WHEN TO MAKE A CORROSION CONTROL TREATMENT (CCT) CHANGE

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Steve Via, AWWA Government Affairs Office

WQTC
November, 2019
Chapter 1 Background and Purpose

When and how should a utility revisit its CCT? .................................................................

Chapter 2 Events That Could Trigger a New CCT

Chapter 3 Evaluate Current CCT and Status .................................................................

  Define Existing CCT .....................................................................................................

  Find and Fix in the event of Elevated Lead or Copper Results .....................................

  Evaluation of Data ........................................................................................................

Chapter 4 Treatment or Water Quality Changes That May Impact CCT ......................

Chapter 5 Determining the Proper Study Method to Use .............................................

Chapter 6 Putting it All Together ....................................................................................

References ......................................................................................................................
Factors Driving A CCT Evaluation and Possible Change

Making a WQ or TRT change

A study or demonstration would drive a CCT change

Can study within the limits of current practice as starting point

Blending or changing Source or blending in Finished Water

Could Involve ‘tweaking’ @ full scale within reasonable ranges

More elaborate would necessitate study or demonstration

Might necessitate ‘drastic’ CCT change to lower lead

Requirement or desire to lower lead levels

See Evaluation Methodology
## EXAMPLE CHANGES THAT WARRANT A CCT EVALUATION

<table>
<thead>
<tr>
<th>1. Water Sources</th>
<th>Change source water</th>
</tr>
</thead>
</table>
| 2. Blending Source or Finished Water Seasonally | Blending of different source waters  
Blending of different finished waters |
| 3. Disinfection | Change in disinfectant type or disinfection strategy |
| 4. WQ Parameters Directly affecting CCT | Change in pH or alkalinity  
Change in inhibitor type (e.g., changing any combination of polyphosphate, blended phosphate, or orthophosphate; as well as adding any P-containing product when no ortho- or poly-phosphate was added before)  
Change of blended or polyphosphate inhibitor product or supplier |
| 5. Treatment Changes | Change in coagulant type (e.g., Fe-based to/from Al-based, or Cl-based to/from SO4-based)  
Change in treatment process that increases NOM  
Change or addition of new oxidant (e.g. adding ozone)  
Addition of ion exchange (IX) |
Example Changes That Do Not Warrant a CCT Evaluation Except Desktop or Solubility

1. Change in blending/seasonal impacts that have historically occurred specifically within allowed WQPs

2. Inhibitor
   - Change in orthophosphate dose, but solubility study helpful
   - Change in orthophosphate vendor (not blended or polyphosphate, see above)

3. Treatment
   - Membrane filtration as long as WQ at tap does not change
   - Change in softening agent
   - Addition of GAC if pH doesn’t change
EVALUATION METHODOLOGY

1. Evaluate Current Status
2. What WQ Parameters Are Changing
3. Determine Level of Investigation Needed
4. Determine if New CCT is Warranted
5. Cautions on Making a CCT Change
EVALUATE CURRENT STATUS-ACTIONS

- Trend and Evaluate Data
- Map Lead lines/Older Housing
- Evaluate Presence of Biofilms
- Conduct Profile Sampling
- Define Current CCT
EVALUATE CURRENT STATUS-OVERCOMES
FROM FIND AND FIX FOR Pb REDUCTION

- Could Result in Lead Reduction------Ending Further Actions

STOP

- But, Could Require Further Actions.....
Evaluation Methodology

1. Evaluate Current Status
2. What WQ Parameters Are Changing—Narrow Down Study Area to Defined Changes
3. Determine Level of Investigation Needed
4. Determine if New CCT is Warranted
5. Cautions on Making a CCT Change
## Based on Change-Define WQP Changing

<table>
<thead>
<tr>
<th>Change</th>
<th>Possible changes in corrosion-related water quality parameters</th>
<th>Potential impacts scale</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Change in finished water pH</td>
<td>Change in DIC/Alkalinity</td>
</tr>
<tr>
<td>Addition of a new source of supply</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Blending of different source waters</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Blending of different finished waters</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Change in free chlorine dose</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Change from chlorine gas to hypochlorite</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Addition of other oxidants/disinfectants</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Conversion to chloramines</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Enhanced coagulation for NOM removal</td>
<td>•</td>
<td>•</td>
</tr>
</tbody>
</table>
Evaluation Methodology

1. Evaluate Current Status
2. What WQ Parameters Are Changing
3. Determine Level of Investigation Needed
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5. Cautions on Making a CCT Change
MANY MECHANISMS CAN IMPACT Pb

- Lead Solubility
- Galvanic Corrosion
- Sequestrant Presence
- ORP
- Ca, Al, Fe, Mn
- Water use Rate
- Water Flow Rate in Pipes/Plumbing
- Scale Disruption
- Microbial Growth
A DIVERSION INTO THE LT LCR PROPOSAL

• Proposal states loops must be used because of scale impacts and coupons only screen & not set OCCT

• What does the proposal mean by a “loop” study-assume---flow through harvested material study
## BUT: TOOLBOX OF AVAILABLE STUDY METHODS

