NDMA IN CALIFORNIA DRINKING WATER

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Introduction

In 1998, concern about the presence of the chemical N-nitrosodimethylamine NDMA contamination at an aerospace facility in eastern Sacramento County prompted investigations of the presence of NDMA in nearby sources of drinking water. (NDMA is associated with liquid rocket fuel.) As a result of findings of NDMA in a drinking water well, follow-up investigations also occurred in southern California.

[Some locations with sources of drinking water that are contaminated with NDMA have also been contaminated by perchlorate, which is used in the manufacture of solid rocket propellants, munitions, and fireworks. Information about perchlorate in California drinking water is available here.]

NDMA has been shown to cause cancer in laboratory animals such as rats and mice when the animals are exposed at high levels over their lifetimes. Chemicals that cause cancer in laboratory animals also may increase the risk of cancer in people who are exposed over long periods of time. Based on animal studies, NDMA has been identified as a probable human carcinogen by the US Environmental Protection Agency. It is also identified as a chemical "known to the state to cause cancer," under California's Safe Drinking Water and Toxic Enforcement Act of 1986 ("Proposition 65").

Because NDMA historically has not been considered a common drinking water contaminant, no federal or state drinking water standards exist. In addition, technologies for the removal of NDMA from high volumes associated with drinking water are currently unavailable.

In April 1998, DHS announced an action level for NDMA of 0.002 micrograms per liter in drinking water, or 0.002 parts per billion (ppb). However, because this concentration is well below the chemical's limit of detection limit, any detectable amount of NDMA in drinking water exceeds the action level. DHS has given advice to utilities about actions that are to be followed when NDMA is detected in public water supplies.

NDMA Findings

A limited number of drinking water wells in public water systems were sampled and analyzed for NDMA. Sampling from selected drinking water sources was prompted by the presence of NDMA at nearby hazardous waste sites, and began in early 1998 in northern California and subsequently in southern California.

In northern California, NDMA was found in eastern Sacramento County, in association with an aerospace facility. In samples collected in February and March 1998, NDMA was found in one drinking water well at concentrations of 0.15 and 0.14 ppb, approximately 70 times the DHS action level. This well was immediately taken out of service.

In southern California, NDMA was in three drinking water wells in the San Gabriel Basin that were sampled in May 1998. Two wells had NDMA at concentrations of 0.07 ppb, 35 times the action level. Although these findings have not been confirmed by subsequent resampling, the wells were removed from service. The third well, already out of service because of trichloroethylene and perchlorate contamination, contained NDMA at 3 ppb (1,500 times the action level).

DHS' Advice to Drinking Water Utilities

Under Section 116455 of the California Health and Safety Code, whenever a well that is used as a drinking water source for a public water system is discovered to contain—or is closed because it contains—a contaminant in excess of an action level, the public water system is required to notify the governing body of the local agency in which users of the drinking water reside (e.g., the city council or county board of supervisors) within 30 days of the discovery or closure.

If NDMA is detected in a drinking water supply at concentrations exceeding the DHS action level, and the utility plans to continue to keep the contaminated source in service because the source is required to meet system demands, DHS will advise the utility to arrange for public notification to its customers.

DHS recommends that whenever public notification occurs as a result of exceeding a drinking water action level, information should be provided to the water-consuming population in the affected area that would not directly receive the public notification, including renters, workers and students.

DHS' Action Level for NDMA

Following the initial northern California findings in February 1998, the DHS Drinking Water Program informed drinking water utilities that the US Environmental Protection Agency (US EPA) has evaluated the health effects of NDMA. In addition, the Office of Environmental Health Hazard Assessment (OEHHA) of the California Environmental Protection Agency has evaluated NDMA's health significance, and had established a "no significant risk" level for the chemical under the state's Safe Drinking Water and Toxic Enforcement Act of 1986 ("Proposition 65").

As a result of that review, DHS established an action level of 0.002 ppb for NDMA. However, because current analytical capabilities do not enable detection at that concentration,

DHS' current approach is to consider any detectable quantity as exceeding the DHS action level for NDMA.

Basis of DHS' Action Level

State and federal risk assessments identify *de minimis* (*i.e.*, 10^{-6}) levels of NDMA as from 0.0007 to 0.002 ppb.

OEHHA (1998a) classifies NDMA as a chemical known to the state of California to cause cancer. OEHHA's 10^{-5} risk level for purposes of warning and discharge prohibition under Proposition 65 is 0.04 microgram per day (OEHHA, 1998b), or 0.02 ppb in drinking water, using Proposition 65's ingestion rate of 2 liters of water consumed per day. For a 10^{-6} level, the risk DHS uses for a drinking water action level, the corresponding concentration of NDMA is 0.002 ppb.

The US EPA (1998) classifies NDMA as B2, probable human carcinogen, based on the induction of tumors at multiple sites in laboratory animals exposed by various routes. NDMA was shown to produce liver tumors after oral administration in rats, and tumors in lung, liver and kidney in rats and mice after inhalation exposures. NDMA also acts as a transplacental carcinogen when administered by various routes to pregnant rats, mice and hamsters. NDMA is also mutagenic, and is structurally related to known carcinogens. US EPA's 10^{-6} risk level in drinking water corresponds to a concentration of NDMA of 0.0007 ppb.

DHS is using the 0.002-ppb concentration of NDMA as an action level, or the detection limit, whichever is higher.

Laboratory Analyses for NDMA

As mentioned above, NDMA is not regulated in drinking water—therefore, no approved method exists for measurement of NDMA in drinking water in the parts per trillion (ppt) range. According to 40 CFR 136, both method 625 and its companion isotope dilution method 1625 list NDMA as an analyte with a detection limit of 50 ppb.

DHS is aware of a limited number of laboratories that may have capability to detect NDMA at lower concentrations. The less sensitive methods use solid phase extraction followed by analysis using gas chromatography/chemiluminescence detection or gas chromatography/mass spectrophotometry (GC/MS). Detection limits are reported to be in the 0.007-0.1 ppb (7-100 ppt) range, More recently, DHS received information about a more sensitive GC/MS method, which claims to offer detection limits near 0.005 ppb (5 ppt). DHS has not independently confirmed any of these methods.

Additional information on the status of laboratory methods for NDMA can be obtained from Dr. Kusum Perera of DHS' Sanitation and Radiation Laboratory, at (510) 540-2201.

References

Office of Environmental Health Hazard Assessment (OEHHA), 1998a. Chemicals known to the state to cause cancer or reproductive toxicity. Title 22, California Code of Regulations (CCR), Section 12000.

Office of Environmental Health Hazard Assessment (OEHHA), 1998b. Specific regulatory levels posing no significant risk. 22 CCR Section 12705.

US Environmental Protection Agency (US EPA), 1998. N-nitrosodimethylamine; CASRN 62-75-9 (04/01/97), Integrated Risk Information Service (IRIS) Substance File, Internet download (http://www.epa.gov/ngispgm3/iris/subst0045.htm).

For More Information

For more information on NDMA in drinking water, please contact Dr. Steven Book of DHS' Drinking Water Program at (916) 323-6111.