thermal treatment or physical treatment).

Mercury-contaminated aspectos will be treated as debris via stabilization (see physical treatment).

Liquid mercury that has been drained from waste instrumentation and plumbing will be treated via amalgamation. Zinc metal powder (or copper) will be mixed with the liquid mercury at ambient * 60°C temperatures, and allowed to react, forming a zinc-mercury alloy (see sec-

andary waste stream treatment).

Large metal objects will be treated via decontamination, chemical oxidation, chemical reduction, and dehydration/evaporation. Chemical immobilist lization of contaminants adhering to the surfaces of waste metals can be accomplished via Polyethylene-Bead Blasting (Polyethylene-Boad Blasting is the removal of contamination via a pressurized spray of polyethylene beads). The contaminants adhere to the beads or will drop onto the floor. The contaminants and beads will be swept up off of the floor and treated via a caustic (hydrogen peroxide or permanganate)

Status

chemical oxidation; chemical reduction; and dehydration/evaporation technologies have been previously used in industry on similar waste types.

Subsystems required

Manual sorting system Amalgamation system Polyethylene-Bead blasting system Chemical oxidation system Acid addition system Chemical reduction system Dehydration/evaporation system

Projected performance

Expected to produce a suitable product that can be stabilized as a final waste form for disposal

Science and Technology Needs

treatment of these specific contaminants within this specific waste matrix is needed.

Implementation Analysis

stream labor intensive. A pressurized spray within the presence of alpha contamination may cause safety concerns.

Input waste stream characterization information needed

Waste stream:

Concentration and form of mercury contaminants (see concentration and chemical form of mercury in the characterization subelement beginning on page I-

Liquid Mercury:

Chemical form and concentration of the mercury (see concentration and chemical form of mercury in the characterization subelement beginning on page I-

Solution pH (see pH in the characterization subelement beginning on page I-19).

Presence of interfering materials, such as oils and greases (see presence and concentration of oil and grease in the characterization subelement beginning on page M-12).

Presence of suspended particles (see presence and concentration of suspended solids in the characterization subelement beginning on page M-12).

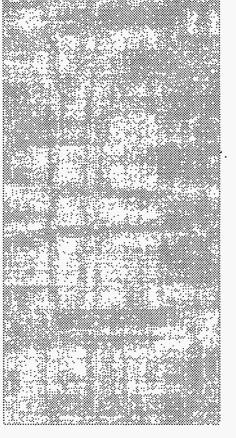
Presence of dissolved salts, copper salts can react with zinc prior to the mercury-zinc reaction (see dissolved salts in the characterization subelement beginning on page 1-19).

Oxidation process solution:

An accurate COD analysis of the waste is required to determine the reagents necessary to promote oxidation of the organics within the waste (Chemical-Oxygen Demand analysis in the characterization subelement beginning on page I-19).

Concentration of metal salts; metal salts, especially silver salts, will react with the oxidizing agents to form metal oxides which can interfere with the effectiveness of the treatment process (see metal salts in the characterization subelement beginning on page I-

The presence and concentration of cyanide and PCBs within the waste process solution will be necessary to select the appropriate oxidation treatment



Name: Y-12 Hazardous Solid Waste **Subelement:** Treatment MWIR#: 919

Matrix: Inorganic Debris / 5430 Site: Oak Ridge

Alternative/Technology

Decontamination via Polyethylene-Bead Blasting Chemical Oxidation; Chemical Reduction (contin-

chemical exidation process. If PCBs are contained within the waste solution an oxidation technique utilizing hydrogen peroxide in combination with an ultraviolet light will destroy them. After the destruction of the organics, the solution can be lowered to a pH of 4-5, and ferrous sulfate added to precipitate the metal contaminants. The slurry is then dehydrated/evaporated down to a sludge: (×60-80 wt. %) to enable the physical treatment. of the heavy metal contaminants via stabilization.

The required concentrations of the reagents will: be based on the Chemical-Oxygen Demand(COD) analysis of the solution. Temperature control and Oxidation-Reduction Potential (ORP) monitoring are standard control technologies utilized for COD analysis. The process can be monliored via the COD analysis to determine when the organics are completely destroyed. For accurate COD analysis, the hydrogen peroxide (if utilized as the oxidizer) must be neutralized prior to the performance of the analysis.

THERMAL TREATMENT ALTERNATIVE + Incineration

Controlled Air Incineration (CAI) --A stationary hearth incinerator usually designed with a two or three stage combustion process. Solid wastes are fed into a primary chamber to be burned using sub-stoichiometric air, thus destroying the volatile constituents. A high-temperature secondary combustion chamber is operated with excess air to ensure the complete destruction of volatile organic materials. Liquid waste materials are burned either in the primary or secondary chambers dependent upon their characteristics. High-temperature volatilities of certain metals (such as arsenic, mercury, selenium, cadmium, and lead) require the subsequent capture in the incinerator offgas. The incinerator offgases would be subsequently cooled in order to allow these metals (or compounds) to condense and be

Status

Science and Technology

Needs

Implementation Analysis

method (see cyanide and PCBs in the characterization subelement beginning on page I-19).

Waste streams produced

Empty containers can be disposed of as LLW (see empty containers disposal beginning on page N-1).

Sludge that requires stabilization (see sludge under secondary waste streams beginning on page 1-

Decontaminated metal debris can be disposed of as a LLW (see metal debris disposal beginning on

Mercury zinc alloy can be disposed of as LLW (but could be classified as alpha-contaminated or TRU waste) (see solidified waste forms disposal beginning on page N-1).

Accepted by industry, commercially available. The -- Batter characterization of the waste stream to deter. -- Normal implementation needs. Captured metals and DOE has operated controlled air incinerators in LLW service.

Subsystem required

Feed sorting for separation of non-combustibles Feed shredder for large solids (if applicable) Offgas treatment system, including offgas scrubber, particulate filters, and mercury sorbents Secondary combustion chamber Ash handling system Stabilization system for treatment residuals

Projected performance

Good organic destruction Post-treatment stabilization of ash residuals using cement is currently in widely used

mine the extent of volatilization of metallic waste constituents. Technology must be demonstrated to assess its applicability to this waste stream, including the operation of the required subsystems. Demonstration of ash immobilization meeting TCLP requirements is needed.

treatment residue will require treatment/stabilization prior to disposal. Controlled air incineration technology is commercially available and is currently planned for usage within the DOE system for this waste type. The required subsystems, except for the mercury collection system, are commercially available. The large number of subsystems required make this technology relatively complicated and labor intensive. However, the modular design of the incinerator and usage of a wide variety of secondary fuels lower operational costs. Separation of noncombustibles and class can be labor intensive.

Input waste stream characterization information needed

Characterization requirements may include the

Subelement: Treatment Y-12 Hazardous Solid Waste MWIR#: 919

Matrix: Inorganic Debris / 5430 Site: Oak Ridge

Alternative/Technology

Thermal Treatment (continued) entrained via a particulate removal device. CAl's operate best on combustible waste, with small amounts of non-combustibles. Separation of easily vitrified materials, such as glass, pnor to waste treatment will be required in order for this waste stream to be compatible with this technology.

Volume reduction is high for combustibles Alternate stabilization techniques possible for better long-term performance

Status

Rotary Klin

Cylindrical refractory-lined shell mounted on a slight incline; rotation of the kiln moves the noncontainenzed waste through while enhancing mixing. High-temperature volatilities of certain metals (such as arsenic, mercury, selenium, cadmium, and lead) require the subsequent capture of the metals in the incinerator offgas. The incinerator offgases would be subsequently cooled in order to allow these metals (or compounds) to condense and be entrained via a particulatel removal device. A high-temperature secondary combustion chamber is also required to complete organic destruction. Rotary klins cannot be used in a service involving routing thermal cycling.

Accepted by industry. The EPA has approved this technology as the BDAT for organics and metal-contaminated nonwastewaters.

The DOE is operating a rotary kiln in LLW service,

Post-treatment stabilization of ash residuals using cement is currently in use.

Subsystems required

Feed pretreatment shredder for large items (as applicable) Feed system Secondary combustion chamber Large offgas treatment system, including offgas scrubber, particulate filters, and mercury sorbents Ash handling system

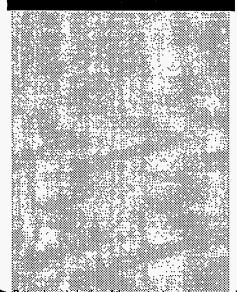
Stabilization system for treatment residuals

Projected performance

Good organic destruction

Rotating kiln seals are questionable regarding con-

Science and Technology Needs



Implementation Analysis

identification of volatile metals in the waste stream. (see volatile metals in the characterization subelement of this waste stream).

Waste streams produced

Bottom ash that requires stabilization (see bottom ash under secondary waste streams beginning on page I-14).

Flyash that requires stabilization (see flyash under secondary waste streams beginning on page 1-14).

Scrubber residue that requires stabilization (see scrubber residue under secondary waste streams beginning on page I-14).

Offgas particulate filters that requires stabilization (see offgas particulate filters under secondary waste streams beginning on page I-14).

Empty containers can be disposed of as LLW (see empty containers disposal beginning on page N-1).

Mercury offgas (see mercury offgas under secondary waste streams beginning on page I-17).

sary to determine the extent of volatilization of other waste constituents. Technology must be demonstrated to assess its applicability to this waste. stream, including the operation of the required subsystems... Demonstration of residuals immobilization meeting TCLP requirements is needed.

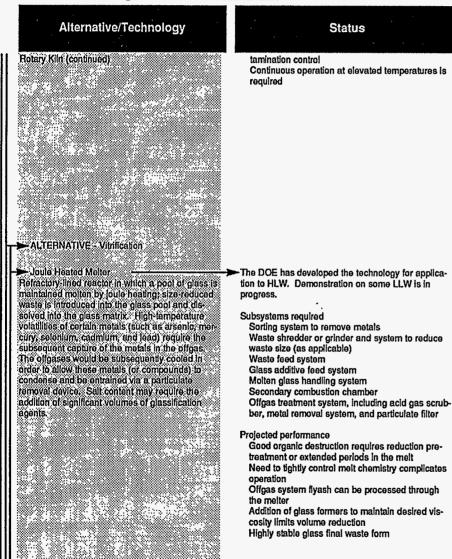
- Better characterization of the waste stream is neces. - Normal implementation needs. Captured metals and treatment residue will require treatment/stabilization prior to disposal. The rotary kiln incineration technology is commercially available and currently used within the commercial sector. The technology is currently in use within the DOE sector for non-cemented sludge wastes. The required subsystems, except for the mercury capture and collection system, are commercially available. The moving parts and large number of subsystems required make this technology relatively complicated and labor intensive. Rotary kilns cannot tolerate frequent startup/shutdown cycles, so a substantial waste feed backlog is necessary to justify implementation.

> input waste stream characterization information needed

Characterization requirements may include the identification of volatile metals within this waste stream (see volatile metals in the characterization subelement beginning on page I-19).

Subelement: Treatment Name: Y-12 Hazardous Solid Waste MWIR#: 919

Matrix: Inorganic Debris / 5430



Science and Technology

►The DOE has developed the technology for applica- - Technology must be demonstrated to assess its applicability to this waste stream, including the opera-

Site: Oak Ridge

Needs

Waste streams produced

Bottom ash that requires stabilization (see bottom ash under secondary waste streams beginning on

Implementation Analysis

Flyash that requires stabilization (see flyash under secondary waste streams beginning on page I-14).

Scrubber residue that requires stabilization (see scrubber residue under secondary waste streams beginning on page I-14).

Offgas particulate filters that require stabilization (see offgas particulate filters under secondary waste streams beginning on page 1-14).

Empty containers can be disposed of as LLW (see empty containers disposal beginning on page N-1).

Mercury offgas (see mercury offgas under secondary waste streams beginning on page 1-17).

tion of the required subsystems. Most DOE demonstrations for vibilication have been performed using nomogeneous solids or sludges.

High power requirements. This technology will be commercially available for waste applications within 2 years, and is currently in use for highly specialized applications within the DOE system. Unit operational costs and life cycle costs fall in the mid-range of this group of technologies. Large number of subsystems are required and need carefully controlled melt chemistry to make this technology relatively complicated. The variable characteristics of this waste stream may not be a good match for this technology. Medium development risk compared to the other thermal technologies.

Input waste stream characterization information

Characterization requirements may include the identification of volatile metals and vitrification qualities due to glass content of this waste stream (see volatile metals in the characterization subelement beginning on page I-19).

Waste streams produced

Stabilized class can be disposed of as a RCRA LLW (but could also be classified as a RCRA alphacontaminated LLW, or TRU waste) (see stabilized glass disposal beginning on page N-1).

Offgas particulate filters that require stabilization (see offgas particulate filters under secondary waste

Subelement: Treatment Name: Y-12 Hazardous Solid Waste MWIR#: 919

Matrix: Inorganic Debris / 5430 Site: Oak Ridge

Alternative/Technology

Joule Heated Melter (continued)

Status

Science and Technology Needs

Implementation Analysis

Empty containers can be disposed of as LLW (see empty containers disposal beginning on page N-1). Mercury offgas (see mercury offgas under secondary waste streams beginning on page I-17).

streams beginning on page I-14).

Plasma Arc Furnace

Refractory-lined chamber Into which unopened, containenzed waste is introduced and melted in the high-temperature arc of a plasma torch. Hightemperature volatilities of certain metals (such as arsenic, mercury, selenium, cadmium, and lead) require the subsequent capture of the metals in the offgas. The offgases would be subsequently cooled in order to allow these metals (or compounds) to condense and be entrained via a particulate removal device. A secondary combustion chamber for treatment of organics is commonly included. Offgas system particulate filters and fly-

ash can be processed through the furnace.

► A large-scale proof-of-principle pilot batch unit has been demonstrated. Upgrades at the pilot plant to a continuous feed system and melt removal are currently in design.

Subsystems required

Waste feed system (with size reduction as applicable to oversize containers)

Molten material handling system for slag and metal Secondary combustion chamber

Offgas treatment system, including offgas scrubber and particulate filters

Projected performance

Good organic destruction with no pretreatment requirements

Technology must be demonstrated to assess its applicability to this waste stream, including the operation of the required subsystems. Demonstration of a complete (continuous) pliot plant is scheduled for late 1994. Demonstration must include continuous feed

and melt removal as well as successful preliminary. chamber redesign for extended service.

from commercial availability, but should be proven in 3-5 years. Unit operational costs are comparable to costs associated with a joule melter. Minimal feed preparation requirements make this the simplest of the thermal treatment options. It requires no segregation of the various components of this waste stream. Highest development risk of the thermal technologies.

Very high power requirements. This technology is far

Input waste stream characterization information needed

Characterization requirements may include the identification of volatile metals in this waste stream (see volatile metals in the characterization subelement beginning on page I-19).

Waste streams produced

Slag may be disposed of as a RCRA LLW (but could also be classified as a RCRA alpha-contaminated LLW, or TRU waste) (see slag disposal beginning on page N-1).

Scrubber residue that requires stabilization (see scrubber residue under secondary waste streams beginning on page I-14).

Offgas particulate filters that require stabilization (see offgas particulate filters under secondary waste streams beginning on page I-14).

Mercury offgas (see mercury offgas under sec-

ondary waste streams beginning on page I-17).

Subelement: Treatment Name: Y-12 Hazardous Solid Waste MWIR#: 919

Inorganic Debris / 5430 Matrix:

Alternative/Technology

Thermal Description

Retorting/roasting -Low-temperature thermal unit in which mercury is vaporized for subsequent capture within the offgas. Options include desorber units (that are externally heated kilns) while other constituents are evacuated via batch waste systems. Volatilization of the other waste constituents is lower than in an incinerator, due to the lower process temperatures. The roaster offgases would be cooled to condense mercury and mercury compounds prior to capture within the offgas. control device. A secondary combustion chamber. is required for treatment of any volatile organics. The treated waste residue contains a large amount of carbon.

Physical treatment via stabilization is applicable to waste streams classified as debris per the EPA debris rule

ALTERNATIVE - Solidification/Stabilization (combustible and small metal debris)

Sulfur Polymer Cement (SPC) Sulfur Polymer Cement is composed of 95% sulfur. It melts at approximately 110 to 120°C and is particularly applicable to the immobilization combustibles and small metal pieces.

technology as the BDAT for high-mercury nonwastewaters.

Subsystems required

Feed pretreatment shredder for large items (as

Small offgas treatment system, including offgas scrubber, mercury scrubber, and particulate filters Secondary combustion system (for treatment of volatilized organics)

Solid residue handling system

Mercury treatment system such as amalgamation Stabilization system for treatment residuals

Projected performance

Good organic destruction in secondary combustion Post-treatment stabilization of incinerator ash residues using cement is currently in wide use Long-term leaching performance is suspect Volume reduction is moderate Residual fixed carbon may impede solidification

Status

Accepted by industry. The EPA has approved this Better characterization of waste stream to determine - Normal implementation needs. Captured mercury extent of valatilization of other waste constituents and whether the waste requires mixing during treatment, (to enable the exposure of all mercury-contam-Insted materials to the unit's processing temperatures). Determination of solidification requirements: for roasted waste materials and the appropriate solidification agent to be used. Technology must be demonstrated to assess its applicability to this waste: stream, including the operation of the required sub-

Site: Oak Ridge

Science and Technology

Needs

Implementation Analysis

and treatment residue will require treatment/stabilization prior to disposal. This technology and its subsystems are commercially available and are currently in use in the commercial sector but the large number of subsystems required make this technology relatively complicated and labor intensive.

Input waste stream characterization information

No specific characterization requirements for this waste stream.

Waste streams produced

Bottom ash that requires stabilization (see bottom ash under secondary waste streams beginning on page I-14).

Flyash that requires stabilization (see flyash under secondary waste streams beginning on page I-

Scrubber residue that requires stabilization (see scrubber residue under secondary waste streams beginning on page I-14).

Offgas particulate filters that require stabilization (see offgas particulate filters under secondary waste streams beginning on page I-14).

Empty containers can be disposed of as LLW (see empty containers disposal beginning on page N-1).

Mercury offgas (see mercury offgas under secondary waste streams beginning on page 1-17).

An amalgamated mercury that can be disposed of as RCRA LLW (see solidified waste forms disposal beginning on page N-1).

► SPC is being developed by the DOE for usage within - Technology must be demonstrated on this waste this type of waste streams at INEL. SPC has been demonstrated on ash. SPC is not compatible with waste streams containing high nitrates.

Subsystems required Waste feed system

Low power requirements. Few subsystems are required and needed to make use of this technology. Low development risk.

Input waste stream characterization information

The percent of sodium, potassium, sulfates,

Name: Y-12 Hazardous Solid Waste MWIR#: 919 Subelement: Treatment

Matrix: Inorganic Debris / 5430

Site: Oak Ridge

Alternative/Technology Sulfur Polymer Cement (SPC) (continued) Chemically-bonded Ceramics (CbC) Chemically-bonded ceramic waste forms are produced by mixing the wastes and inorganic oxide binders together. The mixture is then processed at ambient and near ambient temperatures, pro-moting chemical reactions that bond the Waste-and the Inorganic oxides into a dense ceramic material.

Status

Ingredients feed system
Shredder for combustibles and small metal pieces

Projected performance Expected to pass TCLP

Expected to produce a suitable final waste form for disposal

 CbC is in the early stages for development by the -DOE for usage on this type of waste streams.

Subsystems required Waste feed system

Ingredients feed system

Shredder for combustibles and small metal pieces

Projected performance

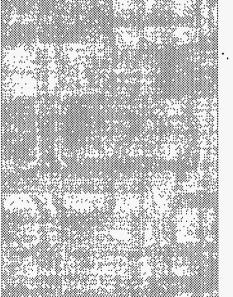
Expected to pass TCLP

Expected to produce a suitable final waste form for disposal

Science and Technology Needs

Technology must be demonstrated on this waste -

scrinicity must be deficiled at a control was in stream:



Implementation Analysis

nitrates, and chlorides (see process residue salt content in the characterization subelement beginning on page M-12).

Waste streams produced

A solidified waste form that requires RCRA LLW disposal (but could also be classified as a RCRA alpha-contaminated LLW) (see solidified waste forms disposal beginning on page N-1).

Low power requirements. Few subsystems are required and needed to make use of this technology. Low development risk.

Input waste stream characterization information needed

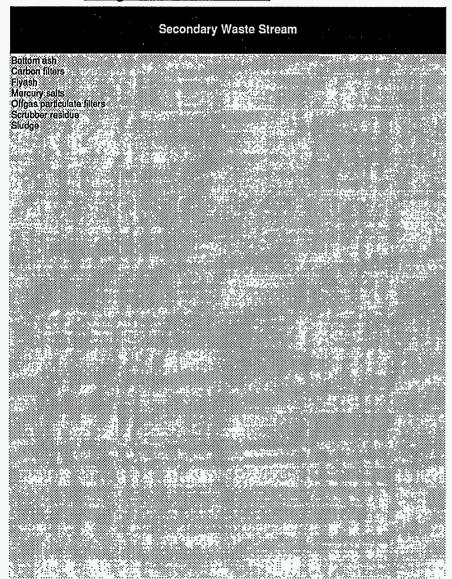
The percent of sodium, potassium, sulfates, nitrates, and chlorides (see concentration of soluble salt in the characterization subelement beginning on page M-12).

Waste streams produced

A solidified waste form that requires RCRA LLW disposal (but could also be classified as a RCRA alpha-contaminated LLW) (see solidified waste forms disposal beginning on page N-1).

Name: Y-12 Hazardous Solid Waste MWIR#: 919 Subelement: Treatment

Matrix: Inorganic Debris / 5430



Treatability Group

Radiological Constituents:

This waste may be classified as a waste containing 10-100 nCl/g of alpha-emitting radionuclides. However the waste may be classified as TRU waste, if the radionuclides in the waste feed become concentrated within the products generated by the treatment process.

Contaminants:

This waste stream is contaminated with toxic metals including cadmium, chromium, lead, and mercury. The following EPA-regulated wastes are suspected to be contained within the waste stream.

F001:Halogenated solvents used in degreasing F002:Halogenated solvents and mixtures F006:Wastewater treatment sludges from electroplating

Site: Oak Ridge

Matrix:

The waste matrix is ash, residues, filters, and mercury salts.

Name: Y-12 Hazardous Solid Waste MWIR#: 919 Subelement: Treatment

Matrix: Inorganic Debris / 5430 Site: Oak Ridge

Science and Technology Alternative/Technology Status Implementation Analysis Needs ALTERNATIVE - Solidification/Stabilization Polyethylene is being developed by the DOE for -Technology must be demonstrated on this waste :-Low power requirements. Few subsystems are Polyethylene is an inert thermoplastic material that usage on these types of waste streams. stream to ensure stabilization of toxic constituents required and needed to make use of this technology. can be processed at low temperatures. Polyethylene has been demonstrated on scrubber and the compatibility of the process with the actual Low development risk. Polyethylene binder and dry waste material are residues. constituents contained in the waste stream. The fed through separate calibrated volumetric or losstechnology needs development on the treatment of Input waste stream characterization information in-weight feeders to an extruder. The materials shredded particulate filters. Subsystems required needed are then thoroughly mixed; heated to a molten condition, and extruded into a suitable mold. On Waste feed system The percent of sodium, potassium, sulfates, Ingredients feed system nitrates, and chlorides (see concentration of soluble Shredder for particulate filters salt in the characterization subelement beginning on cooling, the mixture forms a solid monolithic waste form. No chemical reaction is required for solidifipage M-12). Projected performance Expected to pass TCLP Waste streams produced Expected to produce a suitable final waste form for A solidified waste form that requires RCRA LLW disposal (but could also be classified as a RCRA disposal alpha-contaminated LLW, or TRU waste) (see solidified waste forms disposal beginning on page N-1). Sulfur Polymer Cement (SPC) ➤ SPC is being developed by the DOE for usage within → Technology must be demonstrated on this waste... Low power requirements. Few subsystems are Sulfur Polymer Coment is composed of 95% sulthis type of waste streams at INEL. SPC has been stream to ensure stabilization of toxic constituents required and needed to make use of this technology. demonstrated on ash. SPC is not compatible with fur. It melts at approximately 110 to 120°C and is and the compatibility of the process with the actual Low development risk. constituents contained in the waste stream. The technology needs development on the treatment of shredded particulate filters. particularly applicable to the immobilization comwaste streams containing high nitrates. bustibles and small metal pieces. Input waste stream characterization information Subsystems required needed Waste feed system The percent of sodium, potassium, sulfates, Ingredients feed system nitrates, and chlorides. (see concentration of soluble Shredder for combustibles and small metal pieces. salt in the characterization subelement beginning on page M-12). Projected performance Expected to pass TCLP Waste streams produced Expected to produce a sultable final waste form for A solidified waste form that requires RCRA LLW disposal (but could also be classified as a RCRA alpha-contaminated LLW, or TRU waste) (see solidified waste forms disposal beginning on page N-1).

