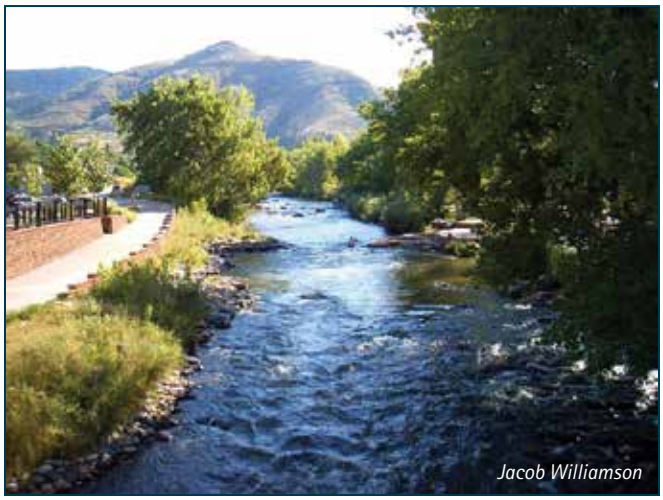
Fate and Effects of Copper: Its Physical and Chemical Forms Matter

CDA HESD continues to support the manufacturing and use of copper products by countering scientifically unjustifiable concerns about the fate and effects of copper as it relates to humans and aquatic organisms. These concerns are sometimes voiced by scientists, engineers, and architects who perceive hazards without more appropriately evaluating actual risks. Those unwarranted technical concerns can lead to misperceptions among the general public, which can then lead to unwarranted legislation (e.g., City of Palo Alto, California) and/or "blacklisting" against the use of copper products (e.g., Clean Production Action & Healthy Building Network Chemicals of High Concern, Green Guide for Health Care, LEED Health Care, Perkins & Will Precautionary List). CDA continues to emphasize that the form of copper—physical or chemical—plays a part in determining its fate and as well as its effect on the environment, and that risk (instead of hazard alone) should be assessed when determining the acceptable uses and discharges of copper.



Jacob Williamson

Throughout the past year, our efforts have focused on three major areas: (1) countering the listing of copper as a component of concern when it comes to building materials, (2) countering the perception that copper poses a major threat to fish by impairing olfaction responses (their sense of smell) and (3) conducting research to help predict the toxicity of metal mixtures that contain copper. To address the first topic, Joe Meyer of ARCADIS U.S., Inc.; Bob Dwyer of ICA HESD; and Joe Gorsuch of CDA HESD presented at the annual meeting of the Society of Environmental Toxicology and Chemistry in Nashville, Tennessee during the month of November.

In addition to this presentation, titled, "Misapplication of Generic Hazard Classification Schemes for Versatile Building Materials: Copper as an Example," CDA is currently in the process of preparing a companion manuscript for publication in a scientific journal. The main themes of the manuscript will be (1) that ad hoc materials-classification systems currently used by architectural organizations are based on hazard information (i.e., potential instead of realized effects), (2) the suspected human health effects of copper are neither scientifically justified nor applicable to most copper-containing building materials since copper must be ingested to cause such reported effects, and (3) that potential environmental effects of runoff water from exterior copper surfaces to aquatic organisms can be controlled by appropriate design and treatment measures.

To counter the perception that copper poses a major threat to olfaction responses in fish, two papers were published in a scientific journal in 2011 by David DeForest of Windward Environmental, LLC; Robert Gensemer of GEI Consultants; Eric Van Genderen of IZA; Joe Gorsuch of CDA; Burt Shephard of USEPA; Bill Adams of Rio Tinto; and Joe Meyer of ARCADIS. Additionally, this group, along with Scott Tobiason of Windward and Anne Fairbrother of Exponent, Inc., collectively made 16 related presentations at international scientific meetings and three presentations at Law Seminars International in Seattle over the course of the last two years.

The main themes of these publications and presentations have focused on the fact that (1) water chemistry matters in determining the toxicity of copper and its impairment of olfaction in fish and (2) olfaction is not impaired in salmonid fishes (e.g., salmon and trout) when the USEPA's biotic ligand model-based water quality criteria (which account for the influence of water chemistry on copper bioavailability) are not exceeded. This advocacy effort is bearing fruit, as regulators are becoming increasingly aware of the results from CDA-funded scientific research.

Furthermore, researchers funded by the Oregon Department of Transportation recently reported that elevated concentrations of dissolved organic carbon (DOC, which chemically binds copper and thus decreases its toxicity) in highway runoff helps to counter the sometimes increased copper concentrations coming from brake pads. One of these researchers, who demonstrated several years ago that copper can impair olfaction responses in salmon, has now advised the Washington State Department of Ecology that "DOC from organic matter is typically present in runoff and streams at concentrations that protect against [dissolved copper] neurotoxicity,", and that "it is unlikely that added dissolved copper from bioretention treatment systems would ever exceed the binding capacity of DOC in receiving waters." Therefore, the importance of context-dependent analysis is now being communicated not only by the Copper Alliance, but by academic and government researchers as well.

As part of these efforts, CDA and ICA HESD have established a Copper-Olfactory Advisory Group that includes participants from ICA members, other metal affiliations, USEPA and consulting firms. The Advisory Group holds semi-annual

teleconferences to discuss the latest research on the copper-olfactory issue and to brainstorm about continuing advocacy strategies, including opportunities to present, publish, and otherwise communicate with researchers and regulators in this field. Notes from the most recent teleconference, conducted in August, are available upon request.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A third major concern for CDA is a growing intent in North America and Europe to regulate the concentrations of metals based on their potential toxicity in mixtures of chemicals, a situation that typically occurs in surface waters. Such an approach would be a major change from the current chemical-by-chemical regulatory approaches used around the world. Without sound scientific information, an overly-conservative regulatory approach might be adopted, adversely impacting copper.

To help regulatory agencies make informed decisions about the toxicity of metal mixtures, CDA and ICA HESD North America have been funding several projects. The first of these projects is a study focusing on the toxicity of copper in mixtures under controlled laboratory conditions at Colorado School of Mines, in order to determine how water chemistry and interactions with other metals (e.g., cadmium, nickel, and zinc) alter the toxicity of copper and said metals. The second project is a field study in the North Fork of Clear Creek—near Blackhawk in central Colorado—a mining-impacted stream that contains elevated concentrations of aluminum, copper, iron, manganese and zinc. This study seeks to determine how the metals listed above interact along a downstream gradient consisting of concentrations of these metals, concentrations of other water chemistry constituents, and physical-chemical features of the streambed. Researchers from Colorado School of Mines, Colorado State University and Harvard School of Public Health, along with Joe Meyer, are conducting the field study. The results of the lab study are being used in a Metal Mixture Modeling Evaluation project. A goal of this proactive project is to provide regulators worldwide with scientifically defensible models that can accurately predict metal mixture toxicity, thus avoiding the need to impose overly-conservative, costly regulations on metal mixtures in surface waters.

In summary, there is a common theme among many of CDA's HESD projects: the form of copper—physical or chemical—matters when it comes to the environment in which the copper exists. Therefore, context- and site-specific assessments are needed to make scientifically-justifiable and common-sense decisions about regulating discharges of copper and about classification schemes for building materials.

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