Enhanced Identification and Segregation of Low Level Waste (LLW) from Transuranic Waste (TRU)

Introduction

With the extended operations suspension of the Waste Isolation Pilot Plant (WIPP) and the consequent inability of waste generating sites to disposition and ship Transuranic Waste (TRU) off site, emphasis is turning to enhancing and expediting the identification and disposition of Low Level Waste (LLW) and Low Level Mixed Waste (LLMW).

ANTECH have considerable experience in the identification, segregation (from TRU) and characterization of LLW for disposal and in the characterization of TRU destined for WIPP.

ANTECH is the only measurement service provider who have applied all three technologies of far field measurement (FF), segmented gamma scanning (SGS) and tomographic gamma scanning (TGS) to the process of LLW – TRU segregation and the assay of both LLW and TRU waste.

We have performed LLW – TRU segregation measurements on over 7,500 waste drums [1] at the Hanford 200 Area using the ANTECH semi-automated and roller conveyor based Gamma Mobile Assay Laboratory (G-MAL) employing Far Field measurement technology.

This mobile assay laboratory is housed in a modified ISO shipping container, which can be located in the field close to the source of drums. It was designed and built by ANTECH to perform LLW – TRU segregation and LLW assay of 55 gallon (200 litre) and 85 gallon waste drums. It has a throughput of up to 60 drums in an 8-hour shift and incorporates four measurement stations each with a shielded and collimated high efficiency high purity Germanium (HPGe) detector and drum rotator.

The G-MAL is shown in Figure 1 (below) operating in the 200 Area at Hanford. Figure 2 (overleaf) shows the interior of the G-MAL during the measurement of test and calibration drums.
At the Advanced Mixed Waste Treatment Plant (AMWTP) at Idaho Falls, ANTECH have performed both LLW – TRU segregation and WIPP certified measurements on several thousand TRU drums using both SGS and TGS measurement technologies.

These measurement technologies make fewer assumptions about the waste matrix and are therefore less conservative in LLW – TRU segregation. They are also less sensitive and therefore tend to require longer measurements. Both SGS and TGS measurements take into consideration the spatial variation of both the matrix density and the distribution of activity. Figure 3 shows an ANTECH SGS-TGS, which was deployed for TRU measurements at the AMWTP.

In the case of the Far Field drum measurement data from the G-MAL and the both the SGS and TGS drum measurement data, the analysis is performed by Subject Matter Experts (SME) located off site at the ANTECH facility in Denver. The analysis process is controlled under a quality assurance (QA) system following a strict QA plan. The QA process controls not only the calibration of the measurement instruments but also the maintenance of control charts to monitor instrument performance and the use of both automated and manual independent technical review (ITR) of the measurement process and the production of measurement and sentencing reports.
ANTECH Enhanced Segregation and Assay

In order to enhance and expedite the identification of LLW drums that are currently stored with an incomplete characterization profile, ANTECH propose to deploy a combination of Far Field, SGS and TGS measurement technologies using the ANTECH Far Field measurement G-MAL system with a portable ANTECH SGS/TGS instrument.

In the first stage of the proposed measurement process, the G-MAL system segregates drums as LLW if they have a TRU content of less than 60 nCi/g. Considering calibration and measurement errors, use of this threshold ensures that no drum with a TRU content of greater than 100 nCi/g is sentenced as LLW. The G-MAL system is sensitive enough to identify LLW with TRU content below 1 nCi/g and such waste can be sent for disposal immediately.

However, many waste drums are known to contain specific sources and in general it is reasonable to expect that many if not most waste drums will have a non-uniform distribution of radioactive sources or perhaps only one source or very few localised sources. An example is the waste drum shown in Figure 4.

![Image](Figure 4. Waste drum measured by the RadSearch G3050 Gamma Camera at a DOE Laboratory showing a strong localised source in only one region)

Because of the overly conservative assumption of uniformity of source distribution inherent in Far Field measurements, it is proposed that drums assessed by the G-MAL with an initial estimated high TRU content of up to 100,000 nCi/g (100 microCi/g) be analysed in a second phase of the process by the SGS/TGS operated in a novel manner.

This further analysis is to assess the heterogeneity of the internal source distribution in the drum and perform further LLW – TRU segregation for those drums with localised sources that are not uniformly distributed and for which the specific activity is less than 100 nCi/g. This approach has been used successfully in assaying glove boxes [2] and other objects at the Argonne National Laboratory (ANL). The basis of this assessment process and its potential can be seen in the following example.
If a waste drum with a density of 0.5 g/cc contained a single transuranic point source with source strength of 100 microCi (100,000 nCi) and it is assayed by the Far Field technique, it will be seen as a TRU drum. This is due to the fact that it is assumed that the activity is uniformly distributed over the whole drum and the measured gamma rays are counted after they have been attenuated in the drum.

The Far Field measurement and density correction process will estimate a much larger distributed activity than is actually present in the drum due to the conservative assumption of uniform distribution of activity. In reality the transuranic activity concentration or specific activity of the example drum with a point source is only 1 nCi/g and the drum is in fact an LLW drum.

By assessing the spatial distribution of TRU activity in a drum using a novel combination of SGS and TGS analysis, it is possible to accurately and correctly characterize many drums with non-uniform activity distributions as LLW.

The proposed three technology process is both robust and defensible and brings with it not only significant cost savings related to drum disposal (LLW instead of TRU) but also the potential of dispositioning large numbers of drums currently awaiting radiological characterization as TRU or LLW, which are in reality LLW. All of the three technologies are established and have been previously approved for use in both segregating LLW from TRU and for both LLW and WIPP certified TRU assay.

References