University of California
Agriculture and Natural Resources | California Institute for Water Resources

Minimizing Hexavalent Chromium in Californian Water: Understanding Hiding Reaction Pathways in Drinking Water and Reinventing Treatment Process

Principal Investigators:

Haizhou Liu
Assistant Professor, Chemical & Environmental Engineering
UC Riverside

Technical Completion Report for project: NIWR2014CA322B
Project period: March 1, 2013 – November 30, 2015

Project Summary

1- Hexavalent chromium Cr(VI) is a highly toxic and soluble compound that poses great public health risks. Regulatory agencies are currently considering revision of rules regarding its presence in drinking water. Commonly available technologies reductively transform soluble Cr(VI) to less toxic Cr(III) particles during coagulation. However, residual Cr(III) could be inadvertently converted back to Cr(VI) by chlorine in downstream disinfection and distribution system. This study investigated the kinetics and mechanisms of Cr(III) solids oxidation by chlorine and formation of Cr(VI) in drinking water condition. Batch experiments were carried out with chromium hydroxide Cr(OH)3(s), chromium oxide Cr2O3(s), and copper chromite Cu2Cr2O5(s) as three model Cr(III) solid phases, with pH varying between 6.0 and 8.5 and bromide concentrations varying between 0.1 and 5 mg/L. Results showed that as Cr(III) solids were oxidized by chlorine, Cr(VI) was generated rapidly in environmentally relevant time scale.

Solution pH impacted the rate of oxidation, with an increase in pH moderately enhancing Cr(VI) formation. Furthermore, the presence of bromide acted as an electron shuttle and catalyzed the formation of Cr(VI) by at least one order of magnitude. The formation of Cr(VI) in bromide-containing water could be problematic considering t One manuscript is currently under preparation for submission to *Environmental Science and Technology* he wide existence of bromide in groundwater sources.

2- One manuscript is currently under preparation for submission to *Environmental Science and Technology.*

3- Chromium(VI), known as hexavalent chromium, is a highly toxic and soluble compound that has been widely observed in groundwater across California. A new drinking water standard specific to chromium(VI) was recently proposed by the California Department of Public Health. The proposed low drinking water standard for chromium(VI) is estimated to pose great challenges for water systems to upgrade treatment approaches to meet the regulation. This research project is advancing the mechanistic understanding of chromium(VI) conversion and formation pathways from water resources to treated drinking water, specifically by residual disinfectants and corrosion scales in water distribution systems. The research will enable the optimal design of treatment strategies and accurate prediction of treatment performance for chromium(VI) removal.

Information Transfer/Outreach Program

Summary of the research project objectives and findings have been published on the website of California Institute of Water Resources:
(http://ciwr.ucanr.edu/CIWR_Making_a_difference/Completed_projects/Minimizing_Hexavalent_Chromium_in_Californian_Water_/)