Panel II - Test Design and Implications: Site Characterization

David Friedman, of EPA's Office of Research and Development, opened this panel discussion by posing two questions to the audience.

1. How applicable are the current tools?

2. How do we address site-specific variations?

Robin Anderson, representing EPA Office of Emergency and Remedial Response (OERR) presented information on how the Superfund program utilizes leaching tests. First, she noted that leaching test results may be used in the selection of a remedy at a Superfund site by providing information to identify:

1. Applicable or Relevant and Appropriate Requirements (ARARs)
2. Remediation levels
3. Treatment effectiveness requirements

In general, she has found that the situation under Superfund is much easier than under the RCRA regulations in that, initially, all Superfund sites are held to the same standards. The goal is to determine that ground water contamination has occurred and then to remediate the contamination to a specific level.

TCLP Results may also be used in assessing the remedial action implementation by providing information on:

4. ARARs Compliance
5. Cleanup Level compliance testing

She explained that Synthetic Precipitation Leaching Procedure (SPLP) results may be used for soil screening level determinations but that TCLP results are generally not used as an indicator of protectiveness or a predictor of future leachate concentrations.

In the context of Superfund sites, the EPA Regions are given latitude to identify one or more leaching tests that are appropriate for their situation (e.g., site-specific decision making).

Ms. Anderson said that Superfund provides soil screening guidance, including a methodology to calculate risk-based, site-specific, soil screening levels (SSLs). These SSLs provide a means for identifying those areas that do not warrant further consideration. She emphasized that SSLs are not national cleanup standards. She stated that generic SSLs are based on default assumptions that are protective when employed for most sites. These generic SSLs can be supplemented by site-specific SSLs that are based on modeling and site-specific assumptions.

The SSL generic ground water model assumptions include:

6. Simple linear equilibrium soil/water partition equation
7. Simple water-balance equation to calculate a dilution factor from mixing in an aquifer
8. Partition equation used to calculate total soil concentration

Alternately, a soil leaching test may be used to calculate soil concentration. Typically the SPLP is used for this purpose. The SPLP is designed to "...model acid rain leaching environment and is generally appropriate for contaminated soil scenario."

Five risk pathways are considered, including:

9. Direct ingestion
10. Inhalation of volatiles and dust, etc.
11. Dermal adsorption
12. Ingestion of homegrown produce
13. Migration of volatiles into basement

Four migration pathways are considered, including::

14. Ground water migration
15. Surface water migration
16. Volatilization and entrainment
17. Direct Contact

Ms. Anderson stressed that in order to support protectiveness and long-term reliability, the leachate test should model the conditions of the site (current and future) and should evaluate the form of the material that is present in the environment. She added that the test should relate directly to the environmental impact of the material and noted that Superfund benefits from a simple scenario because the existing statute limits the evaluations that can be conducted to assessing the extent of contamination and the extent of clean-up, and to compliance monitoring.

Ms. Anderson stated that leaching tests are used in Superfund for the evaluation of treatment effectiveness and for ARAR compliance. The latter use is because the test methods are required by law and are therefore both "required" and "relevant" (e.g., fall under the definition of ARARs). Beyond that, there are only a few instances in which appropriate methods have been defined under the law.

Ms. Anderson noted that once EPA moves beyond the initial stages, there is a great deal of flexibility in the program, including in determining what level of cleanup is needed at a given site and in the ability to monitor contamination based on site-specific conditions. She stated that the overall remediation approach is established using a tiered approach that depends on site-specific conditions. The monitoring requirements are set forth in the Record of Decision (ROD) developed for each site.

Superfund provides soil screening guidance that is based on a conservative (10^{-6}) risk assessment. This risk assessment is augmented by other tests including leaching tests, and includes soil-water partitioning data drawn from leaching tests.

Ms. Anderson indicated that for Superfund, the major question is the threat to human health and the environment that is posed by a given site. They always consider the ground water exposure pathway, and that other pathways and scenarios are assessed. The assessment considers how the leachates will change over time and they use a range of leaching tests to obtain that information. However they are aware that no tests give assessment of long-term behavior. For Superfund, an important question is whether the observed behavior is reversible.

Ms. Anderson concluded her remarks by noting that Superfund is also struggling with the issue of how to employ leaching tests that are relevant to site-specific conditions.

David Merrill, of the Gradient Corporation, described his 10 years of experience in applying leaching protocols. He noted that his first experience with the TCLP was directed at establishing action levels. More recently, he has been working to link leach testing with risk assessment methods. He noted that there has always been a problem with what to do with the leaching results outside of the context of waste characterization and concluded that leaching test results must be interpreted in context of risk assessment.

Mr. Merrill stated that, at present, he uses the TCLP to characterize leaching potential, while information on transport potential may be gained by several means, including the EPA CMTP model.

Mr. Merrill noted that site-specific assessments are difficult to model. However, models can be effective in selecting management strategies. Focusing most of his remarks on metals, he noted that modeling metals transport is still very challenging. He noted that although the EPA models have come a long way over time, especially in the area of metals, a narrow range of leachate numbers still result in a wide range (6 orders of magnitude) of retardation factors for different metals. Given the wide range of transport results, the interpretation of the results is difficult, and Mr. Merrill indicated that more emphasis needs to be placed on what to do with the results. Transport uncertainties need to be considered in leach assessment. These variations can result in 1-2 orders of magnitude or more. He noted that the time scale of the transport process may not match the time scale of leaching process.

