Attachment II-1-12-3

# Thermal Desorption

# CMBST-Coded Waste
# Pre-Demonstration Plan

**Original Submission**
**April 23, 2008**

**Revised**
**December 30, 2010**

**CMBST-Coded Waste**
**Pre-Demonstration Plan**

## Table of Contents

# Section 1 - Introduction

The U. S. Environmental Protection Agency (US EPA) has designated certain commercial chemical products as requiring treatment by the CMBST technology code in order to meet Land Disposal Restriction (LDR) requirements. The hazardous waste treatment standards are listed in 40 CFR 268.40 and the specific technology codes are described in 40 CFR 268.42. These treatment standards and technology codes have been incorporated by reference into the Utah Hazardous Waste Management Rules of R315-13. In these regulations, the CMBST technology code is defined as:

> "High temperature organic destruction technologies, such as combustion in incinerators, boilers, or industrial furnaces operated in accordance with the applicable requirements of 40 CFR part 264, subpart O, or 40 CFR part 265, subpart O, or 40 CFR 266 subpart H, and in other units operated in accordance with applicable technical operating requirements; and certain non-combustive technologies, such as the Catalytic Extraction Process."

The Thermal Desorption (TD) unit at the Permittee's facility is not a combustion process and therefore does not need to comply with the requirements of a high temperature organic destruction technology. A national variance request has been filed with the US EPA and a proposed rule has been drafted for publication in the Federal Register to allow the processing of wastes carrying the CMBST code through the TD unit, in lieu of an incinerator, and then allowing disposal of the residual solid processed material in the Permittee's Mixed Waste Landfill Cell.

This Pre-Demonstration Plan (PDP) provides requirements to conduct Waste Family Demonstration Testing within the TD unit for hazardous wastes requiring the CMBST treatment technology prior to disposal. This testing shall be designated CMBST Waste Family Demonstration Testing to distinguish it from the volatile organic compound (VOC) and semi-volatile organic compound (SVOC) Waste Family Demonstration Testing described in Attachment II-1-12-2, *Pre-Demonstration Plan for Volatile and Semi-volatile Organic Compounds*. The CMBST Waste Family Demonstration Testing shall determine the viability of the TD unit for processing waste containing CMBST codes. Furthermore, the CMBST Waste Family Demonstration Testing is designed to demonstrate that air emissions from the process will be minimized and shall be protective of human health and the environment.

Preliminary Operational Parameters for the CMBST Waste Family Demonstration Testing have been established based on the TD unit design and past experience with similar waste families. Final Operational Parameters shall be established based on the results of the CMBST Waste Family Demonstration Testing.

Attachment II-1-12-2 contains descriptions of a preliminary system test and Waste Family Demonstration Testing for volatile and semi-volatile organic compounds. This Attachment contains descriptions of the CMBST Waste Family Demonstration Testing and consists of a test of the air pollution control (APC) equipment and a test of the operability of the system. Attachment II-1-12-2 provides a majority of the preparatory work for the CMBST Waste Family

Demonstration Testing described in this Attachment and will be referenced consistently throughout this Attachment.

As required in Condition 2.b. of Attachment II-1-12-1, *Thermal Desorption Shakedown Operations and Waste Family Demonstration Testing*, this Attachment has been created to supplement the Demonstration Testing plan described in Attachment II-1-12-2, *Pre-Demonstration Plan for Volatile and Semi-volatile Organic Compounds*.

For consistency, Sections within this Attachment correspond with Sections within Attachment II-1-12-2.

The CMBST-Coded Waste PDP includes:

- a review of results from previous demonstration tests (Section 9);
- a description of the mixed waste feed material used during the CMBST Waste Family Demonstration Testing (Section 7);
- Data Quality Objectives (DQOs) (Section 5);
- analytical verification testing to achieve the DQOs (Section 7);
- a Sampling and Analysis Plan (Section 7);
- quality assurance/quality control (QA/QC) measures for operational testing and analytical data (Section 7);
- expected secondary waste streams and by-products and a discussion of their final disposition (Section 7);
- an outline of the testing (Section 7); and
- personnel (positions) necessary to complete the testing (Section 9).

The TD unit has not been changed from the description within Attachment II-1-12-2, therefore, the language within Attachment II-1-12-2 remains valid.

This Attachment provides a basis for the CMBST Waste Family Demonstration Testing. Additional details shall be provided in the schedule submitted in accordance with Condition 5.b. of Attachment II-1-12-1.

## 1.1 *Definitions*

The definitions of terms used within this Attachment are found in Attachment II-1-12, *Thermal Desorption Separation Plan*.

### *1.2 Acronyms*

The following acronyms are used within this Attachment:

| | | |
|---|---|---|
| APC | = | air pollution control |
| ASTM | = | American Society of Testing Materials |
| AWFCO | = | Automatic Waste Feed Cut-Off system |
| BP | = | boiling point |
| CE | = | condenser efficiency |
| CMBST | = | High temperature organic destruction technologies |
| CLP | = | Contract Laboratory Program |
| DOE | = | Department of Energy |
| dscf | = | Dry Standard Cubic Feet |
| DQO | = | Data Quality Objective |
| LDR | = | Land Disposal Restrictions |
| PDP | = | Pre-Demonstration Plan |
| POHC | = | principal organic hazardous constituent |
| PQL | = | practical quantitation limit |
| QA/QC | = | Quality Assurance/Quality Control |
| RCRA | = | Resource Conservation and Recovery Act |
| RE | = | removal efficiency |
| SCFM | = | standard cubic feet per minute |
| SVOC | = | semi-volatile organic compound |
| TCLP | = | Toxicity Characteristic Leaching Procedure |
| TD | = | thermal desorption |
| TE | = | treatment efficiency |
| TIC | = | tentatively identified compound |
| US EPA | = | United States Environmental Protection Agency |
| VOC | = | volatile organic compound |

# Section 2 – Demonstration Objectives

The TD unit is a separation device designed to treat wastes with volatile constituents to concentrations below LDR standards within the solid processed material. The volatile constituents are concentrated in a liquid condensate stream that shall be sent to a permitted Resource Conservation and Recovery Act (RCRA) facility to be thermally treated using a high temperature organic destruction technology that meets the definition of the CMBST treatment technology code.

Theoretically, all contaminants with boiling points below the operating temperature of the TD unit should be separated from the solid matrix and concentrated in the liquid condensate. Those contaminants that do not have defined boiling points may decompose at elevated temperatures. Furthermore, testing and full-scale operation of similar thermal desorption units operated by the Permittee's TD contractor has demonstrated that compounds that boil within about 150 ˚F of the operating temperature of the TD unit are generally separated from the solid matrix to levels well below 1 ppm. The CMBST Waste Family Demonstration Testing is designed to ensure that the separation occurs as expected and that matrix effects within the waste do not inhibit the separation process and that the process introduces minimal risk to human health and the environment.

During CMBST Waste Family Demonstration Testing, data shall be collected to determine System and Operating Parameters for the TD unit while processing CMBST-coded waste. Sampling and analysis shall be performed to verify regulatory compliance.

## *2.1 Risk Assessments*

A detailed preliminary risk assessment has been completed for thermal desorption operations in a document dated July 14, 2003 (see Condition II.T.5.d. of this Permit). Additional risk assessments were performed using the data from previous Waste Family Demonstration Testing of the TD unit; a description of these additional risk assessments is provided in Section 9.3 of this Attachment.

In order to verify the assumptions of the preliminary risk assessment, a risk assessment shall be performed using the actual vent gas emissions detected during CMBST Waste Family Demonstration Testing. This CMBST Post-Waste Family Demonstration Testing risk assessment shall consider both direct and indirect exposure pathways for constituents found in the vent gas.

## *2.2 Demonstration Plan Objectives*

The objectives of this plan and the associated CMBST Waste Family Demonstration Testing are:

- To determine if the TD process provides adequate separation for the processing of wastes containing CMBST-codes.

- Demonstrate that the processed material is LDR compliant for POHCs and that all analyzable CMBST-coded contaminants are below the practical quantitation limit (PQL) of the analytical method for each specific contaminant.

- Identify and justify representative principal organic hazardous constituents (POHCs) for the entire range of CMBST-coded wastes.

- Demonstrate that the waste constituents are accounted for through analyses of the mixed waste feed material, spikes, processed material, and vent gas.

- Demonstrate, for each POHC, that removal efficiencies (RE) of at least 99.99% are attained.

- Perform a risk assessment using the vent gas results of CMBST Waste Family Demonstration Testing to verify the assumptions of the preliminary risk assessment.

- Evaluate the Secondary Waste Streams generated during TD processing to determine treatment and disposal options.

- Demonstrate that the TD unit, as designed, complies with all applicable conditions of the Permittee's State-Issued Part B Permit and Radioactive Material License.

# Section 3 – Physical Description of Technology

Since no equipment or process changes have been made to the TD unit, the technology description has not changed from the description provided in Section 3 of Attachment II-1-12-2.

# Section 4 – Technical Approach

The CMBST Waste Family Demonstration Testing objectives shall be accomplished by monitoring System Parameters during operation and by acquiring analytical data over the course of CMBST Waste Family Demonstration Testing.

Attachment II-1-12-2 describes three separate testing phases for the demonstration of the VOC and SVOC waste families. These testing phases have been completed in previous Waste Family Demonstration Testing events. This plan describes an additional Waste Family Demonstration Testing phase for the CMBST-coded wastes Waste Family: the CMBST APC Waste Family Demonstration Testing phase. As described below, the preliminary testing and operational testing phases will not be required during CMBST Waste Family Demonstration Testing.

The preliminary testing phase of the TD unit consisted of functional testing, system testing, and shakedown operations. Functional and system testing was completed prior to the Waste Family Demonstration Testing for the VOC and SVOC Waste Families. These test phases are described in Section 4.1 of Attachment II-1-12-2 with details provided in Appendix B of that Attachment. In summary, these tests were performed during construction of the TD unit prior to mobilization to the Permittee's facility and again at the Permittee's facility after it was re-assembled. Shakedown operations were conducted for the VOC and SVOC Waste Families to determine appropriate operating conditions for the Waste Family Demonstration Testing. The contaminants within the CMBST-coded wastes Waste Family have similar chemical behavior and separation characteristics to the contaminants within the VOC and SVOC Waste Families. Therefore, shakedown operations will not be required and the operating conditions confirmed during previous Waste Family Demonstration Testing shall be used during the CMBST Waste Family Demonstration Testing.

