NEW ITEMS IN THE NBMA RESOURCE LIBRARY

Flint May 2016

TITLE: Role of chlorine and chloramine in corrosion of lead-bearing plumbing materials

Author: Edwards, M. and A. Dudi
Source: JSTOR 2004 96:69-81
Abstract: A switch from free chlorine to chloramine disinfectant triggered problems with excessive lead in Washington, D.C., drinking water. High levels of lead originated in the service lines, but excessive lead was also derived from solder or brass plumbing materials. In many cases, the highest lead concentrations emerged from the tap after about 1 min of flushing - a troublesome outcome, given that routine public notification recommended that consumers flush for about a minute to minimize lead exposure. Bench-scale testing found that chlorine reacts with soluble Pb^{+2} to rapidly precipitate a red-brown-colored lead solid that was insoluble even at pH 1.9 for 12 weeks; this solid did not form in the presence of chloramine. Further experiments indicated that chloramines sometimes dramatically worsened lead leaching from brass relative to free chlorine, whereas new lead pipe was not strongly affected.
Document#: WAT.IN.GR.5.1

TITLE: Elevated blood lead in young children due to lead-contaminated drinking water: Washington, DC, 2001-2004

Author: Edwards, M., S. Triantafyllidou, and D. Best.
Source: Environ. Sci. Tech. 2009 43: 1618-1623.
Abstract: Incidence of EBL (blood lead ≥10 μg/dL) for children aged ≤1.3 years in Washington, DC increased more than 4 times comparing 2001-2003 when lead in water was high versus 2000 when lead in water was low. The incidence of EBL was highly correlated ($R^2 = 0.81$) to 90th percentile lead in water lead levels (WLLs) from 2000 to 2007 for children aged ≤1.3 years. The risk of exposure to high water lead levels varied markedly in different neighborhoods of the city. For children aged ≤ 30 months there were not strong correlations between WLLs and EBL, when analyzed for the city as a whole. However, the incidence of EBL increased 2.4 times in high-risk neighborhoods, increased 1.12 times in moderate-risk neighborhoods, and decreased in low-risk neighborhoods comparing 2003 to 2000. The incidence of EBL for children aged ≤ 30 months also deviated from national trends in a manner that was highly correlated with 90th percentile lead in water levels from 2000 to 2007 ($R^2 = 0.83$) in the high-risk neighborhoods. These effects are consistent with predictions based on biokinetic models and prior research.
Document#: WAT.IN.GR.5.2

TITLE: Elevated blood lead levels in children associated with the Flint drinking water crisis: A spatial analysis of risk and public health response

Author: Hanna-Attisha, M., J. LaChance, R. C. Sadler, and A. C. Schnepp
Source: AJPH 2016 106: 283-290.
Abstract: *Objectives*. We analyzed differences in pediatric elevated blood lead level incidence before and after Flint, Michigan, introduced a more corrosive water source into an aging water system without adequate corrosion control.
Methods. We reviewed blood lead levels for children younger than 5 years before (2013) and after (2015) water source change in Greater Flint, Michigan. We assessed the percentage of elevated blood lead levels in both time periods, and identified geo- graphical locations through spatial analysis.
Results. Incidence of elevated blood lead levels increased from 2.4% to 4.9% ($P < .05$) after water source change, and neighborhoods with the highest water lead levels ex- perienced a 6.6% increase. No significant change was seen outside the city. Geospatial analysis identified disadvantaged neighborhoods as having the greatest elevated blood lead level increases and informed response prioritization during the now-declared public health emergency.
Conclusions. The percentage of children with elevated blood lead levels increased after water source change, particularly in socioeconomically disadvantaged neighbor- hoods. Water is a growing source of childhood lead exposure because of aging infra- structure.
Document#: WAT.IN.GR.5.3

TITLE: Reduced risk estimations after remediation of lead (Pb) in drinking water at two US school districts

Author: Triantafyllidou, S., T. Le, D. Gallagher, and M. Edwards

To request information or documents, please contact Sally Brown via e-mail: slb@u.washington.edu or phone: (206) 616-1299.

