PERMITTING AND TESTING OF A VACUUM THERMAL DESORPTION UNIT FOR TREATING MIXED WASTE AT THE ENVIROCARE OF UTAH, INC. MIXED WASTE FACILITY LOCATED AT CLIVE, UTAH

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ABSTRACT

The Utah Department of Environmental Quality, Division of Solid and Hazardous Waste (UDEQ/DSHW) has recently permitted the testing of a commercial vacuum thermal desorption unit (VTD) for treating mixed waste. This VTD unit is located at the Envirocare of Utah, Inc., Clive Facility. After an evaluation of several vendors, Envirocare chose a unit developed by TD*X.

Vacuum thermal desorption is a separation technology primarily targeting mixed wastes. The objective of the technology is to separate organic contaminants from a waste matrix. The separation process is designed to create three output streams: a radioactive waste matrix that meets Land Disposal Restrictions (LDR), a non-radioactive organic condensate, and a non-radioactive emission gas that meets a removal efficiency (RE) of 99.99%.

A template for permitting the unit was created with the help of the TRU and Mixed Waste Focus Area. Many conference calls with the group aided the State of Utah in developing requirements for the construction, shakedown, testing, and eventual operation of the unit. The discussions focused on how to best permit the unit. A plan was developed that used the regulations for a "Miscellaneous Unit" found in Subpart X of 40 CFR 264. This generic permitting solution allowed the agency to incorporate pertinent rules from throughout the hazardous waste regulations.

To date, the VTD unit has undergone shakedown and demonstration testing. Upon evaluation, VTD may be further permitted for full commercial use. VTD could become an important alternative to mixed waste incineration. If final permitting is granted at Envirocare of Utah, organically contaminated mixed wastes could potentially be treated onsite with an LDR compliant waste matrix being disposed of at the facility.

INTRODUCTION

Envirocare of Utah, Inc. is permitted and licensed by the State of Utah as a treatment, storage and disposal facility for certain radioactive and mixed wastes. The facility was originally licensed by the Utah Division of Radiation Control (UDEQ/DRC) for receipt of radioactive waste in 1988 and received a state-issued Part B Permit from the UDEQ/DSHW to receive mixed waste in 1990.

The majority of waste received at the Mixed Waste Facility (MWF) has been material contaminated with characteristic metals. These wastes were treated using a variety of methods including stabilization, solidification, macroencapsulation, and microencapsulation. Envirocare

pursued several methods for treating organically contaminated waste streams. These methods met with minimal success and therefore their receipt of organic wastes has been limited.

After many years of research and negotiations with various vendors, Envirocare submitted a Class 3 Permit Modification Request to the UDEQ/DSHW on November 18, 2002. With this request, Envirocare proposed to construct, test and permit a batch-type vacuum thermal desorption unit at the MWF.

Vacuum Thermal Desorption Permitting Phase

Vacuum assisted thermal desorption (VTD) is a technology designed to separate organics, volatile metals and other contaminants from waste matrices by means of indirectly heating the waste. This section will focus on the UDEQ/DSHW's perspective on permitting the VTD unit, with regards to separation of volatile and semi-volatile organics as defined by USEPA Methods SW-846, Third Edition.

In November 2002, Envirocare of Utah, Inc. submitted a Class 3 Permit Modification Request to its state-issued Part B Permit. This modification request proposed language that would allow Envirocare to move forward with its plans for a VTD unit. Prior to submitting this modification request, extensive research on the part of the facility and the agency had transpired.

Permitting History

UDEQ/DSHW's introduction to VTD began in 1999 in conjunction with the Waste Management Conference held in Tucson, AZ. At that time, Envirocare was working with Sepradyne, Inc., a thermal desorption developer. Sepradyne had a pilot plant in Globe, AZ that removed and recovered mercury from a waste product of the Miami-Globe copper mine. A fieldtrip to the facility provided insight into the viability of a VTD unit to remove volatile contaminants from a waste stream. Several participants of the TRU and Mixed Waste Focus Area were in attendance on the fieldtrip. Although Sepradyne was one of the contractors vying for the bid, Envirocare eventually partnered with TD*X Associates for the design and construction of its VTD unit.

Upon returning to Utah, the UDEQ/DSHW began researching to determine if or how other agencies had permitted similar units. It quickly became clear that there were no commercially viable VTD units permitted for full-scale treatment of hazardous or mixed wastes.

