Technical Issues Around Copper Biotic Ligand Model Implementation

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NCASI Work Related to BLM

• Member of the Technical Review Panel
  – ORDEQ Technical Support Document: An Evaluation to Derive Statewide Copper Criteria Using the Biotic Ligand Model

• Commenting
  – Oregon’s Aquatic Life Water Quality Criteria for Copper
  – Idaho’s Copper Rulemaking
  – Draft Aquatic Life Ambient Estuarine/Marine Water Quality Criteria for Copper
Background - Copper Sources and Exports at Mills

• **Primary Import Vectors**
  - Raw material, coal, clays
  - In mill
    - Corrosion of process piping, storm water runoff from metal roofing

• **Primary Export Vectors**
  - Grits & dregs, pulp, WWTP sludge, lime mud
Biotic Ligand Model

- Requires model to determine criteria
- Requires 11 input parameters, several of which are not commonly measured
  - Sensitive to changes in pH and DOC
- Model output in an instantaneous water quality criteria (IWQC) – how does this translate into a NPDES permit limit?
  - Site and temporally dependent
Free vs. Dissolved Concentrations of Metals

Copper

Cadmium

What to do with BLM Missing Parameters?

- **EPA Draft Technical Support Document published in February 2016**
  - Recommends default, conservative input (10th percentile Level III Ecoregion values) when data are lacking

- **Proposed OR Aquatic Life Water Quality Standards**
  - 25th percentile DEQ physiographic region
Temporal Variability of BLM Parameters

DOC Geochemical Ions (Na, K, Ca, Mg)

IDDEQ data from the North Fork of the Coeur d’Alene River, Enaville
Validity of DOC data

USGS Data: Columbia River between Northport WA and Trail BC
Effect of the Nature of Dissolved Organics

• Copper BLM was parameterized with DOC from natural waters.
• DOC concentrations are model inputs but DOC binding affinity (stability constants) are fixed.
• Studies have shown that
  – anthropogenically influenced DOC has higher binding affinity than natural DOC
  – and DOC with high aromatic contents are strong metal chelators.
Diel pH Variation

pH data in the Sheepscot River above Head Tide (river kilometer 10.35) from July, August, and September for the years 2001-2003, shown by time of day (hour)
Averaging Time

- EPA has recommended moving from a 24 hour averaging time to a 1 hour averaging time for calculation of the acute copper criterion.
- May be appropriate for fast acting toxicants like ammonia but overly conservative for metals such as copper.
Fixed Monitoring Benchmark

- The fixed monitoring benchmark is a statistical technique to determine toxic discharge capacity in a receiving water that will satisfy a specified exceedence frequency while incorporating the IWQC results from the BLM.

- Data intensive – recommend at least two years of monthly BLM data before application.
### Data Collection Costs

(every two weeks or monthly; final effluent and upstream receiving water; downstream receiving water)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Price range</th>
<th>Note*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cu (dissolved)</td>
<td>$20-$35</td>
<td>To evaluate attainment of calculated criteria</td>
</tr>
<tr>
<td>Temperature</td>
<td>Field measurement</td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>Field measurement</td>
<td></td>
</tr>
<tr>
<td>DOC</td>
<td>$35-$40</td>
<td></td>
</tr>
<tr>
<td>Alkalinity</td>
<td>$15-$25</td>
<td></td>
</tr>
<tr>
<td>Ca$^{2+}$</td>
<td>$10-$25</td>
<td>Used also for calculated hardness (SM 2340B)</td>
</tr>
<tr>
<td>Mg$^{2+}$</td>
<td>$10-$25</td>
<td>Used also for calculated hardness (SM 2340B)</td>
</tr>
<tr>
<td>Na$^+$</td>
<td>$10-$25</td>
<td></td>
</tr>
<tr>
<td>K$^+$</td>
<td>$10-$25</td>
<td></td>
</tr>
<tr>
<td>Cl$^-$</td>
<td>$15-$30</td>
<td></td>
</tr>
<tr>
<td>SO$_4^{2-}$</td>
<td>$15-$30</td>
<td></td>
</tr>
<tr>
<td>% Humic acid (HA)</td>
<td>$140-$165</td>
<td>10% typically assumed</td>
</tr>
<tr>
<td>Sulfide (S)</td>
<td>Assumed value</td>
<td>placeholder, not yet used in BLM computations</td>
</tr>
</tbody>
</table>

**Total=$140-$280**

*Field filtered sample recommended for most parameters

From Jeff Louch 2015 West Coast Regional Meeting
Technical Studies Program
Projects Proposed for 2017/2018 Year

- Site specific case studies using the copper biotic ligand model
- Binding of Copper to DOC in Mill Final Effluents