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CALIFORNIA DEPARTMENT OF HEALTH SERVICES

DIVISION OF DRINKING WATER AND ENVIRONMENTAL MANAGEMENT

DRINKING WATER PROGRAM

PERCHLORATE IN CALIFORNIA DRINKING WATER

Updated June 1997

Recently the inorganic chemical perchlorate has been found in certain drinking water supplies in northern and southern California. Perchlorate (as ammonium perchlorate) is used in solid rocket propellants, and has been found in areas where aerospace material development and testing has occurred.

Because perchlorate historically has not been considered a common contaminant, no federal or state drinking water standards exist. However, the Department of Health Services (DHS) has adopted a provision action level for perchlorate in drinking water of 18 micrograms per liter, or parts per billion (ppb).

The primary human health concern related to perchlorate is that it can interfere with the thyroid gland's ability to utilize iodine to produce thyroid hormones. Perchlorate in very high doses has been used in medicine in the treatment of Graves' disease, a condition in which excessive amounts of thyroid hormone are produced.

Northern California

In northern California, perchlorate has been found in eastern Sacramento County. Several sites have been identified as potential sources of perchlorate contamination. These include Aerojet General Corporation's facility, a site formerly owned by McDonnell-Douglas, and a site formerly owned by Purity Oil Company.

As a result of cleanup of contaminated shallow groundwater at Aerojet General Corporation's chemical manufacturing and rocket testing facility near Rancho Cordova, water treated to remove volatile organic chemicals (for example,
trichoroethylene, TCE) has been reinjected into groundwater aquifers in the area. This has occurred since the late 1980's. The reinjected water contains up to 8,000 parts per billion (ppb, equivalent to micrograms per liter) of perchlorate, a chemical component of solid rocket propellant, which is also a contributor to the site's shallow groundwater contamination.

In February 1997, perchlorate in drinking water wells in Rancho Cordova was present in concentrations as high as 65 to 280 ppb, using a laboratory method sensitive to 35 ppb. In April 1997, using an improved method developed by the Department of Health Services' (DHS') Sanitation and Radiation Laboratory sensitive to 4 ppb, perchlorate was also found in several other drinking water wells at concentrations as low as 4 to 16 ppb. (Laboratory Analyses for

Perchlorate)

Because of the perchlorate experience in the northern part of the state, the DHS Division of Drinking Water and Environmental Management headquarters Drinking Water Program advised directed its various its district offices of the DHS Drinking Water Program to include perchlorate testing for drinking water systems that are near aerospace and munitions facilities. Subsequently, fireworks manufacturing facilities were also included.

Southern California

As a result of the expanded sampling and analyses in southern California in April and May 1997, agricultural and drinking water wells in Loma Linda and Redlands in San Bernardino County were found to contain perchlorate in concentrations of 8 ppb to 130 ppb. In all but one case, no water served was above the 18-pbb provisional action level. Where served water exceeded the action level (at concentrations of approximately 40 to 50 ppb), the utility provided bottled water to customers until the contaminated sources was replaced by an alternative source. The origin of this perchlorate is currently unidentified. The perchlorate contamination is in a TCE plume associated with past operations of the Lockheed Propulsion Company.

Perchlorate was also found in Los Angeles County, in certain wells of drinking water systems that serve parts of Baldwin Park, Azusa, Irwindale, West Covina, and La Puente. With one exception, water served was below the 18-ppb provisional action level. In the situation in which the water served was above the action level, the well was immediately removed from use. The origin of the perchlorate contamination has not yet been identified.

DHS' ADVICE TO DRINKING WATER UTILITIES

If perchlorate is found in a drinking water supply at concentrations exceeding the 18-ppb provisional action level, DHS will advise the utility to remove the contaminated source from service. Under Section 116455 of the California Health and Safety Code, the water utility is required to notify its City Council whenever a well is removed from service due to chemical contamination. If the source is required to meet system demands and cannot be removed from service, DHS will advise the utility to arrange for public notification to its customers.

Whenever public notification occurs, information about perchlorate in drinking water is to be provided to the consuming population in the affected area that would not directly receive the public notification, including renters, workers and students.

DHS' PROVISIONAL ACTION LEVEL FOR PERCHLORATE

Following the initial northern California findings in February 1997, the DHS Drinking Water Program informed drinking water utilities that the US Environmental Protection Agency (US EPA) had evaluated the health effects of perchlorate as part of its Superfund activities associated with hazardous waste sites. DHS, in cooperation with the California Environmental Protection Agency's Office of Environmental Health Hazard Assessment, reviewed the US EPA reports on

the risks to human health from exposure to perchlorate. US EPA reported a range of exposures that would be considered to provide adequate health protection that corresponds to a 4-ppb to 18-ppb range of concentrations.

As a result of that review, DHS established its provisional action level of 18 ppb. Perchlorate concentrations lower than 18 ppb are not considered to pose a health concern for the public, including children and pregnant women.

BASIS OF DHS' PROVISIONAL ACTION LEVEL

The 1992 US EPA evaluation used studies on humans as the most appropriate information for evaluating the health risks of perchlorate. Data were derived from medical patients given perchlorate to treat hyperactive thyroid glands (Graves' disease). The measure of effect was the release of iodine from the thyroid and inhibition of iodine uptake by the thyroid, which were the most sensitive indicators of effects. For these effects, the US EPA identified a no observable adverse effects level (NOAEL) of 0.14 mg/kg/day.

