

Nitrates/Nitrites

Nitrates/Nitrites: From [Water Technology](#) Magazine, Volume 31, Issue 5 - May 2008

What they are:

- **Symbols:**
 - Nitrate = NO_3^-

 - Nitrite = NO_2^-

- Nitrate, with a single negative charge, is an ion (or salt) of nitric acid (HNO_3) or other organic or inorganic substances, such as potassium nitrate (KNO_3). Nitrite, also with a single negative charge, is an ion (or salt) of nitrous acid (HNO_2) or other substances.

- **Properties:**
 - Nitrate is colourless, odourless, tasteless, very stable and easily dissolves in water. It moves with water and can migrate for miles from its source.

 - Nitrite is unstable and quickly reacts with other compounds.

Conversions:

Levels of nitrate can be expressed in either of two ways: "nitrate as nitrogen" (symbol: $\text{NO}_3\text{-N}$) or simply as nitrate (NO_3). To convert $\text{NO}_3\text{-N}$ to NO_3 in parts per million (ppm, or mg/L), multiply $\text{NO}_3\text{-N}$ by 4.42.

In ion exchange treatment, to convert NO_3 to the calcium carbonate (CaCO_3) equivalent in ppm, multiply the NO_3 value by 0.81.

Occurrence/health effects:

- Nitrates occur:
 - Naturally in water at low levels. Plants use nitrates as a nutrient. Most nitrates consumed by humans come from dietary raw or cooked vegetables, with few known health effects.
 - In high levels when microorganisms break down fertilizers, animal waste, wastewater or septic seepage, urban drainage or decaying plants. Due to agricultural runoff or animal feedlots, rural waters may be high in nitrates.
- Health effects:
 - Water high in nitrates that is ingested by infants, pregnant women, adults with low stomach acidity or people with a certain enzyme deficiency can cause methemoglobinemia, or “blue baby syndrome,” as the ingested nitrates are converted to nitrites in the body. This reduces the oxygen-carrying capacity of the blood, and severe cases result in brain damage or death.
 - Prolonged intake of high nitrates can result in gastric distress in humans and has been shown to cause cancer in test animals.

Regulation:

US Environmental Protection Agency (EPA) (primary) maximum contaminant levels are:

- Nitrate: NO₃-N = 10 mg/L, or NO₃ = 45 mg/L
- Nitrite (as nitrogen) = 1 mg/L

Water treatment:

- Ion exchange, reverse osmosis, distillation, blending (dilution).
- Ion exchange media for nitrates/nitrites can include standard strong base anion exchange resins, or nitrate-selective resins.

Sources: US EPA, Colorado State Cooperative Extension, Minnesota Department of Health, The Nitrate Elimination Co., Inc., Dave Bauman.

Odour in water;

Taste and odour problems in water are often considered together. Many taste/odour issues are related to the disinfectants used in water treatment.

Other causes are mineral contaminants, for example:

Chlorides in excess of 500 ppm produce a "salty" taste.

Blue green algae, depending on its quantity, can cause "grassy" and "musty" tastes and odours, as well as a "spicy" odour. Algae is also blamed for "fishy, rotten, septic, and medicinal" odours.

Hydrogen sulfide gas causes what is commonly called a "**rotten egg smell.**"

Rotting vegetation is probably the most common cause of taste/odour problems, however.

Odour is classed by the EPA as a secondary contaminant. The effects are strictly aesthetic, and no health issues have been identified. There is a

classification standard called TON (Threshold Odour Number). EPA suggests a limit of 3 TON for odours.

Treatment: Activated carbon adsorption is the most standard approach to taste/odour improvement. Oxidation/reduction is also used. Chlorine is only partially effective for odour improvement, and chloramine is not effective at all. Chlorine dioxide and ozone are excellent oxidizers for odour improvement. Hydrogen peroxide is very effective against hydrogen sulfide.

"Activated carbon has an excellent history of success in treating taste and odour problems. The life of the carbon depends on the presence of organics competing for sites and the concentration of the odour causing compound."
-- Enting Engineering Handbook.