Order Code RS21961
October 25, 2004

Perchlorate Contamination of Drinking Water: Regulatory Issues and Legislative Actions

Mary Tiemann
Specialist in Environmental Policy
Resources, Science, and Industry Division

Summary

Perchlorate is the main ingredient of solid rocket fuel and has been used mainly by the Department of Defense (DOD), the National Aeronautics and Space Administration (NASA), and related industries. This highly soluble and persistent compound has been disposed of on the ground for decades, and now has been detected in sources of drinking water that serve more than 15 million people. It also has been found in milk and lettuce. Thus, concern has grown regarding the potential health risks of exposure to perchlorate. Efforts to make a determination about regulating perchlorate in drinking water have been slowed by uncertainties regarding the health effects of perchlorate exposure at low levels, and because of the need for more research on water treatment technologies and analytical methods. Related issues involve water treatment and environmental cleanup costs, which will depend on the level at which a standard is set. Because of scientific uncertainties and debate over the risks of perchlorate, several federal agencies asked the National Academy of Sciences (NAS) to assess perchlorate's health effects. The NAS review is expected to be completed early in 2005. Meanwhile, Congress has provided cleanup funds to some communities and has directed DOD to evaluate perchlorate contamination and health effects. Several bills would require the Environmental Protection Agency (EPA) to issue a drinking water standard for perchlorate. This report reviews perchlorate issues and related federal actions. It will be updated.

Background

Ammonium perchlorate is widely used in solid propellant for rockets and missiles, and other perchlorate salts are used to manufacture various products including fireworks, air bags, and road flares. Uncertainty over perchlorate's health effects has slowed federal and state efforts to establish drinking water standards and environmental cleanup standards for this compound. However, given perchlorate's persistence in water, concern has escalated with its detection in the groundwater or surface water in 33 states. No federal or state drinking water standard has been established for perchlorate, but efforts are underway, and several states have issued public health goals or advisory levels.

Occurrence. Perchlorate has been used heavily by DOD and its contractors, and perchlorate contamination of ground and surface water has been found most often near weapons and rocket fuel manufacturing facilities and disposal sites, research facilities, and military bases.[1] Regulators were aware of contamination in California and Nevada in the 1980s; however, before 1997, perchlorate could not be detected at concentrations below 400 parts per billion (ppb). In 1997, the California Department of Health Services developed a new analytical method for monitoring perchlorate that lowered the detection limit to 4 ppb. This development prompted several states to test for perchlorate. Within two years, perchlorate had been detected in the sources of drinking water for more than 15 million people in the Southwest and in surface or ground water in scattered locations across the United States.[2] The contamination has most often been found in ground water wells; however, perchlorate has been detected at low levels (5-9 ppb) in the Colorado River, which is a major source of drinking water and irrigation water in California, Nevada, and Arizona.[3] Perchlorate also has been detected in dairy milk in California and Texas, and the source of contamination is thought to have been the water used to irrigate the alfalfa crops that were consumed by dairy cows.

In 1999, EPA required drinking water monitoring for perchlorate under the Unregulated Contaminant Monitoring Rule (UCMR) to determine the frequency and levels at which perchlorate is present in public water supplies nationwide. The regulation requires monitoring by all water systems serving more than 10,000 persons and by a representative sample of smaller systems. In September 2004, EPA reported that perchlorate has been detected in public water systems in 27 states.[4] The agency also reported perchlorate contamination at 64 DOD facilities, seven other federal facilities, and 36 private sites. In a survey by California, perchlorate has been detected in 357 sources of drinking water that supply 92 public water systems.[5]

Health Effects. Perchlorate is known to disrupt the uptake of iodine in the thyroid, and health effects associated with perchlorate exposure are expected to be similar to those

---

[1] U.S. Army Center for Health Promotion and Preventive Medicine, Directorate of Environmental Health Engineering, *Perchlorate in Drinking Water*, Aberdeen Proving Ground, MD. This document notes that, because perchlorate has a short shelf life as an effective propellant, it must be replaced periodically within the DOD's missile and rocket inventory. Consequently, DOD has disposed of large volumes of perchlorate since the 1950s. Also, detonation of rockets, missiles, and fireworks leaves residual perchlorate in the affected areas.

[2] U.S. Environmental Protection Agency. *Region 9 Perchlorate Update*, June 1999, p. 1.

