Tools and Applications for On Site Chemical Analysis

East Land Quality Forum
31 October 2011

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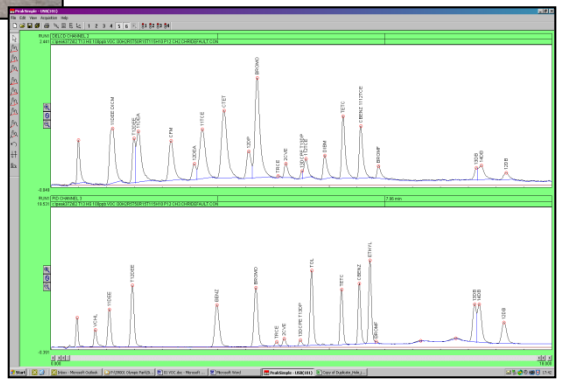
Contents

- On Site Analysis Overview
- Range of Equipment and Determinands
- Considerations for Quality Control and Data Interpretation
- Applications
- Case Studies

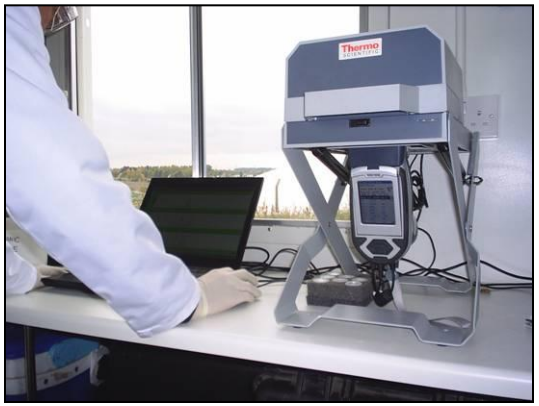
On Site Analysis Overview

- Portable Equipment – Screening or Detailed Analysis
- Rapid on Site Results
- High volume of data supplements off site laboratory
- Immediate Decision Making
- Soil and Water Analysis
- Metals
- Hydrocarbons
- VOCs
- Inorganic Chemicals
- QA and Off Site Laboratory Correlation (DMA) aids decision making
- Environment Agency Guidance
- Properly implemented and QA'd on site analysis can be as accurate or more accurate than off site data
- Cost can be similar to or less than off site analysis if used to best effect



Metals by XRF

- Soil Sample Preparation
  - Point and Shoot
  - Laboratory Test Stand
  - Microwave Dried and Homogenised
- XRF Analysis
  - Soil samples
  - Thin Film
  - Swabs
  - Airborne Dust Samples
  - Not Water Samples
  - Requires RPA, RPS and Local Rules



Limits Of Detection for Contaminants in Soil
All values below represented in ppm (mg/kg)

	Si02 (interference free)	SRM (typical soil matrix)
Ca	330	500
Sc	90	400
Ti	100	160
V	20	70
Cr	65	85
Mn	55	85
Fe	75	100
Co	40	260
Ni	50	65
Cu	25	35
Zn	15	25
As	9	11
Se	6	20
Rb	4	10
Sr	7	11
Zr	5	15
Mo	9	15
Ag	10	10
Cd	10	12
Sn	20	30
Sb	30	30
Ba	90	100
Hg	7	10
Pb	8	13
Th	8	20
U	8	20
P	A/S	A/S
S	A/S	A/S
K	A/S	A/S

RCRA Metals

A/S – LOD's are Application Specific

Metals Other Methods

- Anodic Stripping Voltametry
  - Water Samples
  - Low Detection Limits
  - Requires Soil Extraction

- Colorimetry
  - Water Samples
  - Individual Metals
  - Specific Oxidation States (eg. Cr (VI)
  - Requires Soil Extraction

Hydrocarbons and VOCs

- UV Fluorescence
  - TPH (DRO or EDRO) or site specific product calibration. C10 – 40 range. Approx 1ppm
  - PAH (USEPA 16). Approx 0.5ppm
  - GRO (C6 to C8). Approx 1ppm
  - Detects Aromatic portion of the hydrocarbon product
  - Requires Sample Extraction

- Photo-ionisation Detector (PID)
  - Volatiles Only (headspace screen)
  - Semi-quantitative for mixtures
  - Differential PID for indication of chlorinated compounds