Subelement: Treatment Name: Y-12 Hazardous Solid Waste MWIR#: 919

Matrix: Inorganic Debris / 5430 Site: Oak Ridge

Alternative/Technology

Chemically-bonded Ceramics (CbC)
Chemically-bonded ceramic wasts forms are produced by mixing the wastes and inorganic oxide

Status

Subsystems required Waste feed system

Ingredients feed system Shredder for combustibles and small metal pieces

Projected performance Expected to pass TCLP

Expected to produce a suitable final waste form for

Science and Technology Needs

and the compatibility of the process with the actual constituents contained in the waste stream. The technology needs development on the treatment of shredded particulate filters.

Implementation Analysis

CbC is in the early stages for development by the

Technology must be demonstrated on this waste

Low power requirements. Few subsystems are

because of this technology must be demonstrated on this waste

Low power requirements. Few subsystems are

tream to ensure stabilization of toxic constituents.

Technology must be demonstrated on this waste

Low power requirements. Few subsystems are

required and needed to make use of this technology. required and needed to make use of this technology. Low development risk.

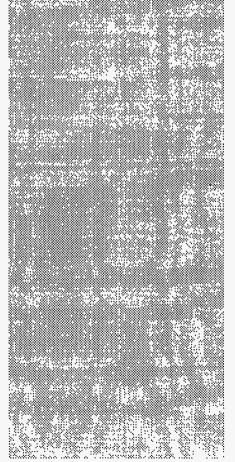
Input waste stream characterization information needed

The percent of sodium, potassium, sulfates, nitrates, and chlorides (see concentration of soluble salt in the characterization subelement beginning on page M-12).

Waste streams produced

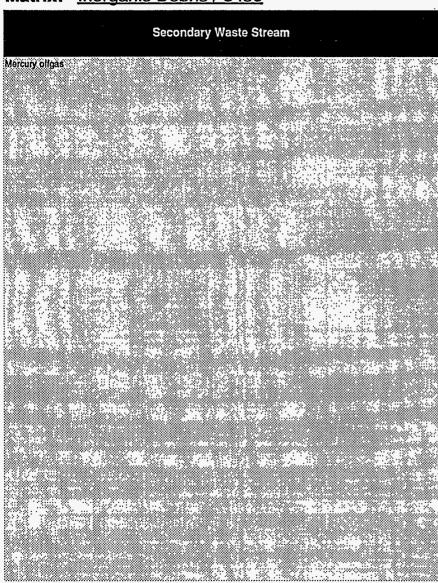
A solidified waste form that requires RCRA LLW disposal (but could also be classified as a RCRA alpha-contaminated LLW, or TRU waste) (see solidified waste forms disposal beginning on page N-1).





Name: Y-12 Hazardous Solid Waste MWIR#: 919 Subelement: Treatment

Matrix: Inorganic Debris / 5430



Treatability Group

Radilogical Constituents:

This waste may be classified as waste containing 10-100 nCl/g of alpha-emitting radionuclides. However the waste may be classified as TRU waste, if the radionuclides in the waste feed become concentrated within the products generated by the treatment process.

Contaminants:

This waste is contaminated with toxic metals including cadmium, chromium, lead, and mercury. The following EPA-regulated wastes are suspected to be contained within the waste stream.

F001:Halogenated solvents used in degreasing.

F002:Halogenated solvents and mixtures

F006:Wastewater treatment sludges from electroplating

Site: Oak Ridge

Matrix:

This waste consists of an offgas stream.

Subelement: Treatment Name: Y-12 Hazardous Solid Waste MWIR#: 919

Matrix: Inorganic Debris / 5430 Site: Oak Ridge

Alternative/Technology

ALTERNATIVE -Mercury Offgas Removal and Treatment

Sodium Hypochlorite injection; Cupric Chloride -- Accepted by Industry. -Injection: Carbon Adsorption

The capture rate of mercury in the offgas utilizing only a wet scrubbing process may not be sufficient. If the concentration of the mercury in the waste is high; additional steps to remove mercury from the offgas may be necessary. Subjecting the offgas to a wet sadium hypochlorite or chelating. agent/cupic chloride injection during the wet scrubbing process or subjecting the offgas to a carbon absorption following the wet scrubbing process will enable a greater capture-rate of mer-

Mercury-contaminated carbon filters will have to be shredded and stabilized.

Mercury-contaminated wet blowdown liquids will: require chemical treatments such as chemical oxidation (to destroy the chelating agent if it is used), chemical reduction of toxic metals, and/or amalgamation of mercury (depending on the concentration of mercury and other metals contained within: the blowdown). The slurry will then be dehydrated down to a sludge and treated via stabilization.

Sodium Sulfide injection

Sodium sulfide is a crystalline solid that dissolves in water and is sprayed into the flue gas prior to acid gas removal. Lower concentrations, approximately 2% to 4% have been found to give better performance than higher concentrations. When used with municipal waste incineration, approximately 0.1 to 1 lb. of sodium sulfide is required per ton of waste.

Status

Subsystems required

Feed pretreatment in treatment of volatile mercury System for mercury removal from carbon if encapsulation of charcoal with mercury is not acceptable

Mercury treatment system such as amalgamation or chemical oxidation

Projected performance

High mercury removal efficiency at low cost Effective at removing trace quantities of other contaminants

Simple to operate and maintain

Potential problem with self-ignition on contact with oxygen

Needs

applicability to this waste stream, including the operation of the required subsystems. The Issue of secandary treatment of the carbon/mercury residual or separation of the mercury from the carbon for final treatment and disposal needs to be resolved.

Science and Technology

Implementation Analysis

that must be demonstrated or applied to this applica-

Input waste stream characterization information needed:

Concentrations of mercury in the waste (see concentration and chemical form of mercury in the characterization subelement beginning on page 1-19).

Waste streams produced

Charcoal that is contaminated with mercury requires stabilization (see carbon filters under secondary waste streams beginning on page 1-14).

Demonstration. New technology employed by a few - Improvements needed in the atomization process to - Normal implementation needs. The technology is operational facilities

Subsystems required

Feed pretreatment in treatment of volatile mercury System for residual treatment

Projected performance

Medium to high mercury removal

Simple to operate

Potential handling and deposition problems with sodium sulfide

improve mass transfer effectiveness. Demonstration of this technology with respect to the treatment of this specific waste stream is needed. A treatment must also be developed to enable for proper disposal: of the resulting residue.

simple, but control and handling of the sodium sulfide requires care to prevent emission of sulfide fumes.

Input waste stream characterization information needed

Concentrations of mercury in the waste (see concentration and chemical form of mercury in the characterization subelement beginning on page 1-19).

Waste streams produced

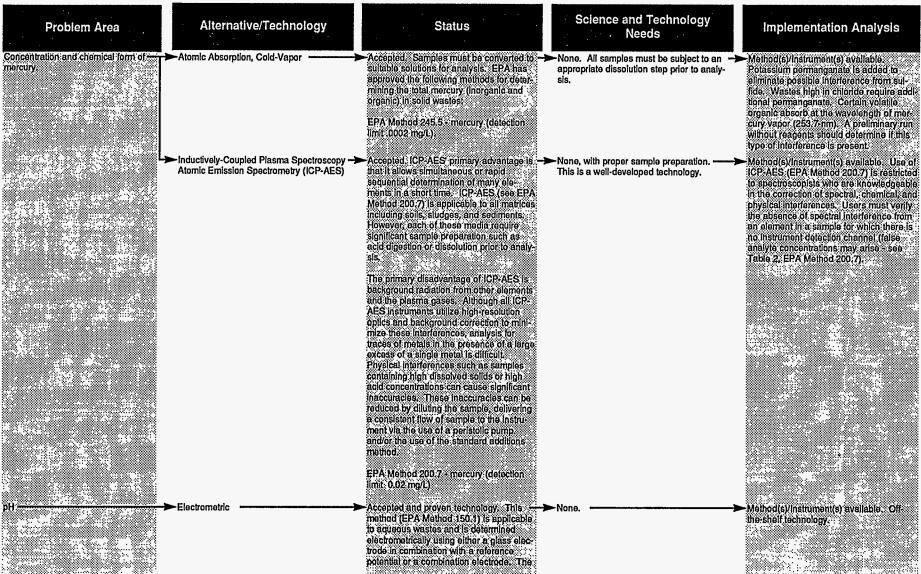
Mercury salts contaminated with radionuclides require stabilization (see mercury salts under secondary waste streams beginning on page 1-14).

Mixed Waste Integrated Program

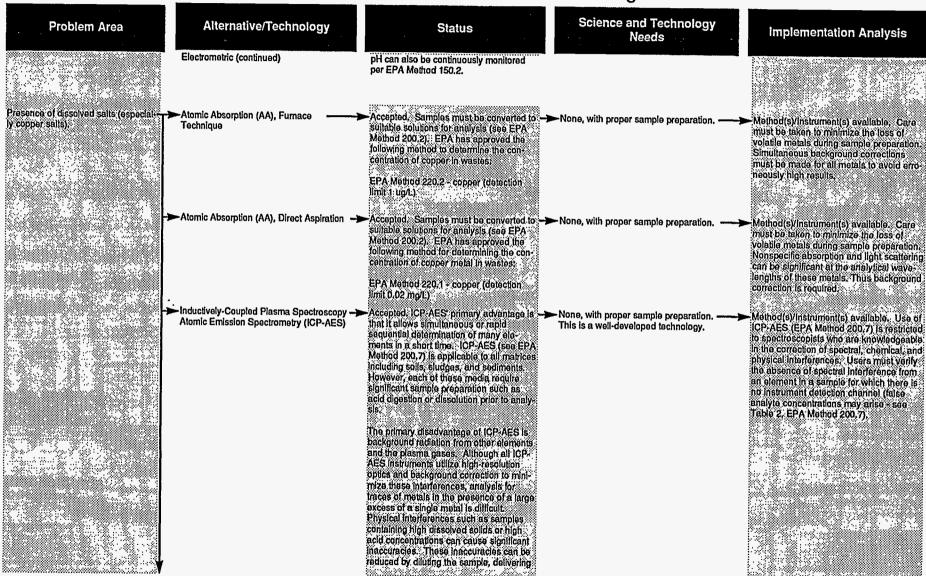
Logic Diagram

Oak Ridge Y-12 Hazardous Solid Waste Characterization Technologies

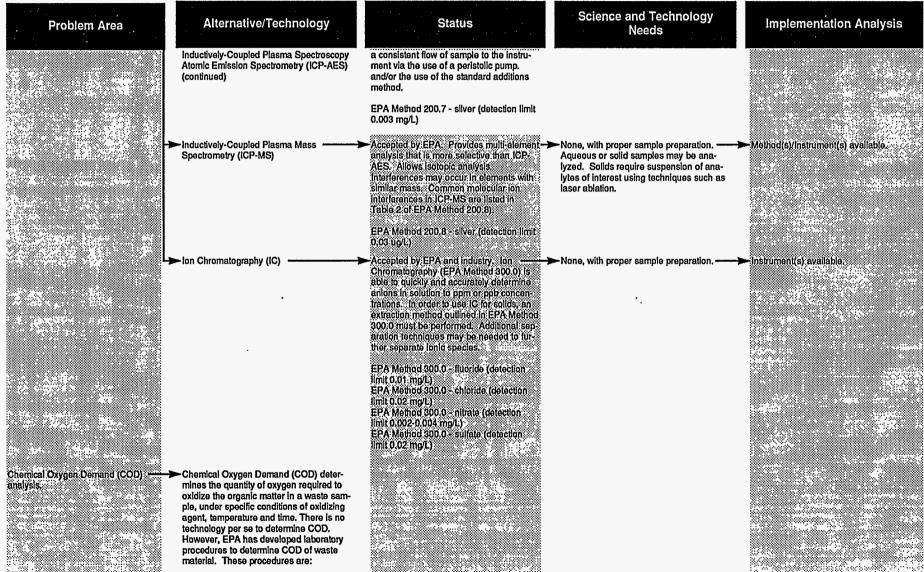
Name: Y-12 Hazardous Solid Waste MWIR#: 919 Subelement: Characterization



Name: Y-12 Hazardous Solid Waste MWIR#: 919 Subelement: Characterization



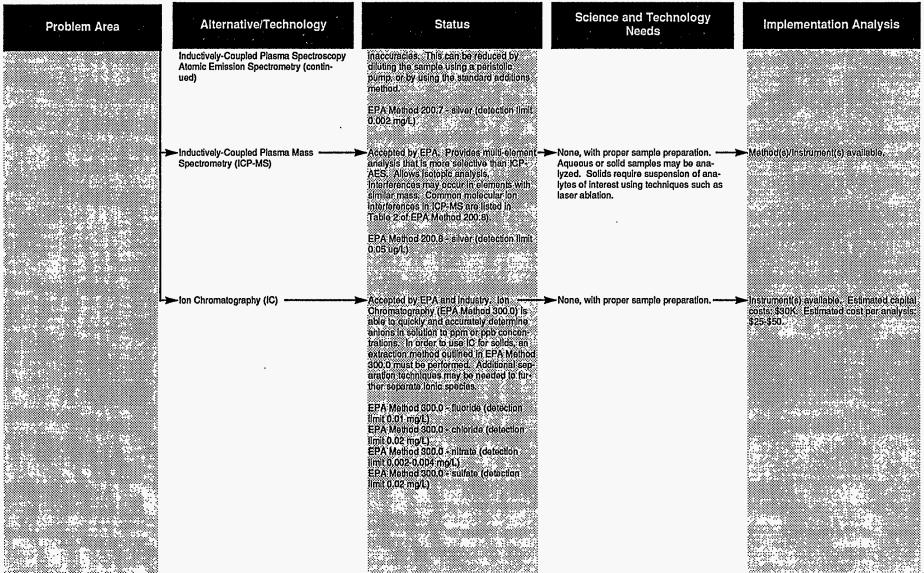
Name: Y-12 Hazardous Solid Waste MWIR#: 919 Subelement: Characterization



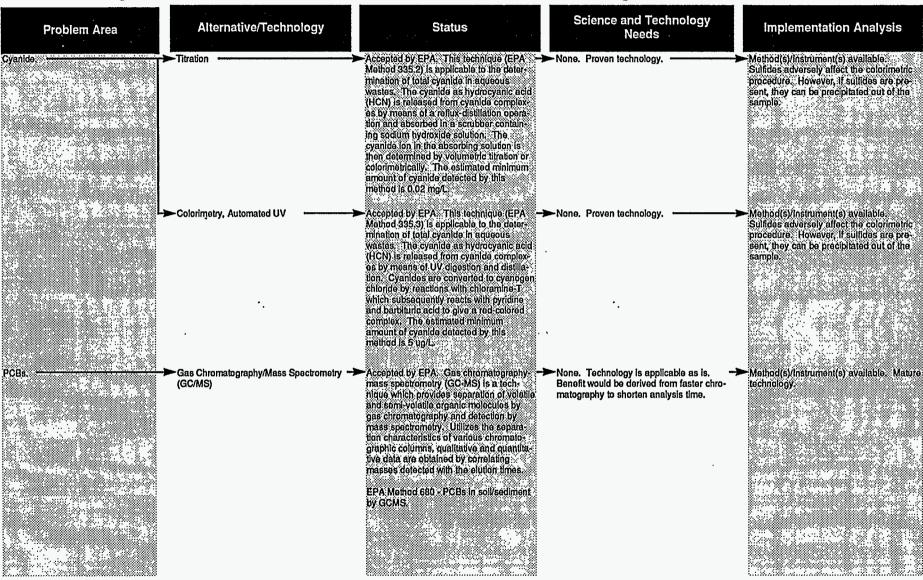
Name: Y-12 Hazardous Solid Waste MWIR#: 919 Subelement: Characterization

Problem Area	Alternative/Technology	Status	Science and Technology Needs	Implementation Analysis
Chemical Oxygen Demand (contine ued)	EPA Method 410.1 (Titrimetric, Mid-Level) EPA Method 410.2 (Titrimetric, Low-Level) EPA Method 410.3 (Titrimetric, High-Level for Saline Waters) EPA Method 410.4 (Colorimetric, Automated; Manual)			
Mātai salts (especiāliy silvēr salts);	Atomic Absorption (AA), Furnace Technique	Accepted. Samples must be converted to sultable solutions for analysis (see EPA Method 200.2). EPA has approved the following method to determine the concentration of silver in wastes: EPA Method 272.2 > silver (detection limit 0.2 ug/1)	→ None, with proper sample preparation. · · · · · · · · · · · · · · · · · · ·	Method(s)/instrument(s) available. Care must be taken to minimize the loss of volatile metals during sample preparation. Simultaneous background corrections must be made for all metals to avoid erroneously high results.
	→ Atomic Absorption (AA), Direct Aspiration →	Accepted. Samples must be converted to sultable solutions for analysis (see EPA Method 200.2). EPA has approved the following method for determining the concentration of silver metal in wastes: EPA Method 273.1 ≈ silver (detection limit 0,002 mg/L)	→ None, with proper sample preparation.	Method(s)/Instrument(s) available. Care must be taken to minimize the loss of volatile metals during sample preparation. Nonspecific absorption and light scattering can be significant at the analytical wavelengths of these metals. Thus background correction is required.
	→ Inductively-Coupled Plasma Spectroscopy → Atomic Emission Spectrometry (ICP-AES)	that it allows simultaneous or rapid sequential determination of many elements in a short time. ICP-AES (see EPA Method 200.7) is applicable to all matrices including soils, sludges, and sediments. However, each of these media require significant sample preparation such as acid digestion or dissolution prior to analysis. The primary dissolvantage of ICP-AES is background radiation from other elements and the plasma gases. Although all ICP-AES instruments utilize high-resolution optics and background correction to mini-	This is a well-developed technology.	Method(s)/Instrument(s) available. Use of ICP-AES (EPA Method 200.7) is restricted to spectroscopists who are knowledgeable in the correction of spectral, chemical, and physical interferences. Users must verify the absence of spectral interference from an element in a sample for which there is no instrument detection channel (false analyte concentrations may arise - see Table 2, EPA Method 200.7).
	•	mize these interferences, analysis for traces of metals in the presence of a large excess of a single metal is difficult. Physical interferences such as samples containing high dissolved solids or high acid concentrations can cause significant.		

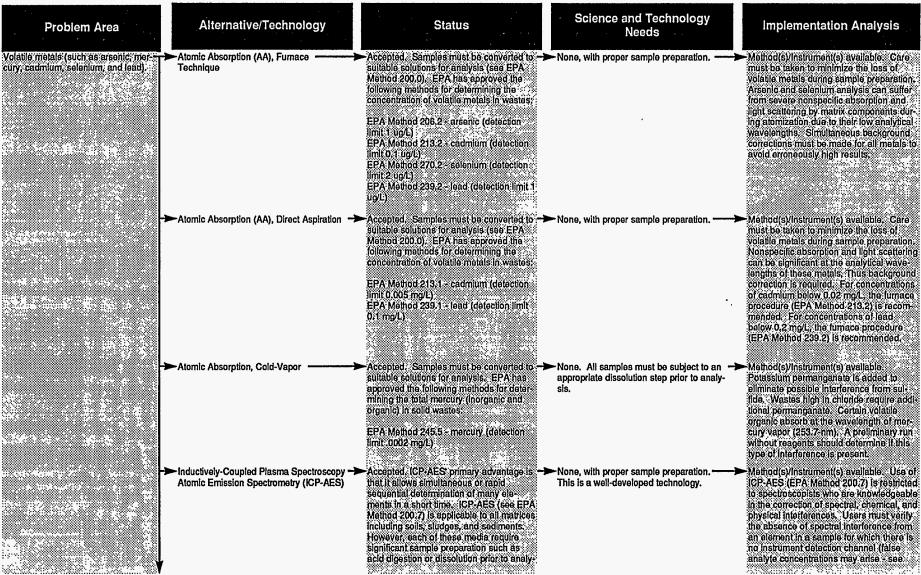
Name: Y-12 Hazardous Solid Waste MWIR#: 919 Subelement: Characterization



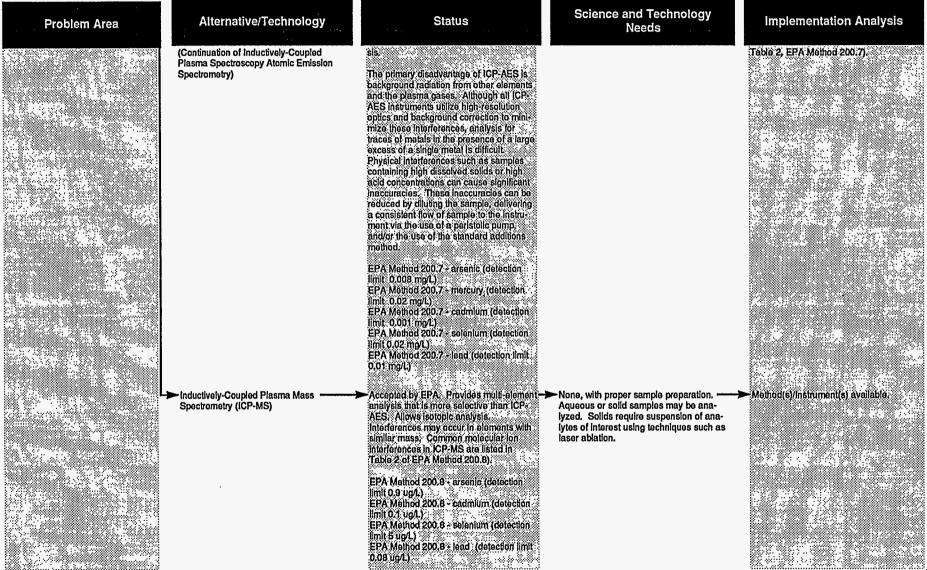
Name: Y-12 Hazardous Solid Waste MWIR#: 919 Subelement: Characterization



Name: Y-12 Hazardous Solid Waste MWIR#: 919 Subelement: Characterization



Name: Y-12 Hazardous Solid Waste MWIR#: 919 Subelement: Characterization



Mixed Waste Integrated Program

Logic Diagram

Rocky Flats
Saltcrete
Treatment Technologies

Name: Saltcrete MWIR#: 340

Matrix: Solidified Process Residues / 3150

Waste Stream

Waste Stream Description

This waste stream consists of solvents (both halogenated and non-halogenated); toxic heavy metals such as cadmium; chromium and sliver. Cyanide is above the LDA Standard

Problems Presented by Waste Stream

The lack of characterization with regard to organic and TCLP metal analysis forces some assumptions in order to select technology options. Waste materials are in the form of coment blocks contained within 2 x4x7 boxes (either poured directly into the box or loosely placed). Prior to 1990 high, waste loading (55 wt.%) yielded a waste form that wasn't always well mixed. The size and weight of these boxes presents handling concerns. This waste material was generated through the solidification of the concentrate from an evaporation process at the Liquid Waste Treatment Facility in Building 374. Thermal treatment of this waste may generate large quantities of NOx in the offgas that will require removal. The presence of solvents and cyanides in some of the waste requires a destruction technology, such as incineration. The likelihood of heavy metal contamination in excess of TCLP limits dictates the immobilization of the waste, based on the currently available analytical information:

The solidified nature of the waste via Portland coment presents the biggest problem for treatment. A portlant of the solidified waste forms will require shredding, crushing, and grinding prior, to any potential subsequent treatments; to ensure that all radionuclides and hazardous materials can be destroyed or isolated.