<table>
<thead>
<tr>
<th>Method</th>
<th>Solubility</th>
<th>Galvanic</th>
<th>Sequestrant</th>
<th>ORP</th>
<th>Ca, Al, Fe, Mn</th>
<th>Water Use and Rate</th>
<th>Scale Disruption</th>
<th>Microbial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theoretical Solubility</td>
<td>M</td>
<td>M</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Research Actual Solubility</td>
<td>M+</td>
<td>M+</td>
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<td></td>
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<tr>
<td>Batch Coupon Weight Loss</td>
<td></td>
<td></td>
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<tr>
<td>Batch Coupon Solubility</td>
<td>H</td>
<td>H</td>
<td>M</td>
<td>L</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Batch Harvested Pipe</td>
<td>H-</td>
<td>H</td>
<td>H-</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
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<tr>
<td>Batch Galvanic Tests</td>
<td></td>
<td>M</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>“Loop” Virgin Pipes</td>
<td>M</td>
<td>H</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>“Loop” Coupons</td>
<td>M</td>
<td>H</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
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<tr>
<td>Flow Through Harvested Pipe</td>
<td>L+</td>
<td>H</td>
<td>L+</td>
<td>H</td>
<td>H</td>
<td>H</td>
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<tr>
<td>Scale Analysis</td>
<td>M</td>
<td>M</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>M</td>
</tr>
</tbody>
</table>
Loop studies have not been successful in evaluating different CCT methods on harvested premise materials like copper/lead solder or faucets—too much variability in materials

- *plus* Harvesting premise pipes from INSIDE a house has liability issues and unintended consequences

- So, we have ~70% of CWS w/o LSL where harvested flow through studies aren’t particularly good

- Many changes don’t affect LSL scales

- LSL pipe studies are also variable and take a long time to settle down
TWO COPPER/SOLDER PIPES FROM SAME HOUSE

![Graph showing the comparison of lead levels in Pipes 6A and 6B.](chart.png)
• Loops have large variability even with LSLs making it hard to compare different test conditions
• Note the high 2SD values making a distinction in test conditions difficult
• These are values after the pipes have “settled” down

<table>
<thead>
<tr>
<th>PO4 Dose</th>
<th>1.2 mg/L</th>
<th>2.5 mg/L</th>
<th>3.0 mg/L</th>
<th>3.5 mg/L</th>
<th>4.0 mg/L</th>
<th>5.0 mg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean ppb</td>
<td>2.9</td>
<td>10.5</td>
<td>5.2</td>
<td>3.8</td>
<td>3.6</td>
<td>3.0</td>
</tr>
<tr>
<td>2 SD ppb</td>
<td>3.4</td>
<td>3.4</td>
<td>15.8</td>
<td>5.0</td>
<td>24.8</td>
<td>7.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose</td>
</tr>
<tr>
<td>Mean ppb</td>
</tr>
<tr>
<td>2 SD ppb</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Loop</th>
<th>Loop 1</th>
<th>Loop 2</th>
<th>Loop 3</th>
<th>Loop 4</th>
<th>Loop 5</th>
<th>Loop 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean ppb</td>
<td>436.9</td>
<td>544.8</td>
<td>682.4</td>
<td>357.7</td>
<td>137.1</td>
<td>81.5</td>
</tr>
<tr>
<td>2 SD ppb</td>
<td>320.0</td>
<td>622.0</td>
<td>374.0</td>
<td>300.0</td>
<td>180.0</td>
<td>70.0</td>
</tr>
</tbody>
</table>

It is really hard to tell differences in TRT with loops
An example different City—All TRT tests showed 1 low pipe and some high pipes

\[ \sim 2 \text{ years to settle down} \]
FLOW THROUGH HARVESTED PIPE STUDIES AND COUPON SOLUBILITY STUDY

Side by side coupon solubility study

Harvested Pipe Data after one year from start and onward—took over a year to settle down
KEY POINTS

• Additional study on scale impacts has a place when scales could be disrupted-flow through harvested pipes are one option **but other options are available and more being researched**

• Coupon solubility tests are very good for lead solubility testing which in many cases is all that is needed or might be needed for quick CCT change when over AL or when there aren’t LSLs or galvanized pipes

• A toolbox approach would seem to be a valid approach to types of studies available and appropriate
GRAND RAPIDS, MI AS AN EXAMPLE

- Serves 280,000 population
- Lake Michigan water source
- Fairly conventional WTP using alum
- Have used a 50/50 polyphosphate blend with a goal of about 1 mg/L PO4 (ortho portion)
- Desire to eliminate poly due to transmission capacity loss
HISTORICAL LEAD HAS BEEN LOW: NOTE GR HAS LSLS
PROFILE SAMPLING ALSO SHOWED LOW LEAD LEVELS

Hence a strategy worked out with EGLE was to move CAUTIOUSLY
KEY STUDIES AT GR TO DATE

Lead solubility coupon studies showed ortho better

But scale studies cautioned switching

Lots of amorphous AL-OH and poly P

Also lots of Lead 4
MANY MECHANISMS CAN IMPACT Pb

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Highlighted Items of Concern for GR
• With close EGLE-City coordination all have agreed in this case to move cautiously, no apparent immediate need to switch and scales might be impacted
• In this case additional scale analysis is planned, further refinement using coupons and a scale impact study of method TBD
Evaluation Methodology

1. Evaluate Current Status
2. What WQ Parameters Are Changing
3. Determine Level of Investigation Needed
4. Determine if New CCT is Warranted—I’ve Done a CCS—Does the Data Justify a Change
5. Cautions on Making a CCT Change
Evaluation Methodology

1. Evaluate Current Status
2. What WQ Parameters Are Changing
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MONITORING POST CCT CHANGE

• Sentinel homes
  – Locate homes with representative material
  – Conduct regular lead monitoring

• Profile Follow Up
  – Allows for more detail assessment of improvement
  – Could be at sentinel homes

• Increased WQP
  – Tighter goals
  – Increased number of sites
  – Increase frequency
SO WHERE ARE WE

• There are no easy answers—It’s not a Cookbook approach
• Can’t Emphasize Enough to Use Caution – Error on the side of not making a change
• For the CCS methods in LT LCR move toward a toolbox approach