VOLUMETRIC LEAD ASSAY

TECHNOLOGY DESCRIPTION

A real-time radioassay system for the rapid characterization of lead forms will be designed that will have the capability of handling large quantities of lead with little or no direct worker exposure. Radioassay of lead at Florida International University Hemispheric Center for Environmental Technology (FIU-HCET) will be carried out to optimize detector parameters and to allow cost savings analysis to be done. The goal is to provide the U.S. Department of Energy (DOE) with a full-scale system able to make a cost-effective determination on how much lead is free from radioactive contamination and may be free released for recycling into the scrap metal industry. The system would not be limited to lead but could be used for the rapid assay of other materials that can be put on a conveyor belt for direct assay.

Because of the self-shielding attributes of lead, traditional contamination survey techniques are not effective in surveying the internal volume of lead forms. Current characterization techniques for determining internal volume contamination require physical samples to be extracted from the interior volume of lead items and laboratory analysis. This characterization technique is time consuming, increases personal lead exposure, delays lead disposition determinations, increases lead laboratory sample management, increases analysis data management, does not provide 100% lead item sampling, costs about $300 per sample, does not validate surface survey results, and impedes recycling because of the above problems. A field screening method is needed that provides quantifiable data that will support the free-release of lead that is not contaminated.

The primary benefits expected from this project include large cost savings and greatly reduced personnel exposure to lead. The objectives of this project are:

- Evaluate current technologies for handling large quantities of lead of various forms.
- Evaluate various radioassay methods for characterizing lead contamination.
- Describe performance range for an integrated, automated system and its suitability to meet DOE needs.
- Identify technology performance uncertainties and how these uncertainties can be mitigated, including technology assessment testing.
- Recommend characterization and handling technologies for integration into a system to address DOE lead characterization needs.
- Deliver a system design of evaluated, commercially available modules with some custom, optimized data analysis software and mechanical subsystems.

TECHNOLOGY NEED

Lead in the form of shot, bricks, plates, and sheeting is used as shielding at all DOE sites to reduce worker exposure from gamma emitting sources. There are approximately nine million pounds of shielding lead in Idaho National Engineering and Environmental Laboratory (INEEL) buildings, emergency shielding reserve storage, mixed waste storage, and in operation surge storage. Approximately one million pounds have been identified as radiologically contaminated and placed into storage. Approximately eight million pounds of shielding lead still remains in operational and deactivated buildings or facilities and is awaiting decommissioning. A large percentage of this lead is not expected to be radiologically surface or volume contaminated.

There is a need for a volumetric lead radioassay system and field method to determine whether millions of pounds of lead shielding in storage at DOE sites can be free released to the recycling scrap metal industry. Methods are also needed to: (1) segregate clean and radioactive lead from other wastes and (2) remove surface contamination without posing additional hazards or creating additional waste streams.

The Site Technology Coordination Group (STCG) Need Numbers and Titles are:

- ID-3.1.45 - Volumetric Radioassay of Lead Sheet, Plate, Shot and Irregular Shapes for NO RAD ADDED Determinations
- ID-7.2.16 - Field Screening of Lead (Shot, Bricks, Sheeting) for Radionuclide Contamination
- AL-00-01-10-DD - Accelerated Real-time, Volumetric Radioassay of Lead Forms

TECHNOLOGY BENEFITS

The development of a real-time volumetric radioassay will provide:

- Fast and inexpensive determination of lead available for reuse and not requiring disposal. (A determination of "No DOE Radiation Added" would not only save on the cost of shipping and disposal, but will also provide revenue due to the recycling of lead.)
- Lower occupational exposure to lead.
- Disposition of difficult lead waste streams that are potentially radioactively contaminated allowing schedule acceleration.

TECHNOLOGY CAPABILITIES/LIMITATIONS

A real-time assay system for the rapid characterization of lead forms will have the capability of handling large quantities of lead with little to no direct worker exposure. A full-scale system would be able to make a cost-effective determination of how much lead is free from radioactive contamination and may be free released for recycling into the scrap metal industry. The system would not be limited to lead but could be used for rapid assay of other materials that are conducive to putting on a conveyor belt for direct assay. The system would be able to handle solid shapes that permitted direct line of sight between the material surfaces and the detectors.

Lead is a high density, high atomic number material. It exists in different forms and is self-shielding; i.e., it absorbs its own internal radiation. The presence of radionuclides inside thick lead materials, particularly transuranic waste (TRU), makes their detection difficult because of the low amounts (and low energy) of gamma rays emitted in the radioactive decay process. Therefore, lead that has been exposed to TRU contamination will take longer to assay to verify the whether or not it contains DOE added radionuclides.

The DOE Secretary has announced a moratorium on recycling volumetrically contaminated metals. While this should have provided additional importance to separate lead that is volumetrically contaminated from what is not, it has instead lead to a major de-emphasis. In general, DOE sites are awaiting reports from a high-level panel on this issue to see whether certain materials now considered to be surface contaminated may be reclassified as volumetrically contaminated. This has led the Deactivation and Decommissioning Focus Area (DDFA) to decide that the project should be concluded at the end of this fiscal year with a full analysis of the technology need, available technologies for handling and assaying lead, and an optimized conceptual design of a system that could be used to safely and cost-effectively assay lead materials. The optimized conceptual design for rapidly handling and assaying lead resulting from this project is expected to make it possible for DOE to implement and deploy a full-scale system in a single year.

