ATTACHMENT 1

Perchlorate: Natural Occurrences, Routes of Exposure, Health Effects, Fate and Transport, Regulatory Standards, and Treatment Methods

Natural Occurrences

Perchlorate salts occur naturally and their abundance correlates with the dryness of the climate. Probability maps in a 2010 publication (Fram, M., and Belitz, K., December 2010, Probability of Detecting Perchlorate under Natural Conditions in Deep Groundwater in California and the Southwestern United States http://ca water.usgs.gov) indicate that the probability of detecting naturally occurring perchlorate above 0.1 µg/L in deeper aquifers in coastal groundwater basins of California is greater than sixty percent, and the probability of detecting perchlorate at a concentration of approximately 1 µg/L is one to five percent. Perchlorate is formed naturally by sunlight or lightning interacting with oxygen and chlorine in the atmosphere, and falls to the earth in rain.

Routes of Exposure

Studies have shown that perchlorate accumulates in some food crop leaves, tobacco plants, and in broad leaf plants. The primary pathway for human exposure to perchlorate are ingestion of contaminated food and drinking water. Perchlorate is readily adsorbed after oral exposure and can migrate from the stomach and intestines to the blood stream[4].

Health Effects

Perchlorate interferes with the natural function of the thyroid gland by inhibiting the uptake of iodide. Iodide is an essential component of thyroid hormones, which are needed for prenatal and postnatal growth and development, as well as for normal body metabolism. Doctors used potassium perchlorate until recently to treat hyperthyroidism related to Graves disease, and it is still used diagnostically to test thyroid hormone production in some clinical settings.

Fate and Transport

Perchlorate is a highly soluble, mobile compound that dissolves and moves with water. For comparison, perchlorate has similar chemical properties in water as nitrate because it is stable in oxygenated water, chemically degrades in anoxic water, and does not adhere to soil particles. Thus, as with nitrate, large perchlorate groundwater plumes can form in permeable and oxygenated aquifers.

Regulatory Standards

Perchlorate is a regulated drinking water pollutant in California, with a maximum contaminant level (MCL) of six µg/L, effective October 18, 2007. Currently, no federal drinking water MCL for perchlorate exists.

Recent studies have led the California Office of Environmental Health Hazard Assessment (OEHHA) to revise the Public Health Goal (PHG) on February 1, 2015, for perchlorate in drinking water from six µg/L to one (1.0) µg/L[5]. PHGs are estimates of the levels of contaminants in drinking water that would pose no adverse health risk to individuals consuming the water on a daily basis over a lifetime. OEHHA established the PHG considering toxicological information about the effects of perchlorate that suggest sensitive populations,

[4] See: https://www.epa.gov/sites/production/files/2014-03/documents/ffrrofactsheet_contaminant_perchlorate_january2014_final.pdf

[5] See http://oehha.ca.gov/media/downloads/water/chemicals/phg/perchloratephgfeb2015_0.pdf

specifically infants, pregnant women and their fetuses, and those with iodine deficiencies, can be especially susceptible to perchlorate . The recent lowering of the PHG was based on increasing the estimated perchlorate uptake rate along with increasing the uncertainty factor from 3 to 10 for observable health response in infants. A PHG does not consider other factors such as cost impacts and is not an enforceable standard. State law requires the Division of Drinking Water to use a PHG as guidance in developing MCLs, which is the enforceable state standard for drinking water that public water systems must meet. The Division of Drinking Water is in the process of evaluating the technical feasibility and cost impacts of lowering the MCL that is currently 6.0 µg/L to the PHG[6] of 1 µg/L.

Treatment Methods

Perchlorate treatment in water is complicated because the perchlorate anion does not respond to typical treatment techniques due to its fundamental physical and chemical nature. Currently, ion exchange is the most common treatment technology for removing perchlorate from groundwater and is used at the Olin site. Biological degradation, thermal treatment, and, more recently, phytoremediation have been used for perchlorate treatment at other cleanup sites.

[6] See http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/MCLReview2016.shtml