Subelement: Treatment

Site: Rocky Flats

Treatability Group

Radiological Constituents:

This waste is classified as contact-handled with 10 - 100 nCi/g of alpha contamination.

Contaminants:

This waste stream is contaminated with halogenated and non-halogenated solvents, toxic heavy metals such as cadmium, chromium, and silver. Cyanide is above LDR standard. The following EPA regulated wastes are suspected to be contained within the waste stream.

F001:Halogenated solvents used for degreasing

F002:Halogenated solvents and mixtures

F003:Non-halogenated solvents

F005:Non-halogenated solvents and mixtures

F006:Wastewater treatment sludges from electroplating

F007:Spent cyanide plating bath solutions

F009:Spent stripping and cleaning bath solutions from electroplating operations

Matrix:

This waste consists of solidified process residues.

Subelement: Treatment Name: Saltcrete MWIR#: 340

Matrix: Solidified Process Residues / 3150 Site: Rocky Flats

Alternative/Technology

CHEMICAL TREATMENT

Although chemical treatment could be applicable to this waste stream, it was dismissed because of the waste stream's estimated large volume, -3000 m³. The high-coment content of the waste equates to a high pH within the material. Chemical separation and treatment of this waste would require excessive dilution, leading to the creation of a large amount of secondary wastes

THERMAL TREATMENT

ALTERNATIVE - Incineration (calcination)

that would also require treatment.

Cylindrical refractory-lined shell mounted on a slight incline; rotation of the kiln moves the noncontainerized waste through while enhancing mixing. Dehydration of this waste will occur resulting in the calcination of the waste materials. A hightemperature secondary combustion chamber is also required to complete organic vapor destruc-

Potential high-temperature volatilization of cadmium may require the subsequent capture of the metal in the incinerator offgas. The incinerator affgases would be subsequently cooled in order to condense this metal (or compounds) prior to being entrained via a particulate removal device. The wooden box would be burned in the klin. Rotary. kilns cannot be used in-service via routine thermal

Status

Science and Technology Needs

Implementation Analysis

Accepted by industry. EPA has approved this technology as the BDAT for organics, as well as cyanide. DOE is currently operating a rotary kiln at the Oak Ridge K-25 site. With the likelihood that the cement waste will calcine, high dust-loading to the offgas system is likely. The offgas system will need to be designed to handle large quantities of dust.

Subsystems required

Feed pretreatment crusher

Wooden box shredder

Large offgas treatment system, including a dry offgas scrubber, and particulate filters to handle high dust loading

Ash handling system

Stabilization system for treatment residuals

Projected performance

Good organic destruction (as well as cyanides) Rotating kiln seals questionable for contamination control

Post-treatment stabilization of ash residuals using cement is currently in wide use

Long-term leaching performance is suspect Volume reduction is moderate: alternate stabiliza-

tion techniques possible for better long-term performance

Calcination of the cemented waste material may lower the overall performance by making the offgas system prone to flow obstructions

- Better characterization of the waste stream to deter - Captured metals and treatment residue will require mine the extent of volatilization of other waste constituents. Technology must be demonstrated to assess its applicability to this waste stream, including the operation of the required subsystems.

treatment/stabilization prior to disposal. The rotary kiln incineration technology is commercially available and currently used within the commercial sector. The technology is currently in use within the DOE sector for non-comented sludge wastes. The required subsystems, as described above, are commercially available. The moving parts and large number of subsystems required make this technology relatively complicated and labor intensive.

input waste stream characterization information needed

Characterization requirements may include the identification of volatile metals in the waste stream. (see volatile metals in the characterization subelement beginning on page J-10).

Waste streams produced

Bottom ash that requires stabilization (see bottom ash under secondary waste streams beginning on

*Flyash that requires stabilization (see flyash under secondary waste streams beginning on page

Scrubber residue that requires stabilization (see scrubber residue under secondary waste streams beginning on page J-7).

Offgas particulate filters that require stabilization (see offgas particulate filters under secondary waste streams beginning on page J-7).

Empty containers that can be disposed of as LLW

Name: Saltcrete MWIR#: 340

Matrix: Solidified Process Residues / 3150

Subelement: Treatment

Site: Rocky Flats

Alternative/Technology

Rotary Kiln (continued)

► ALTERNATIVE - Vitrification

Joule Heated Melter

Refractory-lined reactor in which a pool of glass is maintained moltan by joule heating; size-reduced waste is introduced into the glass pool and dissolved into the glass matrix. High-temperature volatilization of cadmium requires the subsequent capture of the metal in the incinerator offgas. The incinerator offgases would be subsequently cooled in order to allow these metals (or compounds) to condense prior to being entrained via a particulate removal device. Salt content of the waste may require the addition of significant volumes of glassification agents, such as phosphate modifiers.

Status

➤ Ready for demonstration Subsystems required

Waste shredder or grinder and system to reduce waste size

Waste feed system

Glass additive feed system

Molten glass handling system

Secondary combustion chamber

Small offgas treatment system, including acid-gas scrubber, metal-recovery system, and particulate filter

Projected performance

Good organic destruction requires reduction of the organics via pretreatment or extended residence time within the melt

Need to tightly control melt chemistry which may complicate operation

Offgas system flyash can be processed through the melter

Addition of glass formers necessary to maintain viscosity limits; otherwise excellent volume reduction

Highly stable glass final waste form

Science and Technology Needs

Technology must be demonstrated on this waste: stream, including operation of required subsystems. Implementation Analysis

(see empty containers disposal beginning on page N-

→ High power requirements. This technology will be commercially available for waste applications within 2 years, and is currently in use for highly specialized applications in the DOE system. Unit operational costs and life-cycle costs fall in the mid-range of this group of technologies. Large number of subsystems required and the need to carefully control melt chemistry, make this technology relatively complicated. Medium development risk compared to all of the other thermal technologies.

Input waste stream characterization information needed

Characterization requirements may include the identification of volatile metals (see volatile metals in the characterization subelement beginning on page J-10) and vitrification qualities due to salt content of this waste stream. Salts are expected to be comprised of potassium, calcium, and sodium. (see salt content in the characterization subelement beginning on page J-10).

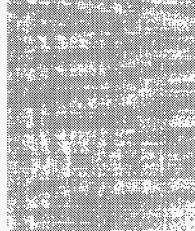
Waste streams produced

Stabilized glass can be disposed of as a RCRA LLW (but could also be classified as a RCRA alphacontaminated LLW, or TRU waste) (see stabilized glass disposal beginning on page N-1).

Offgas particulate filters that require stabilization (see offgas particulate filters under secondary waste streams beginning on page J-7).

Empty boxes can be disposed of a LLW (see empty containers disposal beginning on page N-1).

Scrubber residue that requires stabilization (see scrubber residue under secondary waste streams beginning on page J-7).



Saltcrete MWIR#: 340 Name:

Matrix: Solidified Process Residues / 3150

Subelement: Treatment

Site: Rocky Flats

Alternative/Technology

Status

Science and Technology Needs

Implementation Analysis

Plasma Arg Furnace Refractory-lined chamber into which unopened, contained waste is introduced and melted in the high-temperature arc of a plasma torch. Hightemperature volatilization of cadmium requires the subsequent capture of the metal in the incinerator offgas. The offgases would be subsequently cooled in order to allow this metal (or compounds) to condense prior to being entrained via a particu-late removal device. A secondary combustion chamber for treatment of organics is commonly included: Dual melter tests are currently indicating stabilization additives may be necessary, due to the waste stream's sulfate content.

tem is complete. A continuous pilot-plant demonstration is scheduled for late 1994.

Subsystems required

Waste feed system (with size reduction) molten material handling system Secondary combustion chamber Offcas treatment system, including offgas scrubber and particulate filters Possible need for additive feed system

Projected performance

Highest temperature range, good organic destruction with no pretreatment expected Good volume reduction Highly stable slag waste form Offgas system particulate filters and flyash can be processed through the furnace

Large scale pilot demonstration of a batch-feed sysfull scale system using a batch feed mode. Technology must be demonstrated on this wastestream, including operation of required subsystems. Treatability testing is required with the likelihood that additives will be required.

thest from being commercially available, but should be proven in 3-5 years. Unit operational costs are comparable to joule melter. The technology can process this waste stream with only size modification of the waste. Highest development risk of all of the thermal technologies.

Input waste stream characterization information needed

Characterization requirements may include the identification of volatile metals in the waste stream in this technology. (see volatile metals in the characterization subelement beginning on page J-10).

Waste streams produced

Siag may be disposed of as a RCRA LLW (but could also be classified as a RCRA alpha-contaminated LLW, or TRU waste) (see slag disposal beginning on page N-1).

Scrubber residue that requires stabilization (see scrubber residue under secondary waste streams beginning on page J-7).

Offgas particulate filters that require stabilization (see offgas particulate filters under secondary waste streams beginning on page J-7).

ALTERNATIVE - Thormal Description

- Retorting/roasting

Low-temperature thermal unit in which volatile and nonvolatile organics are volatilized or decomposed. Options include describer units that are externally heated kilns, while others are evacuated batch waste systems. Volatilization of the other waste constituents occurs less frequently than in an incinerator due to the lower processing temperatures. The use of the thermal description lechnology would eliminate the generation of NOx and thus reduce additional subsystems for offgas scrubbing. A secondary combustion chamber is required for treatment of the volatile organics.

Accepted by industry.

Subsystems required

Feed pretreatment crusher Wooden box shredder Moderate offgas treatment system, including offgas scrubber, and particulate filters Secondary combustion system (for treatment of volatilized organics) Solid residue handling system Stabilization system for treatment residuals

Projected performance

Good organic destruction in secondary combustor Post-treatment stabilization of waste residues using cement is currently in wide use Long-term leaching performance is suspect Residual salts will impede solidification

-Beller characterization of waste stream, to determine -> Normal implementation needs. Treatment residue extent of volatilization of any waste constituents, and whether waste requires mixing during processing to expose all contaminated materials to the processing: unit temperatures. Technology must be demonstrated to assess its applicability to this waste stream, includ-Ing the operation of the required subsystems. A waste-specific treatability study is necessary. Determination of solidification requirements for roasted waste materials and the identification of an appropriate solidification agent would be part of the treata-

will require treatment/stabilization prior to disposal. This technology and its subsystems are commercially available and are currently in use in the commercial sector for this waste type. The large number of subsystems required make this technology relatively complicated and labor intensive.

Input waste stream characterization information needed

No specific characterization requirements for this waste stream.

Waste streams produced

Treated solid residue requires stabilization (see treated solid residue under secondary waste streams beginning on page J-7).

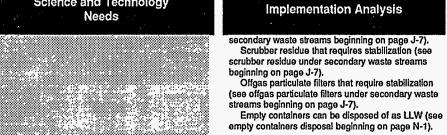
Flyash that requires stabilization (see flyash under

Name: Saltcrete MWIR#: 340 Subelement: Treatment

Matrix: Solidified Process Residues / 3150

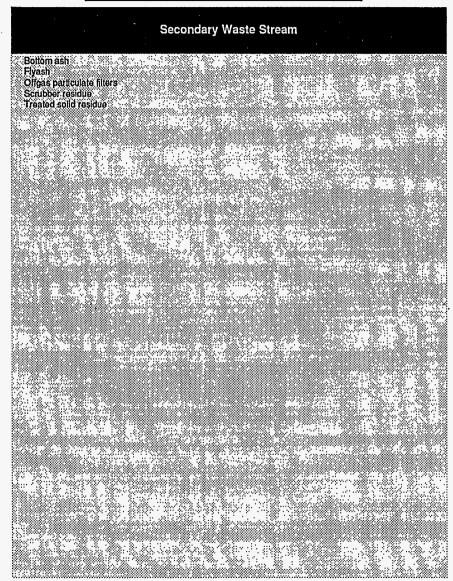
Site: Rocky Flats
Science and Technology

Alternative/Technology Status Retorting/reasting (continued)



Name: Saltcrete MWIR#: 340

Matrix: Solidified Process Residues / 3150



Subelement: Treatment

Site: Rocky Flats

Treatability Group

Radiological Constituents:

This waste may be classified as a waste containing 10-100 nCl/g of alpha-emitting radionuclides. However the waste may be classified as TRU waste, if the radionuclides in the waste feed become concentrated within the products generated by the treatment process.

Contaminants:

This waste stream is contaminated with toxic heavy metals such as cadmium, chromium, and silver. The following EPA regulated wastes are suspected to be contained within the waste stream.

F001:Halogenated solvents used for degreasing
F002:Halogenated solvents and mixtures
F003:Non-halogenated solvents
F005:Non-halogenated solvents and mixtures
F006:Wastewater treatment sludges from electroplating
F007:Spent cyanide plating bath solutions
F009:Spent stripping and cleaning bath solutions from electroplating operations

Matrix:

This waste consists of ash, solid residues, scrubber residue, and particulate filters.

Subelement: Treatment

MWIR#: 340 Name: Saltcrete Matrix: Solidified Process Residues / 3150 Site: Rocky Flats Science and Technology Alternative/Technology Status Implementation Analysis *ALTERNATIVE Solidification/Stabilization → Polyethylene Polyethylene is an inert thermoplastic material that Polyethylene is being developed by DOE for use in — Technology must be demonstrated on this waste -Low power requirements. Few subsystems are these types of waste streams. Polyethylene has stream to ensure stabilization of toxic constituents required and needed to make use of this technology. can be processed at low temperatures. been demonstrated on scrubber residues. and compatibility with the actual waste streams. The Low development risk. Polyethylene binder and dry waste material are technology needs development on the treatment of ted through separate calibrated volumetric or loss-Subsystems required shredded particulate filters. Input waste stream characterization information in-weight feeders to an extruder. The materials are then thoroughly mixed, heated to a molten Waste feed system needed ingredients feed system The concentration of soluble salt contained in the condition, and extruded into a suitable mold. On Shredder for particulate filters scrubber residues (sodium, potassium, sulfates, cooling, the mixture forms a solid monolithic waste nitrates and chlorides) (see concentration of soluble form. No chemical reaction is required for solidifi-Projected performance salt in the characterization subelement beginning on Expected to pass TCLP page M-12). Expected to produce a suitable final waste form for Waste streams produced A solidified waste form that requires RCRA LLW disposal (but could also be classified as a RCRA alpha-contaminated LLW, or TRU waste) (see solidified waste forms disposal beginning on page N-1). Sulfur Polymer Cement (SPC) — SPC is being developed by DOE for use in these — ➤ Technology must be demonstrated on this waste. — Low power requirements. Few subsystems are Sulfur Polymer Cement is composed of 95% sultypes of waste streams. SPC has been demonstratrequired and needed to make use of this technology. stream to ensure stabilization of toxic constituents ed on ash. SPC is not compatible with high nitrates. and compatibility with the actual waste streams. The Low development risk. fur. If melts at approximately 110 to 120°C and is particularly applicable to the immobilization of toxic metals and treatment of incinerator ash. technology needs development on the treatment of Subsystems required shredded particulate filters. Input waste stream characterization information Waste feed system needed Ingredients feed system The concentration of soluble salt contained in the Shredder for particulate filters scrubber residues (sodium, potassium, sulfates, nitrates, and chlorides) (see concentration of soluble Projected performance salt in the characterization subelement beginning on Expected to pass TCLP page M-12). Expected to produce a suitable final waste form for Waste streams produced A solidified waste form that requires RCRA LLW disposal (but could also be classified as a RCRA alpha-contaminated LLW, or TRU waste) (see solidified waste forms disposal beginning on page N-1). Chemically-bonded Ceramics (CbC) - -➤ CbC is in early stages for development by DOE for — Technology must be demonstrated on this waste — Low power requirements. Few subsystems are Chemically-bonded ceramic waste forms are prostream to ensure stabilization of toxic constituents use in these types of waste streams. required and needed to make use of this technology. duced by mixing the wastes and inorganic oxide and compatibility with the actual waste streams. The Low development risk.

Name: Saltcrete MWIR#: 340

Matrix: Solidified Process Residues / 3150

Alternative/Technology

binders together. The mixture is then processed at ambient and near ambient temperatures, pro-moting chemical reactions that bond the waste, and the inorganic oxides into a dense ceramic material.



Status

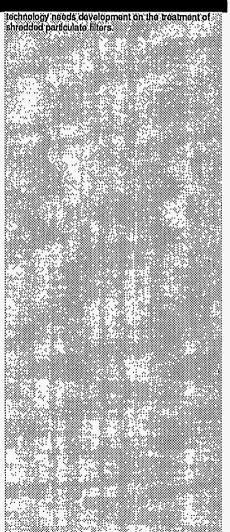
Subsystems required
Waste feed system
Ingredients feed system
Shredder for particulate filters

Projected performance
Expected to pass TCLP
Expected to produce a suitable final waste form for disposal

Subelement: Treatment

Site: Rocky Flats

Science and Technology Needs



Implementation Analysis

Input waste stream characterization information needed

The concentration of soluble salt contained in the scrubber residues (sodium, potassium, sulfates, nitrates, and chlorides) (see concentration of soluble salt in the characterization subelement beginning on page M-12).

Waste streams produced

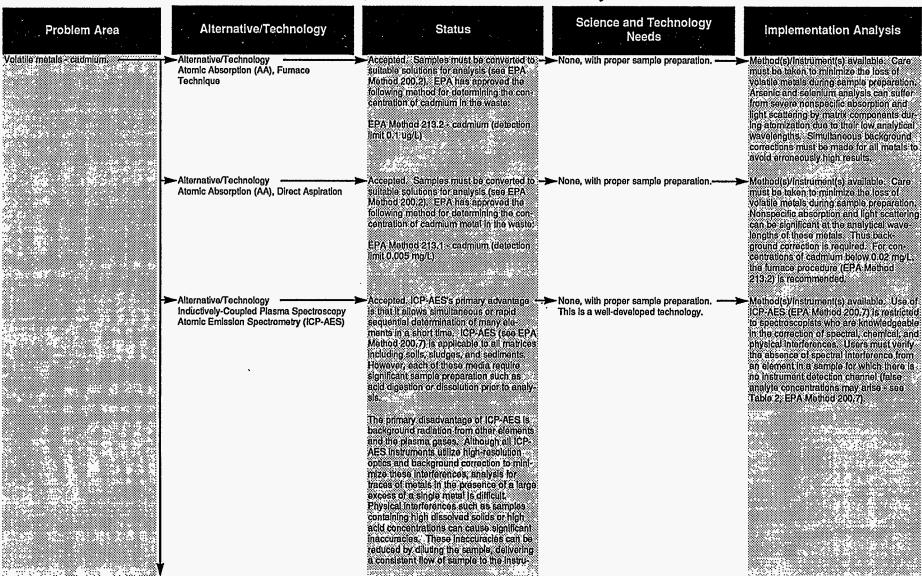
A solidified waste form that requires RCRA LLW disposal (but could also be classified as a RCRA alpha-contaminated LLW, or TRU waste) (see solidified waste forms disposal beginning on page N-1).

Mixed Waste Integrated Program

Logic Diagram

Rocky Flats
Saltcrete
Characterization Technologies

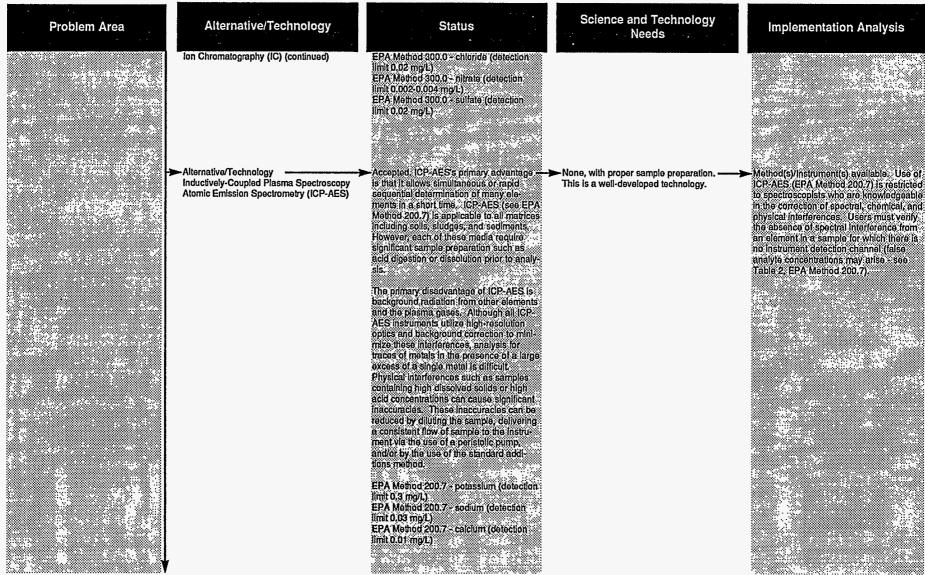
Name: Saltcrete MWIR#: 340 Subelement: Characterization



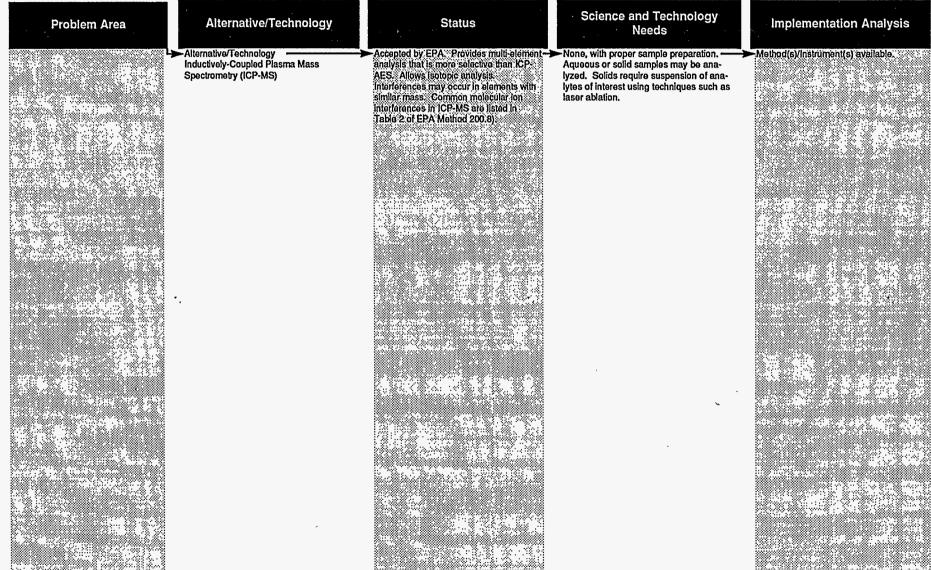
Name: Saltcrete MWIR#: 340 Subelement: Characterization

			ricorty riato	
Problem Area	Alternative/Technology Inductively-Coupled Plasma Spectroscopy Atomic Emission Spectrometry (contin-	Status ment via the use of a peristolic pump, and/or by the use of the standard addl-	Science and Technology Needs	Implementation Analysis
	ued)	tions method. EPA Method 200,7 - cadmium (detection limit 0.001 mg/L)		
	Alternative/Technology Inductively-Coupled Plasma Mass Spectrometry (ICP-MS)	analysis that is more selective than ICP. Allows isotopic analysis. Interferences may occur in elements with similar mass. Common molecular ion interferences in ICP-MS are listed in Table 2 of EPA Method 200,8).	None, with proper sample preparation.————————————————————————————————————	—Maihod(s)/Instrument(s) available.
Salt content (salts are primarily polass - slum, calcium, and sodium)	Alternative/Technology Atomic Absorption, Direct Aspiration	EPA Method 200.8 cadmium (detection ilmit 0.1 ug/L) Accepted. Samples must be converted to suitable solutions for analysis (see EPA Method 200.2). EPA has approved the following methods for determining the concentration of potassium and sodium in wastes.	► None, with proper sample preparation	Method(s)/Instrument(s) available. Care must be taken to minimize the loss of volatile metals during sample preparation. Nonspecific absorption and light scattering can be significant at the analytical wave lengths of these metals. Thus back:
		EPA Method 258.1 + potassium (detection limit 0.01 mg/L) EPA Method 273.1 + sodium (detection limit 0.002 mg/L) EPA Method 215.1 + calcium (detection limit 0.01 mg/L)		ground carrection la required.
	→ Alternative/Technology Ion Chromatography (IC)	Accepted by EPA and industry. Ion	►None, with proper sample preparation.	►Instrument(s) available:
		aration lechniques may be needed to fur- ther separate lonic species. EPA Method 300.0 > Ilucride (detection limit 0.01 mg/L)		

Name: Saltcrete MWIR#: 340 Subelement: Characterization



Name: Saltcrete MWIR#: 340 Subelement: Characterization

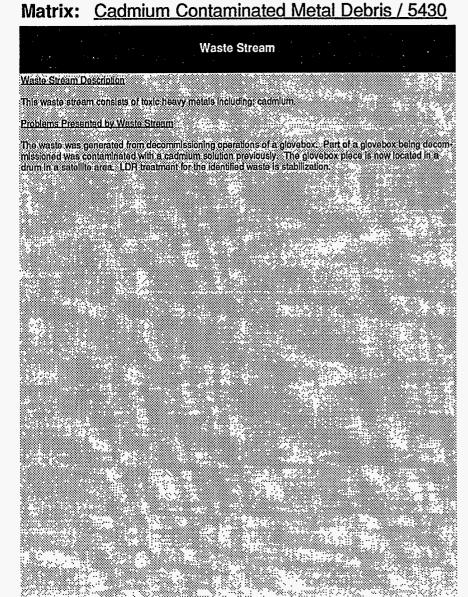


Mixed Waste Integrated Program

Logic Diagram

Savannah River
Cadmium Contaminated Glovebox
Treatment Technologies

Name: Cadmium Contaminated Glovebox MWIR#: 2703 Subelement: Treatment
Matrix: Cadmium Contaminated Metal Debris / 5430 Site: Savannah River



Treatability Group

Radiological Constituents:

This waste is classified as contact-handled with 10 - 100 nCi/g of alpha contamination.

