Accelerated Design and Fabrication of a Mobile Drum Vent System for TRU Retrieval Activities in Hanford 200 West Area Low Level Burial Ground Trenches

Terry Wickland, Heather Klebba*, and Luke Anderson
Nuclear Filter Technology
741 Corporate Circle, Suite R, Golden, Colorado 80401 USA
**Corresponding author: heather@nucfil.com*

1. Introduction

Fluor Hanford (FH) was faced with removing drums from Hanford 200 Area Low Level Burial Ground (LLBG) Trenches. The retrieval process requires performing inspections, radioactive material assay, and venting in preparation for processing drums containing Transuranic (TRU) waste. Waste is then shipped to the Waste Isolation Pilot Plant (WIPP) in New Mexico. Nuclear Filter Technology (NucFil) designed, fabricated, factory tested, qualified and deployed a sophisticated Mobile Drum Vent System (mDVS) that met the venting requirements of this project. Additional contract requirements included that the system be readily mobile between trenches, low cost, safe to operate, reliable, easy to maintain and decontaminate, and have a minimum throughput of three drums per hour with minimum operator interface. This paper describes the engineering approach, venting process, hydrogen concentration analysis, and drum diffusion.

There are about 30,000 drums buried in trenches at Hanford. Of the 15,000 that are determined to be TRU, it is predicted that 7,000 of them have vent clips, providing sufficient ventilation for transportation within the site. The remaining 8,000 TRU drums are expected to require venting and will be processed through the Mobile Drum Vent System (mDVS). Drum ventilation is performed by installation of filters that are compliant with the Trampact for TRUPACT II requirements. The filters are installed in the TRU waste drum lids and vent hydrogen and other flammable gases while retaining radioactive particles. The waste consists primarily of contaminated debris enclosed in 55-gallon drums, each of which has one or more layers of plastic wrapping and/or a plastic liner inside the drums. The drums are contact handled (<100 mr/hr). When a drum is determined through inspection to be corroded, contaminated, bulged, have physical damage, contain liquids, or unknown contents, the drum is over-packed in an 85-gallon drum.

2. Methods and Results

2.1 Engineering Approach

The engineering approach to the mDVS is based on NucFil's experience designing and fabricating four other drum vent systems used at various DOE facilities. Two of these systems are in use at Savannah River Site – one for WIPP headspace gas characterization of TRU drums and one for ventilation of low activity drums with Pu-238 contaminated waste. One system is at the Nevada Test Site performing ventilation and WIPP headspace gas characterization of TRU drums, and one system is at the INEEL Advanced Mixed Waste Treatment Plant performing ventilation and WIPP headspace characterization of legacy TRU drums. The mDVS was engineered in regards to cost, schedule constraints, mission requirements, and new design ideas. In addition, the system was designed to control deflagration gases as opposed to isolating deflagration gases in a chamber rated for containing pressure up to 15 PSI. The system also is capable of venting 30-gallon and 85-gallon drums and provides a conveyor system to accommodate drums.

2.2 Mobile Drum Venting and Hydrogen Gas Sampling Equipment

The mDVS is housed in a custom-built commercial cargo trailer that is separated into two areas: (1) A Test Compartment, in the rear of the trailer, where waste drums are vented and; (2) An Operating Area, toward the front of the trailer, where the Control Station and Analytical Equipment are located and operated. These areas are separated by a partition wall equipped with gloveports isolating the Operator from the Test Compartment. An Equipment Compartment located at the front of the trailer houses the air compressor and the analytical system and Continuous Air Monitoring (CAM) system vacuum pumps.

Fig. 1 Mobile Drum Venting System

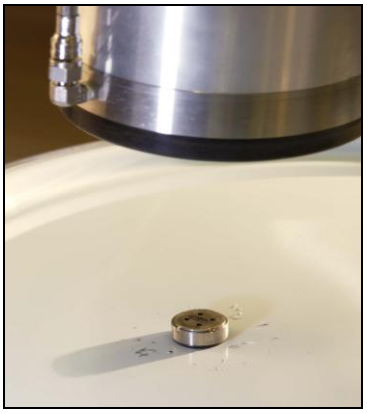

Fig. 2 Installed Drum Vent Filter

Fig. 3 Inside Operator Area

Once drums are conveyed inside of the drum, the Powerhead performs the "cold drilling" and sampling process in an enclosed Seal Housing, preventing the escape of headspace gas. A NucFil-007 series filter is installed, length determined by how far the filter must penetrate the drum lid and any liner present. The patented drum vent filters provide maximum hydrogen permeability and ensure exclusive headspace gas sampling and analysis from within the liner (a WIPP requirement). The device used for analyzing hydrogen concentration in each drum is a Shimadzu GC-14-BPDT Gas Chromatograph.

2.3 Hydrogen Concentration Measurement

During the ventilation cycle -- after the filter's drill penetrates the drum lid but prior to seating the filter -- a sample of gas is withdrawn from the headspace area of the drum. A one-milliliter sample is automatically injected into a gas chromatograph equipped with a thermal conductivity detector, and analyzed for hydrogen concentration. The calibration range is up to 20% hydrogen and the minimum detection limit is 150 parts-per-million. In accordance with the safety basis, drums found to have greater or equal to 15% hydrogen are diffused before further processing. Drums are further diffused to <5% hydrogen to meet a transportation limit.

2.4 Drum Diffusion

On average, the hydrogen concentration of drums analyzed were <2%, with the highest hydrogen concentrations around 30%, and one drum at 51%. Other systems designed/built by NucFil include an evacuation and nitrogen purge cycle until the hydrogen concentration is below the minimum explosive limit for hydrogen in air.

3. Conclusions

NucFil designed and built a mobile drum venting system for Hanford to use outdoors in their trenches to vent and analyze hydrogen and flammable gases prior to shipment to the Waste Isolation Pilot Plant (WIPP) in Carlsbad, New Mexico. Over 10,000 drums of TRU waste have been successfully vented with the mDVS.