REVISED DEFINITION OF HAZARDOUS WASTE RCRA WASTE CHARACTERISTIC TESTING CHANGES

O. Callaway, R. Chessmore, L. Ray, and K. Falconer
UNC Geotech
Grand Junction, Colorado

ABSTRACT

Under 40 CFR 261, the Environmental Protection Agency defines hazardous waste to be 1) waste which exhibits one of the characteristics of a hazardous waste (ignitability, corrosivity, reactivity, and toxicity) or 2) waste which is listed in the regulation as hazardous waste. 40 CFR Part 261 provides tests for determining whether a waste exhibits one of the characteristics and also provides a list of specific hazardous wastes. On June 13, 1986, the EPA proposed to replace the current test for the toxicity characteristic, the Extraction Procedure Toxicity Characteristic (EPTC) with a new test, the Toxicity Characteristic Leaching Procedure (TCLP). This proposed change, if implemented, is of considerable importance to the waste management community because it will modify and expand the universe of waste regulated as hazardous.

The purpose of this paper is to focus on the original EPTC, commonly known as the EP Toxicity test and its replacement, the TCLP, and examine the impacts of the proposed change. The majority of impact stems from the fact that the proposed test expands the list of constituents to be tested from the 14 originally contained in the EPTC to a total of 52 for the TCLP, including the addition of 20 volatile organic compounds, 16 semivolatile organic compounds and 2 additional pesticides. As a result of the addition of these 38 organic parameters, coupled with an entirely new extraction procedure, the number of wastes classified as hazardous by characteristic will be significantly increased.

In summary, this paper will examine the differences in the two tests and assess the impact of these changes.

INTRODUCTION

Recent proposed changes in the testing procedure used to determine if wastes are hazardous could have dramatic implications for your current and future operations.

Section 3001 of the Resource Conservation and Recovery Act (RCRA) charged the Environmental Protection Agency (EPA) with identifying wastes which pose a hazard to human health and the environment if improperly managed. As partial fulfillment of this charge, the EPA developed a procedure to characterize waste as hazardous by virtue of its properties. A fundamental part of this procedure involves the use of a determination commonly referred to as the EP Toxicity test, which compares the concentrations for a list of metals, herbicides and pesticides from an extracted sample with Maximum Contaminant Levels (MCLs).

On June 13, 1986, the EPA proposed a replacement for the EP Toxicity procedure with the intent to improve the original procedure and also to broaden the scope of contaminants to include a substantial list of additional organic compounds not previously considered. The promulgation of this proposed replacement has been delayed and now it appears that notices will be forthcoming in the Federal Register this spring requesting additional comments in order to resolve various contentious issues. Nonetheless, the operational and budgetary implications of this change, now expected for final promulgation at the earliest at the end of this year, may have profound impacts upon how you handle and manage hazardous wastes.

PURPOSES

The purposes of this paper are to:

1. Review the EP Toxicity procedure.
2. Compare the EP Toxicity procedure with the proposed Toxicity Characteristic Leaching Procedure (TCLP).
3. Discuss future implications and ramifications of the proposed TCLP procedure.
4. Discuss future developments in the TCLP, including:

   The inclusion of other changes

   Final promulgation

BACKGROUND

As stated, under RCRA, EPA was to distinguish waste as being hazardous in order to protect human health and the environment. To accomplish this task, the EPA began by developing lists of wastes determined to be hazardous as a result of an investigatory process which included:

- Reviewing of literature sources
- Conducting engineering analyses
- Conducting surveys

- Gathering information from questionnaires
- Conducting site visitations

Obviously, this process could not be applied to all wastes due to the complexity and time involved. Furthermore, a method was needed to identify the infinite combinations of wastes which might be hazardous. Thus, a procedure was developed to classify the waste as being hazardous by virtue of its characteristics. The characteristics are those properties which, if exhibited by a waste, identify the waste as a hazardous waste. These characteristics and limits are:

Ignitability: a flash point of $<140°F$ (60°C).

Corrosivity: a pH $<2..0$ or >12.5 or corrodes steel at a rate greater than 6.35 mm/year at 55C

Reactivity: Unstable, reacts violently with water
Has sufficient CN^- or S^{2-} to produce toxic gas
Capable of detonation

EP Toxicity: an extract of the waste contains concentrations above the MCLs for 8 metals, 4 herbicides and 2 pesticides. (See Table I).