Hydrocarbons and VOCs

- Gas Chromatography
  - Speciated and Quantitative
  - BTEX plus naphthalene speciation (approx 1ppm / 10 ppm naphthalene)
  - TPH Carbon Banded – C10-C40 risk assessment bands (approx 5-50 ppm) or waste classification oil bands (C10 – C25, >C25 – C40, approx 400ppm)
  - VOCs – speciate, screen, specific detectors (5 to 20 ppm)
  - PCBs
  - Requires heated sample headspace or extraction

Other Organics Analyses

- Colorimetric
  - Phenols
- Colour Stain Tubes
  - BTEX
  - Chlorinated Solvents
  - Requires Heated Headspace / Purge

- Immunoassay
  - PCBs
  - Dioxins
  - Pesticides

Inorganics Analyses

- Colorimetric
  - Ammoniacal Nitrogen
  - Cyanide
  - Sulphate
  - Chloride

- Ion Selective Electrodes
  - pH
  - Thiocyanate
  - Redox
  - DO

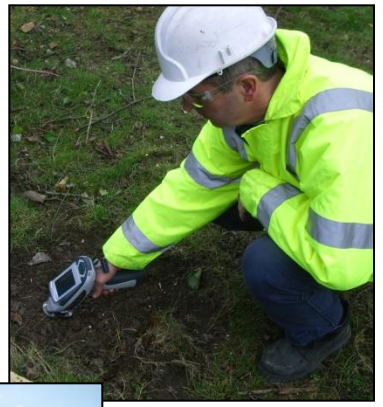
Quality Control

- Controlled Environment
  - Field Test
  - Site Accommodation
  - Mobile Laboratory
  - Qualified and Trained Staff

- Method Validation
  - Instrument Accuracy / Reproducibility
  - Sample Preparation
  - Interferences
  - Spiked Samples
  - Dry Weight or Wet Weight
  - Site Specific Validation (DMA)

- Instrument Calibration
  - Procedure and Records
  - Site QC checks – in batch standards and blanks
  - Include Ancillary Equipment