Contaminante

This waste stream is contaminated with the toxic heavy metal cadmium.

D006: Cadmium

Matrix

This waste consists of cadmium contaminated metal debris.

Name: Cadmium Contaminated Glovebox MWIR#: 2703 Subelement: Treatment Matrix: Cadmium Contaminated Metal Debris / 5430 Site: Savannah River

Science and Technology Alternative/Technology Status Implementation Analysis Needs THERMAL TREATMENT Due to the volatile characteristic of cadmium, thermal treatment is not deemed an appropriate treatment technique. CHEMICAL TREATMENT ALTERNATIVE: Decontamination Acidic rinse ► Decontamination via acidic rinse is a standard tech- - None required. Simple treatment system makes this waste easy to Decontamination of the glove box with a dilute acid rinse will transfer the cadmium contamination nology used by industry to remove heavy metals decontaminate. Although, the presence of acid in an from metal substrates. alpha-contaminated environment may present safety from the glovebox to the acidic solution. The problems. acidic solution can then be neutralized and dehy-drated down to the consistency of a sludge. Subsystems required Acid rinse system Input Waste Stream Characterization Information Neutralization system Needed Dehydration system None required. Projected performance Waste Streams Produced Expected to produce a product that can be stabi-Cadmium oxide, sulfate, chloride, or hydroxide lized into a final waste form for disposal solid/sludge residue (see sludge under secondary waste streams beginning on page K-5). Decontaminated glovebox part or parts can be disposed of as LLW (see metal debris disposal begin-PHYSICAL TREATMENT ning on page N-1). ALTERNATIVE: Decontamination CO2 Blasling Technology has been previously demonstrated on -----None regulred. -Medium power requirements. Few subsystems are CO2 Blasting is the blasting away of contaminants waste streams of similar types. Airline manufacturers required and needed to make use of this technology. (metal and/or organic) from the surfaces of metal such as McDonnell Douglas use this method to strip Low development risk. High-pressure within an and plastic debris. Frozen CO2 is pelletized and paint from airplanes, while firms such as alpha environment may present a safety problem. sprayed via high-pressure at the surface of the Westinghouse use this method to decontaminate debris. The CO2 evaporates and the contamiradioactive equipment. Input waste stream characterization information nants are discharged onto the floor of the room. needed The contaminants can then be swept up off of the Subsystems required None required. floor and treated via stabilization and disposed of CO2 pelletizer No secondary wastes are produced. Internal dryer Waste streams produced Air compressor A particulate waste form that requires solidification Liquid CO2 tank (see particulate under secondary waste streams beginning on page K-5). Projected performance Decontaminated glovebox part or parts can be dis-Expected to produce a product that can be stablposed of as LLW (see metal debris disposal beginlized into a final waste form for disposal ning on page N-1).

Name: Cadmium Contaminated Glovebox MWIR#: 2703 Subelement: Treatment

Matrix: Cadmium Contaminated Metal Debris / 5430

Alternative/Technology

Polyethylene Bead Blasting
Polyethylene Bead Blasting is the blasting away of contaminants (metal and/or organic) from the surfaces of metal and plastic debris. Polyethylene material is pelletzed and sprayed via high-pressure upon the surface of the debris. The impact of the pellets on the debris causes the removal of the contamination from the surface of the debris. The contamination may be attached to the pellets or may lay as particulate upon the floor. The contaminants can then be swept up off of the floor and treated via polyethylene encepsulation and disposed of.

Status

Technology has been previously demonstrated on None required.

waste streams of similar types. This method has been successfully used in the past at Hill Air Force Base to remove contamination from metal parts.

Subsystems required

Polyethylene pelletizer Air compressor

See also polyethylene encapsulation stabilization treatment requirements

Projected performance

Expected to produce a product that can be stabilized into a final waste form for disposal

Science and Technology Needs

Site: Savannah River

e required

Implementation Analysis

Medium-power requirements. Few subsystems are required and needed to make use of this technology. Low development risk. High-pressure within an alpha-contaminated environment may present a safety problem.

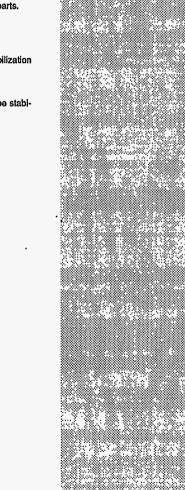
Input waste stream characterization information needed

None required.

Waste streams produced

A particulate waste form that requires solidification (see particulate under secondary waste streams beginning on page K-5).

Decontaminated glovebox part or parts can be disposed of as LLW (see metal debris disposal beginning on page N-1).

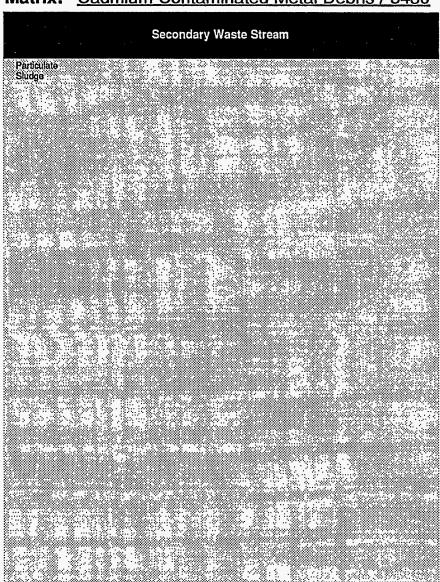






Name: Cadmium Contaminated Glovebox MWIR#: 2703 Subelement: Treatment Site: Savannah River

Matrix: Cadmium Contaminated Metal Debris / 5430



Treatability Group

Radiological Constituents:

This waste may be classified as waste containing 10-100 nCl/g of alpha-emitting radionuclides. However the waste may be classified as TRU waste, if the radionuclides in the waste feed become concentrated within the products generated by the treatment process.

Contaminants:

This waste stream is contaminated with the toxic heavy metal cadmium.

This waste consists of sludge residues and particulate matter.

Name: Cadmium Contaminated Glovebox MWIR#: 2703 Subelement: Treatment

Matrix: Cadmium Contaminated Metal Debris / 5430 Site: Savannah River

Alternative/Technology	Status	Science and Technology Needs	Implementation Analysis
Polyethylene Polyethylene is an inert thermoplastic material that can be processed at low temperatures. Polyethylene binder and dry waste material size fed through separate calibrated volumetric or loss- in-weight feeders to an extruder. The materials are then thoroughly mixed, healed to a molten condition, and extruded into a suitable mold. On cooling, the mixture forms a solid monolithic waste form: No chemical reaction is required for solidifi- cation.	The polyethylene encapsulation process is being developed by the DOE for usage on these types of waste streams. Subsystems required Waste feed system Ingredients feed system Projected performance Expected to pass TCLP Expected to produce a suitable final waste form for disposal	Technology must be demonstrated on this waste stream to ensure stabilization of toxic constituents and compatibility with the actual constituents contained in the waste stream.	Low power requirements. Few subsystems are required and needed to make use of this technology. Low development risk. Input waste stream characterization information needed Amounts of cadmium, sulfates, chlorides, and hydroxides (see amounts of cadmium, sulfates, chlorides, and hydroxides in the characterization subelement beginning on page K-8). Waste streams produced A solidified waste form that requires RCRA LLW disposal (but could also be classified as a RCRA alpha-contaminated LLW waste) (see solidified waste forms disposal beginning on page N-1).
Sulfur Polymer Cement is composed of 95% sulfur. It melts at approximately 110 to 120°C and is particularly applicable to the immobilization of toxic metals and treatment of incinerator ash.	SPC is being developed by the DOE for usage within — these types of waste streams. Subsystems required Waste feed system Ingredients feed system Projected performance Expected to pass TCLP Expected to produce a suitable final waste form for disposal	stream to ensure stabilization of toxic constituents and compatibility with the actual constituents con- tained in the waste stream:	Low power requirements. Few subsystems are required and needed to make use of this technology. Low development risk. Input waste stream characterization information needed Amounts of cadmium, sulfates, chlorides, and hydroxides (see amounts of cadmium, sulfates, chlorides, and hydroxides in the characterization subelement beginning on page K-8). Waste streams produced A solidified waste form that requires RCRA LLW disposal (but could also be classified as a RCRA alpha-contaminated LLW waste) (see solidified waste forms disposal beginning on page N-1).
Chemically-bonded Ceramics (CbC). Chemically-bonded ceramic wasta forms are produced by mixing the wastes and inorganic oxide binders together. The mixture is then processed at ambient and near ambient temperatures, promoting chemical reactions that bond the waste and the inorganic oxides into a dense ceramic material;	The CbC process is in the early stages of development by the DOE usage with these types of waste streams. Subsystems required Waste feed system Ingredients feed system Projected performance Expected to pass TCLP	Technology must be demonstrated on this waste stream to ensure stabilization of loxic constituents and compatibility with the actual constituents of the waste stream.	Low power requirements. Few subsystems are required and needed to make use of this technology. Low development risk. Input waste stream characterization information needed Amounts of cadmium, sulfates, chlorides, and hydroxides (see amounts of cadmium, sulfates, chlorides, and hydroxides in the characterization subelement beginning on page K-8).

Name: Cadmium Contaminated Glovebox MWIR#: 2703 Subelement: Treatment

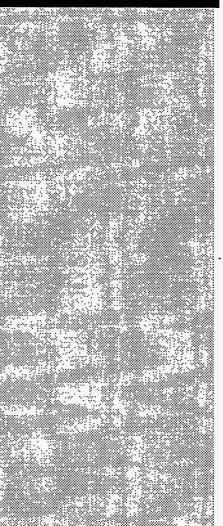
Matrix: Cadmium Contaminated Metal Debris / 5430 Site: Savannah River

Alternative/Technology Chemical-bonded Ceramics (continued)

Status

Expected to produce a suitable final waste form for disposal

Science and Technology Needs



Implementation Analysis

Waste streams produced

A solidified waste form that requires RCRA LLW disposal (but could also be classified as a RCRA alpha-contaminated LLW waste) (see solidified waste forms disposal beginning on page N-1).

Mixed Waste Integrated Program

Logic Diagram

Savannah River
Cadmium Contaminated Glovebox
Characterization Technologies

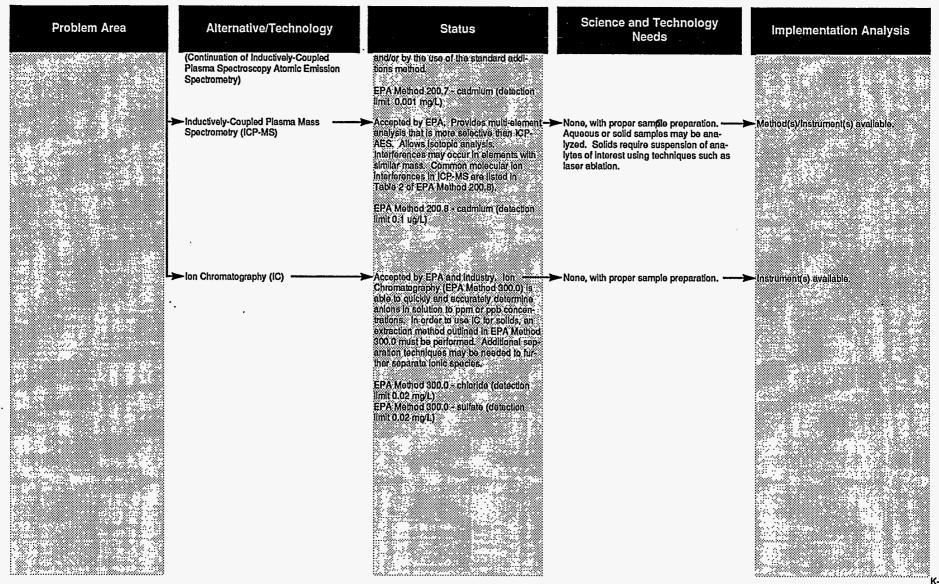
Subelement: Characterization Cadmium Contaminated Glovebox MWIR#: 2703 Name:

Site: Savannah River Cadmium Contaminated Metal Debris / 5430 Matrix:

Method(s)/instrument(s) available. Care must be taken to minimize the loss of olatile metals during sample preparation an be significant at the analytical wave nalyte concentrations may arise + see able 2, EPA Method 200:7), o instrument detection channel (false Implementation Analysis ■ None, with proper sample preparation. This is a well-developed technology. Science and Technology None, with proper sample preparation ccepted. Samples must be converted to - None, with proper sample preparation. Accepted ICP-AES primary advantage is that it allows simultaneous or rapid sequential determination of many ellements in a short time. ICP-AES (see EPA Method 200-7) is applicable to all matices including soils; studges and sediments However, each of these media require significant sample proparation such as acid digestion or dissolution prior to analy races of metals in the presence of a large excess of a single metal is difficult. reduced by diluting the sample, delivering and the plasma gases. Although all ICP. naccuracies. These inaccuracies can be EPA Method 213,1 - cadmium (detection ilmit 0.005 mg/L) The primary disadvantage of ICP AES is background radiation from other elements consistent flow of sample to the instru-EPA Method 213.2 + cadmlum (detection acid concentrations can cause significan sultable solutions for analysis (see EPA Kethod 200.2). EPA has approved the ollowing method to determine the con-Physical interferences such as samples centration of cadmium metal in wastes; containing high dissolved solids or high ment via the use of a peristalle pump. mize thase interferences, analysis for Status Imit 0.1 ug/L) Atomic Absorption (AA), Direct Aspiration ► Inductively-Coupled Plasma Spectroscopy Atomic Emission Spectrometry (ICP-AES) Alternative/Technology Atomic Absorption (AA), Furnace Technique Problem Area Amounts of cadmium, suita ides, and hydroxides.

Name: Cadmium Contaminated Glovebox MWIR#: 2703 Subelement: Characterization

Matrix: Cadmium Contaminated Metal Debris / 5430 Site: Savannah River



Mixed Waste Integrated Program

Logic Diagram

Savannah River SRS Thirds Waste Treatment Technologies

Name: SRS Thirds Waste MWIR#: 919

Matrix: Heterogeneous Debris / 5400

Waste Stream

Waste Stream Description

This waste stream contains heavy metals; including beryllium and mercury, and organics. It is ignitable and reactive.

Problems Presented by Waste Stream

Waste generated primarily through activities in the course of plutonium production. Includes small amounts of TRU waste from on-site laboratories. These wastes are primarily solids consisting of bootles, lab coats, floor, sweepings, and regs.

LDR: treatment requirements for the waste codes listed include incineration, vitrification; chemical reduction, acid leaching, neutralization, and chemical oxidation. All of these treatment technologies are to be followed by stabilization:

The alternative LDR treatment standard for debris is treatment prior to land disposal using any of the following technologies: extraction (physical; chemical, or thermal), destruction (biological; chemical, or thermal), macro/microencapsulation or sealing.

The waste is a mixture of a variety of different materials of different sizes and shapes. Contamination is assumed to have penetrated into the matrices of the combustible (including wood) wastes: Several of the volatile or unstable organics identified, such as methyl isobutyl ketone and hydrazine, may have volatilized or decomposed and may no longer be part of this waste stream.

It is assumed that the mercury referred by the EPA Code D009 refers to the contaminated combustible waste only, and that liquid mercury is not included in this waste stream.

Treatability Group

Radilogical Constituents:

This waste is classified as contact-handled with 10-100 nCl/g of alpha contamination.

Contaminante

This waste is contaminated with heavy metals, including beryllium and mercury, and organics. The following EPA regulated wastes are suspected to be contained within the waste stream.

D001: Unlisted hazardous waste characteristic of ignitability

Subelement: Treatment

Site: Savannah River

D003: Unlisted hazardous waste characteristic of reactivity

D004: Arsenic

D006: Cadmium

D007: Chromium

D008: Lead

D009: Mercury D011: Silver

D019: Carbon tetrachloride

D022: Chloroform

D023: Ortho-cresol

D024: Meta-cresol

D025: Para-cresol

D026: Cresol

P012: Arsenic oxide

P015: Beryllium

P048: 2,4-Dinitrophenol

P113: Thallium oxide

P120: Vanadium oxide

U002: 2-Propanone

U032: Chromic acid, H2Cro4 calcium salt

U052: Cresylic acid

U080: Methylene chloride

U133: Hydrazine

U134: Hydrogen fluoride

U144: Lead acetate

U151: Mercury

U154: Methyl alcohol

U161: Methyl isobutyl ketone

U209: 1,1,1, Tetrachloroethane

U211: Carbon tetrachloride

U220: Toluene

U226: 1,1,1, Trichloroethane

U239: Xylene mixed

Matrix:

This waste consists of heterogeneous debris.

Name: SRS Thirds Waste MWIR#: 919 Subelement: Treatment Matrix: Heterogeneous Debris / 5400 Site: Savannah River

Alternative/Technology

- CHEMICAL TREATMENT

CO2 Blasting: Chemical Oxidation: Chemical Reduction.

(Note: Although only a few chemical oxidation reagents have been identified here, various reagents that could be utilized to perform chamical oxidation include ozone, permanganate, hydrogen peroxide, hypochlorite, and sulfur dioxide. Various oxidation techniques utilized could include wet air oxidation, electrolytic oxidation, or ozonation via an ultraviolet light.)

Chemical deactivation is applicable to all portions of this waste stream. Other chemical treatment technologies are applicable only to the large metals portion of this waste stream.

Chemical deactivation to eliminate the reactivity of the waste will be performed via a controlled reaction, utilizing water as the reagent. The process should be conducted in an atmosphere that will mitigate occurrences of gas generation and/or explosions. Deactivated wastes will be sorted into categories of compustibles and metals.

Combustibles and small metal pieces will be treated via incineration (see thermal treatment or phys-Ical treatment).

Large Metals will be treated via decontamination, chemical exidation, chemical reduction, and dehydration/evaporation. Chemical immobilization of contaminants adhering to the surfaces of waste metals can be accomplished via CO2. Blasting, CO2. Blasting is the removal of contamination via a pressurized spray of frozen carbon dioxide pellets. The frozen CO2 evaporates and the contamination was a contamination of contamination via the contamination of the contamination via the contamination of the contamination via th inants will be swept up off of the floor and treated via a caustic (hydrogen peroxide or permanganate) chemical oxidation process

After the destruction of the organics, the solution can be lowered to a pH of 4-5, and ferrous sulfate added to precipitate the metal contaminants. The slurry is then dehydrated/evaporated down to a sludge to enable the physical treatment of the heavy metal conteminants via stabilization.

Status

Chemical Deactivation: Decontamination via Chemical deactivation; decontamination via CO2 Blasting; chemical oxidation; chemical reduction; and dehydration/evaporation technologies have been previously used in industry on similar waste types.

Subsystems required

Deactivation area/equipment Manual sorting system CO2 blasting system Chemical oxidation system Acid addition system Chemical reduction system Dehydration/evaporation system

Projected performance

Expected to produce a product that can be stabllized into a final waste form for disposal

Science and Technology Needs

treatment of these specific contaminants within this specific waste matrix is needed.

Implementation Analysis

Demonstration of this technology with respect to the . - Many subsystems make the treatment of this waste stream labor intensive. A pressurized spray within the presence of alpha contamination may cause safety concerns.

> Input waste stream characterization information needed

Concentration of organic contaminants (see organic contaminants in the characterization subelement beginning on page L-15).

Oxidation process solution

An accurate COD analysis of the waste is required to determine the reagents necessary to promote oxidation of the organics within the waste (see Chemical-Oxygen Demand analysis in the characterization subelement beginning on page L-15).

Concentration of metal salts. Metal salts, especially silver salts, will react with the oxidizing agents to form metal oxides which can interfere with the effectiveness of the treatment process (see concentration of metal salts in the characterization subelement beginning on page L-15).

pH of the waste (see pH in the characterization

subelement beginning on page L-15).

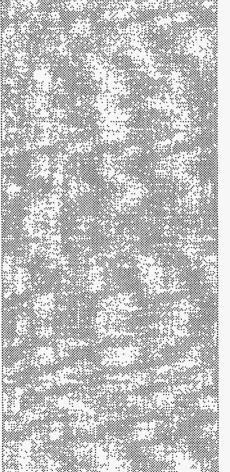
The presence and concentration of organics within the waste will be necessary to select the appropriate chemical oxidation treatment method (see organic contaminants in the characterization subelement beginning on page L-15).

Waste streams produced

Empty containers can be disposed of as LLW (see empty containers disposal beginning on page N-1),

Sludge that requires stabilization (see sludge under secondary waste streams beginning on page

Decontaminated metal debris can be disposed of as a LLW (see metal debris disposal beginning on page N-1).



Name: SRS Thirds Waste MWIR#: 919 Subelement: Treatment

Status

Matrix: Heterogeneous Debris / 5400

Science and Technology Needs

Site: Savannah River

Implementation Analysis

Alternative/Technology

The required concentrations of the reagents will be based on the Chemical-Oxygen Demand (COD) analysis of the solution. Temperature con-trol and Oxidation Reduction Potential (ORP) monitoring are standard control technologies utlized for COD analysis. The process can be mon-tored via the COD analysis to determine when the organics are completely destroyed. For accurate COD analysis, the hydrogen peroxide (if utilized as the oxidizer) must be neutralized prior to the performance of the analysis.