Thus, in summary, EPA in 40 CFR Part 261 defined hazardous waste to be 1) waste which exhibits one of the above characteristics or 2) waste which is listed in the regulation as hazardous.

It is important to realize the waste may pass all of the characteristic tests and yet still be hazardous, because it is listed as being a hazardous waste. Therefore, it is important to check to see if a waste is a "Listed Waste" prior to beginning laboratory analysis to determine if a waste is hazardous by virtue of its chemical characteristics.

DEVELOPMENT OF THE EP (EXTRACTION PROCEDURE) TOXICITY CHARACTERISTIC

In the development of the EP test, EPA was concerned that potentially hazardous waste, if not brought under the control of the RCRA hazardous waste system, might be sent to sanitary landfills where the potential existed for high level leaching activity. The worsecase model used in its development considered the mismanagement scenario of the codisposal of 5% industrial waste with 95% sanitary waste. If sufficient amounts of contamination from the industrial wastes migrated from the landfill, they could pose a potential hazard to the ground water. Since the ground water

TABLE I

EPTC-RCRA Hazardous Waste.

Parameter	MCL(mg/L)
Arsenic	5.0
Barium	100.0
Cadmium	1.0
Chromium	5.0
Lead	5.0
Mercury	0.2
Selenium	1.0
Silver	5.0
Endrin	0.02
Lindane	0.4
Methoxychlor	10.0
Toxaphene	0.5
2,4-D	10.0
2,4,5-TP Silvex	1.0

could be impacted, the regulatory thresholds for the EP Toxicity test were based upon existing drinking water standards. However, the actual regulatory levels were set at 100 times the National Interim Primary Drinking Water Act (NIPDWA) limits. These limits were based upon the assumption that the contaminants migrating from the sanitary landfill would be diluted by a factor of 100 before impacting the groundwater system. This factor of 100 is referred to in this paper as the "generic dilution/ attenuation factor." The maximum contaminant levels or regulatory thresholds are shown in Table I for the characterization of a RCRA hazardous waste. The target constituents consist of a total of 14 contaminants; 8 metals (commonly referred to as the 8 drinking water metals), 4 pesticides and 2 herbicides. An overall concentration range of 50,000 is spanned between the extremes of endrin at 0.02 mg/L and barium at 100 mg/L.

The EP Toxicity test is the only one of the characteristic tests directly related to the actual toxicity of the waste.

PROBLEMS WITH THE EP TOXICITY PROCEDURE/REASONS FOR THE DEVELOPMENT OF THE TCLP

A number of problems became evident in the use of the EP Toxicity procedure for the determination of the hazardous nature of a waste. These problems can be grouped into three areas:

1. Operational problems contained within the procedure. These problems included: the necessity of continually making pH adjustments during the extraction procedure; filtration difficulties particularly for oily type wastes; and the overall length of the method. Additionally, it was hoped that the overall reproducibility of the test could be improved.
2. The need to incorporate additional organic parameters. Fundamentally, the Toxicity Characteristic procedure was developed as a result of Congressional mandate to broaden the overall scope of wastes considered for classification as "hazardous." This was accomplished via the inclusion of additional organic compounds.
3. The desire to make the regulatory levels based upon an actual groundwater transport model and chronic toxic reference levels, rather than a generic dilution/attenuation factor based on limited drinking water standard data.

COMPARISON OF THE EP TOXICITY PROCEDURE AND THE TCLP

The TCLP expands the list of contaminants from 14 to a total of 52. All of the additional contaminants are organic compounds. It is this inclusion of additional organics which will widen the universe of wastes considered to be hazardous and is the fundamental reason for interest and concern by those dealing with hazardous wastes. The additional organic compounds included are both volatiles and semivolatiles. In order to extract the volatile constituents from the sample, a specially designed extraction vessel has been constructed. This vessel is called the "Zero Headspace Extractor or ZHE". Its design and application in the procedure has been the cause of considerable comment. An overall comparison of procedural changes can be found in Table II.

Other changes in addition to the fundamental change involving the inclusion of the ZHE to the TCLP include:

- Using two different buffered solution media, either of which may be applied depending upon the original pH of the waste, eliminates the need for continual pH adjustment during the extraction phase.
- A liquid/solid separation phase accomplished via 0.8μ filter, rather than the 0.45μ filter utilized in the EP Toxicity procedure, allows the filtration phase to be accomplished more rapidly, particularly for oily wastes.
- The TCLP eliminates the Structural Integrity Procedure (SIP) so that monolithic solid waste is ground or milled to the same size in all cases.