- Sample and Reagent Storage and Handling

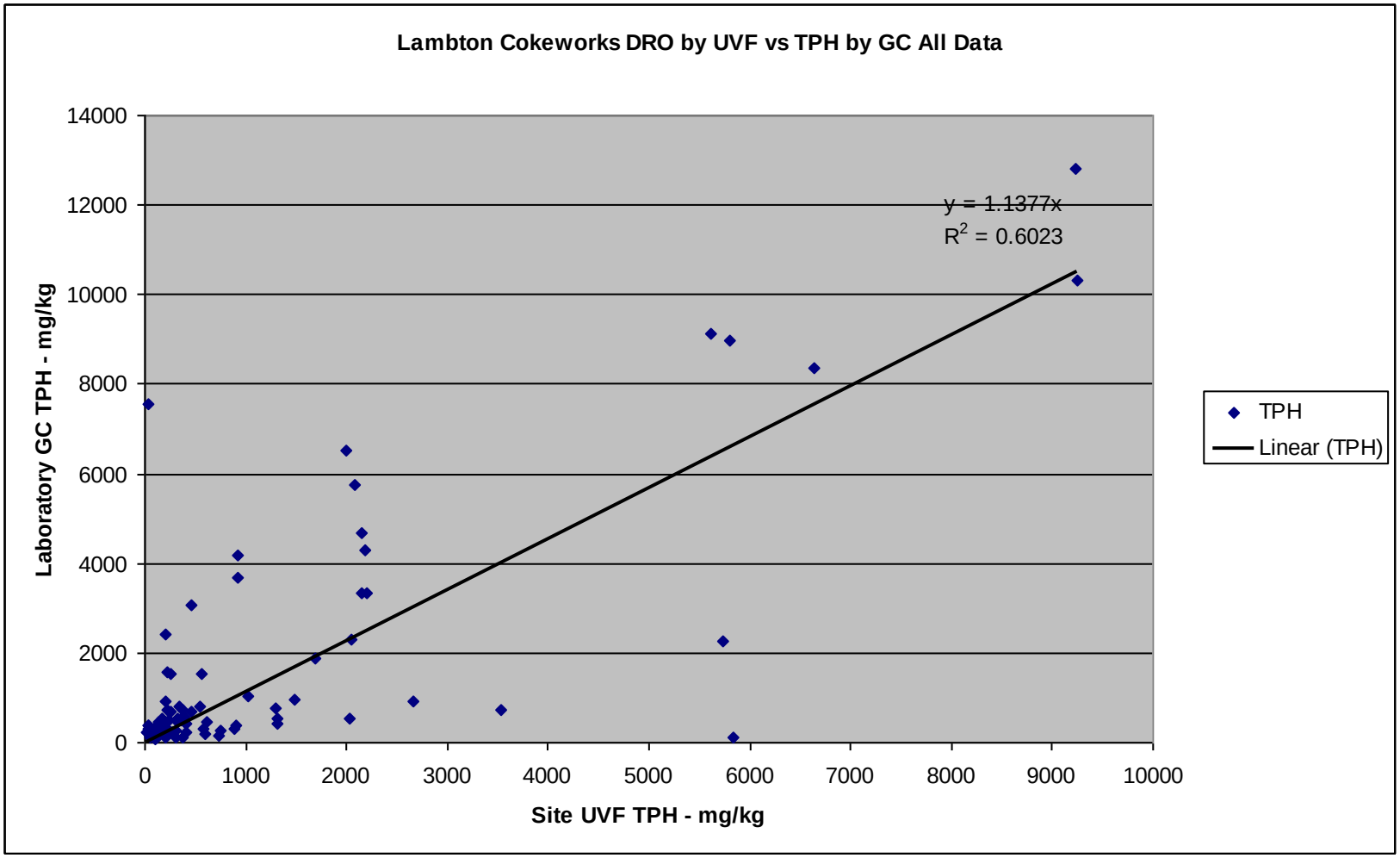


Demonstration of Method Applicability (DMA)

- Environment Agency Guidance on Rapid Measurement Techniques (RMTs)
  - http://publications.environment-agency.gov.uk/pdf/SCHO0209BPIA-e-e.pdf
  - Supports and Promotes use of RMTs
  - Provides Case Studies
  - Sets out Best Practice and use of DMAs

- DMA Details
  - Provides information on certainty and decision making windows
  - Sampling exercise from subject site to obtain 20 or more duplicate samples
  - Different soil / strata types may require separate assessment
  - On and Off Site Analysis
  - Regression Analysis
  - Focus on critical decision making concentration ranges
  - Establish correction factors between on site and MCERTs data
  - Establish decision making rules for interpretation of on site results
  - Establish sample preparation requirements to enable reliable decision making
  - DMA is reassessed on an ongoing basis as more data becomes available

DMA Data Example - TPH



Applications in Contaminated Land Management

- Site Investigation
  - Increased density of data
  - Reactive Sampling Strategy
  - Plume Delineation
  - Reduce SI Phases
  - Combine with rapid sampling techniques

- Earthworks and Remediation
  - Targeted Hotspot Excavation
  - Materials Sentencing / Stockpile Management
  - Excavation Validation
  - Waste Segregation
  - Treatment Management

Applications in Contaminated Land Management

- Waste Classification and Reduction
  - Minimise Hazardous Waste
  - Maximise materials re-use (CLAIRE Code of Practice)

- Health and Safety
  - Identify Hazardous Material
  - Zone Sites for PPE / RPE controls
  - Combine with Real Time Atmospheric Monitoring

- Water Discharge Monitoring
  - Confirm holding lagoon / tank quality prior to discharge
  - Refine Treatment Processes

Case Study
London 2012 Olympic Park

- Enabling Works Remediation supported by On Site RMT Analysis, On Site UKAS Laboratory and Off Site Analysis
- Approx. 12800 Soil Samples Analysed on Site using RMTs (between July 2007 and June 2010)
- Standard Site RMT ‘Screen’
  - TPH
  - PAH
  - GRO
  - Metals
- Additional Requests
  - Phenols / Cyanide / Sulphate / Ammonia / Chloride
- XRF and GC Analysis Trialled for Filter Cake Waste Classification
- Data Used for Stockpile Management and Guidance on Hotspot Excavations

Case Study
Lambton Cokeworks Leachable Cyanide

- Approx. 5300 m3 of stockpiled material affected by leachable cyanide contamination
- Unsuitable for re-use on site according to acceptance criteria derived by ESG.
- Requirement to minimise off site disposal to landfill
- Remediation contractor undertook unsuccessful treatability trials
- Stockpile subsequently treated by sorting of materials under ESG's supervision using on site leachability analysis to guide the segregation of materials.
- Rapid 10:1 Leachate Extraction Method Developed
- Colorimetric Analysis of Leachate
- Stockpile of ‘clean’ material subsequently validated by off site laboratory data
- On Site Analysis at 3 times the frequency of Specified Off Site Analysis
- Approximately 77% of material made suitable; saving in the order of £410,000.