Perchlorate in Drinking Water

By ACSH Staff — November 27, 2020

What is perchlorate? And is it dangerous?

Perchlorate is an inorganic ion containing one chlorine atom bound to four oxygen atoms in a tetrahedral configuration. Perchlorate does not exist on its own; it must be bound to other chemicals, such as ammonia, magnesium, and potassium. Perchlorate can form naturally in the air and is found at low levels in rain or snow. It is found naturally at high levels in certain rock and mineral deposits across the world, and is especially prevalent in deserts. Perchlorate is also manufactured for use as an oxidizer in solid fuels to power rockets, missiles, and fireworks.

**HEALTH EFFECTS**

The major effect of perchlorate is on the thyroid gland. The thyroid is responsible for making hormones that play a role in controlling the a variety of the bodies essential processes, including protein, fat, and carbohydrate metabolism as well as how cells use energetic compounds. Iodine is a critical component of these hormones and perchlorate competitively inhibits the transport of iodide into the thyroid. Disruption of normal thyroid hormone levels from excessive perchlorate exposure can therefore have important health consequences.
ENVIRONMENTAL CONTAMINATION

Perchlorate has been found in lakes, rivers, and groundwater wells across the U.S, in part due to its natural occurrence, but also due to its industrial uses. In 1997, a new method to measure perchlorate in water was developed that allowed the measurement of much lower levels of perchlorate in water (approximately 1 microgram (µg)/liter (L) of water, which is equal to one part of perchlorate per billion parts of water (1 ppb)). Perchlorate has been found in approximately 4% of over 3,800 public water systems across the U.S., with perchlorate levels ranging from 4 µg/L to 420 µg/L.

DRINKING WATER REGULATORY PROCESS

The EPA, under the Safe Drinking Water Act (SDWA, 104th Congress, 1996), may issue legally enforceable standards for contaminants in drinking water. EPA has regulations for approximately 90 drinking water contaminants.

When considering whether to regulate a drinking water contaminant, EPA must consider the following three criteria:

- The contaminant may have an adverse effect on the health of persons
- The contaminant is known to occur, or there is a high chance that the contaminant will occur, in public water systems often enough and at levels of public health concern
- In the sole judgment of the Administrator, regulation of the contaminant presents a meaningful opportunity for health risk reductions for persons served by public water systems.

To regulate a contaminant EPA must first set a maximum contaminant level goal (MCLG). The MCLG is a non-enforceable health goal set at the level at which no known or anticipated health effects will occur. After setting the MCLG, EPA sets the maximum contaminant level (MCL). The MCL is the enforceable drinking water standard that must be set as close to the MCLG as feasible. EPA must factor in the available analytical methods and cost of available treatment technologies in setting the MCL. MCLGs and MCLs are often the same value, however EPA sets the MCLGs at zero for a chemical where there is evidence it causes cancer and there is no dose below which the chemical is considered safe.

PERCHLORATE REGULATION

Perchlorate in drinking water is not currently regulated by the EPA. EPA made this determination in 2020 after a lengthy process of review, which concluded that a maximum contaminant level goal for perchlorate was 56 µg/L, and that concentrations of perchlorate in drinking water systems throughout the US were not occurring with sufficient frequency to warrant a national rulemaking.

Some of the major actions taken by EPA over the years are:

- 1998: EPA first lists perchlorate on the CCL.
- 2002: EPA issues a draft risk assessment on perchlorate that calculates a Reference Dose (RfD) of 0.03 µg/kg/day based on changes in the brain and thyroid in a rat study.
- 2005: The National Research Council (NRC, 2005) evaluates EPA’s 2002 Risk Assessment and RfD and recommends that EPA set its RfD at 0.7 µg/kg/day based on a human study that showed inhibition of iodine uptake by the thyroid. EPA accepts these recommendations
and establishes an RfD of 0.7 µg/kg/day and publishes it in EPA’s Integrated Risk Information System (IRIS).

- 2008: EPA (2008) issues a regulatory determination not to regulate perchlorate in drinking water systems. This determination was based on the conclusion that perchlorate did not occur with a frequency and at levels of public health concern and the development of a regulation did not present a meaningful opportunity for health risk reduction, as required under the SDWA.
- 2009: EPA publishes an interim health advisory of 15 µg/L for perchlorate. A Health Advisory is a non-regulatory guideline that sets out levels of a contaminant at which adverse health effects are not likely to occur.
- 2011: EPA (2011) reverses its 2008 decision and publishes a regulatory determination to regulate perchlorate in drinking water systems. This determination was based on intense activists’ pressure, including some US States’ conclusions that the likelihood of perchlorate occurring at levels of concern had significantly increased compared to the levels described in the 2008 regulatory determination.
- 2012: EPA requests comments from EPA’s Science Advisory Board (SAB) on how best to derive a MCLG for perchlorate. The SAB responds that EPA should derive a perchlorate MCLG that addresses sensitive life stages thorough the use of specialized modeling approaches.
- 2017: EPA convenes an independent review panel to evaluate the models that EPA has developed in response to the SAB comments. The review panel recommends that EPA use a model that specifically considers the effects of perchlorate on the fetuses of pregnant women with low iodine levels and infants exposed to perchlorate though breast milk or formula.
- 2018: EPA convenes a second review panel to review the model that EPA has updated based on the recommendations of the first review panel. The second review panel is largely supportive of EPA’s revised model.
- 2019: EPA (2019) proposes an MCLG of 56 µg/L for perchlorate, based on the revised model. This level is identical to that which could be developed from a RfD proposed independently by Strawson et al. (2004).
- 2020: On July 21, EPA (2020) withdraws its 2011 determination to regulate perchlorate in drinking water, and, on the basis of its MCLG of 56 µg/L, makes a final determination not to regulate perchlorate based on the determination that perchlorate is not found in drinking water with a frequency and at levels of public health concern to support a meaningful opportunity for health risk reduction through a national perchlorate drinking water regulation.

REFERENCES


For further information on this topic, please see this paper [9] by Susan Goldhaber examining the regulatory process for perchlorate in drinking water.