The purpose of the operational testing phase was to determine the capabilities of the TD unit to process different waste matrices. Operational testing was completed on soils, sludges, and solid waste matrices during previous Waste Family Demonstration Testing events. Since the contaminants associated with the CMBST-coded wastes Waste Family are similar to the VOC and SVOC Waste Families, additional operational testing is not required during CMBST Waste Family Demonstration Testing.

This attachment details the CMBST APC Waste Family Demonstration Testing phase. The APC testing phase is the only phase of testing required for this Demonstration Testing. For convenience, future references to the CMBST Waste Family Demonstration Testing within this plan will imply the APC testing phase.

## *4.1 CMBST Waste Family Demonstration Testing*

The CMBST Waste Family Demonstration Testing is designed to determine the TD unit APC system capabilities. This will be accomplished by processing mixed waste containing CMBST-coded contaminants and applicable POHCs corresponding to the separation properties of CMBST-coded contaminants. The results of CMBST Waste

Family Demonstration Testing will be used to set the Operational Parameters for the CMBST-coded wastes Waste Family. All subsequent processing of the feed material within the CMBST-coded wastes Waste Family shall be limited to the Operational Parameters developed during CMBST Waste Family Demonstration Testing.

The CMBST Waste Family Demonstration Testing shall consist of three process runs using mixed waste containing CMBST-codes spiked with applicable POHCs. The effect of moisture content within the waste has been previously examined within the APC Waste Family Demonstration Test for VOCs and SVOCs described in Section 4.2 of Attachment II-1-12-2. Therefore, the CMBST Waste Family Demonstration Test is only necessary on either wet or dry waste but not both. These process runs shall be used to determine the emissions and removal efficiencies of CMBST-coded contaminants and applicable POHCs through the TD unit.

In addition to the data objectives of CMBST Waste Family Demonstration Testing, other Operational and System Parameters shall be monitored according to the frequencies outlined in Table 7-1 of Attachment II-1-12-2. These data objectives shall be accomplished by collecting samples from the feed, processed material, condensate and vent gas.

# Section 5 – Data Quality Objectives

Data Quality Objectives (DQOs) have been established for the Waste Family Demonstration Testing to ensure that Thermal Desorption is a viable option for treating mixed wastes containing CMBST codes. These DQOs have been established using guidance provided by the US EPA, "Guidance for the Data Quality Objectives Process", US EPA QA/G-4 dated September 1994 (EPA/600/R-96/055).

The DQO process consists of seven steps: (1) state the problem, (2) identify the decision, (3) identify inputs to the decision, (4) define the study boundaries, (5) develop the decision rule, (6) specify limits on decision errors, and (7) optimize the design for obtaining data. More detailed descriptions of each step are described in Section 5 of Attachment II-1-12-2.

## *5.1 State the Problem*

**Problem statement:** To collect data that demonstrate Thermal Desorption as a viable option for treating mixed wastes containing CMBST codes.

**Planning Team:** The planning team includes: from the TD contractor, the Thermal Engineer and the Operations Manager; and from the Permittee, the Environmental Engineer, the Quality Assurance Manager, the Lab Manager, and the Director of Mixed Waste Operations. The Permittee's Environmental Engineer is the primary decision maker for this project.

## *5.2 Identify the Decision*

Determine whether all spiked POHC REs and primary known CMBST-coded waste contaminants (those CMBST-coded contaminants that can be analyzed and whose contribution is greater than 1% of the total organic concentration fed into the VTD unit) are greater than 99.99% and support continued operation of the TD unit. Additionally, after all treatment has been completed, all analyzable CMBST-coded contaminants shall be below their respective analytical method PQLs. Other contaminants, including POHCs, shall be below US EPA treatment standards (i.e., LDR-compliant) in the solid processed material prior to disposal.

## *5.3 Identify the Inputs to the Decision*

In order to estimate POHC and primary known CMBST-coded waste contaminant REs, it will be necessary to evaluate the concentration of each POHC and primary known CMBST-coded waste contaminant fed into the dryer and emitted to the atmosphere. To perform risk-based calculations, the concentration of POHC(s) emitted to the atmosphere shall be required. The variables needed are the POHC

and primary known CMBST-coded waste contaminant concentration(s) that are quantified using applicable US EPA Methods.

LDR compliance of the processed material shall be determined by obtaining representative samples of the processed material and analyzing for all potential contaminants that have analytical methods associated with their detection.- This analysis includes contaminants that are associated with both CMBST-coded and non CMBST–coded wastes. The variables associated with sampling and analysis are the representativeness of the sample and the applicability of the POHCs to the known contaminants that do not have analytical methods.

### *5.4 Define the Boundaries of the Study*

Since the TD unit is a batch process, the boundaries are defined by the amount of feed material introduced into the system. One constraint is the laboratory analytical method PQLs and potential interferences associated with the feed, vent gas, and processed material. A further constraint for CMBST-coded wastes is that many contaminants in this waste family do not have approved analytical methods and cannot be analyzed. Therefore, POHCs become a greater factor as surrogates for these non-analyzable contaminants.

Potential errors may occur because the parameter of interest is estimated using data that are subjected to different variabilities from sample collection to sample analysis. Errors within sampling collection shall be controlled through Quality Assurance/Quality Control (QA/QC) sampling, including duplicates, equipment blanks, and field blanks. These techniques are discussed in Section 7.4.1 of this Attachment. Errors within sample analysis shall be minimized by performing data validation as described in Section 7.7 of Attachment II-1-12-2. Quality assurance measures are briefly described in Section 7.6 of this Attachment.

Section 7.4 of this Attachment describes the sampling of the feed and processed material for the CMBST Waste Family Demonstration Testing. All POHC spikes shall be certified by the manufacturer, where certification is possible, or the POHCs may be analyzed by the Permittee to characterize the spike material. Emissions testing shall be performed by personnel who are experienced and qualified in the sampling and analytical methods. The boundary of emission sampling shall be contingent upon the method utilized; EPA Method 0010 is the limiting emission sampling method utilized during this Testing and requires a minimum sample volume of three dry standard cubic meters (105.9 dry standard cubic feet).

A potential measurement error may exist through the assumption that POHCs are representative surrogates of ranges of CMBST-coded contaminants. This error is minimized through careful selection of POHCs used as surrogates. This careful selection requires a review of chemical separation characteristics of both the POHC surrogate and the CMBST-coded contaminants for which the POHC surrogate is being used. Section 6 of this Attachment describes the chemical separation characteristics of both the CMBST-

coded contaminants and the POHC surrogates. Section 6.1 describes the CMBST-coded wastes Waste Family. Section 6.2 describes the justification used for the selected POHC surrogates. The specific waste stream designated for the CMBST Waste Family Demonstration Testing is described in Section 7.3.

### *5.5 Develop a Decision Rule*

If the maximum vent gas mass of each POHC and primary known CMBST-coded contaminant exceeds 0.0001 times the mass fed into the TD unit and the exceedance is not approved by the Executive Secretary, then the CMBST Waste Family Demonstration Testing fails.

The CMBST Waste Family Demonstration Testing fails if, after all treatment and re-treatment has been completed, any CMBST-coded contaminants are detected within the solid processed material above their associated analytical method PQLs or if any of the POHCs are detected above their respective LDR treatment standards.

If the second risk assessment required by Section 2.1 of this Attachment indicates that the standards for the protection of human health and the environment are not met, then the CMBST Waste Family Demonstration Testing fails.

### *5.6 Specify Tolerable Limits on Decision Errors*

The possibility of decision error exists because the parameter of interest is estimated using data that has been subjected to sampling design error and measurement error. The first baseline condition (null hypothesis) for CMBST Waste Family Demonstration Testing is defined by an RE of greater than 99.99% for each POHC and primary known CMBST-coded contaminant. A false positive decision error occurs when the CMBST Waste Family Demonstration Testing was a failure when it actually produced acceptable emissions. The consequences of a false positive decision error are that processing could not be conducted through the TD unit and additional money and time would be invested into fixing the problem that did not exist. These consequences of this false positive decision error do not adversely affect public health or the environment and therefore have a high tolerance. The consequences of a false negative decision error would be that TD processing would be conducted under a hazardous emission scenario. This negative decision error has a much lower tolerance level than the false positive decision error and shall be controlled through the quality assurance of the emission sampling methods. A 'Gray Region' exists where the 99.99% RE may not be met but the risk associated with the emission is demonstrated not to adversely affect human health or the environment.

The second baseline condition is defined by the concentration of contaminants in the processed material. A false positive decision error occurs when the TD unit unsuccessfully treats the waste to LDR treatment standards or the analyzable CMBST-coded contaminants are detected above their respective analytical method PQLs when in actuality the LDR treatment standards were met. The consequences of a false positive decision error are that additional processing through the TD unit would be required or

that CMBST-coded wastes could not be successfully processed through the TD unit. This is tolerable since additional process runs may be completed to bring the processed material to acceptable levels. A false negative decision error occurs when the TD unit successfully treated the waste to LDR treatment standards and CMBST PQLs when in actuality the LDR treatment standards were not met and the processed material was not LDR-compliant. The consequence of a false negative decision error would be that processed material that was not LDR-compliant was disposed in the Permittee's Mixed Waste Landfill Cell. Through analytical testing, the magnitude of a false negative decision error would be minimal and the results tolerable since the processed material shall be placed in an engineered triple-lined hazardous waste landfill cell with continual leachate and groundwater monitoring. A 'Gray Region' exists where the CMBST PQLs may be exceeded by a small margin and quality control of the analytical method demonstrates that the quality control samples are slightly above actual concentrations, but remain within quality tolerances.

The burden of proof is placed on rejecting the baseline conditions, which are true, until overwhelming evidence is presented to indicate that the baseline conditions are not true.

### *5.7 Optimize the Design for Obtaining Data*

Section 7 of this Attachment outlines the minimum sampling technique and processes the Permittee shall use. Other sampling techniques that may be used include: discrete sampling and analysis of feed and processed material streams (without compositing), mass spectroscopy analyses of data, further delineation of tentatively identified compounds (TICs) within the analyses, and additional QA/QC samples. Additional data collection and analysis techniques may be utilized, if required, due to the potential for false negative or false positive decision errors, as explained in the previous section. Any reduction or replacement to the sampling or analysis plans, as described in this Attachment, shall be submitted to the Executive Secretary for approval prior to implementation. The Permittee shall detail and justify any reduction or replacement sampling within the CMBST Post-Waste Family Demonstration Testing Report. The Permittee may conduct additional sampling as long as the minimum sampling requirements, as detailed in this Attachment, are completed.

