Metals Removal in the Membrane Bioreactor Wastewater Treatment Process

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Presentation Outline

• “Motivation” for metals analysis in membrane bioreactor (MBR)
• Pilot MBR process configuration
• Pilot MBR metals data evaluation
• Summary
• Further work
Motivation for MBR Pilot Metals Analysis

Effluent Quality
Evaluation of Reuse Options

Removal Efficiency
Evaluation of MBR Process
Impact on Biosolids Quality

Effluent Quality / Removal Efficiency / Fate
Evaluation of MBR Process
Comparison to CAS Process
Impact on Biosolids Quality
Impact of MBR SRT on Metal Removal
Enviroquip MBR Pilot Plant

Operating Conditions
HRT = 6 hrs
SRT = 18 - 50 days
MLSS = 8,000 - 15,000 mg/L
Membrane Plates

0.4 micron pore size
Test Methodology

• Pilot Sample Locations
  – influent
  – effluent
  – mixed liquor
• Sample Frequency
  – monthly
• Sample Type
  – grab
• Metals Analysis
  – Environmental Laboratory Routines
    (06-02-004, 06-03-004, and 06-01-004)
• Sample Planning Assumptions
  – influent metal variability during sample period
  – grab sampling versus 24-hr composite
Pilot MBR Metal Removal Efficiency

Data Source: Petrasek et al, 1983
Pilot MBR Influent Metal Concentrations

<table>
<thead>
<tr>
<th>Metal</th>
<th>Influent Metal Concentrations (mg/L)</th>
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<tbody>
<tr>
<td></td>
<td>KC MBR</td>
</tr>
<tr>
<td>Cr</td>
<td>0.004</td>
</tr>
<tr>
<td>Cu</td>
<td>0.050</td>
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<tr>
<td>Pb</td>
<td>0.008</td>
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<tr>
<td>Ni</td>
<td>0.005</td>
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<tr>
<td>Zn</td>
<td>0.100</td>
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</table>

Data Source: Petrasek et al, 1983
## Pilot MBR “Estimated” Biosolid Metal Concentrations

<table>
<thead>
<tr>
<th>Metal</th>
<th>WP 2003 (12 samples)</th>
<th>MBR pilot est. (4 samples)</th>
<th>40CFR503 limit</th>
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<tbody>
<tr>
<td></td>
<td>mean max</td>
<td>mean max</td>
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<tr>
<td>As</td>
<td>7 8</td>
<td>14 18</td>
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<tr>
<td>Cd</td>
<td>4 9</td>
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<td>Cr</td>
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<tr>
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<tr>
<td>Hg</td>
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<td>2 4</td>
<td>17</td>
</tr>
</tbody>
</table>
Pilot MBR versus CAS

Impact of Concentration Factor (CF)

$CF = f (SRT, HRT, MLSS)$
Summary

• Metal Removal Efficiency
  – MBR consistent with literature data
  – MBR exceeds EPA guide with the exception of Zn

• Biosolid Metal Concentrations
  – minimal risk of exceeding current 40 CFR 503 biosolid regulation

• Membrane Bioreactor versus Conventional Activated Sludge
  – MBR as suspended solids filter has impact on final effluent metal concentrations
Future Work

Hollow-Fiber Membrane Bioreactor Biological Phosphorus Removal Pilot
South Treatment Plant
July 2004 - March 2005

Flat-Plate Membrane Bioreactor Peak Hydraulic Loading Pilot
West Point Treatment Plant
June 2004 - March 2005

Effluent Quality / Removal Efficiency / Fate
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Questions

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