Water Research Foundation Lead Research

November 9th, 2016

SFPUC and Wholesale Customers
Annual Water Quality and Technology Workshop

advancing the science of water
Jonathan Cuppett & Mike Dirks
Research Manager
Water Research Foundation
One Water

STORMWATER

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E-news Navigation

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Graphic credit
WRF Lead Research

Research Ahead of Lead and Copper Regulation;
Lead and Copper Corrosion: An Overview of WRF Research

January 2016 Update

Lead and Copper Corrosion: An Overview of WRF Research

Jonathan Cappell, Water Research Foundation

This summary of relevant Water Research Foundation (WRF) research projects, both completed and ongoing, provides a basic understanding of the issues surrounding lead and copper corrosion and the Lead and Copper Rule (LCR).

BACKGROUND

In 1991, the U.S. Environmental Protection Agency (EPA) published the LCR, which established that all community water systems (CWSs) and non-transient non-community water systems (NTNCWSs) would be subject to the rule requirements. The primary purpose of the LCR is to protect public health by minimizing lead (Pb) and copper (Cu) levels in drinking water. Pb and Cu enter drinking water mainly from corrosion of Pb- and Cu-containing plumbing materials. A unique aspect of the LCR is that lead and copper have action levels (AL) of 0.015 mg/L for lead and 1.3 mg/L for copper, and therefore do not have Maximum Contaminant Levels (MCLs). The action level for lead is a screening technique for optimal corrosion control based on treatment feasibility, and is not a health-based threshold. The action level for copper does have a health reference based on the prevention of nausea. Copper also has a secondary MCL (SMCL) of 1.0 mg/L, which is based on aesthetics or taste and staining. Table 1 highlights the different regulatory levels of Pb and Cu.

Table 1. Lead and copper regulatory framework

<table>
<thead>
<tr>
<th></th>
<th>Copper</th>
<th>Lead</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL (mg/L)</td>
<td>1.3</td>
<td>0.015</td>
</tr>
<tr>
<td>Health Based Action Level</td>
<td>Yes</td>
<td>No</td>
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<tr>
<td>MCL</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>MCLG (mg/L)</td>
<td>1.5</td>
<td>0</td>
</tr>
<tr>
<td>SMCL (mg/L)</td>
<td>1.0</td>
<td>N/A</td>
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</tbody>
</table>
WRF Lead Research
History of SDWA Lead Regulation

- **SDWA Lead Ban (1986)**
- **Lead Contamination Control Act (1988)**
- **Lead and Copper Rule (1991)**
- **Reduction of Lead Act (2011)**
- **Proposed LCR Revisions (2017)**

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Notable WRF Projects

- **1990**: Lead Control Strategies
- **1994**: Development of a Pipe Loop Protocol For Lead Control
- **1995**: Innovative Techniques for Lead Service Line Location
- **2000**: Lead Pipe Rehabilitation and Replacement Techniques
- **2001**: Role of Phosphate Inhibitors in Mitigating Corrosion
Notable WRF Projects

Contribution of Service Line and Plumbing Fixtures to Lead and Copper Rule Compliance Issues

2008

CSMR: Changes from Water Treatment and Its Impact on Lead Leaching

2010

Lead and Copper Corrosion in New Construction

2011

Galvanic Corrosion Following Partial Lead Service Line Replacement

2013
Innovative techniques for lead service line location

Development of a pipe loop protocol for lead control

Lead control strategies

Role of phosphate inhibitors in mitigating corrosion

Lead pipe rehabilitation and replacement techniques

Contribution of service line and plumbing fixtures to lead and copper rule compliance issues

Galvanic corrosion following partial lead service line replacement

Lead and copper corrosion in new construction

CSMR: Changes from water treatment and its impact on lead leaching

1985

1986 Lead Ban (50% - 8% in pipe fittings)

1988 Lead Contamination Control Act (LCCA)

1990

1991 Lead and Copper Rule (LCR, revised in 2000 and 2007, and est. 2020)

1995

2000

2005

2010

2015

2020

2025

4569 - Evaluation of lead sampling strategies; Controlling lead in drinking water