The contacts made between UDEQ/DSHW and the focus area would prove invaluable in the eventual permitting of the VTD unit.

The unit that Envirocare proposed to permit at its Mixed Waste Facility was the first such application in the country. UDEQ/DSHW queried many state and EPA representatives regarding the best approach to permitting the unit. Following the introductions to the TRU and Mixed Waste Focus Area in 1999, the UDEQ/ DSHW had participated in regular conference calls discussing permitting issues for innovative technologies. Many of these technologies were in the infant stages of development.

Following a series of calls regarding a molten aluminum treatment process, the focus area was seeking a new topic to review. At the request of UDEQ/DSHW, the focus area chose to center its work on Vacuum Thermal Desorption. These discussions began during the latter part of 2001. The focus area was comprised of invited participants from the USDOE, USEPA, states, and the regulated community, including Envirocare. Weekly and semi-weekly conference calls were held to discuss the permitting issues for VTD. Dr. Randy Seeker of the GE Energy and Environmental Research Corporation and David L. Eaton at the Idaho National Engineering and Environmental Laboratories moderated these calls.

The pressing issue for the focus area was what regulatory standards should be used to permit the unit. Many of the group thought that the permitting regulations for incineration should be followed while others disagreed and felt that the Subpart X regulations should apply. Eventually it was decided that the unit should be permitted using the Subpart X "Miscellaneous Unit" regulations found in 40 CFR 264.600. The Subpart X regulations allow the permit writer to choose applicable requirements from all sections of the federal rules. Thus, appropriate sections of the incineration requirements were used, while others that did not apply were omitted.

On November 7, 2002, the TRU and Mixed Waste Focus Area Group published a document entitled *Technical Resource Document on Permitting Vacuum Thermal Desorption Treatment Processes for TRU and Mixed Waste Treatment.* This guidance proved to be the basis for the permit modification request that Envirocare submitted on November 18, 2002.

A Class 3 Permit Modification Request requires the facility to hold a 60-day public comment period and include a public information meeting during that period. Following the facility's 60-day comment period is a time where comments are addressed and the facility and the agency negotiate draft-final permit conditions. During this time period, UDEQ/DSHW and Envirocare spent many hours discussing the details of the permit language. A laptop computer with a projector was employed to project the permit onto the wall and the participants reviewed and refined the document. While at times tedious, this method of review provides a means to produce a final document that is clearly understood by both the facility and the agency prior to issuance.

The draft-final permit modification request was issued for public comment by UDEQ/DSHW on July 17, 2003. The typical time frame for a public comment period for a Class 3 permit modification is 45 days. However, for the VTD modification the public comment period was scheduled to be for 60 days so that the public would have additional time to review and comment on the proposed changes to the Envirocare state-issued Part B Permit. Following responding to the comments that were received from the public, the Executive Secretary of the Utah Solid and Hazardous Waste Control Board issued an approval for the Class 3 Permit Modification Request. This approval allowed Envirocare to construct, and test the TD*X VTD unit at its Mixed Waste Facility.

Facility/Agency Conflict

One common issue that arises between a permitting agency and a regulated facility is timeliness. An agency must balance the need to ensure that the facility is permitted correctly and that its permit is enforceable with the need of the regulated facility for a timely determination.

Regulations require certain public input and comment periods; marketing a product drives a facility's path forward. These two perspectives come in conflict with each other when the facility has potential customers waiting for a treatment option for its waste.

This issue arose during the VTD permitting process. A portion of the drive to permit VTD at this time came from the Fernald site that had regulatory timeframes to remove wastes from its site. Several VTD developers vied for the contract. The contract required the developers to demonstrate that VTD was a viable technology by treating an initial amount of Fernald waste by March 31, 2003. Envirocare eventually partnered with TD*X and won the contract in July 2002 to treat the Fernald waste. The timeframe required by the contract became an issue with the timeframe required by the permitting process.

In order to resolve this issue, Envirocare accepted some permit conditions that in hindsight, made it hard for the facility to successfully test the unit. An example of this is related to the air sampling and test methods used for demonstrating that the unit works as designed and is protective of human health and the environment. The VTD unit has a very low flow rate through the air pollution control system. The company that Envirocare had contracted to perform the air sampling was requested to provide a Sampling and Analysis Plan unique to the TD*X unit that would provide viable results and an accurate assessment of the unit. Instead of a technical document, the air sampling company submitted what amounted to a sales brochure and contract acceptance letter.