To account for unknowns in the risk assessment process, US EPA applies uncertainty factors (UFs). A UF of 1000 was applied to the NOAEL for perchlorate in its 1992 report. The 1000-fold UF is a product of 10 x 10 x 10, where individual contributors to the UF are:

10 for use of a study of short duration, instead of a long-term "chronic" exposure study

10 for the protection of sensitive individuals, e.g., individuals with low iodine diets and individuals with genetically impaired iodide accumulation systems in the thyroid

10 to account for deficiencies in the data available on the effects of perchlorate

The resulting reference dose (RfD) is 0.0001 mg/kg/day (rounded from 0.00014 mg/kg/day). Using standard risk assessment parameters (such as a 70-kg body weight, and 2 liters of drinking water per day) gives a result of 4 ppb (rounded from 3.5 ppb).

In 1995 the US EPA reviewed its 1992 report and material submitted by the Perchlorate Study Group. US EPA commented that in its deliberations there was some discussion that a full 10 for data deficiencies may not be required. As a result, US EPA maintained the 1000-fold UF, but also included a 300-fold UF, in which the individual contributors to the UF were identified as:

10 for use of a study of short duration, instead of a long-term "chronic" study

10 for the protection of sensitive individuals, e.g., individuals with low iodine diets and individuals with genetically impaired iodide accumulation systems in the thyroid

3 to account for deficiencies in the data available on the effects of perchlorate

The resulting reference using a UF of 300 dose is 0.0005 mg/kg/day (rounded from 0.00047

mg/kg/day). Using standard risk assessment parameters gives a result of 18 ppb (rounded from 17.5 ppb).

Hence, the range of 4 to 18 ppb represents the span of UFs, from 1000 to 300, based on the same human data.

In its 1995 report, US EPA acknowledged that "there are many questions about the chronic effects of perchlorate left unanswered by the existing data," finding a series of studies that identified fatal bone marrow effects at doses ranging from 6 to 14 mg/kg/day to be "particularly troubling." US EPA concluded, "until adequate chronic data becomes available that addresses the effects of perchlorate on the hematopoietic system [i.e., bone marrow], we feel that the appropriate provisional RfD is in the range of 1 to 5E-4 [i.e., 0.0001 to 0.0005] mg/kg/day."

As a result of reviewing the 1992 and 1995 evaluations of perchlorate by US EPA, DHS' Drinking Water Program considers the 18-ppb concentration of perchlorate in drinking water to be protective of public health.

NOTES ON US EPA'S PROVISIONAL REFERENCE DOSE FOR PERCHLORATE

Study used to determine RfD: Stanbury, J.B. and J.B.Wyngaarden, 1952. Effect of perchlorate on the human thyroid gland. Metabolism 1: 533-539.

NOAEL= 0.14 mg/kg/day, based on the studies of Graves' disease patients, using the release of iodine from the thyroid and inhibition of iodine uptake by the thyroid as the critical effect.

Reference Dose: 0.0001 mg/kg/day

UF: 1000 (10 for use of less than chronic study, 10 for the protection of sensitive individuals, e.g., individuals with low iodine diets and individuals with genetically impaired iodide accumulation systems in the thyroid, and 10 to account for database deficiencies)

Corresponding drinking water concentration: 4 ppb

Margin of safety relative to thyroid effects (see below): 14,000

Reference Dose: 0.0005 mg/kg/day

UF: 300 (10 for use of less than chronic study, 10 for the protection of sensitive individuals, e.g., individuals with low iodine diets and individuals with genetically impaired iodide accumulation systems in the thyroid, and 3 to account for database deficiencies)

Corresponding drinking water concentration: 18 ppb

Margin of safety relative to thyroid effects: 2,800

Doses of perchlorate above 1.4 mg/kg/day were reported to have adverse effects on the thyroid. In drinking water, this corresponds to (1,400 micrograms/kg/day x 70 kg body weight / 2 L/day =) 49,000 ppb.

Doses of perchlorate of 6-14 mg/kg/day were reported to result in fatal bone marrow effects in Graves' disease patients treated for 2 months or longer. In drinking water, this corresponds to a concentration of (6,000-14,000 micrograms/kg/day x 70 kg / 2 L/day =) 210,000-490,000 ppb.

REFERENCES

US EPA, 1992, Provisional Non-cancer and Cancer Toxicity Values for Potassium Perchlorate (CASRN 7778-74-7) (Aerojet General Corp./CA), Memorandum from Joan S. Dollarhide, Superfund Health Risk Technical Support Center Environmental Criteria and Assessment Office, Office of Research and Development, to Dan Stralka, US EPA Region IX.

US EPA, 1995, Correspondence from Joan S. Dollarhide, National Center for Environmental Assessment, Office of Research and Development, to Mike Girrard, Chairman, Perchlorate Study Group.

LABORATORY ANALYSES FOR PERCHLORATE

1. If a water utility wishes to have its own or its contract lab do analyses for perchlorate, the procedure is:

2. Contact Frank Baumann or Bill Steeber of the Sanitation and Radiation Laboratory Branch (SRLB) at (213) 580-5795 for a copy of the method. (The lab must hold Environmental Laboratory Accreditation Program (ELAP) certification for EPA Method 300.0 -IC. If the lab is not already certified for 300.0, contact ELAP.)

3. Laboratory is expected to develop a Standard Operating Procedure (SOP), determine its Method Detection Limit (MDL) and prepare a data package demonstrating its ability to perform this analysis.

4. When ready, the lab is to inform SRLB, and we will send an ELAP field auditor to the lab. The auditor will bring along one or more performance evaluation (PE) samples which the lab is expected to process while the auditor is there. The laboratory reports the PE data on its letterhead to the auditor.

5. The auditor reports back to the SRLB, and submits copies of the SOP, data package, and PE results, along with his/her recommendation.

6. If the lab successfully passed the site visit and performed within the acceptance limits of the PE sample (+/- 10%), SLRB will issue a "Letter of Approval" to the laboratory.