### *5.8 Other Decision Errors*

Other potential decision errors are discussed in Section 5.8 of Attachment II-1-12-2. The CMBST Waste Family Demonstration Testing is specific to CMBST-coded contaminants only; therefore, these other decision errors are not directly applicable to this plan.

# Section 6- Description of Waste Families

This section describes the CMBST-coded wastes Waste Family. A discussion of waste families, in general, is provided in Section 6.1 of Attachment II-1-12-2. Specifics on testing protocols and procedures are provided in Section 7 of this Attachment.

## *6.1 CMBST-coded wastes Waste Family*

The CMBST-coded wastes Waste Family, as used for this demonstration, consists of mixed wastes with "P" and "U" listed hazardous waste codes that require CMBST as the only nonwastewater treatment standard as defined in 40 CFR 268.40. This Waste Family does not include waste contaminated with those hazardous waste codes that have an alternative treatment standard in addition to CMBST (e.g., U003: acetonitrile with a treatment standard of CMBST and an alternate treatment standard of 38 mg/kg; or U103: dimethyl sulfate with the treatment standard choices of CHOXD; CHRED; or CMBST).

There are 139 listed hazardous waste codes that meet this definition and comprise the CMBST-coded wastes Waste Family. Of the 139, 45 are "P" hazardous waste listed and 94 are "U" hazardous waste listed. Table 6.1-1 lists the 139 compounds associated with this waste family. Compounds that have certified analytical methods associated with there detection are highlighted within Tables 6.1-1 and 6.1-2.

**Table 6.1-1** Compounds within the CMBST-coded wastes Waste Family

| Hazardous Code | Compound | CAS Number |
|---|---|---|
| P001 | Warfarin (> 0.3%) | 81-81-2 |
| P002 | 1-acetyl-2-thiorea | 591-08-2 |
| P003 | Acrolein | 107-02-8 |
| P005 | Allyl Alcohol | 107-18-6 |
| P007 | 5-Aminomethyl 3-isoxazolol | 2763-96-4 |
| P008 | 4-Aminopyridine | 504-24-5 |
| P014 | Thiophenol (Benzene thiol) | 108-98-5 |
| P016 | Dichloromethyl ether | 542-88-1 |
| P017 | Bromoacetone | 598-31-2 |
| P018 | Brucine | 357-57-3 |
| P023 | Chloroacetaldehyde | 107-20-0 |
| P026 | 1-(o-Chlorophenyl)thiourea | 5344-82-1 |
| P027 | 3-Chloropropionitrile | 542-76-7 |
| P028 | Benzyl Chloride | 100-44-7 |
| P034 | 2-Cyclohexyl-4,6-dinitrophenol | 131-89-5 |
| P040 | 0,0-Diethyl O-pyrazinyl phosphorothioate | 297-97-2 |
| P041 | Diethyl-p-nitrophenyl phosphate | 311-45-5 |
| P042 | Epinephrine | 51-43-4 |

**Table 6.1-1** Compounds within the CMBST-coded wastes Waste Family

| Hazardous Code | Compound | CAS Number |
|---|---|---|
| P043 | Diisopropylfluorophosphate (DFP) | 55-91-4 |
| P044 | Dimethoate | 60-51-5 |
| P045 | Thiofanox | 39196-18-4 |
| P046 | alpha, alpha-Dimethylphenethylamine | 122-09-8 |
| P049 | Dithiobiuret | 541-53-7 |
| P054 | Aziridine | 151-56-4 |
| P057 | Fluoroacetamide | 640-19-7 |
| P058 | Fluoroacetic acid, sodium salt | 62-74-8 |
| P062 | Hexaethyl tetraphosphate | 757-58-4 |
| P064 | Isocyanic acid, ethyl ester | 624-83-9 |
| P066 | Methomyl | 16752-77-5 |
| P067 | 2-Methyl-aziridine | 75-55-8 |
| P069 | 2-Methyllactonitrile | 75-86-5 |
| P070 | Aldicarb | 116-06-3 |
| P072 | 1-Naphthyl-2-thiourea | 86-88-4 |
| P075 | Nicotine and Salts | 54-11-5 |
| P084 | N-Nitrosomethylvinylamine | 4549-40-0 |
| P085 | Octamethylpyrophosphoramide | 152-16-9 |
| P088 | Endothall | 145-73-3 |
| P093 | Phenylthiourea | 103-85-5 |
| P095 | Phosgene | 75-44-5 |
| P102 | Propargyl alcohol | 107-19-7 |
| P108 | Strychnine and salts | 57-24-9 |
| P109 | Tetraethyldithiopyrophosphate | 3689-24-5 |
| P111 | Tetraethylpyrophosphate | 107-49-3 |
| P116 | Thiosemicarbazide | 79-19-6 |
| P118 | Trichloromethanethiol | 75-70-7 |
| | | |
| U001 | Acetaldehyde | 75-07-0 |
| U006 | Acetyl Chloride | 75-36-5 |
| U007 | Acrylamide | 79-06-1 |
| U008 | Acrylic Acid | 79-10-7 |
| U010 | Mitomycin C | 50-07-7 |
| U011 | Amitrole | 61-82-5 |
| U014 | Auramine | 492-80-8 |
| U015 | Azaserine | 115-02-6 |
| U016 | Benz(c)acridine | 225-51-4 |
| U017 | Benzal chloride | 98-87-3 |
| U020 | Benzenesulfonyl Chloride | 98-09-9 |
| U021 | Benzidine | 92-87-5 |
| U026 | Chlornaphazine | 494-03-1 |

**Table 6.1-1** Compounds within the CMBST-coded wastes Waste Family

| Hazardous Code | Compound | CAS Number |
|---|---|---|
| U033 | Carbon Oxyfluoride | 353-50-4 |
| U034 | Trichloroacetaldehyde (Chloral) | 75-87-6 |
| U035 | Chloroambucil | 305-03-3 |
| U038 | Chlorobenzilate | 510-15-6 |
| U041 | Epichlorohydrin (1-Chloro-2,3-epoxypropane) | 106-89-8 |
| U042 | 2-Chloroethyl vinyl ether | 110-75-8 |
| U046 | Chloromethyl methyl ether | 107-30-2 |
| U049 | 4-Chloro-o-toluidine hydrochloride | 3165-93-3 |
| U053 | Crotonaldehyde | 4170-30-3 |
| U055 | Cumene (Isopropylbenzene) | 98-82-8 |
| U056 | Cyclohexane | 110-82-7 |
| U058 | Cyclophosphamide | 50-18-0 |
| U059 | Daunomycin | 20830-81-3 |
| U062 | Diallate | 2303-16-4 |
| U064 | Dibenz(a,i)pyrene | 189-55-9 |
| U073 | 3,3`-Dichlorobenzidine | 91-94-1 |
| U074 | cis,1,4-Dichloro-2-butene | 1476-11-5 |
| U074 | trans-1,4-Dichloro-2-butene | 764-41-0 |
| U085 | 1,2,3,4-Diepoxybutane | 1464-53-5 |
| U087 | O,O-Diethyl S-methyldithiophosphate | 3288-58-2 |
| U089 | Diethyl Stilbestrol | 56-53-1 |
| U090 | Dihydrosafrole | 94-58-6 |
| U091 | 3,3`-Dimethoxybenzidine | 119-90-4 |
| U092 | Dimethylamine | 124-40-3 |
| U093 | p-Dimethylaminoazobenzene | 60-11-7 |
| U094 | 7,12-Dimethylbenz(a)anthracene | 57-97-6 |
| U095 | 3,3`-Dimethylbenzidine | 119-93-7 |
| U097 | Dimethylcarbamoyl chloride | 79-44-7 |
| U110 | Dipropylamine | 142-84-7 |
| U113 | Ethyl Acrylate | 140-88-5 |
| U114 | Ethylenebisdithiocarbamic acid | 111-54-6 |
| U116 | Ethylene thiourea | 96-45-7 |
| U119 | Ethyl Methane Sulfonate | 62-50-0 |
| U122 | Formaldehyde | 50-00-0 |
| U123 | Formic Acid | 64-18-6 |
| U124 | Furan | 110-00-9 |
| U125 | Furfural | 98-01-1 |
| U126 | Glycidyaldehyde | 765-34-4 |
| U132 | Hexachlorophene | 70-30-4 |
| U143 | Lasiocarpine | 303-34-4 |
| U147 | Maleic Anhydride | 108-31-6 |

**Table 6.1-1** Compounds within the CMBST-coded wastes Waste Family

| Hazardous Code | Compound | CAS Number |
|---|---|---|
| U148 | Maleic Hydrazide | 123-33-1 |
| U149 | Malononitrile | 109-77-3 |
| U150 | Melphalan | 148-82-3 |
| U153 | Methanethiol | 74-93-1 |
| U156 | Methyl chlorocarbonate | 79-22-1 |
| U163 | N-Methyl N`-nitro N-nitrosoguanidine | 70-25-7 |
| U164 | Methylthiouracil | 56-04-2 |
| U166 | 1,4-Naphthoquinone | 130-15-4 |
| U167 | 1-Naphthylamine | 134-32-7 |
| U168 | 2-Naphthylamine | 91-59-8 |
| U171 | 2-Nitropropane | 79-46-9 |
| U173 | N-Nitrosodiethanolamine | 1116-54-7 |
| U176 | N-Nitroso-N-ethylurea | 759-73-9 |
| U177 | N-Nitroso-N-methylurea | 684-93-5 |
| U178 | N-Nitroso-N-methylurethane | 615-53-2 |
| U182 | Paraldehyde | 123-63-7 |
| U186 | 1,3-Pentadiene | 504-60-9 |
| U191 | 2-Picoline | 109-06-8 |
| U193 | 1,3-Propane sultone | 1120-71-4 |
| U194 | n-Propylamine | 107-10-8 |
| U197 | p-Benzoquinone | 106-51-4 |
| U200 | Reserpine | 50-55-5 |
| U201 | Resorcinol | 108-46-3 |
| U202 | Saccharin | 81-07-2 |
| U206 | Streptozotocin | 18883-66-4 |
| U213 | Tetrahydrofuran | 109-99-9 |
| U218 | Thioacetamide | 62-55-5 |
| U219 | Thiourea | 62-56-6 |
| U221 | Toluenediamine | 25376-45-8 |
| U222 | o-Toluidine hydrochloride | 636-21-5 |
| U223 | Toluene diisocyanate | 26471-62-5 |
| U234 | 1,3,5-Trinitrobenzene | 99-35-4 |
| U236 | Trypan Blue | 72-57-1 |
| U237 | Uracil mustard | 66-75-1 |
| U238 | Urethane (Ethyl carbamate) | 51-79-6 |
| U244 | Thiram | 137-26-8 |
| U248 | Warfarin (< 0.3%) | 81-81-2 |
| U328 | o-Toluidine | 95-53-4 |
| U353 | p-Toluidine | 106-49-0 |
| U359 | 2-Ethoxyethanol | 110-80-5 |