To facilitate moving the permit closer to completion and ready for public comment, Envirocare opted, rather than have the air sampling contractor take the time to develop a proper and acceptable plan, to include every applicable EPA air sampling method verbatim as permit conditions. While this makes permit compliance evaluations easy because it lays the sampling and analysis out in cookbook fashion, it hinders the evaluation of the unit because the EPA methods were not designed for low flow.

As describe later in this paper, testing of the VTD unit is nearing completion and the resolution of discrepancies between permit required testing methods and actual testing methods used has yet to be completed.

Public Participation

There are several facilities in the State of Utah that garner the public's notice. The facility that receives the most attention is the US Army's chemical warfare agent incinerator (TOCDF) followed closely by Envirocare of Utah, Inc.

As mentioned above, a Class 3 Permit Modification Request requires the facility to hold a 60-day public comment period and include a public information meeting during that period. It is imperative that the facility submits a modification request that is complete. This ensures that the public has a document that they can review that accurately represents what the facility proposes.

Because Envirocare was working under short timeframes, the initial modification request lacked specificity. Also, the VTD contractor that Envirocare partnered with was protective of information and submitted it as Business Confidential. Given this, the public asked questions

about the unit that UDEQ/DSHW could not answer because Envirocare had either not provided the information or had submitted information that was protected from public view by a valid claim of Business Confidentiality.

One of the main issues raised by the public was if the unit should be considered an incinerator. The second issue that the public spent considerable time on was whether or not permitting the VTD unit would require Envirocare to receive gubernatorial and legislative approval for a new facility as required by Utah Statute. UDEQ/DSHW made a determination that because the unit uses indirect heating (the waste does not come in direct contact with a flame and is treated in a very low oxygen environment, combustion should not occur) it does not meet the definition of an incinerator found in 40 CFR 260.10.

It was also determined that Utah Administrative Code 19-6-108 did not apply to Envirocare's request to permit the VTD unit. UAC 19-6-108 requires the gubernatorial and legislative approval if one of the following conditions is met: 1) the facility is at a new geographic location, or 2) is a new hazardous waste incinerator or an existing hazardous waste incinerator application for increased capacity, or 3) new non-hazardous waste incinerator or existing non-hazardous waste incinerator application for increased capacity, or 4) modification of the treatment, storage, or disposal facility is outside the boundaries of property owned by the applicant. Following the determination by UDEQ/DSHW, a determination from the Utah Attorneys General Office was requested. The Attorney General substantiated the UDEQ/DSHW determination.

After a facility and a regulatory agency have negotiated permit conditions for a class 3 permit modification request and created a draft-final version of the permit, the agency is required to send the draft final version out for a 45-day public comment period and provide an opportunity for a public hearing on the matter.

In light of the comments received and in an effort to allow the public ample time to understand a complex issue, the 45-day comment period was increased to 60 days. During this comment period a hearing was held on August 12, 2003. This hearing was conducted by UDEQ/DSHW and was attended by several members of the public. Among those in attendance were representatives of HEAL Utah and the Utah Chapter of the Sierra Club. These groups are often interrelated and serve as watch groups for environmental and incineration issues in the state.

Prior to the close of the comment period, HEAL Utah issued an email to its membership asking them to make comments regarding the VTD unit. Seven such letters were received by UDEQ/DSHW. Most of these letters were copies of the main letter sent by the HEAL Utah representative.

One letter was received without signature so UDEQ/DSHW was unable to send the commenter a response. Despite not knowing the author, the comments had firm technical basis and required considerable research to answer competently. The response to these comments was placed in the Public Participation File for the VTD Permit Modification Request in case the author reviewed the public record.

While some of the comments received from the public were based on misinformation and emotion, there were a few technical comments that affected the language of the permit.

Path Forward

Envirocare has continued testing the VTD unit as required by the permit. Following the testing that is described later in this paper, a report will be submitted for UDEQ/DSHW review to determine the unit's ability to successfully treat mixed waste to meet LDR and maintain protection of human health and the environment.

Assuming that the testing is successful, Envirocare will submit a permit modification request that will place permanent operating conditions on the unit. Approval of this modification will allow Envirocare full-scale operation of the VTD unit.