4409 - Controlling lead in drinking water

4351 - Evaluation of lead service line lining and coating techniques;

4586 - Optimization of phosphorous-based corrosion control chemicals;

4584 - Evaluation of flushing to reduce lead levels;

4658 - Corrosion of nonlead pump impeller alloys

4686 - Processes controlling the time for orthophosphate to achieve effective corrosion control

LT-LCR rule anticipated 2019 or 2020

2015 Proposed LCR Revisions

2014 Reduction of lead in drinking water act
45+ WRF lead research projects since 1980’s

Lead Funding

>$15 million value
LCR Project Spotlights

Evaluation of Lead Sampling Strategies

Web Report #4569

Subject Area: Water Quality

Controlling Lead in Drinking Water

Web Report #4409

Subject Area: Infrastructure
Project 4569  Spotlight

• Partnership
• Highlighted challenges with customers performing profiles
• No sampling method was particularly proficient at finding the peak lead level compared to doing a full profile for each sampling event
• Webcast available
• JAWWA publication forthcoming
# Lead & Additional Webcasts
## Expert Symposia

<table>
<thead>
<tr>
<th>Month</th>
<th>Date</th>
<th>Event</th>
</tr>
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<tbody>
<tr>
<td>January</td>
<td>27-Jan</td>
<td>Water Supply Reservoir Management: Rapid Monitoring Methods, Modeling</td>
</tr>
<tr>
<td></td>
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<td>Tools, and Oxygenation and Circulation Techniques</td>
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<tr>
<td>February</td>
<td>26-Feb</td>
<td>Institutional Issues for One Water Management</td>
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<tr>
<td>March</td>
<td>18-Mar</td>
<td>Controlling the Formation of Nitrosamines During Water Treatment</td>
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<tr>
<td>April</td>
<td>7-Apr</td>
<td>Preparing for and Mitigating Algae Blooms and Cyanotoxins—The Utility</td>
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<td></td>
<td>14-Apr</td>
<td>AMR/AMI Standardization for Drinking Water Systems</td>
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<tr>
<td></td>
<td>23-Apr</td>
<td>Green Building Design: Water Quality Considerations</td>
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<tr>
<td>May</td>
<td>12-May</td>
<td>Hexavalent Chromium Treatment with New Ion Exchange Resins and Reduction/Coagulation/Microfiltration</td>
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<tr>
<td></td>
<td>21-May</td>
<td>Energy and Water Quality Management Systems for Drinking Water Utilities</td>
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<tr>
<td>June</td>
<td>23-Jun</td>
<td>Medium Pressure UV Inactivation of Viruses and Cryptosporidium</td>
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<tr>
<td></td>
<td>30-Jun</td>
<td>Monitoring and Responding to Nitrification in the Distribution System</td>
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<tr>
<td>July</td>
<td>9-Jul</td>
<td>Turf Replacement Programs</td>
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<tr>
<td></td>
<td>16-Jul</td>
<td>Using Cost-Benefit Analyses to Compare Drought Management Practices</td>
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<tr>
<td></td>
<td>21-Jul</td>
<td>Financial Resiliency During Drought</td>
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<td></td>
<td>30-Jul</td>
<td>Customer Communications During Drought</td>
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<tr>
<td>August</td>
<td>4-Aug</td>
<td>Legacy of Manganese Accumulation in Water Systems</td>
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<td></td>
<td>20-Aug</td>
<td>Biostability: Operational Definitions and Utility Assessments</td>
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<td>September</td>
<td>22-Sep</td>
<td>Reducing Volatile DBPs in Treated Drinking Water Using Aeration Technologies</td>
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<tr>
<td>October</td>
<td>8-Oct</td>
<td>Evaluation of Lead Line Sampling Strategies</td>
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<tr>
<td></td>
<td>20-Oct</td>
<td>Remote Sensing for Proactive Watershed Management</td>
</tr>
<tr>
<td>November</td>
<td>5-Nov</td>
<td>A Snapshot of Water Loss—Examining the Country’s Water Audit Submissions</td>
</tr>
<tr>
<td>December</td>
<td>15-Dec</td>
<td>Core Messages for Chromium, Medicines and Personal Care Products, NDMA, and VOCs</td>
</tr>
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</table>
Resources: Expert Symposiums: Lead and Copper Symposium 2016

