Continuous Multi-Metal Monitoring

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The leader in near real-time elemental speciation of particulate matter
Presentation Outline

• Xact 625i – Description and Operation
• Accuracy – Comparison Data
• Source Identification
What is the Xact

- Continuous Metals Monitor Based On
  - X-ray Fluorescence
  - Reel to reel tape drive technology
- Able to measure up to 67 metals simultaneously including Pb, As, and Cd and give near real time analysis results
All in blue can be measured by the Xact 625i

Standard Configuration is 44 different elements
## Measurement Capabilities

**Xact 625i Minimum Detection Limits (ng/m³)**  
68% Confidence Level (C10) per US EPA IO 3.3 and Currie *

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</table>

- Detection limit is a function of sampling time – the longer the sampling and analysis time the better the detection limit
- For 1 hour sampling and analysis the detection limits are less than 1 ng/m³
- Ultra high time resolution is now available – 5 minute sampling and analysis
Comparability of Xact to Laboratory Analysis

We will discuss two studies -

• U.S. EPA Environmental Technology Verification (ETV)
• King’s College (London) – Atmospheric Measurement Technology Paper
ETV Accuracy Data

Accuracy Demonstrated Down to 1 ng/m³

- **Lead (Pb):**
  - \( y = 1.06 + 1.56 \)
  - \( R^2 = 0.94 \)

- **Selenium (Se):**
  - \( y = 0.986 + 0.01 \)
  - \( R^2 = 0.93 \)
ETV Accuracy Data

**Zinc (Zn)**

\[ y = 0.97 + 3.01 \]
\[ R^2 = 0.99 \]

**Manganese (Mn)**

Excluded because Xact® did not sample for 24 hours

\[ y = 1.04 + 0.09 \]
\[ R^2 = 1.00 \]
King’s College Study

• Three different sampling locations
  – Roadside in downtown London
  – Industrial Area
  – Urban background

• Xact Compared ICP-MS

Results for Selected Elements

**Cr**
- Slope: 0.99
- Intercept: -1.7

**K**
- Slope: 1.03
- Intercept: -1.23

**Fe**
- Slope: 1.03
- Intercept: -10.1

**Cu**
- Slope: 0.95
- Intercept: -0.03

**Mn**
- Slope: 1.1
- Intercept: 0.17
Results for Selected Elements

**Ni**
- Slope: 1.07
- Intercept: -1.21

**Ba**
- Slope: 1.04
- Intercept: -1.5

**Pb**
- Slope: 1.02
- Intercept: 0.36

**V**
- Slope: 0.87
- Intercept: -0.13

**Ca**
- Slope: 1.14
- Intercept: -0.92

**Zn**
- Slope: 1.04
- Intercept: 0.37
General Approaches to Source Identification

- **Time Resolution**
  - Correlate high concentrations with local activities
- **Chemistry** – compare chemistry measured with known source chemistries (particularly important in an industrial setting)
- **Correlation with Wind Direction**
- **Highly Time Resolved Factor Analysis** (e.g. PMF)
Two 1 hour periods are responsible for most of the daily average

Daily Average = 4.63 µg/m³

- Monitoring on Fenceline of a Pb Smelter
- Variability in concentration is lost when using 24 hour sampling
- Time resolution can allow for a correlation of the measurement with plant activities
- Real time feed back from the monitor may allow for process control
The time resolution of the data allowed for the identification of the specific part of the Pb smelter responsible for the highest concentration events.
Metals are key fingerprint for many sources

Use of highly time resolved metals data allows for better resolution of factors than could be identified based on longer time data\(^2\)

Highly time resolved data allows for easy correlation of factors with specific wind directions\(^3\)

Even Diurnal Variability can be sources can be identified

Xact data used in numerous peer reviewed journal articles

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Users

• Xact 625i is widely used, accepted and trusted – Over 300 installations globally

Government Agencies (Partial List)
• U.S EPA
• Environment Canada
• Ministry of Environment Ontario
• Quebec Ministry of Environment and Climate Change
• California Air Resources Board
• South Coast Air Quality Management District
• Missouri Department of Natural Resources
• National Institute of Environmental Research (Korea)
• China National EMC
• Queensland EPA
• Kansas Department of Environmental Quality

Universities and Research Centers (Partial List)
• University of Toronto
• King’s College London
• University of Birmingham
• University of Manchester
• Paul Scherrer Institute
• Indian Institute of Technology Delhi
• Indian Institute of Technology Kanpur
• University of Massachusetts
• Hong Kong Institute of Science and Technology
• Tsingua University
• Peking University
• Chinese Research Academy of Environmental Science
Summary

- Xact 625i Provides highly accurate, highly time resolved metals concentration data
- Xact is comparable to reference methods of measuring metals
- Data can be useful in source apportionment and identification
Questions?

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