



Perchlorate in Drinking Water Regulatory Update and Treatment Options

Perchlorate is a chemical primarily used in the manufacturing of explosives and rocket propellants for the defense and aerospace industries. Low levels of ammonium perchlorate have also been found to occur naturally in the environment. In 1997, elevated levels of perchlorate were discovered in California drinking water supplies using a new, more sensitive detection technique. More recent occurrence studies have found perchlorate contamination in both groundwater and surface waters serving as drinking water sources for more than 16 million people in at least 26 states nationwide, though most often in the Southwest.

Perchlorate is classified as a goitrogen by the U.S. Environmental Protection Agency (USEPA) because at high levels it can interfere with the thyroid's ability to uptake iodide and thus affect hormone production. Thyroid hormones play a vital role in the growth and development of the central nervous system of fetuses and infants. According to the National Research Council, pregnant women, infants, children, and people with iodine-deficient diets or preexisting thyroid deficiencies may be more sensitive to perchlorate than the general population.

Regulatory Update

The USEPA does not currently regulate perchlorate in drinking water. However, in 2009, the USEPA published an Interim Health Advisory of 15 ppb for exposure to perchlorate from ingesting drinking water. This Interim Health Advisory is not enforceable and is meant to provide guidance to state and local agencies to protect public health as the USEPA considers setting a Maximum Contaminant Level (MCL) for perchlorate. In the process of setting this standard, the USEPA will take into account health risks from exposure to perchlorate, the number of people potentially affected by perchlorate exposure, the amount of perchlorate in drinking water sources, and the cost of removing the contaminant from those sources. Over the past year, the USEPA has been seeking public comment on health risk studies for perchlorate exposure. In February 2011, USEPA has announced the agency's decision to move forward with the development of a regulation for perchlorate under the Safe Drinking Water Act (SDWA). SDWA requires that the Agency issue a proposed national primary drinking water regulation (NPDWR) within 24 months and a final NPDWR within 18 months of proposal.

Some states already regulate perchlorate in drinking water. The California Department of Public Health set an MCL of 6 ppb in 2007. Massachusetts set an MCL of 2 ppb in 2006, with a review of the regulation scheduled for 2012. New Jersey considered establishing an MCL of 5 ppb, but in March 2010 they decided to delay the regulation until after a national standard has been set.

Treatment and Removal

Perchlorate can be removed from drinking water sources using the following advanced treatment techniques:

- regenerable ion exchange
- single-pass ion exchange
- reverse osmosis
- fixed-bed biological treatment.
- fluidized-bed biological treatment

Many of these treatment techniques have the added advantage of removing nitrate, which often co-occurs with perchlorate. However, these treatment techniques can create other challenges for water utilities. For instance, regenerable ion exchange treatment produces concentrated perchlorate waste brine that requires special handling and disposal. Reverse osmosis, besides being expensive, also produces waste brine that must be disposed of. Biological treatment has not yet been used to remove perchlorate from drinking water in the United States because of public acceptance issues and because the finished water must be further treated to meet Surface Water Treatment Rule regulations. However, it is a low cost alternative, and construction of biological treatment processes for perchlorate and nitrate removal are currently planned. It can also be used to treat perchlorate and nitrate laden waste brine.

Single-pass ion exchange is the most common treatment method for perchlorate removal today because it has been proven at full-scale to be simple and relatively low cost. Operations and maintenance (O&M) costs for single-pass ion exchange, as reported in a [Journal AWWA](#) 2009 study based on California installations, are conservatively estimated at \$0.33/1,000 gallons of water treated. However, these costs are affected by nitrate co-occurrence due to its impact on resin capacity. The same study averaged capital costs for single-pass ion exchange installations at approximately \$180,000 plus \$635,000/1,000 gallons of water treated.

WaterRF has just funded a rapid response project that will develop a comprehensive white paper on the state-of-science on perchlorate treatment technologies. The project is expected to begin mid to late February and will be completed in six weeks.

WaterRF Research on Perchlorate

Occurrence Studies

- [National Assessment of Perchlorate Contamination Occurrence \(Order 90902, 2002\)](#)
- [Hypochlorite – An Assessment of Factors that Influence the Formation of Perchlorate and Other Contaminants \(Order 4147, 2009\)](#)

Treatment and Removal Studies

- [Biological Destruction of Perchlorate and Nitrate in Ion Exchange Concentrate \(Order 3137, 2010\)](#)

- [Innovative Alternatives to Minimize Arsenic, Perchlorate and Nitrate Residuals \(Order 91054F, 2005\)](#)
- [Treatability of Perchlorate in Groundwater Using Ion Exchange Technology, Phase I \(Order 90943, 2003\)](#)
- [Treatability of Perchlorate in Groundwater Using Ion Exchange Technology, Phase II \(Order 91038F and 91016F, 2004\)](#)
- [Membrane Biofilm Reactor Process for Nitrate and Perchlorate Removal \(Order 91004F, 2004\)](#)
- [Assessment of the Electrochemical Reduction of the Perchlorate Ion \(Order 90876, 2003\)](#)
- [Application of Bioreactor Systems to Low-Concentration Perchlorate Contaminated Water \(Order 91017F and 90982F, 2004\)](#)
- [GAC Use, Tailoring and Regeneration for Perchlorate Removal from Groundwater \(Order 91035F, 2004\)](#)
- [Removal of Bromate and Perchlorate in Conventional Ozone/GAC Systems \(Order 90836, 2003\)](#)
- [Treatability of Perchlorate Containing Water by RO, NF and UF Membranes \(Order 90932F, 2002\)](#)

Other Helpful Resources

- USEPA's Office of Water information page on perchlorate in drinking water: <http://water.epa.gov/drink/contaminants/unregulated/perchlorate.cfm>
- USEPA's "CLU-IN" page with information on Contaminated Site Clean-Up Information: <http://www.clu-in.org/contaminantfocus/default.focus/sec/perchlorate/cat/Overview/>
- California Department of Public Health perchlorate information page: <http://www.cdph.ca.gov/certlic/drinkingwater/pages/Perchlorate.aspx>
- Massachusetts Department of Environmental Protection perchlorate information page: <http://www.mass.gov/dep/water/drinking/percinfo.htm#stds>
- New Jersey Department of Environmental Protection perchlorate information page: <http://www.state.nj.us/dep//watersupply/perchlorate.htm>
- [A Review of Perchlorate Occurrence in Public Drinking Water Systems](#), Journal AWWA: 101:11, Brandhuber et al., November 2009. (available free to AWWA individual members or by purchase)
- [Perchlorate Occurrence Mapping](#) (Available free from AWWA website)
- [National Cost Implications of a Perchlorate Regulation](#), Journal AWWA: 101:3, Russell et al., March 2009. (available free to AWWA individual members or by purchase)
- [Health Implications for Perchlorate Ingestion](#) (2005 NRC report)