Hosted by the Philadelphia Water Department in cooperation with WRF, this event provided insights on possible future changes to the Lead and Copper Rule, based on recent National Drinking Water Advisory Council (NDWAC) discussions.

www.waterrf.org/resources/expertsymposiums/Pages/lead-copper-symposium-2016.aspx
Lead and Copper Rule: Potential Regulatory Changes, Corrosion Chemistry, and Stakeholder Communication
Project 4409 Spotlight

- Overview of Lead in drinking water and corrosion chemistry
- Lead service line replacement strategies
- 6 - OCCT Case Studies
Project 4409

Controlling Lead in Drinking Water

Web Report #4409

Subject Area: Infrastructure
**LSLR Collaborative**

GOAL: Accelerate voluntary lead service line replacement in communities across the United States

<table>
<thead>
<tr>
<th>Collaborators</th>
<th>4 work groups</th>
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</thead>
<tbody>
<tr>
<td>WRF</td>
<td>Best Practices</td>
</tr>
<tr>
<td>AWWA</td>
<td>Policy</td>
</tr>
<tr>
<td>NAWC</td>
<td>Roadmap</td>
</tr>
<tr>
<td>AMWA</td>
<td>Pilots</td>
</tr>
<tr>
<td>ASDWA</td>
<td>*Reports available in 2017</td>
</tr>
<tr>
<td>NRDC</td>
<td></td>
</tr>
<tr>
<td>Various utility members and other public health agencies</td>
<td></td>
</tr>
</tbody>
</table>
Recent LCR Documents
NDWAC Final Report

Report of the Lead and Copper Rule Working Group
To the National Drinking Water Advisory Council

FINAL

MEMORANDUM

SUBJECT: Lead and Copper Rule Requirements for Optimal Corrosion Control Treatment for Large Drinking Water Systems

FROM: Peter C. Grevatt, Director
Office of Ground Water and Drinking Water

TO: EPA Regional Water Division Directors, Regions I-X

Date Signed: November 3, 2015

EPA OCCT Report

Optimal Corrosion Control
Treatment Evaluation Technical
Recommendations for Primacy
Agencies and Public Water Systems

www.epa.gov/dwregi
nfo/optimal-
corrosion-control-
treatment-
evaluation-technical-
recommendations
MEMORANDUM

SUBJECT: Clarification of Recommended Tap Sampling Procedures for Purposes of the Lead and Copper Rule

FROM: Peter C. Grevatt, Director  
Office of Ground Water & Drinking Water

TO: Water Division Directors  
Regions I - X

State Responses to EPA's Letter to Governors and State Environment and Public Health Commissioners

of WRF LCR Research

2017

- #4351, Evaluation of Lead Service Line Lining and Coating Technologies
- #4586, Optimization of Phosphorus-Based Corrosion Control Chemicals and Flushing for Lead and Copper Control
- #4584, Evaluation of Flushing to Reduce Lead Levels
- #4658, Corrosion of Nonleaded Pump Impeller Alloys in Chlorinated Potable Water

2018

- #4693, Service Line Material Identification Techniques
- #4686, Processes Controlling the Time for Orthophosphate to Achieve Effective Corrosion Control
New Project

- #4693-Service Line Material Identification Techniques
- Evaluate remote sensing technologies
- Document case studies of currently used techniques
- Researcher announced Oct.
- Report - mid 2017

Service Line Material Identification Techniques (RFP 4693)

Objective
Evaluate water service line material identification technologies, techniques, and strategies.