The primary chemical characteristic for separation within the TD unit is the boiling point (BP) of the compound. The boiling points of the 139 compounds in the CMBST-coded wastes Waste Family are varied, ranging from -120 ˚F for carbon oxyfluoride (U033) to 993.2 ˚F for mitomycin C (U010). The boiling point data for the compounds within the CMBST-coded wastes Waste Family are listed in Table 6.1-2 from highest to lowest boiling point. The bottom of the Table includes the sources and citations from which the compound's information was obtained. The Table also includes a notes column which provides additional information on the boiling point information presented. Some of the compounds only had melting points listed but no boiling point data. In general, the compound is listed this way because a traditional boiling point is never reached due to decomposition of the compound. Other compounds sublime (change directly from a solid phase to a gas phase without reaching the liquid phase) and are listed as such. A handful of compounds could not be found in the literature. For these compounds, structurally similar chemical compounds were examined and noted in the table.

**Table 6.1-2** Boiling Points of CMBST-coded wastes Waste Family Compounds

| Hazardous Code | Compound | BP (˚F) | Notes | Source |
|---|---|---|---|---|
| U010 | Mitomycin C | 993.2 | | TOXNET |
| U132 | Hexachlorophene | 894.2 | | TOXNET |
| P018 | Brucine | 878 | | NTP |
| U021 | Benzidine | 753.8 | | TOXNET |
| U073 | 3,3`-Dichlorobenzidine | 694.4 | | TOXNET |
| U091 | 3,3`-Dimethoxybenzidine | 673 | | TOXNET |
| U116 | Ethylene thiourea | 656.9 | | TOXNET |
| U095 | 3,3`-Dimethylbenzidine | 642.2 | | TOXNET |
| U164 | Methylthiouracil | 627.8 | Sublimes | Merck |
| | | | | |
| U234 | 1,3,5-Trinitrobenzene | 599 | | TOXNET |
| P057 | Fluoroacetamide | 573.4 | Sublimes | Spectrum, Merck |
| P072 | 1-Naphthyl-2-thiourea | 573.4 | | Spectrum |
| U167 | 1-Naphthylamine | 573.4 | | TOXNET |
| U168 | 2-Naphthylamine | 572 | | TOXNET |
| U236 | Trypan Blue | 572 | Decomposes | TOXNET & MSDS – ScienceLab.com |
| U087 | O,O-Diethyl S-methyldithiophosphate | < 572 | Based on other Phosphoric acids | CRC |
| U193 | 1,3-Propane sultone | 563 | Decomposes | Chemical Land |
| U221 | Toluenediamine | 541.4 | | CRC |
| U201 | Resorcinol | 536 | | TOXNET |
| U064 | Dibenz(a,i)pyrene | 538.7 | MP | TOXNET |
| P008 | 4-Aminopyridine | 523.4 | | TOXNET |
| U200 | Reserpine | 507.2 | Decomposes | MSDS – ScienceLab.com |

**Table 6.1-2** Boiling Points of CMBST-coded wastes Waste Family Compounds

| Hazardous Code | Compound | BP (˚F) | Notes | Source |
|---|---|---|---|---|
| U148 | Maleic Hydrazide | 500 | Decomposes | Merck |
| U020 | Benzenesulfonyl Chloride | 485.6 | | TOXNET |
| U223 | Toluene diisocyanate | 483.8 | | TOXNET |
| U014 | Auramine | 476.6 | | TOXNET |
| P075 | Nicotine and Salts | 476.6 | | TOXNET |
| U049 | 4-Chloro-o-toluidine hydrochloride | 471.2 | | NTP - 11th Report on Carcinogens |
| U222 | o-Toluidine hydrochloride | 468 | | TOXNET |
| U202 | Saccharin | 445.5 | Sublimes | NTP |
| U090 | Dihydrosafrole | 437.9 | | TOXNET |
| P042 | Epinephrine | 429.8 | Decomposes | Merck |
| U149 | Malononitrile | 425.3 | | TOXNET |
| U119 | Ethyl Methane Sulfonate | 415.9 | | TOXNET |
| P058 | Fluoroacetic acid, sodium salt | 410 | MP | TOXNET |
| U026 | Chlornaphazine | 410 | @ 5 mmHg | Merck |
| U219 | Thiourea | 402.8 | MP - Decomposes | Merck |
| U237 | Uracil mustard | 402.8 | Decomposes | Merck |
| U017 | Benzal chloride | 401 | | TOXNET |
| P046 | alpha, alpha-Dimethylphenethylamine | 401 | | TOXNET |
| | | | | |
| U147 | Maleic Anhydride | 395.6 | | TOXNET |
| U353 | p-Toluidine | 392.7 | | TOXNET |
| U328 | o-Toluidine | 392.5 | | TOXNET |
| U178 | N-Nitroso-N-methylurethane | < 392 | Based on other Carbamic acids | CRC |
| U114 | Ethylenebisdithiocarbamic acid | < 392 | Based on other Carbamic acids | CRC |
| P066 | Methomyl | 383 | Decomposes | FAO |
| U059 | Daunomycin | 374 | Decomposes | NTP |
| U238 | Urethane (Ethyl carbamate) | 365 | | TOXNET |
| P116 | Thiosemicarbazide | 363 | MP | Merck |
| P043 | Diisopropylfluorophosphate (DFP) | 361.4 | | TOXNET |
| U150 | Melphalan | 360.5 | MP - Decomposes | Merck |
| P049 | Dithiobiuret | 357.8 | MP - Decomposes | Merck |
| P028 | Benzyl Chloride | 354.2 | | TOXNET |
| P027 | 3-Chloropropionitrile | 347.9 | | TOXNET |
| P007 | 5-Aminomethyl 3-isoxazolol | 347 | MP - Decomposes | Merck (as Muscimol) |
| P069 | 2-Methyllactonitrile | 339.8 | | TOXNET |
| U089 | Diethyl Stilbestrol | 338 | MP | Merck |
| P041 | Diethyl-p-nitrophenyl phosphate | 338 | @ 1.0 mmHg | Merck (as Paraoxon) |
| P014 | Thiophenol (Benzene thiol) | 336.4 | | TOXNET |

**Table 6.1-2** Boiling Points of CMBST-coded wastes Waste Family Compounds

| Hazardous Code | Compound | BP (˚F) | Notes | Source |
|---|---|---|---|---|
| U097 | Dimethylcarbamoyl chloride | 332.6 | | TOXNET |
| P002 | 1-acetyl-2-thiorea | 329 | MP | TOXNET |
| U015 | Azaserine | 323.6 | Decomposes | Merck |
| U125 | Furfural | 323.1 | | TOXNET |
| U248 | Warfarin (< 0.3%) | 321.8 | MP - Decomposes | Merck |
| P001 | Warfarin (> 0.3%) | 321.8 | MP - Decomposes | Merck |
| U011 | Amitrole | 318.2 | MP | Merck |
| U074 | trans-1,4-Dichloro-2-butene | 316.4 | | TOXNET |
| P093 | Phenylthiourea | 309.2 | | NTP |
| U074 | cis,1,4-Dichloro-2-butene | 306.5 | | TOXNET |
| U055 | Cumene (Isopropylbenzene) | 306.3 | | TOXNET |
| P062 | Hexaethyl tetraphosphate | 302 | Decomposes | CRC |
| U062 | Diallate | 302 | @ 9 mmHg | Merck |
| U038 | Chlorobenzilate | 298.4 | @ 0.04 mmHg | Merck |
| P118 | Trichloromethanethiol | 297.5 | | TOXNET |
| P026 | 1-(o-Chlorophenyl)thiourea | 294.8 | MP | TOXNET; CRC |
| U085 | 1,2,3,4-Diepoxybutane | 291.2 | Decomposes | TOXNET |
| U008 | Acrylic Acid | 286.2 | | TOXNET |
| P109 | Tetraethyldithiopyrophosphate | 282.2 | @ 2 mmHg | NTP |
| P017 | Bromoacetone | 280.4 | | TOXNET |
| P111 | Tetraethylpyrophosphate | 280.4 | @ 2.3 mmHg; Decomposes | Merck |
| U359 | 2-Ethoxyethanol | 275 | | TOXNET |
| U218 | Thioacetamide | 275 | Decomposes | Chemical Land |
| P108 | Strychnine and salts | 270 | @ 5 mmHg | Merck |
| U016 | Benz(c)acridine | 269.6 | MP | TOXNET |
| U191 | 2-Picoline | 264.7 | | TOXNET |
| U244 | Thiram | 264.2 | @ 20 mmHg | ICSC |
| U166 | 1,4-Naphthoquinone | 263.3 | MP (Sublimes above 212 ˚F) | Merck |
| U007 | Acrylamide | 257 | @ 25 mmHg | Merck |
| P085 | Octamethylpyrophosphoramide | 257 | @ 0.05 mmHg | Merck (as Schradan) |
| U173 | N-Nitrosodiethanolamine | 257 | @ 0.01 mmHg | Merck |
| U182 | Paraldehyde | 255.7 | | TOXNET |
| U177 | N-Nitroso-N-methylurea | 255.2 | MP - Decomposes | CRC |
| U094 | 7,12-Dimethylbenz(a)anthracene | 253.4 | MP | Merck |
| U171 | 2-Nitropropane | 248.4 | | TOXNET |
| U163 | N-Methyl N`-nitro N-nitrosoguanidine | 244.4 | MP - Decomposes | TOXNET |
| P044 | Dimethoate | 242.6 | @ 0.05 mmHg | ICSC |
| U041 | Epichlorohydrin (1-Chloro-2,3- | 241 | | TOXNET |