Polyethylene-Bead Blasting; Chemical Oxidation; Chemical Reduction,

(Note: Although only a few chemical oxidation reagents have been identified here; various reagents that could be utilized to perform chemical oxidation include ozone; permanganate, hydrogen peroxide, hypochlorie, and sulfur dioxide. Various oxidation techniques utilized could include wet air oxidation, electrolytic oxidation, or ozonation via an ultraviolet light.)

Chemical deactivation is applicable to all portions of this waste stream. Other chemical treatment technologies are applicable only to the large metals portion of this waste stream.

Chemical deactivation to eliminate the reactivity of the waste will be performed via a controlled reaction, utilizing water as the reagent. The process should be conducted in an atmosphere: that will mitigate occurrences of gas generation and/or explosions. Deactivated wastes will be sorted into categories of combustibles and metals.

Combustibles and small metal pieces will be treated via incineration (see thermal treatment or physical treatment).

Large Metals will be treated via decontamination. chemical oxidation, chemical reduction, and dehydration/evaporation. Chemical immobilization of contaminants adhering to the surfaces of waste metals can be accomplished via Polyethyleneylene-bead blasting; chemical oxidation; chemical reduction; and dehydration/evaporation technologies have been previously used in industry on similar waste types.

Subsystems required

Deactivation area/equipment Manual sorting system Polyethylene-Bead blasting system Chemical oxidation system Acid addition system Chemical reduction system Dehydration/evaporation system

Projected performance

Expected to produce a product that can be stabllized into a final waste form for disposal

treatment of these specific contaminants within this specific waste matrix is needed.

stream labor intensive. A pressurized spray within the presence of alpha contamination may cause safety concerns.

Input waste stream characterization information needed

Waste stream

Concentration of organic contaminants (see organic contaminants in the characterization subelement beginning on page L-15).

Oxidation process solution

An accurate COD analysis of the waste is required to determine the reagents necessary to promote oxidation of the organics within the waste (see Chemical-Oxygen Demand analysis in the characterization subelement beginning on page L-15).

Concentration of metal salts. Metal salts, especially silver salts, will react with the oxidizing agents to form metal oxides which can interfere with the effectiveness of the treatment process (see concentration of metal salts in the characterization subelement beginning on page L-15).

pH of the waste (see pH in the characterization subelement beginning on page L-15).

The presence and concentration of organic within the waste will be necessary to select the appropriate chemical oxidation treatment method (see organic contaminants in the characterization subelement beginning on page L-15).

Name: SRS Thirds Waste MWIR#: 919 Subelement: Treatment Site: Savannah River

Matrix: Heterogeneous Debris / 5400

Alternative/Technology

Bead Blasting, Polyathylene-Bead Blasting is the removal of contamination via a pressurized spray of polyethylene beads. The contaminants adhere: to the beads or will drop onto the floor. The contempants and beads will be swept up off of the floor and treated via a caustic (hydrogen peroxide or permanganate) chemical oxidation process.

After the destruction of the organics, the solution can be lowered to a pH of 4-5 and ferrous sulfate added to precipitate the metal contaminants. The slurry is then dehydrated/evaporated down to a sludge to enable the physical treatment of the heavy metal contaminants via stabilization.

The regulred concentrations of the reagents will be based on the Chemical-Oxygen Demand (COD) analysis of the solution. Temperature control and Oxidation-Reduction Potential (ORP) monitoring are standard control technologies utis-lized for COD analysis. The process can be mon-Itored via the COD analysis to determine when the organics are completely destroyed. For accurate COD analysis, the hydrogen peroxide (if utilized as the oxidizer) must be neutralized prior to the performance of the analysis.

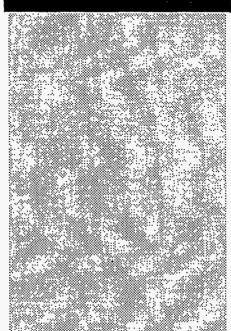
THERMAL TREATMENT

ALTERNATIVE + Incineration

Controlled Air Incineration (CAI) stationary hearth incinerator usually designed with a two-or three-stage combustion process. Solid. wastes are fed into a primary chamber to be burned using sub-stolchiometric air, thus destroying the volatile constituents. A high-temperature secondary combustion chamber is operated with excess air to assure complete destruction of volatile organic materials. Uquid waste materials are burned either in the primary or secondary chambers (dependent on the waste's characterisdis). High-temperature volatilities of certain met-als (such as arsentic, mercury, selenium, cadmi-um, and lead) require the subsequent capture in the incherator offgas. The incherator offgases would be subsequently cooled in order to allow these metals (or compounds) to condense prior to being entrained via a particulate removal device...

Status

Science and Technology Needs



Implementation Analysis

Waste streams produced

Empty containers can be disposed of as LLW (see empty containers disposal beginning on page N-1). Sludge that requires stabilization (see sludge

under secondary waste streams beginning on page

Decontaminated metal debris can be disposed of as a LLW (see metal debris disposal beginning on

-Accepted by industry. The DOE has operated controlled air incinerators in TRU and LLW service. Process may generate TRU wastes, therefore handling systems will need to be designed for such

Subsystems required

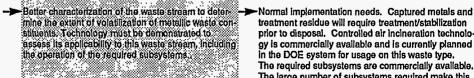
Feed preparation shredder for sizing solids (as

Feed examination system to remove class and other melting materials

Large offgas treatment system, including acid gas scrubber, and particulate filters Ash handling system

Metals treatment system (such as amalgamation. chemical reduction)

Stabilization system for treatment residuals



treatment residue will require treatment/stabilization prior to disposal. Controlled air incineration technology is commercially available and is currently planned in the DOE system for usage on this waste type. The required subsystems are commercially available. The large number of subsystems required make this technology relatively complicated and labor intensive. however the modular design of the incinerator and use of a wide variety of secondary fuels lower operational costs.

Input waste stream characterization information

Characterization requirements may include the identification of volatile metals in the waste stream. (see volatile metals in the characterization subelement beginning on page L-15).

MWIR#: 919 Name: SRS Thirds Waste **Subelement:** Treatment Matrix: Heterogeneous Debris / 5400 Site: Savannah River

Alternative/Technology Status Incineration (continued): Projected performance Good organic destruction Reaction of waste materials with refractory materials may be a problem dependent on the waste stream feed characteristics, of most concern is the hydrofluoric acid due to it's corrosive nature with ceramic materials is corrosive with common refrac-Post-treatment stabilization of ash residuals using cement is currently in wide use; long-term leaching performance is suspect; volume reduction is moderate: alternate stabilization techniques possible for better long-term performance Cylindrical refractory-lined shell mounted on a technology as the BDAT for organics, as well as slight incline; rotation of the kiln moves the noncvanide. The DOE is operating a rotary kiln for containerized waste through the shell, enhancing waste incineration, and planning other operations of mixing. A secondary combustion chamber comthis type. monly follows the primary chamber. High-temperature volatilities of certain metals (such as Subsystems required arsenic, mercury, selenium, cadmium, and lead) Shredding/sorting Large offgas treatment system, including acid-gas require their subsequent capture in the incinerator. offgas. The incinerator offgases would be subsequently cooled in order to allow these metals (or scrubber, metal removal (capture) system, and particulate filters compounds) to condense prior to being entrained Ash handling system Mercury treatment system (such as amalgamation in a particulate. Rotary kilns cannot operate in a cyclic (on-off) mode. Stabilization system for treatment residuals

Science and Technology Needs

Implementation Analysis

Corrosive tendency of waste materials (The acid and salt content will be used to correlate the corrosivity of the waste material. See pH in the characterization subelement beginning on page M-12 and salt content in the characterization subelement beginning on page B-11).

Waste streams produced

Bottom ash that requires stabilization (see bottom ash under secondary waste streams beginning on page L-10).

Flyash that requires stabilization (see flyash under secondary waste streams beginning on page L-10).

Scrubber residue that requires stabilization (see scrubber residue under secondary waste streams beginning on page L-10).

Offgas particulate filters that requires shredding followed by stabilization (see offgas particulate filters under secondary waste streams beginning on page

Empty containers can be disposed of as LLW (see empty containers disposal beginning on page N-1),

Mercury offgas (see mercury offgas under secondary waste streams beginning on page L-13).

sary to determine the extent of possible volatilization : of other waste constituents. Technology must be demonstrated to assess its applicability to this waste stream, including the operation of the required sub-systems. Immobilization agent will have to be selected and demonstrated.

- Accepted by industry. The EPA has approved this - Better characterization of the waste stream is neces. - Normal implementation needs. Captured metals and treatment residue will require treatment/stabilization prior to disposal. The rotary kiln incineration technology is commercially available and currently used within the commercial sector. The technology is currently in use within the DOE sector for non-comented sludge wastes. The required subsystems, as described above, are commercially available. The moving parts and large number of subsystems required make this technology relatively complicated and labor intensive.

Characterization requirements may include the identification of volatile metals in this waste stream (see volatile metals in the characterization subelement beginning on page L-15).

Corrosive tendency of waste materials on refractory materials (The acid and salt content will be used to correlate the corrosivity of the waste material. See

Projected performance

Good organic destruction

Rotating kiln seals questionable for contamination control (i.e., reaction of waste materials with refractory materials must be addressed and, excursions

Input waste stream characterization information needed

Name: SRS Thirds Waste MWIR#: 919 **Subelement:** Treatment Matrix: Heterogeneous Debris / 5400 Site: Savannah River

Alternative/Technology Status within the kiln may produce fugitive emissions via Hotary Kiln (continued) the kiln seals) Post-treatment stabilization of ash residuals using cement is currently in wide use; volume reduction is moderate; alternate stabilization techniques possible for better long-term performance ALTERNATIVE - Thermal Description Low-temperature thermal unit in which volable technology as the BDAT for nonwastewaters containmaterials, such as mercury, are volatilized for subing high levels of mercury. sequent capture of the metal in the offgas. Volatilization of the other waste constituents is Subsystems required Feed pretreatment shredder for sizing (as applicalower than in an incinerator due to lower process temperatures. The roaster offgases would be cooled to condense out mercury and mercury compounds to low levels prior to being entrained Small offgas treatment system, including acid gas scrubber, metals scrubber, and particulate filters via a particulate removal device. Secondary combustion system to ensure destruction of organics (or adsorbents) Carbon adsorption system to capture mercury in the offgas Ash handling system Metals treatment system for treatment of scrubber (such as amalgamation, blowdown or chemical Stabilization system for treatment residuals Projected performance Good organic destruction in secondary combustor Post-treatment stabilization of ash residues using cement is currently in wide use

Science and Technology Needs



peratures). Technology must be demonstrated to

the operation of the required subsystems.

assess its applicability to this waste stream; including

Implementation Analysis

pH in the characterization subelement beginning on page M-12 and salt content in the characterization subelement beginning on page B-11).

Waste streams produced

Bottom ash that requires stabilization (see bottom ash under secondary waste streams beginning on page L-10).

Flyash that requires stabilization (see flyash under secondary waste streams beginning on page L-10). Scrubber residue that requires stabilization (see

scrubber residue under secondary waste streams beginning on page L-10).

Offgas particulate filters that require shredding followed by stabilization (see offgas particulate filters under secondary waste streams beginning on page

Empty containers can be disposed of as LLW (see empty containers disposal beginning on page N-1),

Mercury offgas (see mercury offgas under secondary waste streams beginning on page L-13).

treatment residue will require treatment/stabilization prior to disposal. This technology and its subsystems are commercially available and are currently in use in the commercial sector. Although it has few moving parts, the large number of subsystems required make this technology relatively complicated and labor intensive.

Input waste stream characterization information needed

Characterization requirements may include the identification of volatile metals in this waste stream (see volatile metals in the characterization subelement beginning on page L-15).

Heat of combustion.

Corrosive tendency of waste materials (The acid and salt content will be used to correlate the corrosivity of the waste material. See pH in the characterization subelement beginning on page M-12 and salt content in the characterization subelement beginning on page B-11).

Name: SRS Thirds Waste MWIR#: 919 Subelement: Treatment Matrix: Heterogeneous Debris / 5400 Site: Savannah River

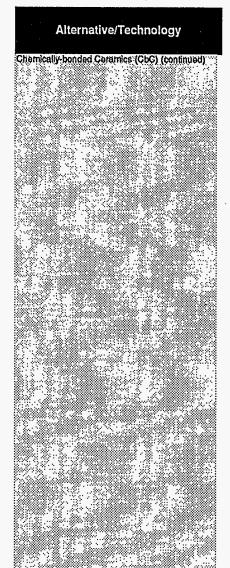
	, and Table 1. The physical actions in the de		
Alternative/Technology Returning/roasting (continued) Physical treatment via stabilization is applicable to waste streams classified as debris per the EPA debris rule ALTERNATIVE - Solidification/Stabilization (combustible and small metal debris)	Status Long-term leaching performance is suspect Volume reduction is moderate	Science and Technology Needs	Waste streams produced Bottom ash that requires stabilization (see bottom ash under secondary waste streams beginning on page L-10). Flyash that requires stabilization (see flyash under secondary waste streams beginning on page L-10). Scrubber residue that requires stabilization (see scrubber residue under secondary waste streams beginning on page L-10). Offgas particulate filters that require shredding followed by stabilization (see offgas particulate filters under secondary waste streams beginning on page L-10). Empty containers can be disposed of as LLW (see empty containers disposal beginning on page N-1), Mercury offgas (see mercury offgas under secondary waste streams beginning on page L-13).
Sulfur Polymer Cement (SPC) Sulfur Polymer Cement is composed of 95% sulfur. It melts at approximately 110 to 120°C and is particularly valuable in the immobilization of combustibles and small metal pieces.	SPC is being developed by the DOE for usage with this type of waste stream at iNEL. SPC has been demonstrated on ash. SPC is not compatible with waste streams containing high nitrates. Subsystems required Waste feed system Ingredients feed system Shredder for combustibles and small metal pieces Projected performance Expected to produce a suitable final waste form for disposal	Technology must be demonstrated on this waste :	Low power requirements. Few subsystems are required and needed to make use of this technology. Low development risk Input waste stream characterization information needed The concentration of sodium, potassium, sulfates, nitrates, and chlorides (see concentration of soluble salt in the characterization subelement beginning on page M-12). Waste streams produced A solidified waste form that requires RCRA LLW disposal (but could also be classified as a RCRA alpha-contaminated LLW) (see solidified waste forms disposal beginning on page N-1).
Chemically bonded ceramics (CbC) Chemically bonded ceramic waste forms are produced by mixing the wastes and inorganic oxide binders together. The mixture is then processed at ambient and near ambient temperatures, promoting chemical teactions that bond the waste and the inorganic oxides into a dense ceramic material.	Frojected performance Expected to produce a suitable final waste form for	Technology must be demonstrated on this waste stream.	

Name: SRS Thirds Waste

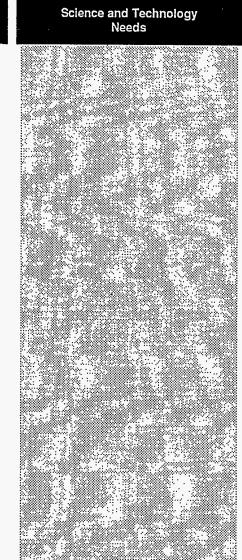
MWIR#: <u>919</u>

Matrix: <u>Heterogeneous Debris / 5400</u>

Subelement: Treatment Site: Savannah River



Status disposal

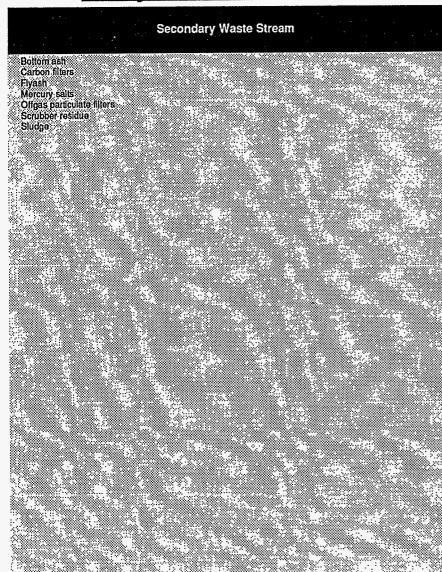


Implementation Analysis

Waste streams produced
A solidified waste form that requires RCRA LLW disposal (but could also be classified as a RCRA alpha-contaminated LLW) (see solidified waste forms disposal beginning on page N-1).

Name: SRS Thirds Waste MWIR#: 919 Subelement: Treatment

Matrix: Heterogeneous Debris / 5400



Treatability Group

Radilogical Constituents:

This waste may be classified as a waste containing 10-100 nCl/g of alpha-emitting radionuclides. However the waste may be classified as TRU waste, if the radionuclides in the waste feed become concentrated within the products generated by the treatment process.

Contaminants:

This waste is contaminated with toxic metals, including arsenic, beryllium, cadmium, chromium. lead, mercury, and silver. The following EPA-regulated wastes are suspected to be contained within the waste stream.

P012: Arsenic oxide

P015: Beryllium

P048: 2,4-Dinitrophenol

P113: Thallium oxide

P120: Vanadium oxide

U002: 2-Propanone

U032: Chromic acid, H2Cro4 calcium salt

Site: Savannah River

U052: Cresylic acid

U080: Methylene chloride

U133: Hydrazine

U134: Hydrogen fluoride

U144: Lead acetate

U151: Mercury

U154: Methyl alcohol

U161: Methyl isobutyl ketone

U209: 1,1,1, Tetrachloroethane

U211: Carbon tetrachloride

U220: Toluene

U226: 1,1,1, Trichloroethane

U239: Xylene mixed

Matrix:

This waste consists of ash, sludge, scrubber residue, filters, mercury salts.

Name: SRS Thirds Waste MWIR#: 919 Subelement: Treatment Matrix: Heterogeneous Debris / 5400 Site: Savannah River

Science and Technology Alternative/Technology Status Implementation Analysis Needs ALTERNATIVE - Solidification/Stabilization Polyethylene Polyethylene is being developed by the DOE for -Technology must be demonstrated on this waste — Low power requirements. Few subsystems are Polyethylene is an inert thermoplastic material that usage on these types of waste streams. stream to ensure stabilization of toxic constituents required and needed to make use of this technology. and the compatibility of the process with the actual can be processed at low temperatures. Polyethylene has been demonstrated on scrubber Low development risk. Polyethylene binder and dry waste material are residues. constituents contained in the waste stream. The fed through separate calibrated volumetric or losstechnology needs development on the treatment of Input waste stream characterization information in-weight feeders to an extruder. The materials Subsystems required shredded particulate filters. needed are then: thoroughly mixed; heated to a molten. Waste feed system The concentration of soluble salt contained in the condition, and extruded into a suitable mold. On Ingredients feed system scrubber residues (sodium, potassium, sulfates, cooling, the mixture forms a solid monolithic waste Shredder for particulate filters nitrates, and chlorides) (see concentration of soluble form. No chemical reaction is required for solidifisalt in the characterization subelement beginning on page M-12). Projected performance Expected to pass TCLP Expected to produce a suitable final waste form for Waste streams produced disposal A solidified waste form that requires RCRA LLW disposal (but could also be classified as a RCRA alpha-contaminated LLW, or TRU waste) (see solidified waste forms disposal beginning on page N-1). Sulfur Polymer Cement (SPC) ► SPC is being developed by the DOE for usage within - Technology must be demonstrated on this waste. Low power regulrements. Few subsystems are Sulfur Polymer Cement is composed of 95% sulthese types of waste streams. SPC has been stream to ensure stabilization of toxic constituents required and needed to make use of this technology. fur: It melts at approximately 110 to 120°C and is demonstrated on ash. SPC is not compatible with and the processes' compatibility with the actual Low development risk. particularly applicable to the immobilization of waste streams containing high nitrates. waste stream's constituents. The technology needs toxic metals and treatment of incinerator ash. development on the treatment of shredded particu-Input waste stream characterization information Subsystems required late filters. needed Waste feed system The concentration of soluble salt contained in the Ingredients feed system scrubber residues (sodium, potassium, sulfates, Shredder for particulate filters nitrates, and chlorides) (see concentration of soluble salt in the characterization subelement beginning on Projected performance page M-12). Expected to pass TCLP Expected to produce a suitable final waste form for Waste streams produced disposal A solidified waste form that requires RCRA LLW disposal (but could also be classified as a RCRA alpha-contaminated LLW, or TRU waste) (see solidified waste forms disposal beginning on page N-1).

Name: SRS Thirds Waste MWIR#: 919 **Subelement:** Treatment Site: Savannah River

Matrix: Heterogeneous Debris / 5400

Alternative/Technology

Chemically-bonded Ceramics (CbC) ---Chemically-bonded ceramic waste forms are produced by mixing the wastes and inorganic oxide binders together. The mixture is then processed at ambient and near ambient temperatures, pro-moting chemical reactions that bond the waste and the inorganic oxides into a dense ceramic

Status

for usage on these types of waste streams.

Subsystems required Waste feed system Ingredients feed system Shredder for particulate filters

Projected performance

Expected to pass TCLP Expected to produce a suitable final waste form for

Science and Technology Needs

stream to ensure stabilization of toxic constituents and the processes compatibility with the actual waste stream's constituents. The technology needs development on the treatment of shredded particu-

Implementation Analysis

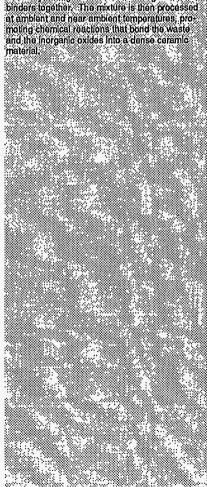
Low power requirements. Few subsystems are required and needed to make use of this technology. Low development risk.

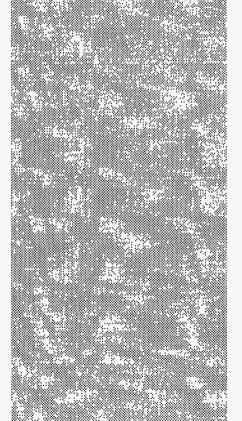
Input waste stream characterization information needed

The concentration of soluble salt contained in the scrubber residues (sodium, potassium, sulfates, nitrates, and chlorides) (see concentration of soluble salt in the characterization subelement beginning on page M-12).

Waste streams produced

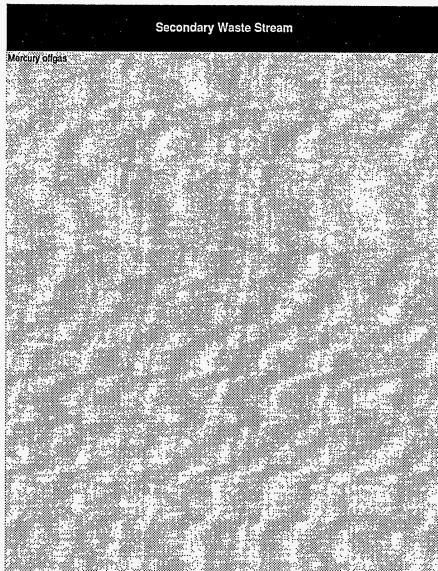
A solidified waste form that requires RCRA LLW disposal (but could also be classified as a RCRA alpha-contaminated LLW, or TRU waste) (see solidified waste forms disposal beginning on page N-1).





SRS Thirds Waste Name: MWIR#: 919

Matrix: Heterogeneous Debris / 5400



Subelement: Treatment

Site: Savannah River

Treatability Group

Radilogical Constituents:

This waste may be classified as waste containing 10-100 nCi/g of alpha-emitting radionuclides. However the waste may be classified as TRU waste, if the radionuclides in the waste feed become concentrated within the products generated by the treatment process.

This waste is contaminated with toxic metals, including arsenic, beryllium, cadmium, chromium, lead, mercury, and silver. The following EPA regulated wastes are suspected to be contained within the waste stream.