Budget
Proposals requesting Water Research Foundation (WRF) funding in the range of $40,000 - $50,000 will be considered for this effort. Total funds requested from WRF will be taken into consideration in the final proposal selection process.
Summary

- Lead Risk Communication
- Lead Service Line Removal
- Corrosion Control (lead and copper) 4686
- Lead in Schools and Childcare Facilities
- 2017 LCR Revisions???
NDWAC Final Report

Report of the Lead and Copper Rule Working Group
To the National Drinking Water Advisory Council

FINAL

• LCR is a treatment technique rule
• Even when corrosion control is optimized, individual premises can have high lead
• Sources of lead exist in premises
• “Lead-bearing materials should be removed from contact with drinking water to the greatest degree possible”
• “Effective elimination of leaded materials ..... is a shared responsibility.”
Robust Public Education is Essential

“Effective elimination of leaded materials in contact with water and minimization of exposure to lead in drinking water is a shared responsibility; public water systems, consumers, building owners, public health officials, and others each have important roles to play.”
Public Education is a Cornerstone

### Lead Control Program

- **Provide Public Education Information and Consumer Confidence Report**

  - **Maintain Water Quality Monitoring**

    - **Corrosion Control Treatment needed?**
      - Yes: **Water Quality Parameter Monitoring**
      - No: **Lead Service Line Replacement Program**

    - **Do Lead Service Lines Exist?**
      - No: **Maintain Water Quality Conditions**
      - Yes: **Customer Requested Tap Sampling**
        - **HAL Exceeded?**
          - Yes: **Contact Health Agency and Report to Customer**
          - No: **Report to Customer and to State**
        - **SAL Exceeded?**
          - Yes: **Report to Customer and to State and Evaluate CCT and other Conditions**
          - No: **Maintain Water Quality Conditions**

### Copper Control Program

- **Provide Information in Consumer Confidence Report**

  - **Is water corrosive?**
    - No: **Public Education**
    - Yes: **Change such that water is not corrosive**

  - **Change Treatment or Source**
WRF Communications Research

Water Utility Primer on EDCs/PPCPs for Public Outreach (4387)

• Distilled and synthesized current information on EDCs and PPCPs into a primer

Dialogue on CECs and Public Health (4463)

• Recommendations to improve communication and collaboration between the water sector, researchers, regulatory agencies and public health groups

Context and Core Messages (4457)

• A context animation (publicly available)
• Technical briefs and “thinking about” pieces by social scientists

Terminology and Improved Communication (4551)

• Key terminology--meanings, connotations, and relations
• Differences in information use and preferences
## Water quality information sources

<table>
<thead>
<tr>
<th>Source</th>
<th>TRUSTED</th>
<th>RELIABLE/KNOWLEDGABLE</th>
<th>EASILY ACCESSIBLE</th>
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<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>n</td>
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<tr>
<td>neighbor</td>
<td>51</td>
<td>12.8%</td>
<td>24</td>
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<td>local government</td>
<td>112</td>
<td>28.2%</td>
<td>122</td>
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<td>political party</td>
<td>4</td>
<td>1.0%</td>
<td>6</td>
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<tr>
<td>water utility/company</td>
<td>243</td>
<td>61.2%</td>
<td>287</td>
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<td>health professional</td>
<td>165</td>
<td>41.6%</td>
<td>176</td>
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<td>environmental organization</td>
<td>235</td>
<td>59.2%</td>
<td>249</td>
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<td>advocacy group</td>
<td>65</td>
<td>16.4%</td>
<td>66</td>
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<tr>
<td>news media</td>
<td>92</td>
<td>23.2%</td>
<td>73</td>
</tr>
<tr>
<td>social media</td>
<td>20</td>
<td>5.0%</td>
<td>15</td>
</tr>
<tr>
<td>friend/family</td>
<td>58</td>
<td>14.6%</td>
<td>31</td>
</tr>
<tr>
<td>other water</td>
<td>7</td>
<td>1.8%</td>
<td>5</td>
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</table>
### How to Talk about Science and Regulation of Contaminants

Which of the following terms would concern you the most?

