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Session I - Introduction and Overview

Background of Toxicity Characteristic leaching Procedure (TCLP) - Todd Kimmell

In 1982, as an employee of the EPA, Todd Kimmell (currently with the Argonne National Laboratory) played a key role in the development of the TCLP. Mr. Kimmell presented an overview of the intent of the TCLP, reviewed the process used to develop the test, and discussed some of the current concerns with the test procedure. A copy of Mr. Kimmell's presentation materials is available through the following link: kimmell1.pdf.

Mr. Kimmell described the TCLP as the second generation of leaching tests at EPA, replacing the Extraction Procedure (EP). The TCLP was developed in response to the 1984 Hazardous and Solid Waste Amendments (HSWA), which directed EPA to examine the EP and make changes to ensure that it accurately predicts leaching potential of wastes when mismanaged. Congress was specifically concerned about the:

1. ability of the EP to accurately represent mobility under a wide variety of conditions, and
2. fact that existing characteristics did not identify wastes that were hazardous due to organic constituents.

The Resource Conservation and Recovery Act (RCRA) directed EPA to establish characteristics that identify wastes that pose a threat when improperly managed. One of the characteristics established was the Toxicity Characteristic (TC), which was developed to identify those wastes which might result in contamination of ground water if improperly managed. EPA was faced with the task of choosing one or more mismanagement scenarios for the TC. Several options were evaluated, with codisposal in a municipal waste landfill chosen as the single scenario to be applied to all wastes. This scenario was believed to be the most appropriate reasonable worst case. The EP was a batch extraction leaching test, based on the municipal waste co-disposal scenario, which presented operational difficulties, including problems with generating a reproducible leachate, questionable applicability to organic contaminants, and it was inappropriate for analysis of volatile organic compounds (VOCs).

In response to HSWA, the TCLP was developed to correct the deficiencies of the EP. Leaching tests are but one component of the TC, which also uses a groundwater transport model to set regulatory levels against which concentrations in the TCLP extract are compared. The regulatory levels in the TC represent a back-calculation from an acceptable chronic exposure level in a receptor well, through the unsaturated and saturated zones, back to the source, the bottom of the landfill. In addition to the groundwater transport model, the EPA Composite Model for Landfills (EPACML) is a key component of the TC.

The TCLP was intended to be a laboratory test designed to simulate leaching in a municipal landfill. During the development of the TCLP, the Agency considered whether the:

- mismanagement scenario upon which the test is based is appropriate for all waste types,
- test protocol can be applied to site-specific risk assessment, and
- individual elements of the test are applicable to specific waste types

Scientists from EPA and the Oak Ridge National Laboratory (ORNL) embarked upon a research effort, using large-scale lysimeters to generate municipal waste leachate (MWL). The MWL was used to leach a variety of wastes under simulated landfill conditions (column leaching). Laboratory-based leaching tests, both batch and column mode, were also used to leach the same waste. The results of these experiments were analyzed statistically to determine which of the laboratory tests best matched the lysimeter data. This research program resulted in a test that:

- Retained the EP's batch extraction format as the basic mode of the test, because it was shown to be more accurate than column extraction.
- Employed an acetate buffer leaching fluid to simulate the effect of decomposing municipal waste.
- Was shown to be more accurate than the EP and other available laboratory leaching tests.
- Was suitable for assessing the leachability of organic compounds.
- Met the HSWA mandate.

The TCLP is operationally similar to the EP, and comprises the following elements:

- An initial separation of liquid and solid phases
- Particle size reduction of monolithic materials.
- Batch-wise extraction (using a rotary apparatus) of the solid phase with a simulated leaching fluid (leachant) for an 18-hour period.
- Separation of the liquid and solid phases, resulting in a liquid extract.
- Combining the extract (leachate) with any original liquid phase.
- Analysis of the combined sample for target constituents.

While the two tests have similarities, the TCLP development team was given the task of addressing the shortfalls of the EP. They developed the zero-headspace extractor to minimize the loss of VOCs during extraction. Operational problems were minimized by using a pre-determined recipe for the extraction fluid and specifying glass fiber filters for liquid/solid separation. Precision and ruggedness were improved by controlling test variables, and practical considerations were addressed, such as ensuring that the test produced sufficient extract for subsequent analyses. Although the TCLP has been promulgated for nine years, concerns with the test remain:

- Is the municipal waste co-disposal mismanagement scenario the right one to model?
- Is the test sufficiently accurate and precise?
- Does the test evaluate the impact of physical stabilization and monolithic wastes.
- The test presents operational difficulties with some waste types (e.g., oily wastes).
- Is the infinite source assumption inherent in the EPACML model, and modeled by the TCLP, valid?

- Is the TCLP end-point (concentration in leachate compared to regulatory threshold) appropriate, or should the end-point reflect a mass of constituent leached over time?

Since the purpose of the meeting is to obtain stakeholder input into EPA deliberation on future directions, and in that vein, Mr. Kimmell felt that any future directions should consider:

- The more complex the situation(s) being modeled, the more complex the model.
- The more accurate the target for the model, the more complex the model.
- The more information you want your model to provide, the more complex the model.
- The more complex the model, typically, the higher the associated effort and cost.

While good science must be the primary consideration, practical constraints must also be considered.