Vacuum Thermal Desorption Testing Phase

This Section will focus on the testing phase of the VTD permitting, with regard to separation of volatile and semi-volatile organics from UDEQ/DSHW's regulatory perspective. The VTD testing consisted of Construction Acceptance, Treatability Studies, Shakedown and Waste Family Demonstration Testing (WFDT).

Please refer to Figure 1. The feed to the VTD unit typically consists of a mixed waste contaminated with various volatile and semi-volatile organics. An inert carrier gas is also fed for vapor transport. The outputs consist of a processed (treated) material, a vent gas and a condensate. The VTD unit is specially designed to contain the radiological material within the processed material such that the condensate and vent gas are below radiological background levels. If the processed material is LDR compliant, it could be disposed if further treatment is not required (e.g. stabilization of heavy metals, etc.). The

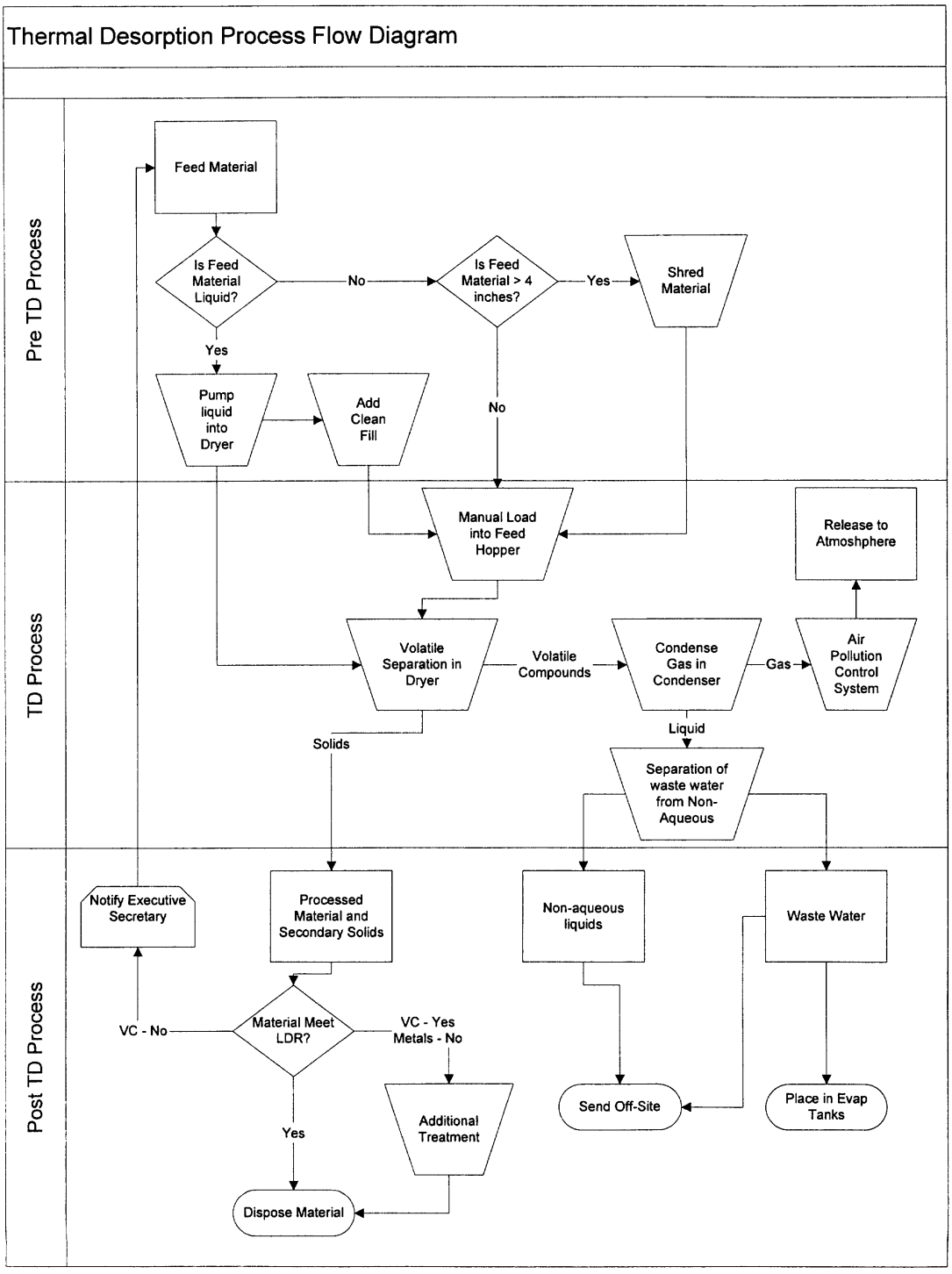

Fig. 1. Thermal desorption process flow diagram.

condensate can be appropriately managed onsite (if permissible with respect to hazardous waste and radiation control regulations) or sent offsite to an appropriate disposal facility.