<table>
<thead>
<tr>
<th>Term</th>
<th>Most worrying</th>
<th>Total worried participants</th>
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</thead>
<tbody>
<tr>
<td>No regulations</td>
<td>19 (38.0%)</td>
<td>39 (78.0%)</td>
</tr>
<tr>
<td>Long term exposure</td>
<td>11 (22.0%)</td>
<td>41 (82.0%)</td>
</tr>
<tr>
<td>Disaster management</td>
<td>8 (16.0%)</td>
<td>27 (54.0%)</td>
</tr>
<tr>
<td>Mixtures of contaminants</td>
<td>2 (4.0%)</td>
<td>41 (82.0%)</td>
</tr>
<tr>
<td>Lack of evidence</td>
<td>2 (4.0%)</td>
<td>25 (50.0%)</td>
</tr>
<tr>
<td>Scientists disagree</td>
<td>0 (0.0%)</td>
<td>21 (42.0%)</td>
</tr>
<tr>
<td>Naturally occurring contaminants</td>
<td>1 (2.0%)</td>
<td>9 (18.0%)</td>
</tr>
<tr>
<td>Negligible risk</td>
<td>1 (2.0%)</td>
<td>13 (26.0%)</td>
</tr>
<tr>
<td>New measuring technologies</td>
<td>1 (2.0%)</td>
<td>7 (14.0%)</td>
</tr>
<tr>
<td>New treatment technologies</td>
<td>0 (0.0%)</td>
<td>4 (8.0%)</td>
</tr>
</tbody>
</table>
LCR Public Comment 2017 -2019

• Questions?

• Contact:
  – Jonathan Cuppett
  – 303.347.6122

• View Link:
  – http://www.waterrf.org/resources/expertsymposiums/Pages/lead-copper-symposium-2016.aspx
<table>
<thead>
<tr>
<th>RESEARCH MANAGER</th>
<th>KNOWLEDGE AREA</th>
<th>PHONE</th>
<th>EMAIL</th>
</tr>
</thead>
</table>
| Jonathan Cuppett     | Utility Finance  
Distribution System Management                                                | 303.347.6122   | jcuppett@waterrf.org         |
| Alice Fulmer         | Chemicals of Emerging Concern                                                   | 303.347.6109   | afulmer@waterrf.org          |
| Katie Henderson      | Water Supply Diversification                                                    | 303.347.6108   | khenderson@waterrf.org       |
| Maureen Hodgins      | Water Efficiency                                                                | 303.734.3465   | mhodgins@waterrf.org         |
| Grace Jang           | Microbials                                                                       | 303.347.6112   | hjang@waterrf.org            |
| Djanette Khiari      | Disinfection By-Products                                                        | 303.347.3478   | dkhiarii@waterrf.org         |
| Leanne Miller        | Resource Recovery (Wastewater Treatment)                                        | 303.347.6105   | lmiller@waterrf.org          |
| Kenan Ozekin         | Climate Change  
Advanced Treatment                                                 | 303.347.3464   | kozekin@waterrf.org          |
| Linda Reekie         | Energy Management  
Utility Management  
Source Water Protection and Management                                         | 303.347.3423   | lreekie@waterrf.org          |
| Mary Smith           | Distribution System Management                                                  | 303.347.6134   | msmith@waterrf.org           |
| Alison Witheridge    | Stormwater                                                                       | 303.347.6103   | awitheridge@waterrf.org      |
| Jian Zhang           | Asset Management                                                                | 303.347.6114   | jzhang@waterrf.org           |
Thank You,
Looking forward to 12/07/16 if not earlier
Comments or questions, please contact:
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(M)720.245.0450
For more information visit:
www.waterrf.org