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TECHNICAL BULLETIN

HEALTH EFFECTS INFORMATION

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Nitrate

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SYNONYMS: There are no synonyms for nitrate but there are a number of nitrogen compounds that are important in nitrate-related health effects, including nitrites, amines and nitrosamines. All may be present along with nitrates in the environment and in the human body.

WHAT IS NITRATE AND WHAT ARE ITS USES?

Nitrate is a naturally occurring oxide of nitrogen. Nitrogen is always present in the air and it reacts with oxygen and ozone to produce nitrogen oxides of which nitrate is one.

Nitrogen oxidation also occurs in growing and decomposing biological systems, and nitrate is present in smoke in significant quantities. Nitrate is an essential component of living things and is a major component of animal manure, human sewage waste, and commercial fertilizers. Nitrates and nitrites have been used for centuries as fertilizers, in explosives and as food preservatives, especially in cured red meats. There are many other uses of nitrates, and the presence of nitrates in the environment is normal and necessary.

HOW CAN I BE EXPOSED TO NITRATES?

Everyone is exposed regularly to nitrates because of their presence in foods, in water and because they are formed during digestion and metabolism in our bodies. Nitrates are not harmful unless our exposure to them is excessive. Young infants, persons taking nitrogen-containing medications, persons with medical conditions that increase internal levels of nitrate, nitrite or nitrosamines, and persons with genetic susceptibility to nitrates are harmed at lower exposure levels than others. However, nitrate exposures above the current MCL may be harmful to everyone.

OCCURRENCE AND SOURCES OF NITRATE IN WATER SUPPLIES

Naturally occurring levels of nitrate in surface and groundwater do not generally exceed 1 milligram per liter (mg/L). Sources of nitrate in water include fertilizers, septic systems, animal manure, industrial wastes, and food processing waste. Nitrate is formed by microbes in some plants, which remove nitrogen from air and oxidize it to nitrate. It can also be naturally occurring in certain geological settings, and can result from decaying organic matter. Elevated levels of nitrate found in well water usually indicate improper well construction or location, overuse of chemical fertilizers or improper disposal of human and animal waste in the vicinity of the well. Water with less than 10 mg/L nitrate as nitrogen (NO₃-N) is generally safe for all household activities including use in foods and beverages.

Water containing 5-10 mg/L nitrate as nitrogen should be tested every quarter for at least one year to determine if levels are increasing or vary seasonally. Since nitrate levels can vary over time, annual testing is recommended at a minimum for all drinking water sources.

HEALTH EFFECTS OF DRINKING NITRATE-CONTAMINATED WATER

The United States Environmental Protection Agency (USEPA) has set a maximum contaminant level (MCL) of 10 mg/L for nitrate (NO₃-N) in public water supplies. The MCL was established primarily to protect infants and pregnant women since levels above 10 mg/L may present a serious health concern for these groups. Nitrate can interfere with the ability of the blood to carry oxygen to vital tissues of the body. Because infants six months old or younger have immature immune and metabolic systems, they are more vulnerable to this interference and could develop methemoglobinemia, or "blue baby syndrome", a potentially deadly disease. Parents and care providers should be sure that water used to make infant formula contains nitrate below 10 mg/L.

In addition, other individuals, such as persons taking nitrogen-containing medications, persons with certain medical conditions that increase internal production of nitrate, nitrite or nitrosamines, or persons with a genetic susceptibility to nitrates should not consume water containing more than 10 mg/L nitrate directly, added to food products, or beverages. Other domestic uses of affected water such as irrigation, washing and bathing do not result in nitrate absorption.

Human studies have shown a potential link between exposure to high levels of nitrate in drinking water and thyroid dysfunction, recurrent respiratory infections, and adverse reproductive outcomes, such as spontaneous abortion. Some studies suggest that nitrate ingestion may be linked to gastric, bladder or other cancers. However, this association has not been firmly established, and current exposure levels do not appear to put the population at risk.

REMOVING NITRATE FROM DRINKING WATER

Heating or boiling water containing nitrate will not remove the nitrate, and may actually concentrate it. Options to consider if the water supply is contaminated with nitrate above the 10 mg/L level, include using bottled water for drinking and for food and beverage preparation, or installing a home water treatment unit. Mechanical filters or chemical disinfection, such as chlorination, do not remove nitrate from water. Nitrate may be successfully removed from water using treatment processes such as ion exchange, distillation, and reverse osmosis. These treatment techniques require careful maintenance and regular sampling to achieve and confirm effective operation. If a treatment system is to be used, one with National Sanitation Foundation (NSF) certification should be selected. For additional information on these options, contact the Drinking Water Section of the Oregon Health Authority at (971) 673-0405.