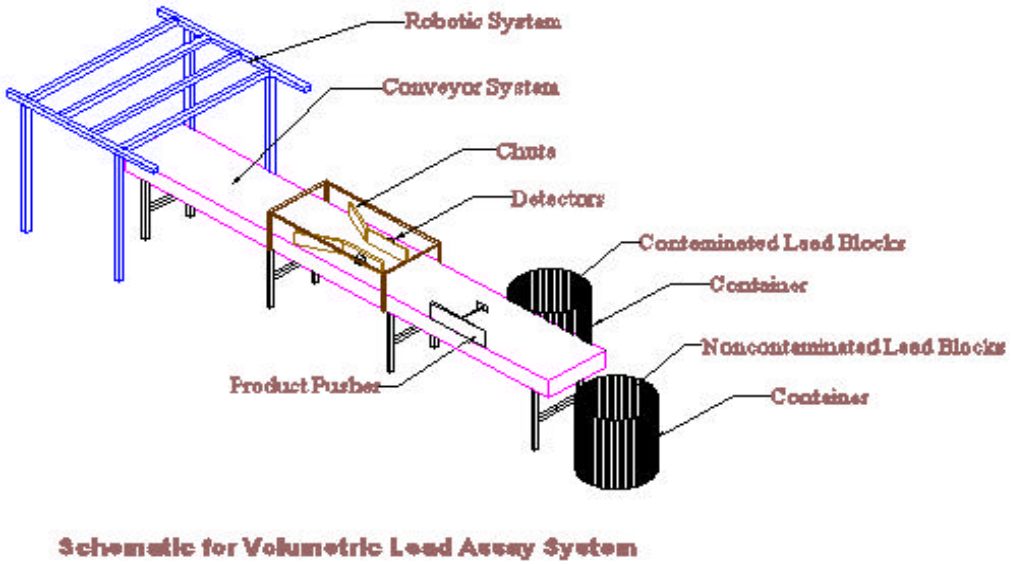
COLLABORATION/TECHNOLOGY TRANSFER

INEEL is collaborating with FIU-HCET in the analysis of information about the quantities and locations of lead in different forms as well as a final conceptual design for the full-scale assay system.

ACCOMPLISHMENTS AND ONGOING WORK

For this project a germanium and a sodium iodide (thallium doped) detector will be used for testing and analysis at FIU-HCET. A system with multiple germanium detectors is under consideration for the final

design of a full-scale system for determination of "No-DOE-Radiation Added" for recycling lead. One design option for this project is to design an entire lead assay system including: robotic loading, conveyor, assay and sorting modules as shown in figure below. The other option is to integrate a robotic loading and sorting modules to an existing FIU-HCET system thereby saving half the cost ($300,000). The radioassay data are expected to verify that 50 to 80 percent of the lead has no surface or volume contamination and therefore can be recycled. Due to the difficulty of surface decontamination of lead, it is probable that lead found to have DOE radiation added will be encapsulated and disposed of at an authorized facility. FIU-HCET has built and used such a system for *in situ* decontamination and characterization of large-bore pipe. The characterization system uses a gamma spectrometric system with four broad energy germanium detectors surrounding a conveyor. The characterization system data are processed by *In Situ* Object Counting System (ISOCS) software. The detectors are arranged such that two detectors are above and below the assayed object, which moves on the conveyor at a preset speed. The FIU-HCET radioassay trailer will be useful as a test bed for this project and will be similar to the expected final lead assay system design. The characterization system will convey lead bricks and other lead forms through to determine whether there is any radioactivity that has been added to the lead material.



Schematic for Volumetric Lead Assay System Showing the Major Components: Conveyor System, Chute, Detectors, Product Pusher, and Containers for Contaminated and Uncontaminated Lead Blocks

Accomplishments to date include:

- Reviewed technologies for 38 different systems from multiple vendors for efficiently handling large quantities of lead.
- Analyzed STCG needs and reviewed gamma spectrometers from a variety of vendors before selecting and procuring a sodium iodide (thallium doped) spectrometric system for comparison with

the DOE method. Also selected and procured a broad energy germanium gamma spectrometric system with ISOCS for the identification of various multiple peaks in the gamma spectrum and for calculation of counting efficiency for different source configurations.

- Collected and analyzed information about the quantity of lead in different forms and in different facilities at INEEL. Information will be used in developing preliminary cost savings information.

TECHNICAL TASK PLAN/TECHNOLOGY MANAGEMENT SYSTEM INFORMATION

TTP No./Title: FT00C252 - Technology Asessment: Contaminated Lead, TRU Monitors, Multiple Sensor Systems, Explosives Contamination
Tech ID/Title: None

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