

TES Bretby is the UK's premier environmental testing laboratory producing high quality analytical data for more than 20 years. As a Mowlem plc business, we provide a comprehensive range of environmental analytical services to consulting, industrial and government clients situated within the UK, Europe and across many countries world-wide. Our main business aim is to provide you with meaningful data, not just facile numbers.

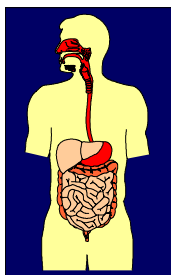
## Bio-accessible metals

Many brownfield sites are contaminated with metals. Typical laboratory analysis involves the measurement of metal concentrations following vigorous extraction by boiling with concentrated aqua-regia (hydrochloric and nitric acids) for up to 3 hours. Environmental toxicity depends on a number of factors, one of the most important being the proportion which can be absorbed by living organisms. This is known as the bioaccessible fraction.

Methods designed to assess the bioaccessible fractions are known as **Physiologically Based Extraction Tests (PBET's)**. They are *in vitro* tests designed to recreate the conditions found in the gastrointestinal tract of a 2 to 3 year old child. This is the group considered to be most at risk from soil ingestion.

## Bio-accessible versus bio-available

**Bioavailable:** the fraction of the chemical that can be absorbed by the body through the gastrointestinal system, the pulmonary system and the skin. This data must be produced by dosing animals with contaminated soil followed by testing of blood and/or organs (*in vivo*). Testing is expensive and time consuming.



**Bioaccessible:** the fraction of a substance that is available for absorption by an organism. *In vitro* tests have been developed which are less expensive than the above. The bioaccessible fraction is usually greater than the bioavailable fraction so it can be used to provide a conservative estimate of bioavailability.

## PBET Method Detail

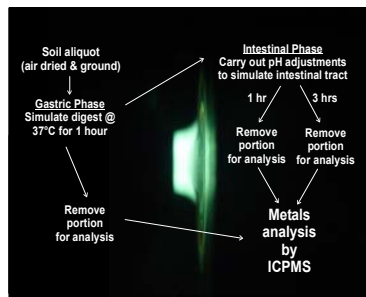
The method requires 1g of an air-dried and ground soil sample. This can be taken from either a tub or jar sample. The method involves two distinct phases:

### 1. Gastric Phase

The sample is mixed with simulated gastric solutions at pH 2.5 and digested at 37°C under anaerobic conditions. After 1 hour a portion of the solution is removed and examined for dissolved metal content by ICPMS.

### 2. Intestinal Phase

The pH of the above solution, is raised to neutral and the composition of solution adjusted to represent those found in the intestinal tract. The sample is mixed at 37°C under anaerobic conditions. After 1 hour and then 3 hours, aliquots are removed and analysed by inductively



Coupled Plasma Mass Spectrometry (ICPMS). In addition the original soil sample is analysed for its aqua-regia extractable metal content.

This method is capable of analysing for the following metals: *Arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc.*

## Reporting

We report the following:

- Aqua-regia extractable metal content
- Bioaccessible metal (Gastric Phase)
- Bioaccessible metal (Intestinal Phase–1 hour)
- Bioaccessible metal (Intestinal Phase–3 hour)
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The highest of the above three values is taken as the bioaccessible value and this is expressed as a percentage of the total metal concentration.

Such *in vitro* tests can only be used as an approximation of what actually occurs *in vivo* and do not fully mimic all of the physiological processes by which ingested contaminants can be released and absorbed. Current literature has focused on arsenic and lead, but work is ongoing to cover a broader range of contaminants.

## Meeting Point

**Linda Heath**  
ICPMS Senior Analyst



Linda joined TES Bretby over six years ago as a graduate scientist after gaining wide experience working for many years in the water industry. She has specialised in wet chemistry and Inductively Coupled Plasma and enjoys working as a Senior Analyst in our ICPMS Laboratory. This laboratory is now equipped with two ICPMS spectrometers in addition to the existing three ICPOES machines. Using her ICP expertise, Linda has recently developed the method for analysis of bioaccessible metals.

## CONTACT US

For further information about any of the issues raised in this bulletin or to discuss your analytical requirements please contact:

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