Construction Acceptance

In February of 2003, personnel from UDEQ/DSHW traveled to TD*X's construction facility in South Carolina. Officials from Fernald and Envirocare personnel also attended the Construction Acceptance demonstration. During the week of February 11, 2003 at the South Carolina facility, a demonstration was performed by TD*X personnel wherein uncontaminated soil was introduced into the feed hopper of the VTD unit. Some complications arose when the hopper valve was opened to let dirt from the hopper move into the dryer unit. Eventually, the TD*X personnel were able to overcome the complications. Fernald personnel and the UDEQ/DSHW accepted the demonstration phase of the Construction Acceptance. The VTD unit was disassembled and shipped to Utah. The VTD unit arrived in Utah in late February 2003.

Treatability Studies

The State of Utah Hazardous Waste Management Rules allow the use of treatability studies. Treatability studies are defined as, "A study in which a hazardous waste is subjected to a treatment process to determine:(1) whether the waste is amenable to the treatment process, (2) what pretreatment (if any) is required, (3) the optimal process conditions needed to achieve the desired treatment, (4) the efficiency of a treatment process for a specific waste or wastes, or (5) the characteristics and volumes of residuals from a particular treatment process." The Utah Hazardous Waste Management Rules (R315-2-4(f)) limit the amount of waste that can be treated in a treatability studies, to 250 kg/day (about 551 pounds per day). On March 5, 2003, TD*X and Envirocare performed a treatability study on about 418 pounds of mixed waste. The treatability study was used to demonstrate that the unit had successfully been reassembled at Envirocare.

Since the unit was designed to process significantly more than 551 lbs. per batch, Envirocare submitted a request to the Utah Solid and Hazardous Waste Control Board (The Board) for a variance from the treatability study quantity limits. In order to test the limits of the VTD unit, Envirocare accepted 175 drums at its facility of specifically chosen mixed waste from Fernald. The total weight of the drums was just less than 50,000 pounds. The Board granted a 30-day test period that allowed the VTD unit to process up to 18,000 kg/day or about 39,600 lbs/day. In addition, the Board stipulated that no more than the 175 drums of waste could be processed under the treatability study variance. From March 6, 2003 until April 5, 2003, TD*X processed waste. However, as is expected with process equipment start-ups, mechanical problems arose. Consequently, TD*X and Envirocare were only able to test the unit's capabilities with 43 drums that totaled 13,080 pounds. Because of the problems discovered during start up, the VTD unit required some modifications to fix mechanical problems, processed material not meeting LDR standards and radiological contaminants in the condensate and vent gas.

Due to regulatory time constraints, a second variance could not be considered for Board approval until June 2003. In order to test some of the modifications TD*X had made to the unit, Envirocare and TD*X ran treatability studies during the month of May using only 300 or 400 pounds of mixed waste per day. A total of only 13 drums were processed in May.

A second variance was requested and approved by the Board. The Board stipulated that instead of a calendar day time limit, a 30-day processing limit would be imposed for days when the unit actually processed waste i.e. any day when processing happened constituted one day. The number of drums allowed during this variance approval were those left over from the first variance request. The second variance was granted on June 12, 2003.

When treatability studies were used under the provisions of the second variance, two problems seemed to recur, in addition to the expected mechanical problems: treated waste not meeting LDR, and material handling issues. Some of the processed material was not meeting the LDR limits and TD*X needed to refine their batch recipe to find the proper operating conditions. The material handling issues included the radiological component not always staying with the treated waste matrix, i.e. the carrier gas contaminated the air pollution control system radiologically. Consequently, the condensate, vent gas and process equipment downstream from the dryer were sometimes mildly contaminated, from a radiological standpoint. This was one of the issues that TD*X needed to address. In addition, another issue was that the waste handling system had difficulty transferring the processed material from the unit into a receiving container.

