Hexavalent Chromium in Drinking Water
Regulatory Update and Treatment Options

Hexavalent chromium is a form of the metallic element chromium. Chromium naturally occurs in rocks, animals, plants, soil, and in volcanic dust and gases. It comes in several different forms including trivalent chromium and hexavalent chromium. Trivalent chromium is often referred to as Chromium (III) and is an essential nutrient for the body. Hexavalent chromium, or Chromium (VI), is generally used or produced in industrial processes and has been demonstrated to be a human carcinogen when inhaled.

Water sources can be affected by hexavalent chromium naturally, or through contamination plumes from industrial centers, landfills, and improper discharge of industrial processing streams. The health effects of hexavalent chromium through ingestion—the dominant exposure route for drinking water—have seen limited study and yielded uncertain conclusions. However, a study conducted by the National Toxicology Program (NTP) that was published in 2007 concluded that hexavalent chromium is carcinogenic when ingested in drinking water. Therefore, utilities and public health officials have begun to investigate the feasibility of reducing hexavalent chromium concentrations in drinking water.

Regulatory Update

The current national drinking water standard, or maximum contaminant load (MCL), for total chromium is 100 micrograms per liter, or parts per billion (ppb). Some states have adopted stricter standards. For instance, California's current standard for total chromium is 50 ppb. Total chromium is the combined concentration of all states of the metal chromium, including hexavalent chromium and the less toxic trivalent chromium.

Hexavalent chromium is one of 20 chemicals that are currently being reviewed by USEPA for possible further regulation. In September 2010, the USEPA issued a draft risk assessment of hexavalent chromium in its Integrated Risk Information System (IRIS) database, which specifically addressed the health risk of hexavalent chromium from ingestion from drinking water. The 60-day comment period started September 30 and ends November 29, with a listening session on November 18. The risk assessment will be completed by summer 2011. It is probable that this risk assessment will lead to a more stringent national standard for total or hexavalent chromium.

The results of the NTP study also triggered the Office of Environmental Health Hazard Assessment (OEHHA) in California to draft a proposed public health goal for hexavalent chromium in drinking water of 0.06 ppb. Once the public health goal is officially set by OEHHA, California's Department of Public Health will establish a state MCL for hexavalent chromium in 1–2 years. To establish drinking water standards, regulators typically use the results

of toxicological studies like the NTP study to calculate a dose that is meant to protect people from a 70-year lifetime of exposure and to limit the cancer risk to one case in every million people. Regulators also consider the feasibility and costs of removing hexavalent chromium from drinking water before they establish a standard.

Treatment and Removal

Hexavalent chromium is found more often in groundwaters than in surface waters. It can be removed using a handful of proven treatment techniques depending on the level present in the source water, removal goals, other water quality parameters, competing treatment objectives, and treatment waste disposal options. Anion exchange (both strong-base and weak-base), membrane filtration by nanofiltration and reverse osmosis, reduction followed by coagulation and precipitation, and adsorption can remove hexavalent chromium from drinking water. Research conducted by a collaboration of southern California drinking water utilities, USEPA, and the Water Research Foundation found that weak base anion exchange and reduction-coagulation-filtration could remove hexavalent chromium to below 5 ppb for the utilities' particular groundwater source.

WaterRF Research on Hexavalent Chromium

The Foundation has conducted the following studies that utilities can draw from to help in understanding and addressing hexavalent chromium removal:

Occurrence Studies

- Occurrence Survey of Boron and Hexavalent Chromium (2004, Order 91044F)
- Geochemical Controls on Chromium Occurrence, Speciation, and Treatability (2004, Order 91043F)

Treatment and Removal Studies

- Hexavalent Chromium Removal Using Anion Exchange and Reduction With Coagulation and Filtration (2007, Order 91193)
- Low-Level Hexavalent Chromium Treatment Options: Bench-Scale Evaluation (2004, Order 91042F)

Other Helpful Documents

- USEPA's basic information page about chromium in drinking water: http://water.epa.gov/drink/contaminants/basicinformation/chromium.cfm
- California's proposed public health goal and pending regulation of hexavalent chromium, Office of Environmental Health Hazard Assessment: http://oehha.ca.gov/water/phg/pdf/HexChromfacts082009.pdf
- Information on the National Toxicology Program health effects study: http://www.nih.gov/news/pr/may2007/niehs-16.htm
- National Toxicology Program hexavalent chromium information page: http://ntp.niehs.nih.gov/files/NTPHexaVChrmFactR5.pdf