Mr. Nihar Mohanty, of the Massachusetts Department of Environmental Protection (MA DEP), described his department's work in setting clean-up standards. The MA DEP uses probabilistic risk assessment, employing a slightly different approach then described in the EPA contaminated soil guidance. They employ data collected from many sites within Massachusetts, which exhibit less heterogeneity than from sites nationwide, and do not have leaching-based standards. At present, Massachusetts does not allow TCLP results to be used to establish clean-up levels. Mr. Mohanty hoped that any new EPA leaching methods might complement the tiered approach that is currently used in Massachusetts.

Mr. Mohanty stated that they use risk models to determine the 90th percentile value at the point of exposure. Essentially, they work backwards from the ground water well (the point of exposure) to determine how much of a given contaminant can be in a given waste and still not pose a threat. He noted that there is some uncertainty due to variation in the sampling results.

Mr. Mohanty described their work at a uranium site that had been leaching for over 25 years. The basic questions to be answered can be phrased as:

18. How much can we leave in place and not affect groundwater?
19. Should we consider reversibility?
20. Where do we sample: close or more distant?
21. How do we limit costs and the number of samples?
22. Do we consider batch or column leaching Adsorption or desorption?

He noted that they must balance the costs against the statistical validity of the sampling approach and the ultimate decision. Mr. Mohanty concluded by discussing five issues that he hoped could be addressed in any new leaching test protocols.

1) Compounding uncertainties: As you know, there are uncertainties due to heterogeneities of geologic media and sampling techniques of a contaminant during site characterizations. If a contaminant exists under reducing conditions at a site (usually this is the case except for radioactive material), analysis under oxidizing conditions (in the presence of iron oxides) would add errors. Others at this meeting have suggested that errors up to three-fold have been observed during TCLP measurements. In light this, a proposed method should be sufficiently robust to reduce the measurement uncertainty that may be compounded due to heterogeneity from a single site. Some guidelines for collecting samples for TCLP would be helpful.

(2) Statistical issues: As an example, three samples are collected from a single site showing three different partitioning coefficients, 1 mL/g, 50 mL/g and 300 mL/g under equilibrium conditions. What number may be used to represent actual conditions at a site? Should averaging be allowed. or should additional samples be collected to reduce uncertainty? It may be impossible to satisfy the minimum requirements of statistics. Mr. Mohanty recommended using a reasonably conservative sampling scenario or safeguards that perhaps over predicts leaching (known bias) to some degree.

(3) Ionizing organics show different leaching behavior under different pH conditions. So, if the test is not run for pHs where a chemical is known to leach the most, there is a potential to under predict leaching. This is most important for a compliance or "bright

line" test recommended in the first tier of a tiered approach.

(4) The proposed new methods assume that the pH and the solid-to-liquid ratio are the key parameters. The leaching characteristics of monolithic materials are also given importance, which makes sense. To be consistent, the proposed method should clearly state the acceptable sample preparation methods, in order to represent monolithic behavior in a lab.

5) Determining equilibrium conditions during a test: Mr. Mohanty agreed that grinding a sample would help achieve a quick equilibrium in a test. For example, if a chemical does not achieve equilibrium within the proposed time frame of the test, how does one consistently measure equilibrium conditions? Would it be acceptable to assume equilibrium conditions when a chemical does not desorb/adsorb more than 5% (mass) in 24 hours after the duration of the proposed time frame? If equilibrium is not achieved during the time allowed for the test, the it would be helpful to have a method of predicting equilibrium conditions based on results of the "short time" test. The conservative way is preferable, if not exact. It would be good to have guidelines so that everyone determines equilibrium in the same way.

Ginny Colten-Bradley, of the EPA Office of Solid Waste, Economics, Methods, and Risk Assessment Division, briefly described EPA's composite model with transformation products (CMTP). Ms. Colten-Bradley noted that the CMTP is not designed to be a site-specific tool. It does, however, use equations that are similar to those in site-specific models, but the CMTP is hard-wired to accept national inputs. She noted that changes are underway to allow it to be used in a site-specific fashion. In general, it is a probabilistic tool which does result in a range of values. However, when low infiltration rates are used, the range of results is reduced. She noted that the difficulties lie in the fact that site parameters vary widely, and those parameters can greatly affect the dilution-attenuation factors.

Ms. Colten-Bradley noted, regarding metals, that some issues have been raised regarding fossil fuels and EPA wants to address them. There were questions from the audience about how you select the proper percentile? Is it stable at 95%, 90%? How do you determine the sensitivity to specific parameters? Ms. Colten-Bradley responded that most important parameters had been assessed with sensitivity analyses, though more work is underway. She noted that there is some concern about adsorption.

At the end of the panel discussion on site characterization, a number of issues and questions were raised by members of the audience. Richard Lesser, RMRS, Inc., commented that he believes that the size reduction requirement it is too conservative for debris. He prefers the bulk product approach, such as is used for PCBs, where substitute D is allowed.

Bart Simmons, Cal/EPA, noted that the speciation of metals is important. For Selenium, a simple total analysis and a deionized water leaching provide a good assessment. He asked if EPA can collect or catalog such cases?

Richard Lesser, of RMRS, Inc., commented that EPA should develop alternative methods to assess adsorption. They should be quick and dirty tests. Pennsylvania has established a three-tiered testing approach involving:

1. total analysis
2. SPLP to compare the results to the drinking water limits
3. full risk assessment

Hans van der Sloot, Netherlands Energy Research Foundation, commented that, with regard to testing costs, the column tests are very expensive but cost can be controlled.