Further changes include making strict specifications for the extraction vessels, as well as specifying uniform agitation during the extraction. Additionally, the extraction time was reduced from as much as 24 hours in some cases for the EP test to 18 hours in all instances for the TCLP.

The proposed TCLP also requires the separate analysis of phases, for example, where the waste is a multiphase oil type. Following the analysis of the phases, the TCLP involves the mathematical recombination of the analytical data. Additional post extraction is required for the metals and semivolatile organics. With the EP extract, the metals are analyzed directly. The TCLP requires a total metals digestion prior to analysis. The TCLP also incorporates additional quality control requirements not specified within the EP Toxicity method.

Although the regulatory limits or MCLs for metals do not change under the proposed TCLP, the utilization of compoundspecific dilution/attenuation factors coupled with chronic toxicity reference levels is a fundamentally different approach than that utilized with the EP Toxicity. These changes are summarized below:

CHANGES IN SETTING REGULATORY LEVELS:

- The MCL values set in the EP Toxicity method use a generic dilution/attenuation factor of 100 and are solely based upon levels from the National Interim Primary Drinking Water Act.
- The TCLP incorporates compoundspecific dilution/attenuation factors based upon a groundwater

TABLE II

Comparison of the Extraction Procedure (EP) and the Toxicity Characteristic Leaching Procedure..

Items	EP	TCLP
1. List of contaminants	14 Total 8 Metals 4 Pesticides 2 Herbicides	52 Total 8 Metals 20 Volatile Organic Compounds 16 Semivolatile Organic Compounds 6 Pesticides 2 Herbicides
2. Leaching media	Distilled deionized water; 0.5 N acetic acid added to sample/water solution to maintain pH at 5.0 ± 0.2 as required with 400 ml maximum.	(1) Acetate buffer solution, pH= 4.93 ± 0.05, or (2) acetic acid solution, pH = 2.88 ± 0.05. An initial test on the waste will determine which extraction fluid is to be used.
3. Liquid/solid separation	0.45 μ filtration to 75 psi in 10 psi increments.	0.6 - 0.8 μ glass fiber filter filtration to 50 psi.
4. Monolithic material/ particle size reduction.	Use of Structural Integrity Procedure (SIP) or grinding and milling.	Grinding or milling only. Structural Integrity Procedure not used.
5. Extraction vessels.	Unspecified design.	Zero-headspace vessel (ZHE) required for volatiles. Bottles used for non-volatiles. Blade stirrer vessel not used.
6. Agitation	Blade/stirrer vessel acceptable or rotary end over-end tumbler.	Rotary agitation only in an end-over-end fashion at 30 ± 2 rpm.
7. Extraction Time	24 hours.	18 hours
8. Monitoring during extraction.	pH must be monitored by set intervals.	Not required.
9. Multiple solutions for single sample	No.	Yes; possibility of generating 2 or more solutions from the initial sample exists. Each solution is analyzed separately. Results are mathematically recombined when 2 or more phases are present.
10. Post preparation	Herbicides and pesticides only require an extraction.	Metals total digestion. Semivolatiles, herbicides and pesticides extraction. Run volatiles directly.
11. Quality control requirements	Standard additions required. One blank per sample batch.	Standard additions required in some cases. One blank per 10 extractions and every new batch of extract. Analysis specific to analyte.

Note that while the EP only addresses those species for which National Primary Drinking Water Standards (NIPDWS) exist, the TCLP can be applied to other toxicants.

TABLE III

Selected Examples of Regulatory Levels for Toxicity Characteristic Contaminations

Contaminant	Apportioned[1] Chronic Toxicity Reference Level (mg/L)	D/A Factor	Calculated[1] Level (mg/L)	Quantitation Limit (mg/L)	Regulatory[2] Level (mg/L)
Acrylonitrile	0.002	14.4	0.029	5.0	(5.0)
Arsenic	0.05	100.0	5.0	0.025	5.0
1,2,Dichloroethane	0.005	75.0	0.40	0.05	0.40
1,1,1,2-Tetrachloroethane	0.7	14.4	10.08	0.05	10.0

[1]Apportioned Chronic Toxicity Reference Level Multiplied by Dilution Attenuation Factor.