**Table 6.1-2** Boiling Points of CMBST-coded wastes Waste Family Compounds

| Hazardous Code | Compound | BP (˚F) | Notes | Source |
|---|---|---|---|---|
| | epoxypropane) | | | |
| U093 | p-Dimethylaminoazobenzene | 240.8 | MP - Decomposes | ICSC |
| U206 | Streptozotocin | 239 | MP - Decomposes | Merck |
| U197 | p-Benzoquinone | 239 | Sublimes | CRC |
| P102 | Propargyl alcohol | 236.5 | | TOXNET |
| U126 | Glycidyaldehyde | 234.4 | | TOXNET |
| U058 | Cyclophosphamide | > 230 | | MSDS – ScienceLab.com |
| U110 | Dipropylamine | 228.7 | | TOXNET |
| U042 | 2-Chloroethyl vinyl ether | 226.4 | | TOXNET |
| P034 | 2-Cyclohexyl-4,6-dinitrophenol | 224.6 | MP | TOXNET |
| P016 | Dichloromethyl ether | 222.8 | | TOXNET |
| U053 | Crotonaldehyde | 219.2 | | TOXNET |
| U176 | N-Nitroso-N-ethylurea | 218.3 | MP - Decomposes | NTP |
| U123 | Formic Acid | 213.8 | | TOXNET |
| P070 | Aldicarb | 212 | MP - Decomposes | ICSC |
| U113 | Ethyl Acrylate | 210.9 | | TOXNET |
| U034 | Trichloroacetaldehyde (Chloral) | 208.0 | | TOXNET |
| P005 | Allyl Alcohol | 206.6 | | TOXNET |
| U143 | Lasiocarpine | 203 | MP | TOXNET; ICSC |
| P088 | Endothall | 202 | | Spectrum |
| P023 | Chloroacetaldehyde | 185.9 | | TOXNET |
| U056 | Cyclohexane | 177.3 | | TOXNET |
| P040 | 0,0-Diethyl O-pyrazinyl phosphorothioate | 176 | | Merck (as Thionazin) |
| U156 | Methyl chlorocarbonate | 158.9 | | TOXNET |
| P067 | 2-Methyl-aziridine | 152.6 | | TOXNET |
| U213 | Tetrahydrofuran | 149 | | TOXNET |
| U035 | Chloroambucil | 149 | MP | TOXNET |
| U046 | Chloromethyl methyl ether | 139.1 | | TOXNET |
| P045 | Thiofanox | 134.6 | MP | TOXNET |
| P054 | Aziridine | 132.8 | | TOXNET |
| P003 | Acrolein | 126.7 | | TOXNET |
| U006 | Acetyl Chloride | 123.3 | | TOXNET |
| P084 | N-Nitrosomethylvinylamine | 118.4 | | NTP - 11$^{th}$ Report on Carcinogens |
| U194 | n-Propylamine | 117 | | TOXNET |
| U186 | 1,3-Pentadiene | 107.6 | | TOXNET |
| P064 | Isocyanic acid, ethyl ester | 103.1 | | TOXNET |
| U124 | Furan | 88.7 | | TOXNET |

**Table 6.1-2** Boiling Points of CMBST-coded wastes Waste Family Compounds

| Hazardous Code | Compound | BP (˚F) | Notes | Source |
|---|---|---|---|---|
| U001 | Acetaldehyde | 68.2 | | TOXNET |
| P095 | Phosgene | 46.8 | | TOXNET |
| U092 | Dimethylamine | 44.2 | | TOXNET |
| U153 | Methanethiol | 42.6 | | TOXNET |
| U122 | Formaldehyde | -2.4 | | TOXNET |
| U033 | Carbon Oxyfluoride | -120 | | ICSC |

| Source | Source Citation |
|---|---|
| TOXNET | U. S. National Library of Medicine Toxicology Data Network - http://toxnet.nlm.nih.gov |
| Merck | Merck Index, Eleventh Edition, 1989 |
| CRC | Handbook of Chemistry and Physics, 62nd Edition, 1981-1982 |
| NTP | National Toxicology Program - http://ntp.niehs.nih.gov |
| ICSC | NIOSH International Chemical Safety Cards - www.cdc.gov/niosh/ipcs/icstart.html |
| FAO | Food and Agriculture Organization of the United States - www.fao.org |
| Chemical Land | Chemical Search Engine – www.chemicalland21.com |
| Spectrum | Spectrum Laboratories Chemical Fact Sheets – www.speclab.com |

### *6.2 Principal Organic Hazardous Constituents (POHCs)*

POHCs in general are defined in Section 2.bb. of Attachment II-1-12 as specific compounds that are representative of waste families processed through the TD unit. Many of the compounds within the CMBST-coded wastes Waste Family do not have associated certified analytical methods for their detection; therefore, a surrogate compound shall be necessary to ensure treatment has been accomplished. Further, rather than testing each individual CMBST-coded constituent that is analyzable, specific compounds shall be chosen to represent subsections of the waste family during CMBST Waste Family Demonstration Testing. These waste family representative compounds (surrogates) have similar separation characteristics as the waste they represent and are known as POHCs.

As described previously, the primary chemical characteristic for separation within the TD unit is the boiling point of the compound. Table 6.1-2 has been delineated into three subcategories based upon boiling point ranges of the compounds. The three delineated ranges are:

1. compounds with boiling points below 400 °F;
2. compounds with boiling points between 400 and 600 °F; and
3. compounds with boiling points greater than 600 °F.

The feed mixed waste material, during CMBST Waste Family Demonstration Testing, shall be spiked with applicable POHCs for each of these ranges. POHCs were chosen through research using the criterion described in Section 6.1.3. of Attachment II-1-12-2. CMBST Waste Family Demonstration Testing results for POHCs shall be applicable to all compounds within the associated subsection (boiling point range) of the CMBST-coded wastes Waste Family for which the POHC is a surrogate. The Permittee's POHC research initially focused on compounds within the CMBST-coded wastes Waste Family. The analyzable subset within each temperature range was reviewed for chemical availability. After specific chemicals were chosen based upon availability, discussions were conducted with the vent gas analytical testing laboratory. None of the selected POHCs from within the CMBST-coded wastes Waste Family would provide confident chemical analysis in the vent gas samples and were rejected from consideration. The list was reviewed a second time with similar results; therefore, POHCs were not chosen from within the CMBST-coded wastes Waste Family, but instead were chosen based upon their availability and boiling point. The POHCs were chosen to provide a range of boiling points throughout the temperature range of the CMBST-coded wastes Waste Family.

Specific POHCs for each temperature range and justifications for these POHCs are as follows (a summary of the selected POHCs is provided in Table 6.2-1):

**Compounds with boiling points below 400 ˚F**

Table 6.1-2 lists 99 of the 139 compounds within the CMBST-coded wastes Waste Family with boiling points below 400 ˚F. Of these 99 compounds, 32 have certified analytical methods for their detection. These compounds all have similar separation characteristics to the volatile organics waste family that have been previously demonstrated. Two readily available POHCs have been chosen to represent this boiling point range. The two compounds chosen are trichloroethylene (TCE) with a boiling point of 188 ˚F and either m-, p-, or o- cresol (methylphenols), each with a boiling point of approximately 396 ˚F. The applicability of the TD unit for volatile organic compounds within this boiling point range has been demonstrated twice previously using these and other POHCs as well as normal operations over the last several years.

**Compounds with boiling points between 400 and 600 ˚F**

Table 6.1-2 lists 31 of the 139 compounds within the CMBST-coded wastes Waste Family with boiling points between 400 and 600 ˚F. Seven of these 30 compounds have certified analytical methods for their detection. One POHCs has been identified to represent the compounds within this boiling point range. This compound is dibenzofuran with a boiling point of 545 ˚F. Further, the m-, p-, or o- cresol is a

transitional POHC, representing both the higher end of the compounds with boiling points below 400 ˚F range and the lower end of this boiling point range.

**Compounds with boiling points greater than 600 ˚F**

Table 6.1-2 lists nine of the 139 compounds within the CMBST-coded wastes Waste Family with boiling points greater than 600 ˚F. Of these nine compounds, four have certified analytical methods for their detection. POHCs with boiling points above 600 ˚F are not available in quantities necessary for spiking. Research has discovered that many polycyclic aromatic hydrocarbons (PAHs) have boiling points above 600 ˚F (e.g., anthracene, chrysene, benzo(k)fluoranthene, etc.) and that these contaminants are present in high concentrations within coal tar. The Permittee plans to purchase coal tar and analyze it for higher boiling point PAHs prior to the CMBST Waste Family Demonstration Testing. The coal tar will be made less viscous as necessary by adding diesel fuel and spiking it into the feed material with the other POHCs. The specific POHCs within the coal tar will not be ascertained until after this analysis is completed. After the preliminary analysis has been completed, the POHCs identified shall be included in the schedule documentation and require at least seven days notice to the Executive Secretary prior to the testing event in accordance with Condition 5.b. of Attachment II-1-12-1.

Table 6.2-1 POHC Summary

| Chemical | Boiling Point (˚F) |
|---|---|
| Trichloroethene | 188 |
| Cresol (m-, o-, or p-) | 396 |
| Dibenzofuran | 545 |
| Coal Tar (PAHs) | 400-900 |

# Section 7 – Waste Family Demonstration Testing Operations

Since the preliminary testing phase has already been completed and since no new waste matrices are being introduced for an operational phase, the CMBST Waste Family Demonstration Testing shall consist of only the APC demonstration phase. This section will define feeding and spiking specifications, process monitoring, sampling, and analysis that shall be conducted during the CMBST Waste Family Demonstration Testing.

The CMBST Waste Family Demonstration Testing shall be completed using the mixed waste feed material described in Section 7.3, spiked with each of the POHCs described in Section 6.2. The Permittee shall receive Executive Secretary approval for the waste selected prior to CMBST Waste Family Demonstration Testing.

The CMBST Waste Family Demonstration Testing shall consist of three process runs of a similar matrix from a single generator. Additional process runs may be completed, as desired by the Permittee. Each process cycle will take approximately four to eight hours, potentially longer, to assure that the CMBST-coded contaminants have been volatilized from the solid processed material.

The mixed waste shall be sampled and analyzed prior to spiking to provide data for RE calculations. Sampling of the processed material, condensate, and vent gas shall be performed during each of the process runs. Analyses shall be performed for the POHCs as well as other analyzable CMBST-coded contaminants in the waste. Radiological parameters shall also be analyzed during the testing process.