[3] Perchlorate contamination in the Colorado River has been traced to the Kerr McGee Chemical Plant in Henderson, Nevada, where commercial perchlorate production began in 1951. Since 1997, the state of Nevada and the U.S. EPA have worked with Kerr McGee to control the source of perchlorate releases. Since 2002, perchlorate concentrations in the river have ranged from 4 to 6 ppb. U.S. Environmental Protection Agency, Region 9, *Perchlorate Monitoring Results: Henderson, Nevada to the Lower Colorado River*, June 2004.

[4] U.S. Environmental Protection Agency, *Federal Facilities Restoration and Reuse: Known Perchlorate Releases in the U.S. -Sept. 23, 2004*, available at [http://www.epa.gov/fedfac/documents/perchlorate_links.htm#occurrences], visited Oct. 18, 2004.

[5] California Department of Health Services, *Perchlorate in California Drinking Water: Monitoring Update*, October 4, 2004, For detailed monitoring results, see [http://dhs.ca.gov/ps/ddwem/chemicals/perchl/monitoringupdate.htm], visited Oct. 6, 2004.

caused by iodine deficiency.[6] Iodine deficiency decreases the production of thyroid hormones, which help regulate the body's metabolism and growth. A key concern is that impairment of thyroid function in pregnant women can affect fetuses and infants and can result in delayed development and decreased learning capability. Studies have not directly measured the impact of perchlorate on human metabolism and growth, but adverse effects of perchlorate on thyroid hormones and development of the fetal brain have been observed in rats.[7] Several epidemiologic studies indicate that thyroid changes occur in humans at significantly higher concentrations of perchlorate than the amounts typically observed in public water supplies.[8]

Researchers generally agree that more studies are needed on perchlorate's health effects. For example, there are few studies of perchlorate as a potential carcinogen. EPA has not classified perchlorate as a carcinogen, and the California health hazard assessment office has determined that perchlorate does not pose a known cancer risk to humans.[9]

Federal Responses to Perchlorate Contamination

Various governmental agencies have been examining issues related to perchlorate contamination. In 1998, an Interagency Perchlorate Steering Committee (IPSC) was formed that involved 24 different federal, state, local, and tribal government agencies. The committee was established "to ensure an integrated approach to addressing perchlorate issues and to inform and involve stakeholders about technical and regulatory developments."[10] A perchlorate working group, comprised of federal agencies, also was established to coordinate interagency activities. Initiatives at the federal level are being undertaken by several agencies and departments, including DOD, EPA, the Food and Drug Administration (FDA), and others.

Department of Defense. The DOD, which has the greatest number of identified sites with perchlorate contamination, has spent $26 million on developing and testing perchlorate treatment technologies. Perchlorate cleanup is proceeding at several sites, but DOD's general policy is to remediate sites to meet drinking water standards. In the

---

[6] California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, *Public Health Goal for Perchlorate*, March 2004, pp. 1-2. In March 2004, California published a final public health goal (PHG) of 6 ppb for perchlorate. A PHG is set at a level determined to pose no significant risk to individuals, including sensitive groups (i.e., infants, pregnant women, and individuals with iodine deficiency). California officials will use the public health goal to establish an enforceable drinking water standard, which must be set as close to the goal as is economically and technologically feasible.

[7] Ibid.

[8] Michael A. Kelsh et al., "Primary Congenital Hypothyroidism, Newborn Thyroid Function, and Environmental Perchlorate Exposure Among Residents of a Southern California Community," *Journal of Occupational Environmental Medicine*, 2003, p. 1117.

[9] California EPA, Office of Environmental Health Hazard Assessment, *Frequently Asked Questions about the Public Health Goal for Perchlorate*, March 2004.

[10] U.S. Environmental Protection Agency, *The Interagency Perchlorate Steering Committee*, at [http://www.epa.gov/safewater/ccl/perchlorate/ipsc.html].

absence of a perchlorate standard, this approach has been problematic for communities that are experiencing, or are threatened with, perchlorate contamination of water supplies.

