

Overview of Real-Time Measurement Technologies

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Existing DEP Guidance Documents

- ◆ Field Analysis Manual (1994)
- ◆ Alternate Ground Water Sampling Techniques Guide (1994)
- ◆ Field Sampling Procedures Manual (1992)
- ◆ Currently updating all three references into one document

Advantages of Field Analytical Methods

- ◆ Allows field personnel to make informed decisions
- ◆ Delineation of target contaminants can be completed in one or two phases
- ◆ Reduce overall cost of investigation
- ◆ Increased total sample size is more compatible to statistical evaluation methods
- ◆ Increased number of sample locations results in greater resolution of the contamination in the matrix

Disadvantages of Field Analytical Methods

- ◆ Personnel on site must be mechanically competent
- ◆ Field personnel need the authority to make decisions
- ◆ Cost effectiveness evaluation may be based upon need for large number of samples to be collected
- ◆ Targeted contaminant identity must be known prior to site activities to control costs
- ◆ Heterogeneous conditions may lead to inconsistent data sets (problem with lab methods as well)
- ◆ Field extractions may produce results which are biased low (i.e. immunoassay extraction in clay soil)
- ◆ Field analytical methods may not be applicable to all site conditions

Field Analytical Method Applications

- ◆ Assess impacts to potable water
- ◆ Monitor purge water
- ◆ Screen ground water during exploratory drilling
- ◆ Real time data for monitor wells
- ◆ Define extent of soil contamination
- ◆ Evaluation of in situ remediation
- ◆ Define emergency response actions
- ◆ Estimate amount of contaminated soils
- ◆ Determine source of contamination
- ◆ Optimize location of permanent monitor wells

Desired Goals:

- ◆ Real time results
- ◆ Real time site evaluation
- ◆ Real time decisions
- ◆ Real time feedback to project team
- ◆ Optimize dynamic workplan decision process

Examples of Field Analytical Procedures and/or Methods

Immunoassay (OQA Certification Offered - SW846)

- ◆ PCBs, TPH, BTEX, TNT, PAHs

GC, GC/MS (OQA Certification Pending)

- ◆ VOCs, SVOC, PAHs, Pesticides, PCBs, TPH screening

X-ray Fluorescence (OQA Certification Pending)

- ◆ Metals

Immunoassay Methods

Advantages

- ◆ Selectivity
- ◆ Sensitivity
- ◆ Portability
- ◆ Rapid Turnaround Time

Disadvantages

- ◆ Inappropriate as an initial Survey Method
- ◆ Does not identify specific analytes within an analyte class

Slide adopted from Lesnik, 2003

Field Analytical QA/QC

Immunoassay

- ◆ Standards run with each batch
- ◆ Daily method blank
- ◆ Method specific SOP

GC - GC/MS

Advantages

- With GC/MS definitive compound identification is possible
- A broad spectrum of organic chemical analysis
- Field portable GC analysis can be of equal quality as fixed laboratory data
- Dual column analysis can also provide definitive compound identification

Source: FATE Website

GC - GC/MS

Disadvantages

- Coelution of analytes
- Higher degree of expertise required than most other instrumentation
- Sample carryover
- Multicomponent compound interferences with individual analytes
 - Petroleum with BTEX or PAH
 - PCBs with chlorinated pesticides
 - Toxaphene with chlorinated pesticides

Source: FATE Website

Field Analytical QA/QC

GC, GC/MS

- ◆ Initial and continuing calibration
- ◆ Instrument tuning
- ◆ Daily method blanks
- ◆ Method specific SOP

X-ray Fluorescence for Metals

Advantages

- Light weight, battery lasts 8 to 10 hours
- Analysis in less than five minutes
- Analyses of as many as 35 elements simultaneously in a single analysis.
- The sample is not destroyed
- No solvents, no waste generated
- Operators trained in one or two days
- Little or no sample preparation required

Source: FATE Website

X-ray Fluorescence for Metals

Disadvantages

- Action levels for some elements (i.e., arsenic, cadmium) may be lower than the detection limits of XRF.
- Interferences (i.e., arsenic and lead). Site-specific calibration standards can compensate
- License required to operate some FPXRF instruments
- Cd-109 source replaced every two years
- Si(Li) detector will require liquid nitrogen

Source: FATE Website

Field Analytical QA/QC

X-ray Fluorescence for Metals

- ◆ Daily X axis calibration
- ◆ Initial element response update
- ◆ Daily calibration check

Navy's Rapid Sediment Characterization (RSC) Program Relies on Field Analytical Methods

RSC	Laboratory Analyses
Benefits <ul style="list-style-type: none"> ◆ rapid results can guide sampling locations ◆ potential for high data density for mapping 	Benefits <ul style="list-style-type: none"> ◆ standard methods that are very quantitative ◆ can often remove interferences
Limitations <ul style="list-style-type: none"> ◆ often non-specific ◆ semi-quantitative ◆ matrix sensitive 	Limitations <ul style="list-style-type: none"> ◆ often blind sampling ◆ long delays to results ◆ expensive (\$K/sample)
Cost per Sample <ul style="list-style-type: none"> ◆ XRF (metals): \$50 ◆ UVF (PAHs): \$100 ◆ Immunoassay (PCBs): \$50 ◆ QwikSed: \$200 	Cost per Sample <ul style="list-style-type: none"> ◆ ICP/MS (metals): \$350 ◆ GC/MS (PAHs): \$550 ◆ GC/ECD (PCBs): \$400 ◆ Amphipod bioassay: \$1200
Throughput <ul style="list-style-type: none"> ◆ XRF: 40 samples per day ◆ UVF: 20 samples per day ◆ Immunoassay: 50 samples per day ◆ QwikSed: 6 – 12 samples per day 	Throughput <ul style="list-style-type: none"> ◆ Metals, PAHs, Bioassay: 30 – 90 days for data turnaround is not unusual

Slide adapted from Argonne, 2002/Crumbling 2003

Resources

- ◆ Field Analytical Technologies Encyclopedia (FATE) - <http://fate.clu-in.org>
- ◆ The **EPA REMediation And CHaracterization Innovation Technologies** (EPAREACHIT) <http://www.epareachit.org>