The Future of Laboratory and Field Filtration

Low Level Dissolved Metals Improvements

WaterTech
April 12, 2012

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Vice President
CARO Analytical Services
1. Challenge
   • Why do we need such low metals data?

2. Solutions
   • Instrumentation & Processes
   • Filtration

3. Evaluation of Filtration Devices
   • Approach
   • Findings/Data
   • Recommendation
30 Second Biography

- Environmental Laboratory
  - Chemistry, Microbiology, Aquatic Toxicity

- Locations
  - Richmond, Kelowna & Edmonton

- People
  - 50+ Staff
  - 10+ Professional Chemists
  - Industry Involvement: CALA, BCELTAC, ACPBC & EMA
Laboratory Perception

We are not CSI!
Why do we need such low metals data?

1. New Regulations/Environmental Protection

2. Clients Requests

3. Market Competition

“Order of Magnitude” DL improvements needed
The Solution - Instrumentation

Agilent’s 7700 Series ICP-MS

- Octopole Reaction System
- Interference Removal
- High Matrix Introduction
- Significantly Lower DLs
The Solution – Processes

Other Issues Amplified at Low Levels

Systematic Validation:

1. **ICPMS** – Introduction Systems, Gases, Programming
2. **Water Source** – Ultrapure Water System
3. **Containers** – Various Suppliers
4. **Environmental Controls** – Storage, Workspace, Procedures
5. **Training**

Filtration continued to be the predominant challenge:

1. Dissolved > Total
2. Poor Low Level Duplicate Data
3. False Positives
Filtration Techniques
- Syringe
- Gravity
- Vacuum

Contamination:
- Containers & Filters
- Sampling & Transfer
- Environment Conditions
- Training

Other Issues:
- Timing: Field vs. Lab
- Precipitation
- Extra Steps in Process
Evaluation of Commercially Available Filtration Apparatuses:

1. Traditional: membrane filtration apparatus
2. Syringe: VWR Supplied
3. Inline: SCP, Environmental Express, Waterra

Screening Considerations:

1. Contamination
2. Speed & Capacity
3. Convenience
4. Cost
Pre-Screening

Partnership With Environmental Express:

- Flipmate™ Product
- Product Required Optimization

Further Product Development & Testing

- Several Prototypes Developed
- Tandem Testing – CARO & EE
- Replicates = 10
## Filtration - Assessment

<table>
<thead>
<tr>
<th>Filter Type</th>
<th>Notes</th>
<th>B</th>
<th>Na</th>
<th>Mg</th>
<th>K</th>
<th>Ca</th>
<th>Ni</th>
<th>Cu</th>
<th>Zn</th>
<th>Pb</th>
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<tr>
<td>Detection Limit</td>
<td></td>
<td>1</td>
<td>10</td>
<td>5</td>
<td>10</td>
<td>10</td>
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<td>0.1</td>
<td>1</td>
<td>0.02</td>
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<td>Lowest Regulatory Limit</td>
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<td>10</td>
<td>100</td>
<td>100</td>
<td>50</td>
<td>0.5</td>
<td>0.2</td>
<td>1</td>
<td>0.1</td>
<td></td>
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<tr>
<td>Filter A</td>
<td>Very Slow, High Cost</td>
<td>ND</td>
<td>49</td>
<td>ND</td>
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<td>ND</td>
<td>ND</td>
<td>ND</td>
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<tr>
<td>Filter B</td>
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<td>123</td>
<td>7</td>
<td>57</td>
<td>212</td>
<td>4.59</td>
<td>3.8</td>
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<td>Filter C</td>
<td>High Cost, Contamination</td>
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<td>ND</td>
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<td>22</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
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<td>Flipmate Prototype A</td>
<td>Flipmate Original</td>
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<td>ND</td>
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<td>13</td>
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<td>15</td>
<td>ND</td>
<td>0.2</td>
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</table>

All numbers in ug/L
Metals Commonly Affected by Filtration:

B, Na, Mg, Al, K, Ca, Mn, Fe, Ni, Cu, Zn, Sr, Zr, Mo, Cd, Sb, Ba, Pb

General Study Observations:

• Lead:
  – DL = 0.02 ug/L; Regulatory Limit: 0.1 ug/L
  – Observations @ 0.12, 0.44, 0.18 ug/L

• Calcium
  – DL = 10 ug/L; Regulatory Limit: 50 ug/L
  – Observations @ 212, 22, 152 ug/L

• Manganese
  – DL = 0.05 ug/L; Regulatory Limit: 0.2 ug/L
  – Observations @ 0.15, 0.09, 0.08 ug/L
# Filtration - Assessment

## Final Filter Assessment:

<table>
<thead>
<tr>
<th>Filter</th>
<th>Contamination (1-10)</th>
<th>Speed/Capacity (1-3)</th>
<th>Convenience (1-3)</th>
<th>Cost (1-3)</th>
<th>Total (Max = 19)</th>
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<td>3</td>
<td>1</td>
<td>14</td>
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<td>C</td>
<td>5</td>
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<td>3</td>
<td>2</td>
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<td>D - Flipmate</td>
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<td>3</td>
<td>13</td>
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</table>
Filtration – Recommendation

Environmental Express Flipmate

- **Simplifies Filtration Process**
  - Integrate, Closed, Single Use System
  - Simple to use in field and lab
  - Small Sample Volumes Possible
  - Vacuum and Gravity Options

- **Relatively Inexpensive**
  - Low Unit Cost
  - Low Cost of Use
  - Compact – Storage, Shipping

- **Quality Improvements**
  - Lower Cross Contamination Risk
  - Low “Internal” Contamination

**Improved LL Metals Data**
1. Challenge – Need For Low Metals
   • Regulatory, Client, Industry Pressures

2. Solutions
   – Instrumentation and Process Improvements
   – Filtration Continues to Pose a Challenge

3. Evaluation of Filtration Apparatuses

4. Recommendation

5. Happy Clients
Thank You

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