In September 2003, the DOD adopted a perchlorate sampling policy that includes sampling on Base Realignment and Closure (BRAC) properties. However, DOD has been criticized by Members of Congress, communities, and states for not evaluating other sites. On October 1, 2004, DOD and the California EPA adopted a procedure for prioritizing perchlorate sampling efforts at DOD facilities throughout California. The procedure document is intended to provide guidance on the steps that the state and DOD will take to identify and prioritize the investigation of areas on military sites where perchlorate has likely been released near drinking water sources. DOD has stated that it will characterize and respond to identified problems under its existing environmental response programs.[11]

A key issue for DOD concerns the potential perchlorate cleanup cost, which will depend largely on any standards set by EPA and/or a state. This is because federal and state drinking water standards are used as cleanup standards, specifically under the Comprehensive Environmental Response, Compensation, and Liability Act (Superfund) and in other cases as well. Consequently, parties responsible for cleanup are interested in seeing a standard set at a level that assures public health protection but that is not so strict that added costs are incurred without providing a public health benefit. Public water suppliers that will have to treat their water share this concern.

EPA Regulation of Perchlorate in Drinking Water. EPA has taken several steps toward establishing a drinking water standard for perchlorate, but has not yet made a formal determination to regulate perchlorate. In 1997, when a better detection method became available for perchlorate and water monitoring increased, scientific information for perchlorate was extremely limited.[12] In 1998, EPA placed perchlorate on the list of contaminants that are candidates for regulation, but concluded that information was insufficient at that time to make a determination as to whether perchlorate should be regulated under the Safe Drinking Water Act (SDWA). The agency listed perchlorate as a priority for further research on health effects and treatment technologies, and as a priority for collecting occurrence data.

Perchlorate Risk Assessment. In 1992, and again in 1995, EPA issued draft reference doses (RfDs) for perchlorate exposure that would be expected to protect against any health threats. An RfD is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure that is likely to be without appreciable risk of adverse non-cancer effects during a lifetime. In developing an RfD, EPA incorporates factors to account for sensitive populations, study duration, inter- and intraspecies variability, and data gaps. The draft RfD range of 0.0001 to 0.0005 milligrams per kilogram (mg/kg) body weight per day would be equivalent to a drinking water concentration of 4 ppb-18 ppb. EPA takes the RfD into consideration when setting a drinking water standard. The agency also must consider cost, the capabilities of monitoring and treatment technologies, and other sources of perchlorate exposure.

---

[11] For information on DOD's general environmental cleanup efforts, see CRS Report RL32537, *Defense Cleanup and Environmental Programs: Authorization and Appropriations for FY2005*.

[12] U.S. Environmental Protection Agency, *Region 9 Perchlorate Update*, June 1999, p. 1.

EPA proceeded with efforts to assess perchlorate risks, and a 1999 external review draft toxicological review and risk characterization developed a human risk benchmark of 0.0009 mg/kg per day (with a 100-fold uncertainty factor), which would convert to a drinking water equivalent level of 32 ppb. However, EPA determined that the available health effects and toxicity database was inadequate for risk assessment. In 1999, EPA issued an Interim Assessment Guidance for Perchlorate, which recommended that EPA risk assessors and risk managers use the standing reference dose range of 4-18 ppb for perchlorate-related assessment activities.

In 2002, EPA completed a draft risk assessment for perchlorate that concluded that the potential human health risks of perchlorate exposures include effects on the developing nervous systems and thyroid tumors, based partly on rat studies that observed benign tumors and adverse effects in fetal brain development. The draft assessment included a revised draft RfD intended to be protective for both types of effects. The assessment provided a conversion of the draft RfD to a drinking water equivalent level of 1 ppb. This document has been controversial. For example, some commenters expressed concern about EPA's use of a new risk assessment approach, and about its selection of studies for consideration in conducting the risk assessment.

In January 2003, EPA affirmed the 1999 Interim Guidance that recommended continuing the use of the 1992 and 1995 draft reference doses for perchlorate-related assessment activities. Based on this RfD range, the provisional clean-up levels would range from 4-18 ppb. EPA suggested that consideration be given to the lower end of the range until a final level is adopted. The 1999 guidance remains the applicable guidance, until replaced by new guidance that will be based on a finalized risk assessment.[13]

A key challenge for EPA is to identify a standard for perchlorate that assures public health protection. Public water suppliers and parties responsible for environmental cleanup also are concerned that the standard be set at a level that is safe, while avoiding setting an overly strict standard that offers no added public health benefit. Data gaps regarding the effects of exposure to low levels of perchlorate have made it difficult for regulators to know what the appropriate level is and, in such cases, standards are set more conservatively as a precaution. More research could reduce the uncertainty, but pressure is growing on EPA to issue a standard so that communities can take informed actions.