[2]If the Quantitation Limit is Greater Than the Calculated Level, the Quantitation Limit Becomes the (Technology Based) Regulatory Level (Indicated by Level in Parenthesis).

transport model. Additionally, the TCLP incorporates chronic toxicity reference level data. A calculated regulatory level is obtained by simply multiplying the chronic toxic reference level by the individual dilution attenuation factor. See Table III for several specific examples. If the calculated regulatory level is below the laboratory quantitation limit, the regulatory level is set at the laboratory quantitation limit.

As stated, the regulatory levels for the eight metals is the same in the TCLP as in the EP. This is the case since the TCLP arrives at a dilution/ attenuation factor of 100, which is the same as was assumed in the EP. There are seven instances where the calculated regulatory levels are indeed below the laboratory quantitation limit, and in those instances, as stated, the regulatory level is set as being equal to the laboratory quantitation limit.

IMPLICATIONS AND RAMIFICATIONS FROM THE IMPLEMENTATION OF THE TCLP

The ramifications from the promulgation of the TCLP will be considerable. Obviously, the most significant impact will be wastes which contain organics not included under the list of EP Toxicity test, but are now on the TCLP list. Several of the fundamental changes are:

- The overall universe of hazardous waste will be broadened. This is primarily a result of the incorporation of additional organics, 38 in all, and not fundamentally as a result of any changes in the procedure itself. However, it is possible that additional metallic wastes will also become classified as hazardous due to the changes within the procedure itself, particularly from the incorporation of the buffered acetic acid extraction liquid used in the TCLP. Consequently, wastes which were treated as non-hazardous previously may indeed be classified as being hazardous now, and thus the methods for handling and properly disposing of them may be fundamentally changed.
- The overall laboratory analytical costs will increase. The cost for an entire set of TCLP parameters will be in the order of 5 times the roughly $500 required for the full list of EP Toxicity parameters. The costs will approximately double again if oily types of waste are analyzed.
- The entire process of determining if a waste is hazardous by virtue of the TCLP characteristic will be far more complex. The sampling, preservation and shipment of samples will be more complex and costly. The evaluation of the analytical data will be more difficult as well.

RECENT DEVELOPMENTS

At this time, it looks as though the EPA will issue notices this spring in the Federal Register requesting additional comments on the leaching procedure, as well as the characteristic itself in order to further address many unresolved issues. The Federal Register notice will include additional chemicals and will incorporate updated

MCL/regulatory levels as a result of additional information on toxicity levels during the interim period since original issuance.

The earliest the regulation will be ready for promulgation is now expected to be in December, 1988. For additional information contact Gail Hansen at FTS 475-6722 or John Goodrich Mahoney at (202) 382-4794, both with the EPA. All of the final changes promulgated for the TCLP in conjunction with the RCRA toxicity characteristic will be incorporated into the application of the TCLP to current uses in the land ban disposal rules issued in November of 1986.

FUTURE EVOLUTION OF THE TCLP

The future of most environmental regulations have significant, continued focus on organics; the TCLP will be no exception. The recently passed National Drinking Water Act (June 1986) incorporated additional organics at a rate of 25 per every three year period, infinitely into the future. Thus, it is not difficult to envision expansion of the TCLP list of constituents to a list approaching the current Appendix IX list.

There will also be increased focus on the capability of nonhazardous solvents to mobilize hazardous constituents. Current consideration is being given to a "Solvent Override" feature based upon a "Solvent Power" determination which would include wastes as being hazardous simply based upon the amount of nonhazardous solvent they contain. It is also reasonable to expect the regulatory limits to continue to be lowered as a result of the past trends as well as the improvement of laboratory quantitation levels. The latter will allow the regulatory level to be set closer to its calculated level.

BIBLIOGRAPHY

U.S. Environmental Protection Agency. Hazardous Waste Management System; Identification and Listing of Hazardous Wastes; Notification Requirements; Reportable Quantity Adjustments. Proposed Rule, 51 Federal Register 21648, June 13, 1986.

U.S. Environmental Protection Agency. Hazardous Waste Management System; Land Disposal Restrictions. Final Rule, 51 Federal Register 40572.

Callaway, O., J. Parr and M. Bollinger, "Comparison of EPA's EP and TCLP Procedures," Analytical Techniques and Residuals Management in Water Pollution Control, Water Pollution Control Federation. Speciality Conference Series, Los Angeles, California, June 1-2, 1987.