The treated emissions (vent gases) shall also be tested for hydrogen chloride as an indicator of potential combustion within the TD unit. In conjunction with this measurement, the feed material will be analyzed for TOX and an assessment of the total concentration of Cl- fed into the TD unit shall be estimated (based on the TOX data and the amount of chlorine in the spike chemicals). The estimated feed Cl- concentration shall be compared with the measured emission concentration of HCl and both a quantitative and qualitative assessment shall be made. An HCl emission rate greater than 0.1 pounds per hour shall require a more thorough review as it may be an indication of potential combustion within the TD system. Metals are not associated with CMBST-coded contaminants and will not need to be analyzed in the vent gas stream. Furthermore, particulate matter, dioxins and furans, and visual opacity were analyzed and found compliant in the two previous Waste Family Demonstration Tests for the TD unit. The results of these previous demonstration tests are described in Section 9. These additional tests will not be performed during CMBST Waste Family Demonstration Testing.

Throughout each process run, the TD unit shall be operated continuously, without shutdown. If shutdown occurs, the Permittee shall immediately notify the onsite regulators and evaluate options on the applicability of the test. The Permittee shall document the shutdown in the CMBST Post-Waste Family Demonstration Testing Report.

The limiting emissions testing procedure (EPA Method 0010) requires a sample volume of at least three dry standard cubic meters (105.9 dry standard cubic feet). It is anticipated that approximately 11 to 40 cubic feet of feed material will be required for each process run.

## *7.1 Pre-Processing Operations*

Prior to operation of the TD unit, the feed material shall be prepared to the processing specifications provided in Sections 3 and 6 of Attachment II-1-12.

### *7.1.1 POHC Spiking*

Spiking of the waste feed material with POHCs within CMBST Waste Family Demonstration Testing shall be performed by one of the following methods:

(1) pumping the POHC into the dryer feed hopper using a metering pump;

(2) charging the spike material directly into the feed hopper, using containers, at the same time that the hopper is charged with solid feed material; or

(3) combining the spike material with clean absorbent or solvent in a separate container and feeding this container with the other feed containers.

The Permittee shall accurately measure the mass of the spiking material introduced into the TD unit for RE calculations. All POHC spikes shall be certified by the manufacturer, where certification is possible, or the POHCs may be analyzed by the Permittee to characterize the spike material.

## *7.2 Process Monitoring*

### *7.2.1 System Parameters*

During the CMBST Waste Family Demonstration Testing, System Parameters shall be monitored as explained in Section 7.2.1 of Attachment II-1-12-2. Each of the parameters discussed in Attachment II-1-12-2 shall be monitored during the CMBST Waste Family Demonstration Testing. Through this testing, Operational Parameters shall be verified for the CMBST-coded wastes Waste Family.

### *7.2.2 Automatic Waste Feed Cut-Off (AWFCO) System*

The AWFCO system shall remain unchanged from those parameters specified in Section 7.2.2 of Attachment II-1-12-2.

### *7.2.3 Monitoring Instruments*

The CMBST Waste Family Demonstration Testing does not contain any monitoring instrumentation different from the instruments discussed in

Attachment II-1-12-2. Therefore, the instrumentation discussion in Section 7.2.3 of Attachment II-1-12-2 remains valid for the CMBST Waste Family Demonstration Testing.

### *7.3 Feed Waste*

The CMBST Waste Family Demonstration Testing process runs shall include mixed waste contaminated with CMBST-codes. The Department of Energy (DOE) has approximately 50 cubic meters of legacy waste that contains CMBST-codes. This waste stream consists of a variety of waste forms including liquid decontamination residues, tank sludges, non-conforming incinerator ash, resin, and dewatered sludges (paints, oils, etc.). Appendix A of this attachment provides information on the waste stream that the Permittee has chosen as feed material during the CMBST Waste Family Demonstration Testing.

Many hazardous waste codes are associated with this legacy waste. The waste stream contains the non-CMBST hazardous waste codes that require treatment to LDR standards prior to disposal. Any of the following hazardous waste codes may be present:

D001, D002, D004, D005, D006, D007, D008, D009, D010, D011, D012, D013, D014, D015, D016, D017, D018, D019, D020, D021, D022, D023, D024, D025, D026, D027, D028, D029, D030, D031, D032, D033, D034, D035, D036, D037, D038, D039, D040, D041, D042, D043

F001, F002, F003, F004, F005, F006, F007, F008, F009, F010, F039

P004, P010, P011, P012, P015, P022, P029, P030, P037, P048, P050, P051, P059, P068, P094, P098, P105, P106, P112, P123

U002, U003, U004, U005, U009, U012, U018, U019, U022, U027, U028, U029, U031, U036, U037, U039, U043, U044, U045, U047, U048, U050, U051, U052, U057, U060, U061, U063, U069, U070, U075, U076, U077, U078, U079, U080, U081, U083, U086, U088, U103, U107, U108, U111, U112, U117, U118, U120, U121, U127, U128, U129, U131, U133, U134, U138, U151, U154, U158, U159, U160, U161, U165, U169, U170, U180, U184, U188, U196, U208, U209, U210, U211, U220, U225, U226, U227, U228, U235, U239, U240, U243, U246, U247, U249, U271, U277, U278, U279, U280, U383, U404

All of these hazardous waste codes fit into waste families that have been successfully demonstrated on previous Waste Family Demonstration Testing.

The waste stream is also contaminated with the following CMBST waste codes:

P002, P003, P014, P027, P028, P057, P075, P095

U001, U006, U007, U008, U010, U011, U017, U020, U033, U035, U041, U055, U056, U058, U064, U089, U113, U119, U122, U123, U124, U125, U147, U150, U167, U176, U177, U182, U213, U219, U221, U222, U234, U236, U237, U238, U244, U248, U359

Of these 47 CMBST-coded contaminants, 15 have certified analytical methods associated with them. The CMBST-coded contaminants in the Mixed Waste feed material with certified analytical methods are:

P003, P028

U001, U007, U008, U011, U017, U055, U056, U119, U122, U167, U213, U234, U359

### *7.4 Sampling and Analysis*

The two data objectives of the CMBST Waste Family Demonstration Testing are to ensure the processed material is LDR-compliant and to ensure that emissions meet specific standards. To meet these two data objectives, two sampling and analysis methodologies shall be used during the CMBST Waste Family Demonstration Testing.

- The first sampling and analysis methodology characterizes the processed material and verifies compliance with LDR standards and that all analyzable CMBST-coded contaminants expected within the mixed waste feed material are below their associated analytical method PQL concentrations.

- The second sampling and analysis methodology characterizes both the feed material and the vent gas emissions in order to calculate REs. Data from this second sampling and analysis methodology shall also be used to verify material balances over the TD unit.

The collection of additional samples may be necessary for the Permittee to verify LDR compliance with contaminants not associated with the CMBST Waste Family Demonstration Testing (e.g., metals). The processed material shall not be approved for disposal in the Permittee's Mixed Waste Landfill Cell until all contaminants are verified LDR-compliant.

Sampling locations on the TD unit are designed to capture the process streams of bulk solids, process liquids, and vent gases. Approved US EPA sampling methods and apparatus shall be used for all sample collection. The system is equipped with sampling access ports for the collection of vent gas samples. Further, a sample manifold has been fabricated with enough access ports to achieve all vent gas sampling objectives. A description of the vent gas sample collection and analysis methods are detailed in the Emission Test Protocol of Appendix C in Attachment II-1-12-2. Bulk solids shall be sampled as described in Section 7.4 of Attachment II-1-12-2. Table 7-1 of this

attachment provides an overview of the sample locations and sampling methods and frequencies for the CMBST Waste Family Demonstration Testing samples.

Codified sampling and analytical methods shall be used, primarily from US EPA Standard Methods. The reference analytical methods for each parameter are provided in Table 7-1. The Permittee shall submit all data in accordance with the US EPA's CLP, Level IV reporting requirements. Sampling methods shall be performed in accordance with US EPA Standard Methods for solid grab samples, direct liquid samples, and vent gas samples. All sample technicians shall have knowledge, training, and experience in the sampling methods. Sample technicians shall wear clean nitrile rubber disposable gloves when handling the sample equipment and containers. The sampling equipment shall be decontaminated prior to each use by washing with a non-phosphate laboratory detergent, followed by rinsing with clean tap water, and final rinsing with reagent grade distilled water. This preparatory work shall be documented in the Operating Record.

All sample collection preparatory work shall be performed in accordance with the appropriate sampling method. Sample containers for organic compounds shall be filled to zero headspace. Pre-labeled sampling containers of appropriate size and preservative (if necessary) shall be supplied to the sample technicians by the Permittee's lab manager. The Permittee shall maintain chain of custody records for all samples generated during CMBST Waste Family Demonstration Testing. A record of all samples collected shall be recorded in the TD operations logbook.

**Table 7-1. CMBST Waste Family Demonstration Testing Sampling**

| Location ID | Collection Method and Frequency | Parameter | Methods |
|---|---|---|---|
| CMBST-FEED-1<br>CMBST-FEED-2<br>CMBST-FEED-3 | Composite grab from waste material fed into the dryer | VOC | 8260 |
| | | SVOC | 8270 |
| | | Radioactive isotope Analysis* | Various lab methods |
| CMBST-PROC-1<br>CMBST-PROC-2<br>CMBST-PROC-3 | Composited from grab samples as processed material is discharged from the TD unit, or three grabs per process cycle of processed material | VOC | 8260 |
| | | SVOC | 8270 |
| | | Radioactive isotope Analysis* | Various lab methods |
| CMBST-ORG-1<br>CMBST-ORG-2<br>CMBST-ORG-3 | Grab sample from condensate transfer tank recirculation line; once at end of each process cycle | VOC | 8260 |
| | | SVOC | 8270 |
| | | Radioactive isotope Analysis* | Various lab methods |
| CMBST-VENT-1<br>CMBST-VENT-2 | Method 0030; 20 liter sample pairs | VOC | 8260 |

| | | | |
|---|---|---|---|
| CMBST-VENT-3 | Method 0010; 105.9 dscf Method 26A; throughout | SVOC | 8270 |
| | | HCl | 26A |
| | Method TO-11A | Aldehydes | TO-11A |
| | Continuous filtered air and grab samples; results to be submitted to DRC | Radioactive emission gas analysis** | Continuous or grab samples |

* = Shall meet radioactive concentration limits in the Permittee's Radioactive Materials License.