Source: Sci. Total Environ. 2014 466-7:1011-1021

Abstract: The risk of students to develop elevated blood lead from drinking water consumption at schools was assessed, which is a different approach from predictions of geometric mean blood lead levels. Measured water lead levels (WLLs) from 63 elementary schools in Seattle and 601 elementary schools in Los Angeles were acquired before and after voluntary remediation of water lead contamination problems. Combined exposures to measured school WLLs (first-draw and flushed, 50% of water consumption) and home WLLs (50% of water consumption) were used as inputs to the Integrated Exposure Uptake Biokinetic (IEUBK) model for each school. In Seattle an average 11.2% of students were predicted to exceed a blood lead threshold of 5 μg/dL across 63 schools pre-remediation, but predict- ed risks at individual schools varied (7% risk of exceedance at a "low exposure school", 11% risk at a "typical exposure school", and 31% risk at a "high exposure school"). Addition of water filters and removal of lead plumbing lowered school WLL inputs to the model, and reduced the predicted risk output to 4.8% on average for Seattle elementary stu- dents across all 63 schools. The remnant post-remediation risk was attributable to other assumed background lead sources in the model (air, soil, dust, diet and home WLLs), with school WLLs practically eliminated as a health threat. Los Angeles schools instead instituted a flushing program which was assumed to eliminate first-draw WLLs as inputs to the model. With assumed benefits of remedial flushing, the predicted average risk of students to exceed a BLL threshold of 5 μg/dL dropped from 8.6% to 6.0% across 601 schools. In an era with increasingly stringent public health goals (e.g., reduction of blood lead safety threshold from 10 to 5 μg/dL), quantifiable health benefits to students were predicted after water lead remediation at two large US school systems.

Document#: WAT.IN.GR.5.4

TITLE: Drinking Water Distribution Systems: Assessing and Reducing Risks

Author: Committee on Public Water Supply Distribution Systems

Source: National Academies Press 2006 404 pgs http://www.nap.edu/catalog/11728.html

Abstract: Most regulatory mandates regarding drinking water focus on enforcing water quality standards at the treatment plant and not within the distribution system. Ideally, there should be no change in the quality of treated water from the time it leaves the treatment plant until the time it is consumed. However, in reality substantial changes can occur to finished water as a result of complex physical, chemical, and biological reactions. Indeed, data on waterborne disease outbreaks, both microbial and chemical, suggest that distribution systems remain a source of contamination that has yet to be fully addressed. As a consequence, the U.S. Environmental Protection Agency (EPA) has renewed its interest in water quality degradation occurring during distribution, with the goal of defining the extent of the problem and considering how it can be addressed during rule revisions or via non-regulatory channels. To assist in this process, EPA requested that the National Academies' Water Science and Technology Board conduct a study of water quality issues associated with public water supply distribution systems and their potential risks to consumers. The following statement of task guided the expert committee formed to conduct the study:

1) Identify trends relevant to the deterioration of drinking water in water supply distribution systems, as background and based on available information.

2) Identify and prioritize issues of greatest concern for distribution systems based on a review of published material.

3) Focusing on the highest priority issues as revealed by task #2, (a) evaluate different approaches for characterization of public health risks posed by water quality deteriorating events or conditions that may occur in public water supply distribution systems; and (b) identify and evaluate the effectiveness of relevant existing codes and regulations and identify general actions, strategies, performance measures, and policies that could be considered by water utilities and other stakeholders to reduce the risks posed by water-quality deteriorating events or conditions. Case studies, either at the state or utility level, where distribution system control programs (e.g., Hazard Analysis and Critical Control Point System, cross-connection control, etc.) have been successfully designed and implemented will be identified and recommendations will be presented in their context.

4) Identify advances in detection, monitoring and modeling, analytical methods, information needs and technologies, research and development opportunities, and communication strategies that will enable the water supply industry and other stakeholders to further reduce risks associated with public water sup- ply distribution systems.

Document#: WAT.IN.GR.5.5