Shakedown Operations

Shakedown Operations are defined in Envirocare's state-issue Part B permit as optimization processes for the VTD unit and are completed to determine preliminary operating parameters that will be used in the Waste Family Demonstration Test. In December 2003, Envirocare's permit modification request for VTD was approved for shakedown and it was allowed four shakedown periods of 360 hours. Each shakedown period required a request to and approval from the UDEQ/DSHW.

The treatability study hours were included in the first shakedown period of 360 hours. Consequently, the majority of the first 360 hours had already been used when the permit modification was approved. During January 2004, shakedown continued and Envirocare requested its second 360 hours of shakedown. In February 2004, UDEQ/DSHW granted the second 360 hours of shakedown. Envirocare and TD*X continued processing waste and were able to process several batches continuously. Radiological contamination in the Air Pollution Control (APC) system, processed material handling problems and mechanical failure/maintenance problems were virtually eliminated.

During the shakedown period, UDEQ/DSHW began collecting split samples of the processed material and the condensate. The samples were analyzed by the Utah State Laboratory. The results were very helpful for numerous reasons as follows:

1. The analytical information that Envirocare received from its lab was not available to UDEQ/DSHW until a complete QA review by Envirocare staff was performed. Sometimes, this period was several months.

2. The split samples of condensate (almost 100% organics) taken by the UDEQ/DSHW were substantially different than the samples the State Lab typically receives.

Consequently, it gave the State Lab a buffer period (before WFDT) to get used to analyzing the samples and reporting the results in a timely manner.

3. Envirocare is required by its Radiation Materials License to scan any items leaving the site for radiation content, e.g. lab samples. Liquid samples took roughly eight hours to scan. In order to speed up this process, UDEQ/DSHW collaborated with UDEQ/DRC. The Executive Secretary of the Radiation Control Board granted approval for UDEQ/DSHW to take immediate custody of the samples.

4. The split samples were an opportunity to compare differences between the Utah Stat lab and Envirocare's lab.

In mid-March of 2004, a "pre-test" was performed. This test was to determine if the VTD unit was ready for WFDT. The test was designed to load the VTD unit with sand and then spike the sand with specific Principal Organic Hazardous Constituents (POHC). The POHCs chosen were to reflect the volatile and semi-volatile organic constituent vapor pressure ranges (defined by methods 8260/8270 of SW-846). The POHCs were: carbon tetrachloride, 1,2 di-chloroethylene, dicholorbenzene, m-cresol and tri-chloroethylene. One concern with the testing was that a waste solid matrix could contain hazardous constituents that were below detection limits and when separated during VTD operations, could be above detection limits in the condensate or vent gas matrix. To help eliminate this possibility the sand was pre-processed in the VTD unit prior to the pre-test. UDEQ/DSHW monitored the pre-test activities. Vent gas samples were collected for HCl, volatile and semi-volatile organics, CO, O2, dioxins/furans, radioactive emission gas, particulate matter (including a radiological analysis), metals and visible emission. Composite samples of the waste feed, processed material and the condensate were also split with the facility.

One of the permit conditions requires that a Removal Efficiency (RE) of 99.99% be met. Another condition requires that the condensate and vent gas do not contain anything that wasn't in the original feed material. This second condition was required to help determine if any chemical breakdown, reaction or combustion occurred during waste processing. The pre-test results identified the following:

- First, while the feed material was a clean sand and had been pre-processed in the VTD unit, PCE was detected as a contaminant. It was not clear how PCE was introduced into the feed. Two possible sources are contamination in the feed hopper from an earlier run or contamination in the container used to hold the pre-processed sand. PCE was detected in the vent gas. The resulting calculation for the RE was 63%.
- Second, the condensate and vent gas tested positive for organics that were not present in the feed material.
- Third, a large number of dioxins and furans had been detected in the vent gas that was not initially documented in the feed material.

In order to demonstrate that PCE could pass the RE requirements and that the first test was not representative of the process, a second "pre-test" was designed and executed. In this test, clean sand was spiked with PCE. The results from this second test showed a PCE RE of over 99.99%.

