The Chromium VI Calamity

By Kelly A. Reynolds, MSPH, PhD

Hexavalent chromium (also known as chromium VI), became a well-known drinking water hazard following the 2000 film, *Erin Brokovich*. In the film, actress Julia Roberts gave an Oscar-winning performance as a small town legal assistant who linked the groundwater contaminant to serious health problems in local residents. Today, chromium VI is still being detected in drinking water supplies and remains an unregulated waterborne contaminant consumed daily by millions of Americans.

Infamous actions

The Erin Brokovich story is now well known and contributes to the general distrust consumers have of big business. In the historical (circa 1991) California case, Roberta Walker noticed that residents of the small town of Hinkley, CA were becoming sick and both domestic and wild animals were dying. Around this time, a large utility company—Pacific Gas & Electric Co. (PG&E)—offered to purchase her less-than-desirable property for an over-valued price. This raised suspicions, which led to a 1993 lawsuit involving 650 plaintiffs and an eventual PG&E payout of $333 million dollars (USD). The consequence resulted in the highest compensation of any environmental-related human health impact event in US history. The problem: from 1952 to 1966, PG&E was discharging chromium VI into the environment (CA EPA). Originally used to combat corrosion in cooling-tower water, the waste product was stored in unlined ponds at the utility. Eventually the waste made its way the surrounding soil and the groundwater aquifer.

Apples and oranges

Although PG&E informed Hinkley residents of the groundwater chromium contamination in the early 90s, consumers were told the exposure was not a concern. After all, chromium was found naturally in the environment—in foods and vegetables—and was an essential element commonly included in multivitamin supplements; like so many elements, chromium can exist is a variety of forms. Some forms of chromium metal are highly beneficial. Resistant to corrosion and tarnishing, the combination of steel and metallic chromium creates the popular product stainless steel. Stainless steel production and chrome plating (electroplating with chromium) are primary commercial uses. Wastes from steel and pulp mills are common anthropogenic sources of environmental contamination. While trivalent chromium (chromium III) may be an essential element potentially required in trace amounts for mammal metabolism, exposure to larger concentrations of chromium III and to different forms, including chromium VI, can be toxic. Chromium III is the dominant, naturally occurring species in the environment but commercial uses of chromium have resulted in a number of US sites in need of environmental cleanup.

Human health risks

Perhaps the greatest population-exposure route to chromium compounds is via contaminated drinking water. In 2010, an investigation led by the Environmental Working Group (EWG), documented chromium VI in 31 out of 35 US cities. Of these, 25 were positive above the proposed public health goal in California, which is lower than US EPA's current goal. EWG further reported that 70 million Americans are thought to consume drinking water contaminated with chromium VI. Given that the metal is both odorless and tasteless, one would not even know they were exposed. Chromium, however, may be difficult to control in drinking water due to natural background levels. Exposures to high concentrations of chromium VI are known to cause a range of symptoms, including skin ulcers and more severe, acute health effects, such as kidney and liver failure. The most definitive examples of adverse health effects related to chromium are from occupational exposures. Workers in industries, such as electroplating, leather tanning and other chromium-use operations, have been documented to experience skin ulcerations and elevated cancer risks. Health effects associated with the concentrations commonly detected in drinking water are still being evaluated, although a link to stomach cancer has been documented. Low-level and chronic exposures are associated with carcinogenic effects in both humans and animals, but more research is needed to evaluate the dose-response relationship more thoroughly.

Regulatory uncertainties

In 1991, US EPA set an enforceable standard for total chromium (i.e., chromium III and chromium VI together) at 100 ppb. California set a more stringent maximum contaminant level of 50 ppb. At the time, US EPA and the state of California set these standards, however, chromium VI was not a known carcinogen.

Today, new information suggests the standards should be lowered in order to protect public health. Unfortunately, the acceptable level of chromium VI in drinking water relative to a human health risk assessment is not known. Recognizing the cancer-causing potential of chromium, California set a state public health goal (a non-enforceable guideline) of 0.02 ppb in 2011.

This goal is problematic since it may be beyond the capacity of municipal water treatment. In addition, natural background concentrations of total chromium have been detected several orders of magnitude higher than the state guideline. Much uncertainty surrounds the risk assessment related to hexavalent chromium and thus setting an acceptable, technically feasible and enforceable standard has been continually delayed. Currently, enhanced chromium monitoring is required for select utilities under US EPA's *Unregulated Contaminant Monitoring Rule (UCMR)*.

Consumers have other options for protection against chromium VI exposures in drinking water. Certain POU treatment devices capable of removing chromium from drinking water are available.

In May, 2012, the US EPA published a revised *UCMR 3* that requires testing not just for total chromium, which includes all forms of the element, but also for chromium VI, specifically. Data collected under the *UCMR 3* on the occurrence of targeted contaminants will be used for determining the need for future US EPA regulation. In the meantime, consumer advocacy groups have grown impatient. In 2012, the Natural Resources Defense Council (NRDC) and EWG filed a lawsuit against California regulators for failing to set an enforceable drinking water standard for chromium VI. For many, the slow progress toward control of chromium VI in drinking water supplies is unacceptable.

Current status

The chromium VI calamity continues to make headlines. PG&E currently conducts monthly monitoring and cleanup of their chromium VI catastrophe in Hinkley, CA. Repeated monitoring indicates that the waste plume has expanded further in the aquifer. Thus, more action is needed. A revised containment plan is expected to be finalized in the fall of 2013. Environmental action groups are pressuring US EPA and California to set more appropriate standards for chromium VI in drinking water. According to the EPA website on the current schedule for reassessment of the human health risks, however, dates to further characterize the chromium VI hazard are to be determined. The US Food and Drug Administration regulates bottled water to the same chromium standard as US EPA (i.e., 100 ppb). Thus, bottled water may not be free of chromium carcinogens, depending on the specified pre-packaging treatment works utilized. Consumers have other options for protection against chromium VI exposures in drinking water. Certain POU treatment devices capable of removing chromium from drinking water are available. Ion exchange resin columns certified to remove hexavalent chromium are effective, and RO units may be certified for chromium removal and other toxic metals as well.

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