In an effort to resolve some of the uncertainty and debate over perchlorate's health effects and EPA's latest assessment of those effects, EPA, DOD, NASA, and the Department of Energy have asked the National Academy of Sciences to review the science for perchlorate and EPA's draft risk assessment. The NAS review is expected to be completed early in 2005. The NAS review may help EPA reduce the uncertainty in its risk assessment, and the review committee will determine whether the risk assessment is consistent with current scientific evidence and make recommendations accordingly.

Food and Drug Administration. In an effort to determine the presence and levels of perchlorate in food, the FDA recently collected 500 samples of foods for

---

[13] Memorandum from Marianne Lamont Horinko, Assistance Administrator for Solid Waste and Emergency Response, U.S. Environmental Protection Agency, *Status of EPA's Interim Assessment Guidance for Perchlorate*, Jan. 22, 2003.

perchlorate analysis. Foods that have been sampled include lettuce, broccoli, cantaloupes, spinach, carrots, milk, tomatoes, and bottled water. Samples were taken in areas where water sources are believed to be contaminated with perchlorate.[14] The FDA is now evaluating the data, and plans to collect and analyze another 750 samples during FY2005. FDA's research is significant to EPA's standard-setting efforts, because EPA will take into account exposures to perchlorate from food and other sources when establishing a drinking water standard. Specifically, if other exposure sources are significant, EPA will set a stricter drinking water standard to account for those exposures.

Congressional Actions in the 108th Congress

Interest in perchlorate regulation and cleanup has grown this Congress, as reports of water contamination have increased, and as DOD has deferred cleanup at most sites, pending the establishment of a drinking water standard.

Several perchlorate-related provisions have been enacted. In the National Defense Authorization Act for FY2004 (P.L. 108-136), Congress required DOD to provide for an independent human health study and review of exposure to perchlorate in drinking water. (The DOD expects that study to be completed by June 2005.) The conference report for the Military Construction Appropriations Act for FY2004 (P.L. 108-132, H.Rept. 108-342) directed DOD to submit a report identifying sources of perchlorate on Base Realignment and Closure (BRAC) properties and plans to remediate the contamination on these sites.[15] Also, the House report (H.Rept. 108-187) for H.R. 2658, the DOD FY2004 Appropriations Act (P.L.108-87), directed DOD with EPA to conduct a study of perchlorate contamination of groundwater in Southern California, Arizona, and Nevada, to be completed by April 2004. This pending report must include recommendations for a standard for acceptable levels of perchlorate groundwater contamination. The Ronald W. Reagan National Defense Authorization Act for FY2005, H.R. 4200, includes a "Sense of Congress" that DOD should develop a plan for remediating perchlorate contamination resulting from DOD activities when the contamination poses a health hazard, and continue evaluating contaminated sites, notwithstanding the lack of a drinking water standard. Additionally, Congress has provided some funding for perchlorate cleanup activities in specific areas through several appropriations acts (P.L. 108-287, P.L. 108-199, P.L. 108-137, and P.L. 108-7).

Pending bills (H.R. 2123, H.R. 5344, and S. 502) would require EPA to issue a drinking water standard for perchlorate. H.R. 2123 and S. 820 focus on preventing contamination. S. 2550 (S.Rept. 108-386), a water infrastructure bill, would require the U.S. Geological Survey to conduct a national survey of sites contaminated with perchlorate. Other bills would authorize funding for groundwater cleanup in areas with contaminated water supplies (e.g., H.R. 4459, passed by the House on September 21, 2004, and H.R. 1284, H.R. 2991, H.R. 4606, and H.R. 5234).

---

[14] U.S. Food and Drug Administration, *FDA Collection and Analysis of Food for Perchlorate*, Dec. 23, 2003, at [http://www.cfsan.fda.gov/~dms/clo4surv.html], visited Sept. 15, 2004.

[15] Department of Defense, *Perchlorate on BRAC Properties Report to Congress*, July 7, 2004. See [http://www.denix.osd.mil/denix/Public/Library/Water/Perchlorate/perchlorate.html]. In July, the DOD submitted its report on plans to address perchlorate at BRAC properties. The report identified contamination in ground and/or surface water at 13 installations in 10 states.