Since it is possible for the condensate to contain organics from previous batches, Envirocare and UDEQ/DSHW considered the possibility that the constituents in the vent gas or the condensate could have come from the waste feed. Both UDEQ/DSHW and Envirocare hired expert chemists to evaluate the potential issue of chemical reaction, chemical breakdown or combustion having occurred in the VTD unit. Envirocare's expert concluded that none of the condensate or vent gas components could have been derived from the feed constituents. However, UDEQ/DSHW's expert felt that a pyrolysis reaction might have taken place albeit with only small amounts of reaction products potentially present.

The third issue was attributed to the dicholorbenzene (DCB) spike chemical. A sample of the spike material was sent for analysis of dioxins and furans. The analytical results showed that, indeed, almost all of the dioxins and furans detected in the vent gas were present in the DCB.

Waste Family Demonstration Testing

In late August 2004, Waste Family Demonstration Testing began. In addition to the required tests for UDEQ/DSHW, the EPA was present for TSCA purposes (PCBs). The testing was broken into two groups: Operational testing and Air Pollution Control Testing (APC).

Operational Testing

The permit requires that two waste matricies (soil and sludge) be tested during the APC testing phase. The APC testing phase requires a full-scale vent gas test program. The purpose of the Operational Testing was to test the APC system's ability to meet the RE of 99.99% for additional waste matricies without the burden of a full-scale vent gas test program.

On August 16, 2004, WFDT began with Operational Testing. UDEQ/DSHW, Envirocare and TD*X personnel were present for the testing. Operations went smoothly on August 16 with no concerns noted. Split samples of the feed material and condensate were given to the State regulators on the 16th.

During waste processing on August 17, 2004, a problem with the vacuum pump occurred. In order to solve the problem, TD*X personnel had to disconnect the feed piping to the vacuum pump for about two minutes. This resulted in a vent gas release to the building. However, no concerns were noted because all personnel present in the building had donned the proper PPE.

Operational WFDT concluded on August 18. During the course of the week, UDEQ/DSHW collected three composite waste feed samples, three composite condensate samples and three processed material samples. All of the samples were taken to the Utah State Laboratory for analysis. Results were not available when this paper was written. The results are expected to be presented at the Symposium.

Air Pollution Control Testing

APC testing consisted of two mixed wastes streams spiked with POHCs; one waste somewhat dry and one waste somewhat wet. Two additional tests were performed as duplicates. For the four tests described, four days were scheduled to complete the tests.

APC testing was performed on Monday, Wednesday, Thursday and Friday August 23, 25, 26 and 27, 2004, respectively. There was a basic "routine" each day during the warm up of the VTD unit as follows:

- POHCs were weighed and prepared for the feed process. The POHCs were chemical grade and certified.
- Condensate from the previous run was pumped into totes and weighed. Samples were taken to characterize the previous day's run.
- Processed material samples were taken from the previous day's run.
- The vent gas contractor set up the equipment and performed the required calibrations, leak tests, etc.

UDEQ/DSHW took split samples of the waste feed, processed material and condensate. At the end of each day, the vent gas contractor performed the necessary recoveries and sent the samples for analysis. Table 1 shows the required sampling for the APC WFDT. UDEQ/DSHW collected three waste feed samples, three condensate samples and three processed material samples from the tests of August 23, 26 and 27 2004.

The APC tests on August 23, 2004 and August 26, 2004 finished without major issues. Mechanical problems were encountered on August 25, 2004. During the final third of the test, the vent gas contractor observed that the flow dropped drastically. This issue was conveyed to the TD*X crew. It was determined that a seal on one of the filters was breached. Consequently, the vent gas testing could not be used. A retest was scheduled for September 8, 2004. The September 8, 2004 test was completed without incident. UDEQ/DSHW collected one feed sample, one condensate sample and one processed material sample from the September 8 test.

Table I. Description of Various Sample Parameters for APC WFDT

Location	Collection Method and Frequency	Parameter	Methods
FEED	Composite grab from waste material fed into the dryer	VOC	8260
		SVOC	8270
		pH	9045
		TS	160.3
		TPH	418.1
		Metals	6010/7471