P012: Arsenic oxide

P015: Beryllium

P048: 2,4-Dinitrophenol

P113: Thallium oxide

P120: Vanadium oxide

U002: 2-Propanone

U032: Chromic acid, H2Cro4 calcium salt

U052: Cresylic acid

U080: Methylene chloride

U133: Hydrazine

U134: Hydrogen fluoride

U144: Lead acetate

U151: Mercury

U154: Methyl alcohol

U161: Methyl isobutyl ketone

U209: 1,1,1, Tetrachloroethane

U211: Carbon tetrachloride

U220: Toluene

U226: 1,1,1, Trichloroethane

U239: Xylene mixed

Matrix:

This waste consists of an offgas stream.

Program Logic Diagram Mixed Waste Integrated

SRS Thirds Waste Name:

MWIR#: 919 Heterogeneous Debris / 5400

Matrix:

Subelement: Treatment

Site: Savannah River

Alternative/Technology

Status

-ALTERNATIVE -Mercury Offgas Removal and

Sodium Hypochiorite Injection; Cupric Chloride: - Accepted by Industry.

cient. If the concentration of the mercury in the waste, is high, additional steps to remove mercury from the offgas may be necessary. Subjecting the The capture-rate of mercury in the offgas utilizating only a wet scrubbing process may not be suffioffgas to a wet sodium hypochlorite by chelating agenticupic chloride injection, during the wet scrubbing process or subjecting the offgas to a carbon absorption following the wet scrubbing process will enable a greater capture-rate of men

sulation of charcoal with mercury is not acceptable

Feed pretreatment in treatment of volatile mercury System for mercury removal from carbon if encap-

Subsystems required

Mercury-contaminated carbon fillers will have to be stredded and stabilized.

tion of mercury and other metals contained within the blowdown). The stury will then be dehydrated dation (to destray the chelating agent if it is used) nation of mercury (depending on the concentra-Mercury-contaminated wet blowdown liquids will down to a sludge and treated via stabilization.

approximately 2% to 4% have been found to give Sodium sulfide is a crystallina solid that dis-solves in water and is sprayed into the flue gas-prior to acid gas removal. Lower concentrations, better performance than higher concentrations. When used with municipal waste incineration, pproximately 0.1 to 1 lb, of sodium sulfide is required per ton of waste.

System for residual treatment

operational facilities

High mercury removal efficiency at low cost Effective at removing trace quantities of other cont-Simple to operate and maintain Potential problem with self-ignition on contact with for disposal Mercury treatment system such as amalgamation or chemical oxidation Projected performance aminants

improve mass transfer effectivaness. Demonstration of this technology with respect to the treatment of this specific wasts stream is needed. A treatment must also be developed to enable proper disposal of the mprovements needed in the atomization process to -Demonstration. New technology employed by a few Feed pretreatment in treatment of volatile mercury

Simple to operate Potential handling and deposition problems with Medium to high mercury removal Projected performance sodium sulfide

The issue of secondary beatment of the carbon/mer:
cury residual or seperation of the mercury from the
carbon for that treatment and disposal needs to be Science and Technology Needs

There are commercially available sorbent systems that must be demonstrated or applied to this applica-

Implementation Analysis

Input waste stream characterization information

Concentrations of mercury in the waste (see concentration and chemical form of mercury in the characterization subelement beginning on page L-15).

Waste streams produced
Charcoal that is contaminated with mercury
requires stabilization (see carbon filters under secondary waste streams beginning on page L-10).

simple, but control and handling of the sodium sulfide requires care to prevent emission of sulfide fumes. ■ Normal implementation needs. The technology is

Input waste stream characterization information

(see concentration and chemical form of mercury in the characterization subelement beginning on page Concentrations levels of mercury in the waste L-15).

Waste streams produced

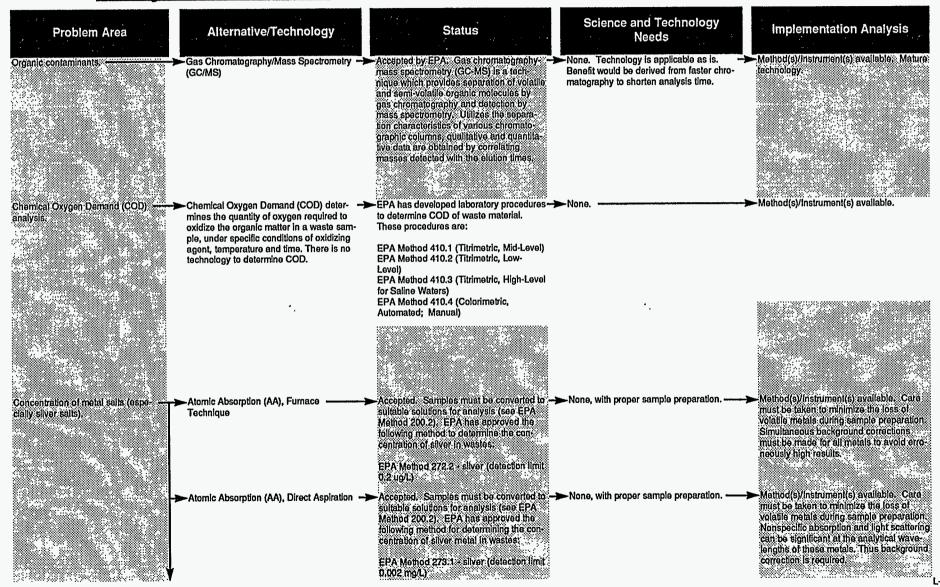
Mercury salts contaminated with radionuclides require stabilization (see mercury salts under secondary waste streams beginning on page L-10).

Mixed Waste Integrated Program

Logic Diagram

Savannah River SRS Thirds Waste Characterization Technologies

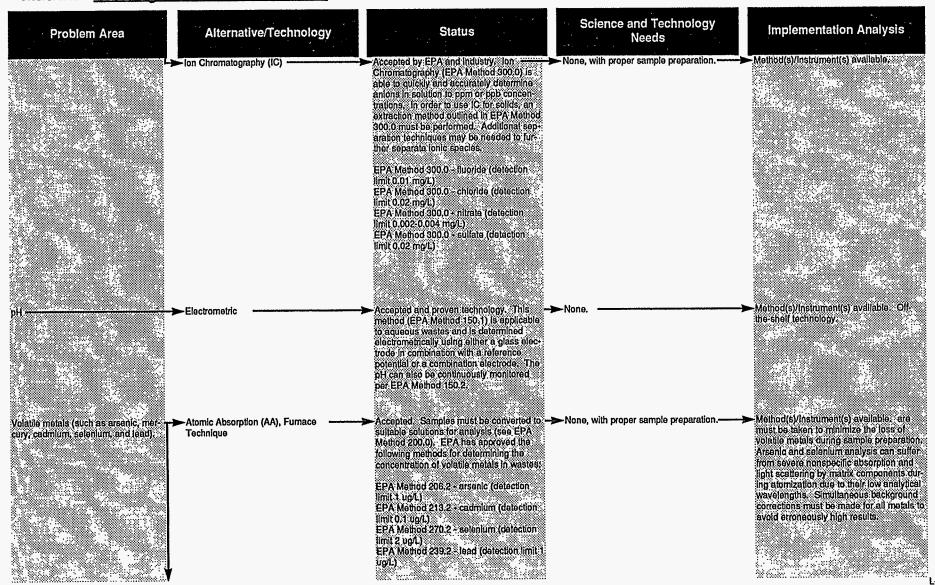
Name: SRS Thirds Waste MWIR#: 919 Subelement: Characterization



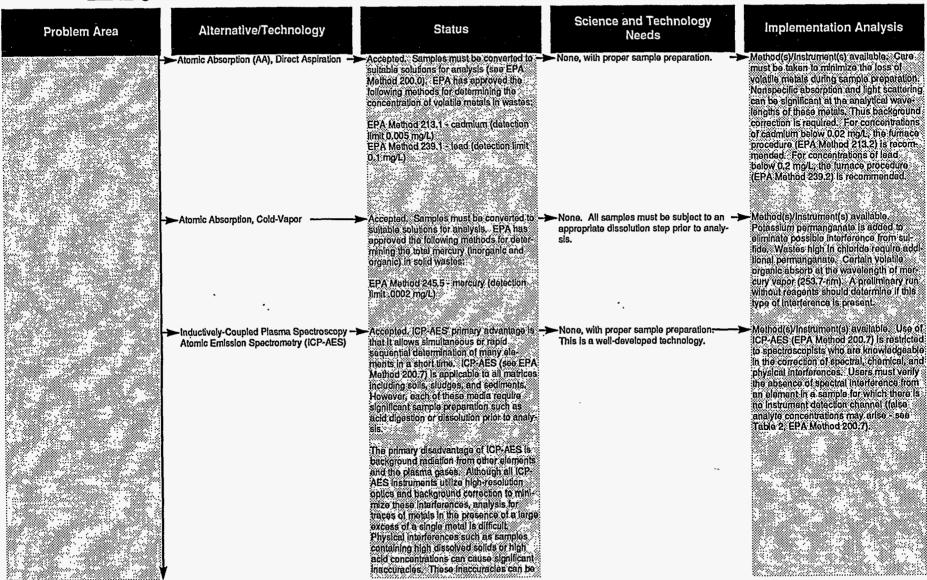
Name: SRS Thirds Waste MWIR#: 919 Subelement: Characterization

Problem Area	Alternative/Technology	Status	Science and Technology Needs	Implementation Analysis
	Inductively-Coupled Plasma Spectroscopy— Atomic Emission Spectrometry (ICP-AES)	Accepted: ICP-AES' primary attventage is that it allows simultaneous or rapid sequential determination of many elements in a short time. ICP-AES (see EPA Method 200.7) is applicable to all matrices including soils, sludges, and sediments. However, each of these media require significant sample preparation such as acid digestion or dissolution prior to analysis. The primary disadvantage of ICP-AES is background radiation from other elements and the plasma gases. Although all ICP-AES Instruments utilize high-resolution optics and background correction to minimize these interferences, analysis for traces of metals in the presence of a large excess of a single metal is difficult. Physical interferences such as samples containing high dissolved solids or high acid concentrations can cause significant inaccuratios. This can be reduced by diluting the sample using a peristolic pump, or by using the standard additions method. Estimated detection limit for silver metal: EPA Method 200.7 - silver (detection limit 0.002 mg/L)	None, with proper sample preparation. This is a well-developed technology.	Method(s)/Instrument(s) available. Use of ICP-AES (EPA Method 200.7) is restricted to spectroscopists who are knowledgeable in the correction of spectral, chemical, and physical interferences. Users must verify the absence of spectral interference from an element. In a sample for which there is no instrument detection channel (false analyte concentrations may arise - see Table 2, EPA Method 200.7).
	➤ Inductively-Coupled Plasma Mass	Accepted by EPA. Provides multi-element— analysis that is more selective than ICP- AES. Allows isotopic analysis. Interferences may occur in elements with similar mass. Common multicular ion interferences in ICP-MS are listed in Table 2 of EPA Method 200,8). Estimated Instrument detection limits for silver metal: EPA Method 200,8 - silver (detection limit 0.05 ug/L	None, with proper sample preparation. — Aqueous or solid samples may be analyzed. Solids require suspension of analytes of interest using techniques such as laser ablation.	- → - Meihod(s)/instrument(s) available

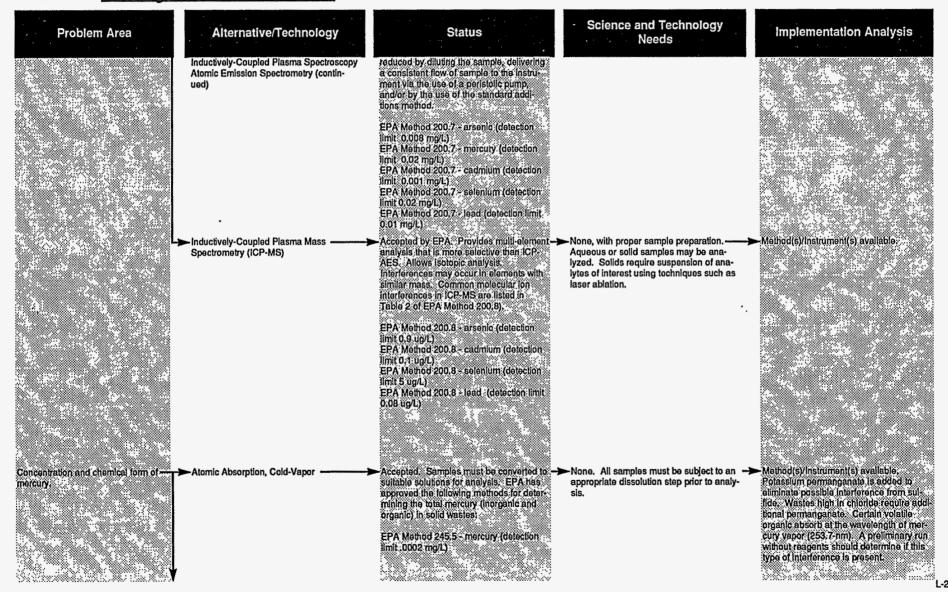
Name: SRS Thirds Waste MWIR#: 919 Subelement: Characterization



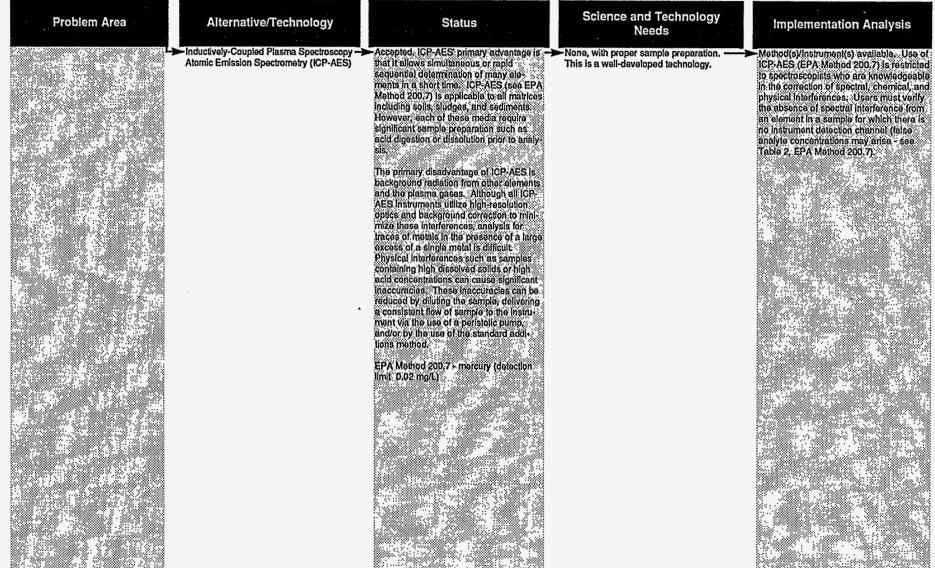
Name: SRS Thirds Waste MWIR#: 919 Subelement: Characterization



Name: SRS Thirds Waste MWIR#: 919 Subelement: Characterization



Name: SRS Thirds Waste MWIR#: 919 Subelement: Characterization



Mixed Waste Integrated Program

Logic Diagram

West Valley Pyridine/Cyanide Waste Treatment Technologies

Name: Pyridine/Cyanide Waste MWIR#: 1051 Subelement: Treatment

Matrix: Uncatagorized Aqueous-Organic Liquids / 2190

Waste Stream

Waste Stream Description

This waste stream consists of toxic heavy maters like chromium and has acidic corrosivity and toxicity characteristics.

Problems Presented by Waste Stream

LDR treatment standards for this waste stream are deactivation and chemical reduction followed by stabilization. However, the LDR treatment standards do not address the Pyridine contained within the waste (i.e., no destruction of organics is involved in the deactivation or chemical reduction treatment processes).

The waste was generated through laboratory analysis of cyanide. The waste stream was previously named "Pyridine/Cyanide standards." The waste profile indicates that this waste is an addic aqueous waste contaminated with toxic metals and organics.

However, an aqueous solution with a pH of less than 2 (iden) fled by the "acidic" description fisted on the waste's profile report and the definition of an acidic waste carrying the EPA code D002) should contain no cyanide. This is due to the reaction between the cyanide and hydrogen atoms that form hydrogen cyanide cases, which would be released into the almosphere.

It is reasonable to conclude that a mistake may have been made with the listing of "acidic" on the waste profile sheet. Historically, cyanide analysis are carried out under basic conditions to prevent the formation of hydrogen-cyanide gases.

Both scenarios of waste audity and basicity will be evaluated separately, enabling the identification of appropriate treatment methods for each scenario. Prior to treatment, waste characterization requirements will include the verification of the waste's pH, to enable the selection of the appropriate waste treatment technology.

This waste consists of approximately 0,023, M3 (6: gallons) of waste and therefore, may possibly be handled in a laboratory setting

Treatability Group

Radiological Constituents:

This waste is classified as a Beta-Gamma emitter and as a contact-handled waste possessing < 10 nCi/g of alpha-emitting radionuclides.

Contaminants:

This waste stream is contaminated with toxic heavy metals such as chromium and has (acidic) corrosivity and toxicity characteristics. The following EPA regulated wastes are suspected to be contained within the waste stream

D002: Unlisted hazardous waste characteristic of corrositivity

Site: West Valley

D007: Chromium D011: Silver D038: Pyridine

Matrix:

This waste consists of uncategorized aqueous organic liquid.

Name: Pyridine/Cyanide Waste MWIR#: 1051 **Subelement:** Treatment

Matrix: Uncatagorized Aqueous-Organic Liquids / 2190 Site: West Valley

Alternative/Technology

Status

Implementation Analysis

CHEMICAL TREATMENT

Carbon Adsorption -Pyridine/Cyanida Wasta Assumptions: Acidic solution; Cyanide is depleted; Pyridine is < 5% by

Waste solution will be neutralized to a pH in the range of 5+7, via a caustic addition process.

The neutralized waste solution will be cycled through granular activated carbon that has been packed in columns, allowing the pyridine to attach to the carbon.

The reputed amount of carbon will be based on ... the organic contaminant's breakthrough point (the saturation point of the carbon). The amount of contaminants that can be actively adsorbed by activated carbon ranges from approximately 0:10 to 0.15 gram of organics per gram of carbon.

The decrease of Total Organic Carbon (TOC) can be used to indicate a decrease in the concentrations of organics in the wastewater. TOC englysis can be used as a surrogate analysis if the analyte: cannot be measured by other means.

-Activated carbon is commonly used on wastewaters --- Need to demonstrate that activated carbon contains. ---- If no stabilization technology for this media can be containing low levels of organic constituents. The EPA has approved biological treatment or wet-air oxidation, followed by carbon adsorption as the BDAT for wastewaters containing the organic constituent. pyridine. Has been used previously in industry to treat similar types of waste.

Subsystems required Caustic addition system Activated carbon filtration system

Projected performance Expected to produce a final waste form that can potentially be stabilized

ing ~5-10% organics can be stabilized and successfully pass the TCLP.

Science and Technology

Needs

identified, or if the pyridine concentration adsorbed to the media is such that it will not pass the TCLP, a petition for regulatory determination from the EPA can be initiated. If granted, this would enable the organically-contaminated carbon media to be classified as a "debris" and therefore exclude this media from being subjected to chemical destruction requirements, prior to being disposed of in a landfill.

If either of the situations indicated above is anticipated, a petition for a regulatory determination from the EPA should be sought prior to performing the treatment of the wastewater via carbon adsorption.

Input waste stream characterization information needed

Concentration of pyridine (see concentration of pyridine in the characterization subelement beginning on page A-12).

pH of the waste (see pH of waste in the characterization subelement beginning on page A-12).

The presence and concentration of suspended solids (concentrations >50 mg/l can interfere with the treatment process) (see presence and concentration of suspended solids in the characterization subelement beginning on page A-12).

The presence and concentration of oil and grease (concentrations >10 mg/l can interfere with the treatment process) (see presence and concentration of oil and grease in the characterization subelement beginning on page A-12).

Waste streams produced

Pyridine sorbed onto activated carbon material that requires stabilization (see activated carbon material under secondary waste streams beginning on page A-9).

Deactivation/neutralization via caustics, chemical oxi- — Demonstration of this technology with respect to the 💨 Multiple treatment systems make this treatment process labor intensive. Acid in the presence of an alpha-contaminated waste may present safety concerns. Because of the small amount of waste, this waste stream could be treated in the laboratory.

Chamical Oxidaflan/Reduction + Pyridine/Cyanide Waste Assumptions: Acidic solution; Cyanide is depleted; Pyridine concentration is > 5% by volume. (Note: Although only s few chamical oxidation reagents have been identified here, vanous reagents that could be utilized.

dation/reduction via hydrogen peroxide/ferrous sulfate, and dehydration/evaporation are standard chemical treatment technologies that have been used previously in industry to treat similar types of waste.

treatment of these specific contaminants within this. specific waste matrix is needed.

Subelement: Treatment MWIR#: 1051 Name: Pyridine/Cyanide Waste

Matrix: Uncatagorized Aqueous-Organic Liquids / 2190 Site: West Valley

Alternative/Technology

Chemical Oxidation Reduction (continued) to perform chemical exidation include ozone, permanganate, hydrogen peroxide, hypochlorite, and sulfur dioxide. Various oxidation techniques utilized could include wet air oxidation, electrolylic exidation, or exenation via an ultraviolet light).

A causife addition to deactivate/neutralize the waste will be performed. A hydrogen peroxide and ferrous sulfate exidation/reduction process conducted at a pH of 4-5 will oxidize the organics and reduce any hexavalent chromium to trivalent chromium and any silver into an oxide form. This process will be followed by a caustic addition to produce a pH of 7-8, which will destroy any excess hydrogen peroxide. The remaining solution would be dehydrated to produce a metal. (chromium, silver, and Iron) hydraxide/oxide slugge,

The required concentrations of the reagents will be based on the Chemical Oxygen Demand (COD) requirements of the waste. Temperature control and Oxidation-Reduction Potential (ORP) monitoring are the standard control technologies for this process. However, for this small volume the process can be monitored via COD analysis until it has been established that the organics are completely destroyed. In order to obtain an accurate COD analysis, the peroxide must be neutralized prior to the performance of the COD analysis.

- Chemical Oxidation/Chemical Reduction -Pyndine/Cyanide Waste Assumptions: Basic solution; Cyanide is not depleted and is < 500 ppm. [Note: Although only a few chemical oxidation reagents have been identified here, various reagents that could be utilized to perform chemical axidation include azone, permanganate, hydrogen peroxide, hypochlorite, and sulfur dioxide. Various oxidation techniques utilized could include wet air oxidation, electrolytic oxidation, or ozonation via an ultraviolet light.)

A chemical exidation process (via hydrogen peroxide, hypochlorite, permanganate, or ozone) conducted at a solution pH in the range of 10:11.5 will Status

Subsystems required

Caustic neutralization system Chemical oxidation system Chemical reduction system Dehydration/evaporation system

Projected performance

Expected to produce a product that can be stabilized into a final waste form for disposal

-Deactivation/neutralization via caustics and acids: --chemical oxidation/reduction via hydrogen peroxide, hypochlorite, permanganate, or ozone; chemical reduction via ferrous sulfate; and dehydration/evaporation are all standard chemical treatment technologles that have been used previously in industry to treat similar types of waste.

Subsystems required

Acidic neutralization system Chemical oxidation system Chemical reduction system Dehydration/evaporation system Science and Technology Needs

Implementation Analysis

Input waste stream characterization information needed

An accurate COD analysis of the waste is required to determine the reagents necessary to promote oxidation of the organics within the waste (see Chemical Oxygen Demand analysis in the characterization subelement beginning on page M-12).

Concentration of metal salts. Metal salts, especially silver salts, will react with the oxidizing agents to form metal oxides which can interfere with the effectiveness of the treatment process (see concentration of metal salts in the characterization subelement of this section).

pH of the waste and the presence and concentration of cyanide within the waste will be necessary to select the appropriate oxidation treatment method (see pH of the waste and the presence and concentration of cyanide in the characterization subelement beginning on page M-12).

