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LEACHATE ANALYSIS

Leachate analyses are routinely conducted in an effort to characterise the mobile phase of a waste or stockpiled material. The data obtained from detailed leachate analysis are then used to classify the waste or to estimate ground or surface water contamination.

Presently there are a number of alternate leachate analyses available, each designed specifically to deal with various waste types and stockpiling applications. It is of the utmost importance that the most appropriate leachate technique is chosen to ensure project data quality objectives (DQO's) are satisfied.

TCLP – USEPA Method 1311

An acronym for ***Toxicity Characteristic Leaching Procedure***, this procedure is probably the most popular of all leachates, and the most widely misused.

The buffering solutions (pH 4.93 and 2.88) used in the TCLP were designed specifically to simulate landfill conditions. Buffer #1 (pH 4.93) is used for neutral to acidic materials whilst buffer # 2 (pH 2.88) is used for alkaline wastes.

The rather conservative approach of utilising a more acidic buffer for alkaline materials was designed to accommodate the relentless acidic conditions associated with putrescible waste landfills. This characteristic of the TCLP often thwarts successful cement encapsulation remediation programs. Selection of the TCLP for cement encapsulated wastes to be disposed of in a mono filled cell (ie: no putrescible material) will obviously lead to incorrect conclusions. In fact, selection of the TCLP for any application other than that concerning co-disposal with uncharacterised waste or with putrescible material will lead to incorrect conclusions.

ASTM D3987-85 Shake Extraction of Solid Waste with Water

This procedure provides a half way point between acidic TCLP conditions and in situ conditions, by allowing a leach in deionized water. The introduction to this ASTM procedure clearly states the intention NOT to replicate field conditions, but rather to simulate a laboratory benchmark against which various waste types may be assessed. The leach is intended to replicate the soluble portion of a waste when the major contributor to the pH regime is the waste itself. (ie. a mono filled cell)

AS 4439 – 1997 Bottle Leaching Procedure

Commonly known as the *Standards Australia* version of TCLP, this procedure is in fact far more accommodating than the USEPA procedure. The procedure differs from TCLP in two main areas:

1. Maximum sample particle size for AS4439 is 2.4mm, in contrast to the TCLP that allows 9.5mm.

2. In addition to the standard TCLP buffer solutions, AS4439 allows the use of three alternate buffers – depending on the application.

i	Reagent Water	-	applicable when a waste is undisturbed and left on site.
ii	Tetraborate pH 9.2	-	for acid volatile target analytes and in situations of co-disposal.
iii	Local water	-	when exposure to local ground, surface or seawater is expected.

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The particle size reduction (to 2.4mm) called for in the Australian Standard, effectively contravenes the assessment of encapsulated wastes – where the structure of the 'briquette' is of importance. Waste treated with cement purely for pH adjustment purposes are generally not affected by particle size reduction. Due to the increased surface area contact, smaller particle sizes tend to leach contaminants at higher levels.

The buffer solution options available allow 'waste type' and 'disposal situation' to be included in the decision process.

Significantly, the NSWEPA *Environmental Guideline for the Assessment, Classification and Management of Non-Liquid Wastes* whilst referring to TCLP throughout, clearly endorses AS4439 as the preferred procedure.

Consistent with the TCLP, the AS4439 procedure accommodates both volatile and semi/non-volatile target analyses in parts 2 and 3 of the standard respectively.

SPLP – USEPA Method 1312

The ***Synthetic Precipitation Leach Procedure*** was originally designed to simulate leaching under acid rain conditions. The procedure as written in USEPA SW-846 selects the appropriate buffer on the basis of site location with reference to the Mississippi River. For Australian purposes, a selection process similar to that of the TCLP (based on waste pH) has been adopted.

The SPLP offers three alternate buffers:

i #1, pH 4.2 - A 60/40 w/w mix of Sulphuric and Nitric Acid in Reagent Water
ii #2, pH 5.0 - A 60/40 w/w mix of Sulphuric and Nitric Acid in Reagent Water
iii #3, Reagent Water - Used for all acid volatile and naturally volatile target analytes

This procedure is particularly useful in assessing on-site stockpile run off, where the only external influence is natural precipitation.

EP/MEP – USEPA Methods 1310A and 1320

The combination ***Extraction Procedure Toxicity Test*** and ***Multiple Extraction Procedure*** adds a third dimension (time) to the TCLP.

The EP is an intensive 24 hour leach at pH 5.0 using an acetic acid buffered solution. Co- disposal landfill conditions are simulated by adjusting the pH at 15 to 30 minute intervals during the leach, thereby not allowing the sample pH to dominate. Consistent with traditional procedures, the resultant leachate is then analysed for target analytes. The third dimension is introduced with the sequential leaching (MEP) of the remaining residue.

The MEP is specifically designed to simulate the leaching that a waste will undergo from repetitive precipitation of acid rain on an improperly designed sanitary landfill. For each leach a newly prepared 60/40 w/w mixture of sulphuric and nitric acids in deionised water (pH 3.0) is used to perform extractions on the residue remaining from the prior leach. Repetitive leaching is carried out a minimum nine times, with a separate analysis conducted on each of the resultant leachates. If the concentration of any constituent of concern increases from the 7^{th}, 8^{th}, or 9^{th} extraction, the procedure is repeated until these concentrations decrease.

EP/MEP is not applicable for the assessment of volatile analytes.

Trouble Shooting

Laboratories with a poor understanding of leachate complexity often detrimentally improvise documented procedures. A few common errors that have the potential to grossly bias results are listed below:

- The use of axial rather than end-over-end tumbling. (Grossly reducing surface area contact)
- Ad hoc reduction of sample size (Increasing the effect of sample heterogeneity)
- Filtration of the leachate through a non-prescribed pore size. (Changing the solids load in the leachate)
- Failure to correctly preserve or prepare the leachate for analysis. (Changing the determinative procedure)