		Radioactive isotope Analysis**	Various lab methods
PROCESSED MATERIAL	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
		pH TS TPH Metals	9045 160.3 418.1 6010/7471
		Radioactive isotope Analysis**	Various lab methods
CONDEN-SATE	Grab sample from condensate transfer tank recirculation line; once at end of each process cycle	VOC	8260
		SVOC	8270
		pH Fuels* TPH Metals	150.1 - 418.1 6010/7471
		Radioactive isotope Analysis**	Various lab methods
VENT GAS	Method 0010; 240 minutes Method 23; 240 minutes Method 18; 240 minutes Method 26A; 240 minutes	SVOC	8270
		PCDD/PCDF	8290
		VOC	8260
		HCl	26A
	Continuous gas monitoring or grab samples; to be submitted to DRC	Radioactive emission gas analysis***	Continuous or grab samples
	Method 5; 240 minutes	PM – radioactive isotope analysis***	Various lab methods
	Method 5; 240 minutes	PM	5
	Method 10; continuous	CO	10
	Method 29; 240 minutes	Metals	6010/7471
	Method 9	Visible emissions	9
OUTER SHELL HEAT SOURCE FLUE	Method 9	Visible emissions	9

All applicable analytical methods that report chromatograph results shall include a report of all TICs and an analysis of TICs at 85% probability match of the spectral standard library.

*** Fuels = Fuels recycling parameters: Heating value (BTU content), Method ASTM D-240; total chlorine; total sulfur.**

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

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

On August 27, 2004, about two thirds of the way into the cycle, the primary carbon adsorption drum temperature began to rise. At the same time, the vent gas contractor observed a yellow film developing on the air-sampling equipment. The drums were hot enough that the TD*X crew needed to spray them with water to cool them down. The water boiled on contact. TD*X was able to finish the cycle. UDEQ/DSHW took a split sample of the vent gas fluid. The field pH was close to 0 (zero).

Further lab analysis showed that HCl had been formed. The conclusion was that a carbon bed fire had occurred. However, the oxygen content of the vent gas, during the cycle, was well below the auto-ignition point of about 10%. TD*X, Envirocare and UDEQ/DSHW analyzed the problem. Based on the collective review, it appeared that methyl ethyl ketone and acetone in the vent gas had heated up the carbon bed. However, it is still unclear exactly how the HCl formed. The UDEQ/DSHW believes that ketones in the vent gas heated up the carbon just enough to provide the activation energy required to start a highly exothermic pyrolysis reaction. The pyrolysis reaction would have HCl as one of its byproducts. TD*X and Envirocare believe that the heat was solely due to the heat of adsorption on carbon of ketone. The adsorption caused the temperature to increase and chemical breakdown to occur.

However, the actual mechanism may not be important. UDEQ/DSHW discussed the issue with the carbon adsorption manufacturer, US Filter Westate. It is well known by US Filter that ketones have a high heat of adsorption and may cause combustion in a carbon bed. In order to limit this potential, US Filter recommends an air velocity of 25 ft/min in order to dissipate the heat generated from the adsorption.

The fundamental permit issue with the carbon adsorption incident is that the feed material used in the August 27, 2004 WFDT did not contain HCl. And, since HCl was detected in the vent gas, a determination on how it was formed was needed or the test would be considered unsuccessful. The permit was drafted to cover a scenario where WFDT produces unsuccessful results. The facility is allowed to provide information to demonstrate that with minor changes to the VTD unit, a successful test would be likely.

Envirocare and TD*X proposed that a simple finned "heat exchanger" could be put in the carbon adsorption drums, complete with temperature probes, to remove excess heat caused by adsorption. This was an alternative to the 25 feet/min flow recommended by US Filter because the VTD unit has flows well below 25 feet/min. This proposal was accepted and additional tests were required for ketone wastes to demonstrate if the minor changes were successful.

On November 15, 2004, the adjustment was tested. One drum of mixed waste, mildly contaminated with ketones, was processed. The carbon drum only reached temperatures of 80 deg F. A second treatment cycle, with four drums of wastes with ketones at about the same concentration that resulted in the excess heat being generated in the carbon drums, was subsequently processed. With this waste, the carbon drums stayed under 90 deg F, however, an unrelated problem with filter plugging did occur and a valve seal failed. Repairs were made to the seal and testing has continued without incident.

CONCLUSIONS

Because this is the first unit of its size for treating organic mixed wastes using vacuum thermal desorption, the issues identified so far have not been a complete surprise. The concept seems promising and the equipment and dedication of the contractor are impressive. The proof will be if the unit can pass the WFDT and operate in a cost effective manner.

At the time of the writing of this paper, complete analytical results were not available. It is expected that a presentation of the results will be given at the Symposium.