Waste streams produced

Residual waste slurry/sludge that requires solidification (see slurry/sludge under secondary waste streams beginning on page M-9).

treatment of these contaminants within this specific waste matrix is needed.

process labor intensive. Acid in the presence of an alpha-contaminated waste may present safety concerns. Because of the small amount of waste, this waste stream may possibly be treated in the labora-

Input waste stream characterization information needed

An accurate COD analysis of the waste is required to determine the reagents necessary to promote oxidation of the organics within the waste (see Chemical Oxygen Demand analysis in the characterization subelement beginning on page M-12).

Concentration of metal salts. Metal salts, espe-

Subelement: Treatment Pyridine/Cyanide Waste MWIR#: 1051 Name:

Matrix: Uncatagorized Aqueous-Organic Liquids / 2190 Site: West Valley

Alternative/Technology

Chemical Oxidation/Reduction (continued) oxidize and destroy the organics and convert cyanide to cyanate. The solution is then reduced via an acidic compound to a pH of 6-8, where the cyanate is converted to bicarbonate and oxygen. Hydrogen peroxide, if used as the oxidizer, will also be neutralized at the pH of 6-8. The solution is then lowered to a pH of 4-5, terrous sulfate is added and the chromium and silver are reduced and converted to an oxide form. The remaining solution would be dehydrated to produce a metal. (chromium, silver, and iron) hydroxide/oxide studge.

The required concentrations of the reagents will be based on the Chemical Oxygen Demand (COD) requirements of the waste. Temperature control and Oxidation-Reduction Potential (ORP) monitoring are the standard control technologies for this process. However, for this small volume the process. However, for this small volume the process can be monitored via COD analysis until it has been established that the organics are completely destroyed. In order to obtain an accurate COD analysis, the hydrogen peroxide (If utilized as the oxidizer) must be neutralized prior to the performance of the COD analysis.

Reduction

Pyridina/Cyanida Waste Assumptions: Basid solution. Cyanide is not depleted and is > 500 ppm. (Note: Although only a few chemical oxida-tion reagents have been identified here, various reagents that could be utilized to perform chemical oxidation include ozona, permanganate, hydrogen peroxide, hypochlorite, and sulfur dioxide. Various oxidation techniques utilized could include wat air exidation, electrolytic exidation, or ozonation via an ultraviolet light.)

For wastes containing cyanide concentrations > 500 ppm, electrolytic or wet air oxidation will be used prior to chemical exidation to reduce the CNconcentration < 500 ppm. The pH required for the electrolytic process is 11,5/12; the pH required for the wet air exidation process is 10-11.5. Lime can be added to the waste during the electrolytic process fand the wet air oxidation process if nec-

Status

Projected performance Expected to produce a product that can be stabilized into a final waste form for disposal

Electrolytic or Wet Air Oxidation; Chemical — Deactivation/neutralization via caustics and acids; chemical oxidation/reduction via hydrogen peroxide, hypochlorite, permanganate, or ozone; chemical reduction via ferrous sulfate; and dehydration/evaporation are all standard chemical treatment technologies that have been used previously in industry to treat similar types of waste. The EPA has approved biological treatment or wet-air oxidation, followed by carbon adsorption as the BDAT for wastewaters containing the organic constituent, pyridine.

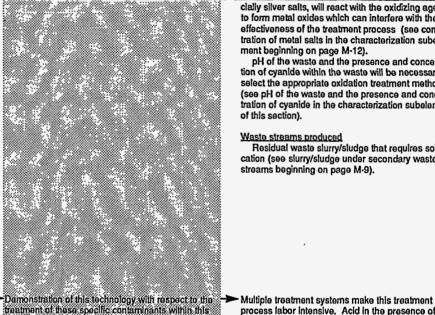
Subsystems required

Electrolytic or a wet air oxidation system Caustic and/or acidic neutralization system Chemical oxidation system Chemical reduction system Dehydration/evaporation system

Projected performance

Expected to produce a product that can be stabllized into a final waste form for disposal

Science and Technology Needs



specific waste matrix is needed.

Implementation Analysis

cially silver salts, will react with the oxidizing agents to form metal oxides which can interfere with the effectiveness of the treatment process (see concentration of metal salts in the characterization subelement beginning on page M-12).

pH of the waste and the presence and concentration of cyanide within the waste will be necessary to select the appropriate oxidation treatment method (see pH of the waste and the presence and concentration of cyanide in the characterization subelement of this section).

Waste streams produced

Residual waste slurry/sludge that requires solidification (see slurry/sludge under secondary waste streams beginning on page M-9).

process labor intensive. Acid in the presence of an alpha-contaminated waste may present safety con-

Input waste stream characterization information

An accurate COD analysis of the waste is required to determine the reagents necessary to promote oxidation of the organics within the waste (see Chemical Oxygen Demand analysis in the characterization subelement beginning on page M-12).

Concentration of metal salts. Metal salts, especially silver salts, will react with the oxidizing agents to form metal oxides which can interfere with the effectiveness of the treatment process (see concentration of metal salts in the characterization subelement beginning on page M-12).

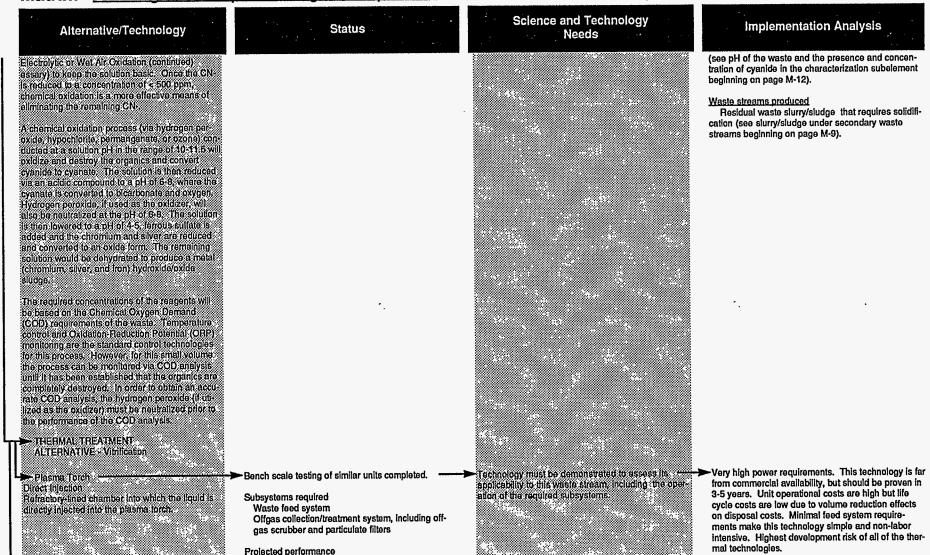
pH of the waste and the presence and concentration of cyanide within the waste will be necessary to select the appropriate oxidation treatment method

Name: Pyridine/Cyanide Waste MWIR#: 1051 Subelement: Treatment

Highest temperature range, good organic destruc-

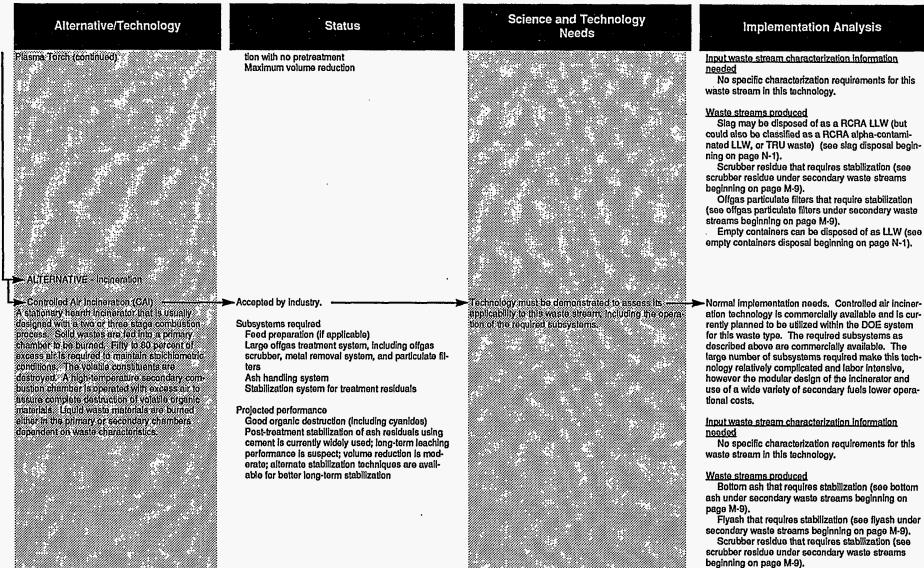
Matrix: Uncatagorized Aqueous-Organic Liquids / 2190

Site: West Valley



Subelement: Treatment Name: Pyridine/Cyanide Waste MWIR#: 1051

Matrix: Uncatagorized Aqueous-Organic Liquids / 2190 Site: West Valley



Implementation Analysis

Input waste stream characterization information

No specific characterization requirements for this waste stream in this technology.

Waste streams produced

Slag may be disposed of as a RCRA LLW (but could also be classified as a RCRA alpha-contaminated LLW, or TRU waste) (see slag disposal beginning on page N-1).

Scrubber residue that requires stabilization (see scrubber residue under secondary waste streams beginning on page M-9).

Offgas particulate filters that require stabilization (see offgas particulate filters under secondary waste streams beginning on page M-9).

Empty containers can be disposed of as LLW (see empty containers disposal beginning on page N-1).

ation technology is commercially available and is currently planned to be utilized within the DOE system for this waste type. The required subsystems as described above are commercially available. The large number of subsystems required make this technology relatively complicated and labor intensive. however the modular design of the incinerator and use of a wide variety of secondary fuels lower opera-

Input waste stream characterization information

No specific characterization regulrements for this waste stream in this technology.

Waste streams produced

Bottom ash that requires stabilization (see bottom ash under secondary waste streams beginning on

Flyash that requires stabilization (see flyash under secondary waste streams beginning on page M-9).

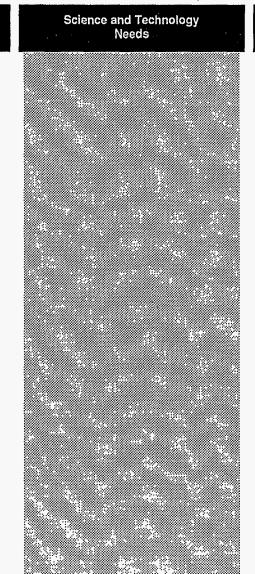
Scrubber residue that requires stabilization (see scrubber residue under secondary waste streams beginning on page M-9).

Name: Pyridine/Cyanide Waste MWIR#: 1051 Subelement: Treatment

Status

Matrix: <u>Uncatagorized Aqueous-Organic Liquids / 2190</u> Site: West Valley

Alternative/Technology Controlled Air Incineration (continued)



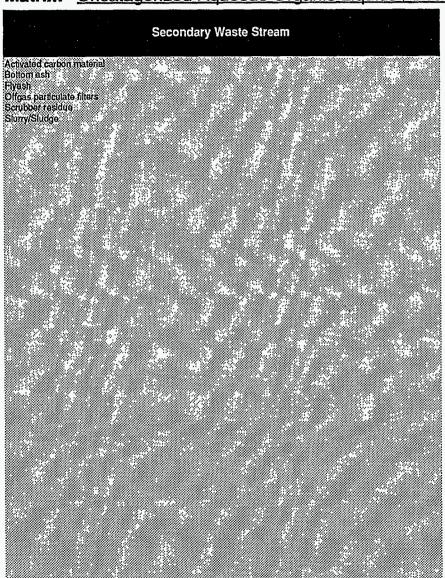
Implementation Analysis

Offgas particulate filters that require stabilization (see offgas particulate filters under secondary waste streams beginning on page M-9).

Empty containers can be disposed of as LLW (see empty containers disposal beginning on page N-1).

Name: Pyridine/Cyanide Waste MWIR#: 1051 Subelement: Treatment

Matrix: <u>Uncatagorized Aqueous-Organic Liquids / 2190</u> Site: West Valley



Treatability Group

Radiological Constituents:

This waste may be classified as a Beta-Gamma emitter and as a contact-handled waste possessing < 10 nCi/g of alpha-emitting radionuclides.

Contaminants:

This waste stream is contaminated with toxic heavy metals such as chromium and silver.

Matrix:

This waste consists of sludges, residue, ash, particulate filters, and activated carbon material.

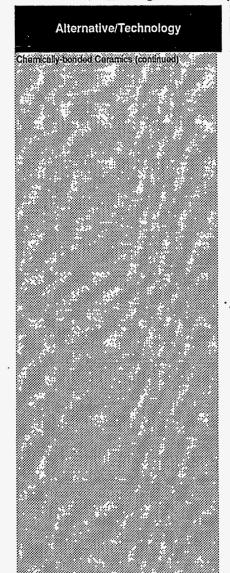
Name: Pyridine/Cyanide Waste MWIR#: 1051 Subelement: Treatment

Matrix: Uncatagorized Aqueous-Organic Liquids / 2190 Site: West Valley

Science and Technology Alternative/Technology **Status** Implementation Analysis Needs ALTERNATIVE Stabilization/Solidification Polyethylene Technology must be demonstrated on this waste Polyethylene is being developed by the DOE for — Low power requirements. Few subsystems are Polyahyléne is an inert thermoplastic material that can be processed at low temperatures. stream to ensure stabilization of toxic constituents required and needed to make use of this technology. usage within these types of waste streams. and compatibility with the actual constituents con-Polyethylene has been utilized previously to stabilize Low development risk. Polyethylene binder and dry waste material are lained within the waste stream. The technology indeeds development on the treatment of shredded particulate filters. scrubber residues. fed through separate callbrated volumetric or loss-Input waste stream characterization information in-weight leeders to an extruder. The materials are then thoroughly mixed, heated to a molten condition, and extruded little a sulfable molt. On Subsystems required needed Waste feed system The concentration of soluble salt contained in the Ingredients feed system scrubber residues (sodium, potassium, sulfates, nitrates, and chlorides) (see concentration of soluble cooling, the mixture forms a solid monolithic waste. Shredder for particulate filters form. No chemical reaction is required for solidifisalt in the characterization subelement beginning on Projected performance page M-12). Expected to pass TCLP Expected to produce a suitable final waste form for Waste streams produced A solidified waste form that requires RCRA LLW disposal disposal (but could also be classified as a RCRA alpha-contaminated LLW waste) (see solidified waste forms disposal beginning on page N-1). -SPC is being developed by the DOE for usage within - Technology must be demonstrated on this waste Sulfur Polymer Cement (SPC) Low power requirements. Few subsystems are Sulfur Polymer Cement is composed of 95% sulfur. It melts at approximately 110 to 120°C and is required and needed to make use of this technology. these types of waste streams. SPC has been stream to ensure stabilization of toxic constituents and compatibility with the actual constituents condemonstrated on ash. SPC is not compatible with Low development risk. tained within the waste stream. The technology particularly applicable to the immobilization of waste streams that contain high nitrates. toxic metals and treatment of incinerator ash. needs development on the treatment of shredded Input waste stream characterization information particulate filters. Subsystems required needed Waste feed system The concentration of soluble salt contained in the scrubber residues (sodium, potassium, sulfates, ingredients feed system Shredder for particulate filters nitrates, and chlorides) (see concentration of soluble salt in the characterization subelement beginning on page M-12). Projected performance Expected to pass TCLP Expected to produce a suitable final waste form for Waste streams produced A solidified waste form that requires RCRA LLW disposal disposal (but could also be classified as a RCRA alpha-contaminated LLW waste) (see solidified waste forms disposal beginning on page N-1). Chemically-bonded Caramics (CbC) CbC is in early stages for development by the DOE Technology must be demonstrated on this waste Low power requirements. Few subsystems are Chemically-bonded ceramic waste forms are prostream to ensure stabilization of toxic constituents for usage within these types of waste streams. required and needed to make use of this technology. and compatibility with the actual constituents conduced by mixing the wastes and inorganic oxide Low development risk. binders together. The mixture is then processed Subsystems required tained within the waste stream. The technology at ambient and near ambient temperatures, pro-Waste feed system needs development on the treatment of shredded Input waste stream characterization information moting chemical reactions that bond the waste Incredients feed system particulate filters. needed and the inorganic oxides into a dense ceramic. Shredder for particulate filters The concentration of soluble salt contained in the scrubber residues (sodium, potassium, sulfates, nitrates, and chlorides) (see soluble salt in the char-

Subelement: Treatment Name: Pyridine/Cyanide Waste MWIR#: 1051

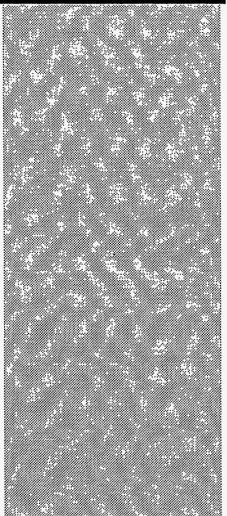
Matrix: Uncatagorized Aqueous-Organic Liquids / 2190 Site: West Valley



Status

Projected performance Expected to pass TCLP Expected to produce a suitable final waste form for





Implementation Analysis

acterization subelement beginning on page M-12).

Waste streams produced

A solidified waste form that requires RCRA LLW
disposal (but could also be classified as a RCRA
alpha-contaminated LLW waste) (see solidified
waste forms disposal beginning on page N-1).

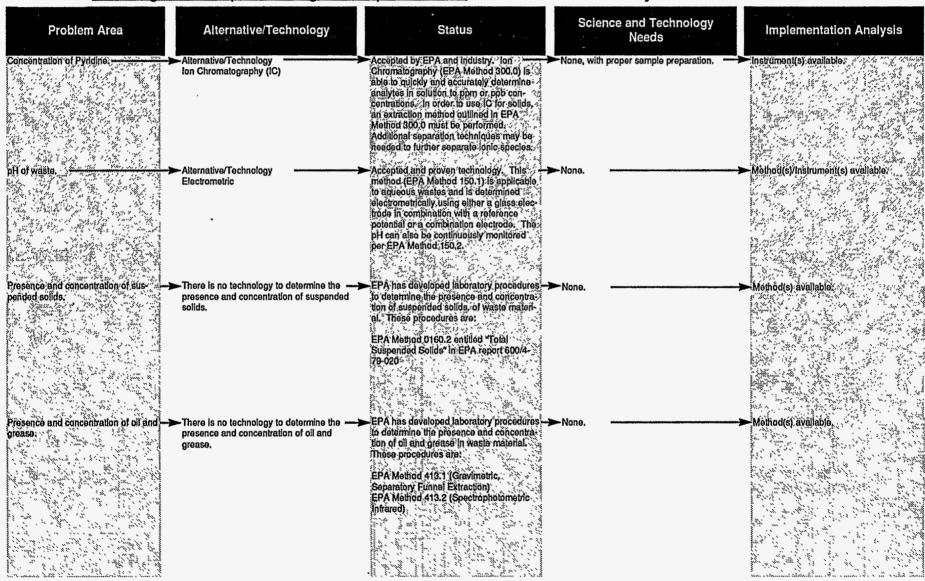
Mixed Waste Integrated Program

Logic Diagram

West Valley
Pyridine/Cyanide Waste
Characterization Technologies

Name: Pyridine/Cyanide Waste MWIR#: 1051 Subelement: Characterization

Matrix: Uncatagorized Aqueous-Organic Liquids / 2190 Site: West Valley



iagram Logic Program Integrated Waste Mixed

Subelement: Characterization 1051 MWIR#: Pyridine/Cyanide Waste Name:

to spectroscopisis who are knowledgeable in the correction of spectral, chamical, and can be significant at the analytical wayer. Jengths of these metals, Thus background Method(s)/Instrument(s) aveilable. Use of ICP-AES (EPA Method 200.7) is restricted an element in a sample for which there is yolatile metals during sample preparation. Nonspecific absorption and light scatterin physical Interferences. Users must verify. The absence of spechal interference from Method(s)(instrument(s) available. Care Implementation Analysis no instrument detection channel (false analyte concentrations may arise - see must be taken to minimize the loss of EPA Method 200,7). correction is required. neatisty high results. Table 2, None, with proper sample preparation. Science and Technology None, with proper sample preparation. None, with proper sample preparation. This is a well-developed technology. Needs West Valley Site: Accepted, ICP-AES primary advantage is — that it allows simultaneous or reptd sequential determination of many elements in a short time. ICP-AES (see EPA Method 200.7) is applicable to all matrices Level)
EPA Method 410,3 (Titrinetric, High-Level
for Salline Waters)
EPA Method 410,4 (Cologimetric, Accepted, Samples must be converted to EPA Method 410:1 (Tidimetric Mid-Level) EPA Method 410:2 (Tidimetric, Low: following method to determine the con-EPA Method 272.2 * silver (detection limit 0.2 ug/L) EPA Method 273.1% silver (detection limit 0.002 mg/L) significant sample preparation such as acid digestion or dissolution prior to analyfollowing method for determining the can-centration of sliver metal in wastes: Accepted. Samples must be converted sultable solutions for analysis (see EPA sultable solutions for analysis (see EPA Method 200.2). EPA has approved the Method 200,2); EPA has approved the including solls, sludges, and sediments, However, each of these media require EPA has developed laboratory procedu to determine COD of waste material. centration of silver in wastest Status Uncatagorized Aqueous-Organic Liquids / 2190 These procedures are: Automated: Manual) oxidize the organic matter in a waste sam-Alternative/Technology Inductively-Coupled Plasma Spectroscopy Atomic Emission Spectrometry (KCP-AES) ple, under specific conditions of oxidizing mines the quantity of oxygen required to agent, temperature and time. There is no Atomic Absorption (AA), Direct Aspiration Alternative/Technology Chemical Oxygen Demand (COD) Atomic Absorption (AA), Furnace echnology to determine COD. Alternative/Technology edsa) silis (esbe-Chemical Oxygen Demand (COD) analysis of waster Problem Area Matrix:

Program Logic Diagram Mixed Waste.Integrated

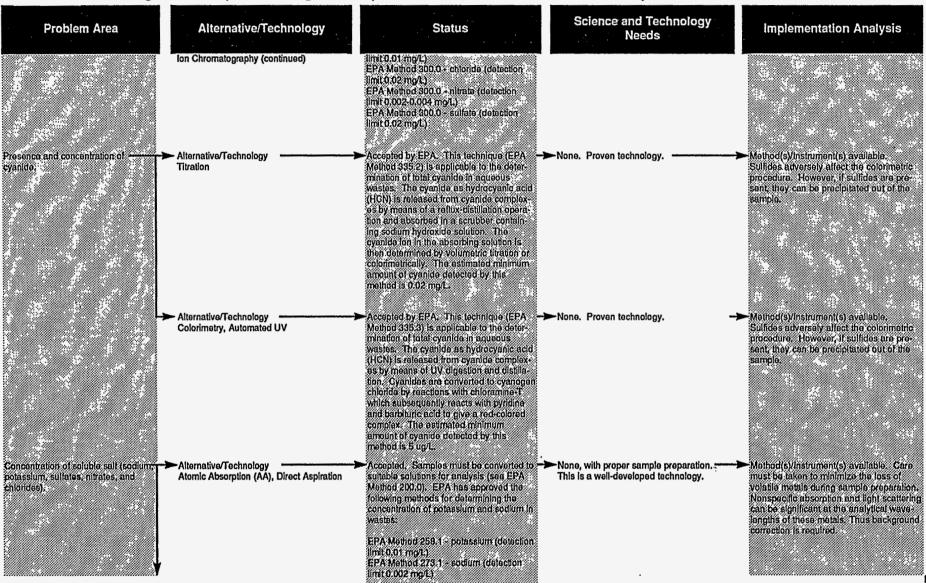
Subelement: Characterization 1051 MWIR#: Pyridine/Cyanide Waste Name:

West Valley Site: Uncatagorized Aqueous-Organic Liquids / 2190 **Matrix:**

₹-15 Implementation Analysis //ethod(s)/instrument(s) available. istuments) available None, with proper sample preparation. ---Aqueous or solid samples many yead. Solids require suspension of analytes of interest using techniques such as laser ablation. None, with proper sample preparation. Science and Technology Chromatography (EPA Method 300.0) is able to quickly and accurately determine anions in solution to poin or pob concervations. In croter to use IC to solute an extraction method outlined in EPA Method extraction method outlined in EPA Method Accepted by EPA. Provides multi-element analysis that is more selective than ICP. AES. Allows teatopic analysis. 300.0 must be performed. Additional sep-gration lectualques may be needed to fur-ther seperate lonic species. Estimated mightum detector limits for the aniquis of oplics and background corrector to mini-mae these interferences, analysis or recess of metals in the presence of a farge EPA Mathed 200.8» silver (detection limit) 0.05 ug/L} The pilmany disacramede of ICPAES is beckground radiation from other elements and the plasma gases. Although all ICPAES instruments utilize high resolution. nighterences may occur in elements with similar mass. Common molecular on nerterences in ICP-MS are listed in EPA Method 200,7 - silver (delection lifti) 0.002 mg/L nacturable. This can be reduced by allufung the sample using a personic rump, or by using the standard additions. EPA Mathad 200.0 - fluoride (detection acid concentrations carricause significan ferences such as samples containing high dissolved solids or high accepted by EPA and industry. Inn cass of a single metal is difficult able 2 of EPA Method 200.8). Status nterest are as follows: Inductively-Coupled Plasma Spectroscopy Atomic Emission Spectrometry (continued) Alternative/Technology Inductively-Coupled Plasma Mass Spectrometry (ICP-MS) Ion Chromatography (IC) → Alternative/Technology ★-Alternative/Technology Problem Area

Name: Pvridine/Cvanide Waste MWIR#: 1051 Subelement: Characterization

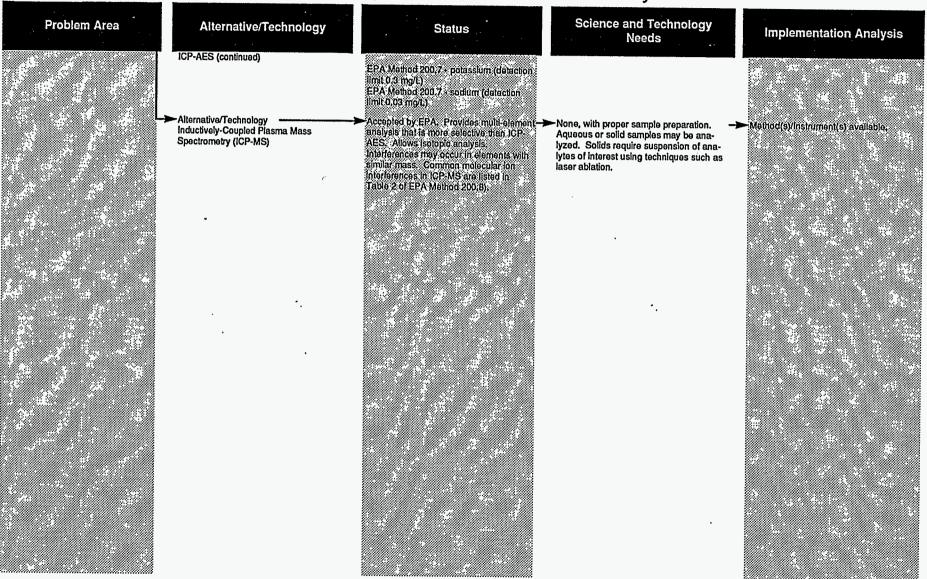
Matrix: Uncatagorized Aqueous-Organic Liquids / 2190 Site: West Valley



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			4
			,

Name: Pyridine/Cyanide Waste MWIR#: 1051 Subelement: Characterization

Matrix: Uncatagorized Aqueous-Organic Liquids / 2190 Site: West Valley



Mixed Waste Integrated Program

Logic Diagram

Disposal Options

Name: Disposal

Matrix: All

Waste Stream

Waste Stream Description

All residuals generated from the treatment of wastes will require disposal in an appropriate disposal facility. These treatment residuals may be classified as transuranic wastes; low-level wastes; or alpha-contaminated low-level wastes (also known as 'reclassified low-level waste'). These treatment residuals may be comprised of solidified wastes, solidified salls (from various off-gas treatment systems); metal drums and/or other waste containers. Disposal of mixed waste (waste that exhibits RGRA hazardous as well as radioactive attributes) is governed by stipulations contained in EPA-approved (or an EPA-authorized state agency) RCRA permits as well as by stipulations. tigns contained in DOE Orders and/or NRC (Icense provisions. Disposal facilities that dispose of RCRA regulated hazardous wastes are ultimately responsible for determining and certifying that they meet applicable RCRA standards.

The Hazardous and Solid Waste Amendments (HSWA) of 1984 required the EPA to develop treatment standards for all listed and characteristic hazardous wastes. These treatment standards were developed to designate restrictions/limits on allowable disposal concentrations for specific waste contaminants/characteristics. These limits were derived from toxicological data and are considered to be protective of human health and the environment.

Currently, the EPA defines treatment standards via the following:

- 1) Treatment standards are expressed as limits, with respect to a contaminant concentration within a body of waste.
 2) Treatment standards are expressed as limits, with respect to a contaminant concentration within a waste's leachate. Contaminants' with regard to hazardous wastes are defined as those constituents contained within a waste's leachate that have concentrations exceeding EPA's regulatory limits, specified in 40 CFR Part 251. The limits applicable to constituents contained within a waste's leachate are only applicable to a leachate that has been generated via the EPA's Toxicity Characteristic Leach Procedure (TCLP).
- 3). Treatment standards are also expressed by requirements dicitating that certain types of wastes; be subjected to EPA-specified treatment technologies. These EPA-specified treatment technologies are termed Best Demonstrated Available Technologies (BDATs). The EPA's BDAT treatment technology selection is based upon an evaluation of commercially available waste treatment technologies; that are capable of reducing the threat to human health and/or the environment, that is posed by the waste during its presence in a disposal facility.

The use of BDAT treatment standards does not torce waste treatment via a specific treatment or technology. Alternate treatment technologies may be used if it can be demonstrated that they are able to meet EPA's applicable. treatment standards (as defined in the text above in notes 1) and 2).

A waste that is classified as a hazardous debris is defined as 1) a solid material exceeding a 50 mm (2.5 inch) particle size that is a manufactured object, plant or animal matter, or a natural geologic material; and 2) a material that exhibits the characteristic of a hazardous waste (as defined by RCRA in 40 CFR Part 261) and/or is contaminated with an EPA-listed hazardous waste contaminant (as defined by RCRA in 40 CFR Part 261); and 3) a material nal that has been discarded or is intended for discard...

Contaminants with regard to debris wastes are defined as those constituents contained within a waste's extract/leachate having contaminant concentrations exceeding their respective regulatory limits; as defined by the EPA under RCRA. These limits are applicable to constituents contained within a waste's extract/leachate, provided the extract/leachate is generated via the EPA's Extraction Procedure Toxicity Characteristic test (EP TOX test) or the EPA's Toxicity Characteristic Leaching Procedure (TCLP), respectively.

Hazardous wastes that are classified as nazardous gebris are subject to the LDR prohibitions. Before a hazardous debris can be disposed of, hazardous debris 1) must be treated by EPA-designated waste treatment technologles that have been deemed applicable to debris wastes; or 2) must be treated to meet EPA specified treatment standards that are applicable to all EPA listed waste contaminants and/or waste characteristics associated with that particular waste.

EPA has identified seventeen BDAT treatment technologies deemed to be applicable to hazardous debris. EPA has matched debris waste treatment technologies with certain types of debris waste, based upon the composition of a waste's substrate and the contaminants that are present on or empedded within that substrate.

With the exception of using immobilization/stabilization waste treatments; the consequences of using EPA-specified BDAT waste treatment technologies upon debris wastes are two-fold; 1). The treated debris would no longer be considered to be by contain a hazardous waste, (provided that the treated debris does not exhibit any hazardous waste characteristics and that EPA-specified destruction or extraction technologies are used for all types of debris and contaminants contained within the waste matrix); 2) Since freated debris is no longer considered to be a hazardous waste; it is not required that the debris be disposed in a RCRA Subtitle C (RCRA Part B-permitted) disposal facility.

The EPA has determined that debris wastes treated with an immobilization/stabilization treatment technology are not excluded from Subtitle C regulation; because the contaminants have not been destroyed or removed, but rather contained indefinitely. Further, performance standards for immobilized debris have not yet been established. The only requirement placed upon a hazardous debris that has been treated by an immobilization/stabilization. treatment technology, is that the likelihood of migration of toxic contaminants has been substantially reduced, or that the leachability of the hazardous contaminants is reduced. There is no requirement that an immobilized/stability of the hazardous contaminants is reduced. There is no requirement that an immobilized/stability of the hazardous contaminants is reduced. There is no requirement that an immobilized/stability of the hazardous contaminants is reduced. There is no requirement that an immobilized/stability of the hazardous contaminants is reduced. lized hazardous debris waste must pass EPA's exicity characteristic (or other similar) leaching procedure test.

Name: Disposal

Matrix:

PROBLEMS PRESENTED BY THE WASTE STREAM

and/or veatment facilities.

Waste Stream

be metal (excluding lead bricks). Note: Lead bricks are specifically excluded from being defined as a debris waste by the EPA and therefore, must be disposed of as a fiastactous waste or decontaminated from being defined and recycled the bring the second of the property cony. contaminated astbestbes metcury contaminated carbon fillers fillers contaminated with flazandous-metals perficulate; waste contained astbestbes metcury contaminated (a.g., complete, protein, or appured dums); and verious pleases *Verrice from technologies have been selected by the advance to the DOE debte wastes discussed in this source of the selected from the selected of the DOE debte wastes of the DOE debte.

The lack of adequate chemical (e.g., types of contaminants) and physical (e.g., size and composition of waste objects) characterization and state of the sectors of paracterization and physical characterization data were available, the use of the decause physical characterization data is lacking, specific contaminant concentration, limits are assumed to be applicable to meet LDRs when, if additional characterization data were available, the use of the decause physical characterization data were available, the use of the contaminant concentration when a variable to meet a specific contaminant concentration.

Alpha-contaminated tow-level waste (reclassified tow-level waste) contains become interest and connected tow-level waste (reclassified tow-level waste) contained to alpha-contaminated waste managed as (< 10 nCVg) or transmittic wastes (< 100 nCVg). Treatment of alpha-contaminated wastes may concentrate the radioactivity level within the wastes resulting in treatment residuals with world have to be managed as transminities are as all laber the private sector or the DOE complex for such transminities the reliables or tor the alpha-contaminated tow-level waste from which they are derived.

Specific phrasas used throughout this analysis have been defined below:

erotecting all also mort, bevisces to besodative at an existing the second to the contract of the second to the se

Commercial low-level realigacine mixed-waste disposal facility permits are facility-and lsoppe-specific. Commercial disposal facilities generally accept waste containing a level-waste disposal facility permits are facility-and lsoppe-specific. Commercial disposal facilities generally accept waste containing a level-waste disposal facility permits are facility and lsoppe-specific.

as reclassified low-level waste), as wastes which contein redionucible concentrations in the renge of 10-100 nCVg. Thorsides of the selected disposal lacility. DOE lacilities generally define low-level waste which contains radionucides in a total concentration of 💝 10 nover the selected disposal lacilities generally define of the contains the selected disposal lacilities and the se espiano memmitanos plasw, ent bris basaqaib, ed of selasw entrio asiasinarismi entracinarismi en

The Fitting the U.S. Nuclear Regulatory Commission (VRC) is responsible for the sound disposal lectly elegated for the properties of the U.S. Nuclear Regulator (VRC) and properties to the properties of the prop

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DOB Otders define barteumsche se weele finat contain elements who eating nather (s > 92 With concentrations > 100 gOVg

Name: Disposal

Matrix: All

Problem Area Empty containers Metal debris

Alternative/Technology

DISPOSAL FACILITY

Commercial low-level waste disposal facilities dispose of low-level radioactive wastes. Commercial low-level waste disposal facility permits are issued by the NRC or by NRC-authorized state government agencies. These permits are facilityand Isotope-specific. Commercial disposal facilities can generally accept waste containing selected radionuclides with a concentration of < ~ 10 nCi/g.

Status

-COMMERCIAL LOW-LEVEL WASTE - Commercial low-level waster disposal facility No science or technology requirements ties are available to 'Compact State' waste generators needing to dispose of low-level alpha-, beta- and gamma-contaminated wastes. In most cases commercial low-level waste disposal facilities can dispose of radioactive incineration residuals, fly ash and wastes generated from the operation of pollution-control equipment. The specific types of wastes accepted by each facility is identified in its waste acceptance criteria, which is dictated by the facility's licenses/permits. Disposal, monitoring, and closure technologies for this type of waste disposal facility are well established. Commercial low-level waste disposal facilities exist and are operational, Performance data on commercial low-level waste disposal facilities is not available,

> Commercial low-level waste disposal facilities are located at Barnwell, South Carolina; Richland, Washington; Beatty, Nevada; and Clive, Utah, The status of each facility is summarized as follows:

- Barnwell, South Carolina: This facility can accept waste from states who are making progress on their own disposal sites until July 1, 1994. Thereafter, it will only accept waste from within the

Southeast compact.
Richland, Washington: This facility no longer accepts wastes from outside the Northwast and Rocky Mountain compacts. Beatty, Nevada: This facility was closed. on January 1, 1993,

 Clive, Utah: This facility recently entered into a contract with the DOE to dispose of a broad range of low-level alpha-, betaand gamma-contaminated radioactive

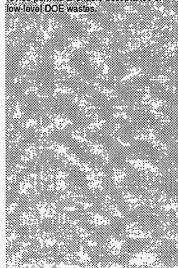
Science and Technology Needs

need to be resolved to dispose of wastes at commercial low-level waste disposal facilities.

Implementation Analysis

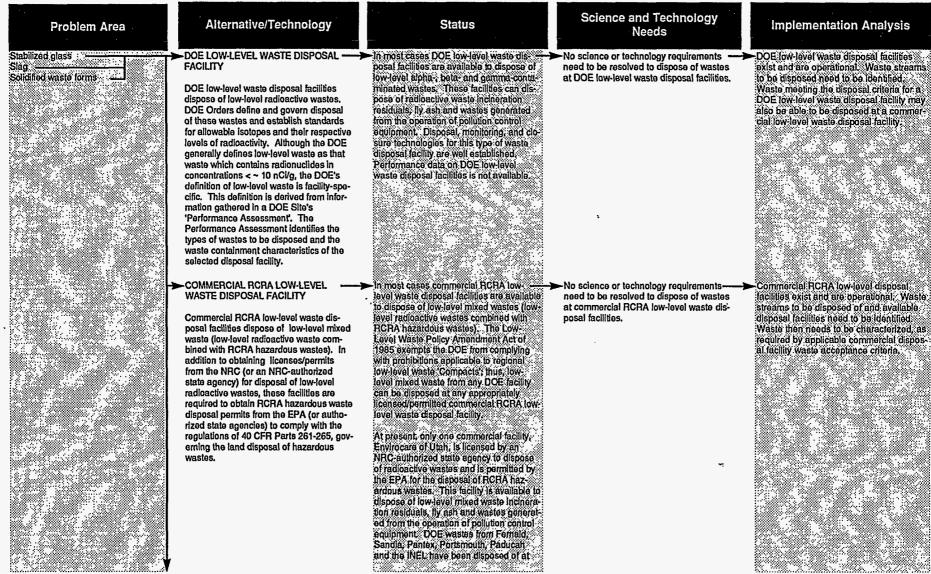
Commercial low-level waste disposal facil-Ities are oriented toward serving a clientele of government agencies, universities, research institutions and hospitals. Operating permits reflect the waste types and radionuclides that these generators produce. Allowable radionuclides and concentration acceptance criteria are established in facility-specific permits. In general, commercial low-level waste disposal facilities accept common radionuclides in concentrations < ~ 10 nCi/g.

The process of permitting and constructing commercial low-level waste disposal facilities requires government and public support. In order to facilitate disposal of waste at these facilities, DOE definitions of low-level and transuranto wastes should be made consistent with NRC regulatory language. Commercial disposal facilities may need to modify their operations and revise permits to enable acceptance of



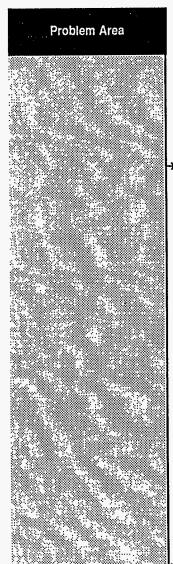
Name: Disposal

Matrix: All



Name: Disposal

Matrix: All



Alternative/Technology

DOE RCRA LOW-LEVEL WASTE DIS-POSAL FACILITY

DOE RCRA low-level waste disposal facilities could be used to dispose of low-level mixed waste (low-level radioactive wastes combined with RCRA hazardous wastes). DOE Orders define and govern disposal of these wastes and establish standards for allowable isotopes and their respective levels of radioactivity. Although the DOE generally defines low-level waste as that waste which contains radionuclides in concentrations < ~ 10 nCl/g, the DOE's definition of low-level waste is facility-specific. This definition is derived from information gathered in a DOE Site's 'Performance Assessment'. The Performance Assessment identifies the types of wastes to be disposed and the waste containment characteristics of the selected disposal facility. These facilities would be required to obtain RCRA hazardous waste disposal permits from the EPA (or authorized state agencies) to comply with the regulations of 40 CFR Parts 261-265, governing the land disposal of hazardous wastes.

Status

Envirocare of Utah. This disposal facility. has recently entered into a contract with the DOE allowing the disposal of a broad range of DOE's low-level mixed wastes.

ities do not exist. Such facilities could dispose of low-level mixed wastes (low-level radioactive contaminated wastes combined with RCRA hazardous wastes). such as incineration residuals, empty drums, stabilized glass, personnel protective equipment, fly ash and wastes generated from the operation of pollution control equipment. Waste acceptance criteria: would be established and defined via facility-specific performance assessments. It is anticipated that DOE RCRA low-level waste disposal facilities would be able to dispose of radioactively-contaminated

wastes having radioactivity concentrations < ~ 10 nCi/g. Status of this disposal tech-

nology is conceptual.

need to be resolved to dispose of wastes at DOE RCRA low-level waste disposal facilities.

Science and Technology

Needs

Implementation Analysis

DOE:RCRA low-level waste disposal facili. -> No science or technology requirements -> DOE:RCRA low-level disposal facilities do not exist. Waste streams that could be disposed at such a facility need to be identified. Facilities then need to be permitted and constructed to enable the disposal of these wastes. Waste meeting the disposal criteria for a DOE RCRA lowlevel waste disposal facility may also be able to be disposed at a commercial RCRA low-level waste disposal facility



Name: Disposal

Matrix: All

Science and Technology Alternative/Technology Implementation Analysis Status **Problem Area** Needs DOE RCRA ALPHA-CONTAMINATED DOE RCRA alpha-contaminated low-level No science or technology requirements need to be resolved to dispose of waste disposed facilities do not exist. → DOE RCRA alpha-contaminated low-level need to be resolved to dispose of wastes disposal facilities do not exist. Waste Such facilities could dispose of alpha lowat DOE RCRA alpha-contaminated lowstreams to be disposed at such a facility level mixed wastes (alpha low-level level waste disposal facilities. Adequate need to be identified. Facilities then need radioactive contaminated wastes com-DOE RCRA alpha-contaminated low-level disposal technology design criteria, in the to be permitted and constructed to enable bined with RCRA hazardous wastes) in concentrations <= 100 nCirg. Types of waste disposal facilities would accept and form of approved hazardous waste disthe disposal of these waste streams. dispose of alpha-contaminated low-level posal facility construction criteria and DOE wastes that could be included in this cate-gory are incineration residuals, drums. mixed wastes (reclassified low-level low-level waste disposal criteria, already radioactive wastes combined with RCRA hazardous wastes). These disposal facilipersonnel protective equipment, fly ash and wastes generated from the operation ties would be specifically constructed to of pollution control equipment. Status of this disposal technology is conceptual. Performance data on DOE RCRA alpha-contaminated low-level waste disposal dispose of waste that is contaminated with alpha-emitting transuranic radionuclides having half-lives greater than 20 years and concentrations in the range of ~ 10-100 nCi/g. In addition to complying with facilities is not available. DOE Orders, these facilities are required to obtain RCRA hazardous waste disposal permits from the EPA (or EPA-authorized state agencies) to comply with the regulations of 40 CFR Parts 261-265, governing the land disposal of hazardous wastes. GEOLOGIC REPOSITORY ➤ The DOE's geologic repository, WIPP, — could be an option for the disposal of TRU need to be resolved to dispose of waste at facility must be completed before waste Geologic repositories are facilities that mixed-wastes (transurante wastes comthe DOE's geologic repository. The can be accepted for disposal. could dispose of TRU mixed-wastes bined with RCRA hazardous wastes): repository has been constructed and is in (transuranic wastes combined with RCRA Types of wastes that could be included in the process of obtaining permits and this category are incineration residues. hazardous wastes). These repositories approvals that will enable it to commence are constructed in geologic formations stabilized glass and ash, slags, and other operation. deep underground. The DOE's Waste solidified wastes with radioactive concen-Isolation Pilot Project (WIPP) is such a trations s 100 nCi/g. This disposal tech-nology is awaiting demonstration. WIPP repository. DOE Orders define transuranic waste as containing elements whose is currently in the process of obtaining a atomic number is > 92 with concentrations no-migration variance from the EPA and > 100 nCl/g. DOE Orders will govern dis-Is expected to begin receiving wastes in posal of the transuranic component of the year 2000. Performance data on geothese wastes. EPA regulations found at logic repositories, in the form of performance models, is being gathered by the DOE. Currently, the WIPP waste accep-40 CFR Parts 261-265 govern disposal of the RCRA-regulated hazardous component of these wastes, thus a disposal pertance criteria dictate that it cannot accept mit from the EPA (or EPA-authorized state wastes that have been generated from environmental restoration related or nonagency) would be required. detense related activities.

Table 1.
SAMPLING OF RADIONUCLIDES FROM

Radionuclide	Chemical and/or Physical Form	Maximum Average Concentration*
Americium	Volumetric bulky materials	0.23 nCi/g
Barium 133	Volumetric bulky materials	4.0 nCi/g
Cobalt 60	Volumetric bulky materials	0.36 nCi/g
Cesium 137	Volumetric bulky materials	0.56 nCi/g
Curium 244	Volumetric bulky materials	10 nCi/g
Lead 210	Volumetric bulky materials	230 nCi/g
Potassium 40	Volumetric bulky materials	10 nCi/g
Plutonium	Volumetric bulky materials	8.2 nCi/g
Plutonium 239	Volumetric bulky materials	9.9 nCi/g
Plutonium	Volumetric bulky materials	10 nCi/g
Plutonium	Volumetric bulky materials	350 nCi/g
Plutonium	Volumetric bulky materials	10 nCi/g
Radium 228	Volumetric bulky materials	1.8 nCi/g
Strontium 90	Volumetric bulky materials	20 nCi/g
Thorium 230	Volumetric bulky materials	15 nCi/g
Uranium	Volumetric bulky materials	18 nCi/g
Uranium	Volumetric bulky materials	110 nCi/g
Uranium 234 .	Volumetric bulky materials	37 nCi/g
Uranium 238	Volumetric bulky materials	28 nCi/g
Yttrium 90	Volumetric bulky materials	20 nCi/g

^{*} averaged over entire load of waste.