** = Shall not exceed effluent concentration limits for specific materials in R313-15-302

All applicable analytical methods that report chromatograph results shall include a report of all compounds listed for the method and tentatively identified compounds (TICs) with an analysis at 85% probability match of the spectral standard library. This analysis will specifically examine the spectral signature of those non-analyzable CMBST-coded contaminants present within the feed waste (as described in Section 7.3, above).

All sample designations have a 'CMBST' prefix to distinguish these samples as pertaining specifically to the CMBST Waste Family Demonstration Testing. Sample collection shall be performed at each location using the following methodology:

**FEED Samples:** Feed samples of the waste material shall be collected while the waste is being loaded into the feed hopper. In the feeding process, drums of feed material are tipped one at a time into the feed hopper. A hoist that is mounted to the TD unit lifts the drums. An operator stands on a gallery platform located at the feed hopper to collect the FEED samples. The sampler shall collect two aliquots from each waste drum fed into the TD unit by grabbing a quantity from the top of each drum before it is fed, and a similar quantity from the bottom of each drum (top of material in the hopper) after the drum is loaded into the hopper and before spike materials are added. The grab samples shall be collected using a stainless steel scoop or spoon and placed in a stainless steel collection bowl for compositing. The composite sample shall be divided and analyzed for VOCs, SVOCs, radiological compounds, and any other applicable CMBST-coded contaminants.

**PROC Samples:** The processed material shall be sampled and analyzed to verify compliance with LDR standards. Samples shall be collected either directly from the processed material cooling vessel or from the processed material container after the processed material has cooled to a reasonably safe temperature. Samples shall be collected using a stainless steel scoop or spoon and composited within a stainless steel collection bowl. If the containers are sampled, at least three random sample aliquots will be collected and will be composited into a single sample for each container (process cycle). The samples shall be divided and analyzed for VOCs, SVOCs, radiological compounds, and any other applicable CMBST-coded contaminants. Other analyses outside the scope of the CMBST

Waste Family Demonstration Test may be completed to ensure LDR compliance of the processed material.

**ORG Samples:** Condensate (ORG) samples shall be collected from each process cycle within CMBST Waste Family Demonstration Testing. The condensate sample shall only include the organic (oily) portion of the condensate, not the aqueous portion. The condensate samples shall be collected directly from the discharge line as the condensate is being off-loaded into a liquid container. During the off-loading process, the physical nature of the condensate shall be observed (color, consistency, viscosity, etc.) to determine the point at which organic material is being discharged. The condensate samples shall be divided and analyzed for VOCs, SVOCs, radiological compounds, and any other applicable CMBST-coded contaminants.

**VENT Samples:** Non-radiological vent samples shall be collected by personnel who are experienced or knowledgeable in the US EPA methods utilized for this purpose. These samples shall be collected through access ports within specially designed manifold(s) located after the primary and secondary carbon adsorption beds. The emission gas flow, at this point, consists of non-condensable gases that have been cooled to less than 50 ˚F and filtered to remove particulates and organic compounds. The flow rate of the emission gas typically ranges from 5 to 25 scfm and is at or near ambient pressure. Generally, variations in flow rate are expected during the process cycle but shall be limited for a majority of the test.

Radiological samples shall be collected by the Permittee's health physics personnel who have been specifically trained in the collection of vent gas samples from the TD unit. These samples shall be collected through access ports within a separate manifold located after the non-radiological vent samples manifold system.

The vent gas sample manifolds are constructed of four-inch pipe in the vent hose after the primary and secondary carbon adsorption beds. As identified in Table 7-1, at least five separate samples shall be collected for each process cycle (VOCs, SVOCs, HCl, aldehydes, and radiological). The results of these analyses shall be used for RE calculations, risk assessment calculations, HCl content determination, and radioactivity determination. In support of these analyses, US EPA methods 1 through 3 shall be performed to characterize the emission gas velocity, moisture content, molecular weight, and oxygen and carbon dioxide concentrations.

The low flow rate of the vent gas through a small (four-inch) line creates unique situations for the Emissions Test personnel. An Emission Test Protocol specific to the Permittee's TD vent gas sampling has been developed and is included in Appendix C of Attachment II-1-12-2. This Emission Test Protocol provides details of the vent gas sampling, including all necessary modifications to the US EPA methods.

Prior to the CMBST Waste Family Demonstration Testing, the Permittee shall submit a complete testing schedule to the Executive Secretary as required by Condition 5.b. of Attachment II-1-12-1.

### *7.4.1 Duplicate Samples and Field Blanks*

The quality of the sampling events shall be assessed during CMBST Waste Family Demonstration Testing. These quality samples include duplicates, field blanks, and equipment blanks (collected from rinsate from the sampling equipment after decontamination from a prior sampling event). Duplicates, equipment blanks, and field blanks shall be named with an appropriate suffix relative to the sampling location that they assess: -DUP for duplicate, -EB for equipment blank, and -FB for field blank. For example, CMBST-FEED-1-EB would be the equipment blank sample collected from the first feed material sample for the CMBST Waste Family Demonstration Testing.

Duplicates, field blanks, and equipment blanks shall be collected during CMBST Waste Family Demonstration Testing. At a minimum, during CMBST Waste Family Demonstration Testing, a duplicate shall be required for the following:

- one of the FEED samples; and
- one of the PROC samples.

All duplicate samples shall be collected randomly. Duplicate samples shall be collected from the composite sampling bowl. The duplicate samples shall be analyzed for all of the same parameters as the original samples.

Additionally, at least one equipment blank and one field blank shall be collected during the CMBST Waste Family Demonstration Testing. All blank sample collection times and dates, as well as results, shall be documented in the CMBST Post-Waste Family Demonstration Testing Report described in Section 8 of this Attachment.

Quality control for the vent gas sampling events are specified in the US EPA Methods utilized. These methods and measures are described in Appendix C of Attachment II-1-12-2. Personnel familiar with these methods (Emissions Test personnel) shall perform this sampling.

## *7.5 Secondary Waste Streams*

The TD unit may generate secondary waste streams that include spent filters and spent carbon adsorption media. If generated, containers of secondary waste shall be labeled and managed in accordance with the requirements of this Permit. Any wastes created shall be documented in the CMBST Post-Waste Family Demonstration Testing Report.

### *7.6 Quality Assurance*

All data collected during CMBST Waste Family Demonstration Testing shall be generated following the quality assurance requirements designated for the US EPA methods utilized. The Permittee shall maintain on-site, a Quality Assurance Manual based US EPA methodology.

### *7.7 Data Validation*

Validation of the analytical data shall be performed as described in Section 7.7 of Attachment II-1-12-2.

# Section 8 – Reporting

A CMBST Post-Waste Family Demonstration Testing Report shall be submitted to the Executive Secretary, within 90 calendar days of completion of the testing unless an extension is granted in writing by the Executive Secretary. At a minimum, the CMBST Post-Waste Family Demonstration Testing Report shall include the following data:

- System Parameter electronic data logged from the PLC data management system for the parameters described in Table 7-1 of Attachment II-1-12-2;

- all alarm logs recorded by the computer from the PLC data management system during the CMBST Waste Family Demonstration Testing;

- manual data logged by the operators for feed rates, sampling frequencies, flow rates, differential pressures, and other data described in this Attachment and Attachment II-1-12-2;

- inspection forms completed in preparation of, and during, the CMBST Waste Family Demonstration Testing; and

- analytical laboratory reports, including laboratory quality control data, for all of the samples listed in Table 7-1 of this Attachment.

The Permittee shall submit all raw data in the CMBST Post-Waste Family Demonstration Testing Report. Accepted laboratory surrogate recoveries shall be within the US EPA Standard Method's required limits and all recoveries shall be reported by the laboratories. All required calculations shall be documented and checked.

Additionally, System Parameters for each process cycle (and process run) shall be tabulated and the results explained in the CMBST Post-Waste Family Demonstration Testing Report. Operating Parameters shall be tabulated for each process cycle including dryer temperature (high and low), solids temperature (high and low), system pressure (high and low), and processing times (feed time, cycle time, hold time, etc.).

A qualitative and quantitative examination shall be made of the compounds identified in the condensate and vent gas to establish that recovery of the POHCs and primary known CMBST-coded waste contaminants has occurred in the gas condensing system. The Permittee shall provide a written assessment validating that recovery has occurred. During this assessment, evidence of a small amount of incidental organic chemical changes is acceptable, provided that both recovery is obvious and that the risk of emitted compounds is calculated and it is demonstrated that processing CMBST-coded contaminants in the TD unit is protective of human health and the environment. A determination that the unit is primarily performing separation shall be made through individual process cycle and overall testing material balances. The CMBST Post-Waste Family Demonstration Testing Report shall include a calculated percentage of separation within the CMBST Waste Family Demonstration Testing and the Permittee shall

compare that value to the feed to make a determination that the TD unit is primarily performing separation. Since the amount of separation is dependant on the feed waste, a numerical performance value cannot be placed on this percentage of separation until after the feed is evaluated. This information will be presented and justified in the CMBST Post-Waste Family Demonstration Testing Report.

Risk assessment calculations showing REs and the fate of POHCs and other hazardous components shall be performed and detailed within the CMBST Post-Waste Family Demonstration Testing Report.

# Section 9 - Personnel, Training, Previous Experience and Radiation Monitoring

## *9.1 Personnel*

Key personnel for CMBST Waste Family Demonstration Testing shall be provided in the schedule required by Condition 5.b. in Attachment II-1-12-1. The positions required to be identified include:

- The TD contractor's Thermal Engineer
- The TD contractor's Operations Manager
- The Permittee's Director of Mixed Waste Operations
- The Permittee's TD Project Manager
- The Permittee's Environmental Engineer
- The Permittee's Quality Assurance Manager
- The Permittee's Director of Health Physics
- The Permittee's Safety & Health Manager
- The Permittee's Laboratory Manager

Operations personnel for the CMBST Waste Family Demonstration Testing shall work under the direct supervision of the TD contractor's Thermal Engineer, the TD contractor's Operations Manager, or the Permittee's Director of Mixed Waste Operations. Health physics support shall be supervised by the Permittee's Director of Health Physics.

The CMBST Waste Family Demonstration Testing shall be performed within the Permittee's Mixed Waste facility and is thereby governed by Attachment II-6, *Contingency Plan*. This attachment contains a list of emergency coordinators for the site that are on call 24-hours per day.

Operations of the TD unit shall be conducted by TD contractor personnel, certified in accordance with the training requirements of Attachment II-4, *Personnel Training Plan*, during the CMBST Waste Family Demonstration Testing. At least two qualified TD operators shall be present at all times during operation of the TD unit. Site personnel, under the direction of the Permittee's Director of Mixed Waste Operations, shall manage the waste prior to processing within the TD unit.

The Permittee shall only accept and use valid analytical results from a Utah Department of Health certified laboratory (Utah Certified Laboratory) or from a non-Utah certified laboratory with approval from the Executive Secretary.

Vent gas sampling shall be conducted by Emissions Test Contractor personnel who shall be qualified in source emission testing. The Emissions Test Contractor shall have the necessary staff, expertise, and equipment to perform this function.

### *9.2 Training*

Training for operators of the TD unit shall be conducted in accordance with Attachment II-4, *Personnel Training Plan*, and shall be documented in the Operating Record.

### *9.3 Previous Experience*

The previous experience of the TD contractor principals prior to partnering with the Permittee is documented within Section 9.3 and Appendix A of Attachment II-1-12-2.

Pilot-scale studies were conducted at the Permittee's facility in November, 2002, using a one-gallon per process cycle, bench-scale version of the TD unit. Two separate batches were treated with a waste stream that had relatively high levels of radioactive contamination. The condensed material was examined from both of these batches and a gamma spectroscopy analysis was completed. The results were undetectable for radioactivity within the separated condensate. An analysis of the processed material was not conducted at that time.

The full-scale TD unit at the Permittee's facility has been operational since March, 2003 and has been through several demonstration tests including Waste Family Demonstration Testing for the VOC and SVOC Waste Families in August/September, 2004 and Bi-annual Demonstration Testing in October 2006. A substantial amount of data was collected during these tests which demonstrated the high treatment efficiency of the system. Both of these tests demonstrated the applicability of the TD unit for processing VOCs and SVOCs.

The VOC/SVOC Waste Family Demonstration Testing in 2004 consisted of three Operational Demonstration Tests and four APC Demonstration Tests. The Operational Demonstration Tests consisted of dry and wet waste feed material as well as liquid waste feed material. The APC Demonstration Tests were performed in duplicate for both wet and dry waste feed material. The APC Demonstration Test feed material was spiked with specific POHCs (carbon tetrachloride, trichloroethylene, 1,2-dichloroethene, and 1,2-dichlorobenzene, and m-cresol) at concentrations from 5,000 to 30,000 mg/kg. The testing demonstrated that all processed material was LDR compliant, all POHC REs were greater than 99.99%, visual opacity was 0%, carbon monoxide emissions were below nine parts per million after dispersion, the cancer risk to adults was less than $1 \times 10^{-6}$, the hazard index to children was less than one, and the total mass balance had recoveries greater than 75%.

The Bi-annual Demonstration Testing in 2006 consisted of four APC Demonstration Tests. The Bi-annual Demonstration Testing was performed in duplicate for both wet and dry waste feed material. The feed material was spiked with specific POHCs (carbon tetrachloride, trichloroethylene, 1,2-dichloroethene, and 1,2-dichlorobenzene, and p-cresol) at concentrations ranging from 4,000 to 31,000 mg/kg. The testing demonstrated that all processed material was LDR compliant, all POHC REs were greater than 99.99%, visual opacity was 0%, carbon monoxide emissions were below nine parts per million

after dispersion, the cancer risk to adults was less than 1 x $10^{-6}$, the hazard index to children was less than one, and the total mass balance had recoveries greater than 75%.

These tests concluded that the TD unit does not emit non-compliant levels of particulate matter, metals, carbon monoxide, VOCs, SVOCs, dioxins/furans, or radionuclides and that the processed material was LDR compliant throughout.

Since March, 2003, the full-scale TD unit at the Permittee's facility has logged over 2800 operational hours and processed over 280 batches. Through all of this processing, only one instance has been noted where the processed material was not LDR compliant and required re-treatment. Verification of the re-treatment processing from that batch demonstrated LDR compliance and the processed material was disposed in the Permittee's Mixed Waste Landfill Cell.

### *9.4 Radiation Monitoring*

All waste feed material treated during CMBST Waste Family Demonstration Testing shall be mixed waste with radiological contamination.

Radiological vent gas samples shall be collected on standard particulate filters, charcoal (carbon) filters, silica gel columns, and within marinelli jars (grab samples). In order to evaluate radiological emissions throughout the process cycle, the filters shall be changed out, and the marinelli jar grab samples taken, at specific points within the process cycle. The sampling plan for radiological samples is further detailed in the Emissions Test Protocol of Appendix C in Attachment II-1-12-2. Additional details shall be provided in the schedule required by Condition 5.b. in Attachment II-1-12-1.

The particulate filters shall be analyzed for gross alpha, gross beta, on-site gamma spectroscopy, and other radiochemical analysis if needed to identify radiological contributors. The charcoal filters shall be screened for gross beta to evaluate the presence of I-129 and will also be analyzed on-site by gamma spectroscopy and off-site for other radiochemical analyses (e.g., alpha spectroscopy, liquid scintillation counting, etc.) if necessary. The silica gel columns shall be analyzed for radiochemical parameters. The marinelli jars shall be analyzed on-site by gamma spectroscopy and sent off-site if detections are observed.

# Section 10 - Acceptance Criteria

## *10.1 Acceptance Criteria*

The CMBST Waste Family Demonstration Testing may be considered successful or unsuccessful based upon the data collected. There are three possible outcomes of the CMBST Waste Family Demonstration Testing as follows:

- The results of the CMBST Waste Family Demonstration Testing demonstrate that the TD unit was successful in meeting the test objectives;
- The results of the CMBST Waste Family Demonstration Testing demonstrate that the TD unit was unsuccessful in meeting the test objectives;
- The results of the CMBST Waste Family Demonstration Testing indicate that the TD unit was unsuccessful in meeting the test objectives; however, the Permittee can demonstrate that the testing was actually successful or that minor corrections can be made to the TD unit that will provide successful results.

The CMBST Waste Family Demonstration Testing shall be determined to be successful if the following acceptance criteria are met:

- The processed material meets LDR standards for all POHCs and all analyzable CMBST-coded contaminants are below their respective analytical method PQLs after all processing has been completed.
- All POHC and primary known CMBST-coded waste contaminant REs are greater than 99.99%.
- The cancer risk, based upon exhaust concentrations, is less than $1 \times 10^{-6}$ for an adult residing at the point of maximum concentration.
- The hazard index, based upon exhaust concentrations, is less than one for a child residing at the point of maximum concentration for the duration of the test.
- The average overall total mass balance has a recovery greater than 75% of the feed.

The CMBST Waste Family Demonstration Testing shall be considered unsuccessful if one or more of the following results occur:

- The processed material does not meet LDR standards for all POHCs or all analyzable CMBST-coded contaminants are not below their respective analytical method PQLs. However, if this criterion is not met, the waste may be reprocessed

(without associated vent gas monitoring) and re-analyzed for the specific failing parameters;

- POHC and primary known CMBST-coded waste contaminant REs are less than 99.99%;

- A qualitative examination of the compounds identified in the condensate and off-gas establishes that recovery of the POHCs and primary known CMBST-coded waste contaminants has not occurred in the off-gas treatment train.

- The cancer risk is greater than 1 x $10^{-6}$ for an adult residing at the point of maximum concentration;

- The hazard index, based on exhaust concentrations, is greater than one for a child residing at the point of maximum concentration; or

- The average total overall mass balance has a recovery less than 75% of the feed.

The Permittee shall submit the results of the CMBST Waste Family Demonstration Testing in a CMBST Post-Waste Family Demonstration Testing Report as required by Section 8 of this Attachment. The Permittee may propose in this report that unsuccessful results were incorrect, or that minor system adjustments may need to be made to provide successful results. Requests for any additional testing shall be submitted to the Executive Secretary with the CMBST Post-Waste Family Demonstration Testing Report.

### *10.2 Efficiency Calculations*

RE calculations shall be completed using data collected during the CMBST Waste Family Demonstration Testing. The masses required for the RE calculations shall be estimated using the chemical specific analytical data and the measured flow rates for each of the system streams (with the exception of the mass of POHC fed into the dryer which will be measured directly).

The RE shall be calculated to determine the efficiency of the air pollution control system using the following formula:

$$\text{RE} = \frac{\text{mass}_{\text{feed}} - \text{mass}_{\text{vent gas}}}{\text{mass}_{\text{feed}}} \times 100$$

where,

$\text{mass}_{\text{feed}}$ = the mass of the POHC (weight in lbs) fed into the dryer, and

$\text{mass}_{\text{vent gas}}$ = the mass of the POHC (weight in lbs) found in the vent gas.

The $mass_{feed}$ shall be calculated by multiplying the total feed by the POHC concentration. The $mass_{vent\ gas}$ is calculated by multiplying the measured vent gas flow rate by the POHC concentration.

### *10.3 Material Mass Balance Calculation*

Historically, in the TD contractor's pilot testing operations on a similar scale to this TD unit as well as previous operations with this unit at the Permittee's facility, overall mass balance recovery calculations based upon operational data have provided a recovery of total mass greater than 75%, and often in the range of 90 to 110%. If the measured recovery of the total mass is less than 75%, an engineering evaluation shall be made to determine the reason for this low result. An explanation and the results of this engineering analysis shall be provided in the CMBST Post-Waste Family Demonstration Testing Report.

The Permittee shall use data collected during CMBST Waste Family Demonstration Testing to calculate the material mass balance for the TD unit using the following formula:

$$\textbf{Total mass}_{\textbf{feed}} + \textbf{mass}_{\textbf{nitrogen}} = \textbf{Total mass}_{\textbf{processed material}} + \textbf{Total mass}_{\textbf{condensate}} + \textbf{Total mass}_{\textbf{vent gas}}$$

where,

Total $mass_{feed}$ = the total mass (weight in lbs) of all material introduced into the dryer,
$mass_{nitrogen}$ = the total mass (weight in lbs) of the nitrogen gas fed into the system,
Total $mass_{processedmaterial}$ = the total mass of the processed material (weight in lbs),
Total $mass_{condensate}$ = the total mass of the condensate (weight in lbs), and
Total $mass_{vent\ gas}$ = the total mass (weight in lbs) of the vent gas.