Australian Government
Department of the Environment and Water Resources

fact sheet

Oxides of nitrogen (NOx)

Rank 1 of 90 substances

The National Pollutant Inventory (NPI) provides information on the types and quantities of substances being emitted into the Australian environment, and holds data on reported sources of oxides of nitrogen emissions in Australia.

This fact sheet provides information about oxides of nitrogen. It describes how you might be exposed to this substance, how exposure might affect you and the environment, its common uses, and its physical and chemical properties.

For more information about terms used in this fact sheet, see the glossary on the NPI web site:

http://www.npi.gov.au/epg/npi/contextual_info/glossary.html

What are oxides of nitrogen?

Oxides of nitrogen are a mixture of gases that are composed of nitrogen and oxygen. Two of the most toxicologically significant compounds are nitric oxide (NO) and nitrogen dioxide (NO_2). Other gases belonging to this group are nitrogen monoxide (or nitrous oxide, N_2O), and nitrogen pentoxide (N_2O_5).

Health effects

What effect might oxides of nitrogen have on my health?

Low levels of oxides of nitrogen can irritate eyes, nose, throat and lungs, possibly leading to coughing, shortness of breath, tiredness and nausea. Exposure can also result in a build up of fluid in the lungs for 1-2 days after exposure. Breathing high levels of oxides of nitrogen can cause rapid burning, spasms and swelling of tissues in the throat and upper respiratory tract, reduced oxygenation of tissues, a build up of fluid in the lungs, and maybe even death.

Skin or eye contact with high concentrations of oxides of nitrogen gases or nitrogen dioxide liquid will likely lead to serious burns.

How might oxides of nitrogen enter my body?

Oxides of nitrogen may be inhaled or absorbed through the skin.

How might I be exposed to oxides of nitrogen?

Most people are exposed to oxides of nitrogen by breathing in polluted air. People who live near combustion sources such as coal burning power plants or areas of high motor vehicle usage, or live in households that burn a lot of wood or use kerosene heaters or gas stoves may be exposed to higher levels of nitrogen oxides. Workers employed in facilities that use welding materials, produce nitric acid or certain explosives, may inhale oxides of nitrogen during their work.

Nitrogen dioxide and nitric oxide are found in tobacco smoke.

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What are the oxides of nitrogen health guidelines?

Workplace exposure:

Currently, the eight-hour time weighted average (TWA) exposure limits are 31 milligrams of nitric oxide (NO) per cubic metre of air, 45 milligrams of nitrous oxide (N_2O) per cubic metre of air and 5.6 milligrams of nitrogen dioxide (NO_2) per cubic metre of air. A 15-minute short term exposure limit (STEL) has been established for NO_2 at a level of 9.4 milligrams per cubic metre.

Australian drinking water guidelines:

In 2004, the National Health and Medical Research Council (NHMRC) and the National Resource Management Ministerial Council (NRMMC) established the following guidelines for acceptable water quality:

Based on health considerations, the concentration of nitrates should not exceed 50 milligrams per litre of drinking water for bottle-fed infants up to 3 months of age, up to 100 milligrams per litre of drinking water for adults and children over 3 months of age.

Where a water supply has between 50 and 100 milligrams of nitrate per litre of drinking water, active measures are required to ensure that those caring for infants are aware of the need to use alternative water sources in making up bottle feeds for infants under 3 months of age.

Based on health considerations, the concentration of nitrites should not exceed 3 milligrams per litre of drinking water.

Environmental effects

What effect might oxides of nitrogen have on the environment?

Excessive levels of the oxides of nitrogen, particularly nitrogen dioxide (NO_2), can cause death in plants and roots and damage the leaves of many agricultural crops. NO_2 is the damaging component of photochemical smog. Excessive levels increase the acidity of rain (lower the pH), and thus lower the pH of surface and ground waters and soil. The lowered pH can have harmful effects, possibly even death, on a variety of biological systems.

How might oxides of nitrogen enter the environment?

Oxides of nitrogen are part of the biogeochemical cycling of nitrogen, and are found in air, soil and water.

In the atmosphere, the oxides of nitrogen are rapidly equilibrated to nitrogen dioxide (NO_2), which eventually forms acid rain. In the stratosphere, oxides of nitrogen play a crucial role in maintaining the levels of ozone. Ozone is formed through the photochemical reaction between nitrogen dioxide and oxygen.

Where in the environment do oxides of nitrogen end up?

Oxides of nitrogen are rapidly broken down by reacting with other substances found in the air. Nitrogen dioxide can form nitric acid in sunlight, and is a major constituent of acid rain, tropospheric ozone and smog. Nitrogen oxides react in the soil and the water to nitric acid.

What are the oxides of nitrogen environmental guidelines?

The following ambient air quality standards were established for nitrogen dioxide in 1999:

Averaging period of 1 hour, a maximum of 0.12 parts per million, with a maximum allowable exceedence of 1 day per year.

Averaging period of 1 year, a maximum of 0.03 parts per million.

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Common uses

Nitrogen dioxide is produced for the manufacture of nitric acid. Most nitric acid is used in the manufacture of fertilisers, while some is used in the production of explosives for both military and mining uses.

Sources

Industry sources

Industrial sources of oxides of nitrogen are electricity supply, mining, oil and gas extraction, manufacturing industries and petroleum manufacturing.

Diffuse sources

A variety of agricultural (both cultivation and animal feeding) and forestry (both “burn-offs” and clear-felling) activities increase the rate of natural processes that produce oxides of nitrogen. Fuel burning activities, such as for heating, and cigarette smoking are also diffuse sources of oxides of nitrogen.

Transport sources

Oxides of nitrogen are present in the exhausts of all vehicles, including motor vehicles, lawn mowers, shipping/boating, aeroplanes and railways.

Natural sources

The biological cycling of nitrogen includes processes that produce nitric oxide and nitrous oxide as intermediates.

Thermal processes in the atmosphere (during lightning or bushfires/wildfires) produce oxides of nitrogen.

Consumer products that contain oxides of nitrogen

Nitrate containing fertilisers contain oxides of nitrogen.

Comparison to other substances

NPI rank

Currently, the NPI considers 90 substances for reporting purposes.

Oxides of nitrogen was ranked 1 of the 90 substances (rank 1 being highest perceived risk).

The total hazard score taking into account both human health and environmental criteria is 4.5 (on a scale of 0-6).

Factors taken into account to obtain this ranking and these scores include the extent of the material’s toxic or poisonous nature, the measure of its ability to remain active in the environment and whether it accumulates in living organisms. It does not take into account exposure to the substance.

For further information about the ranking process, please see our Technical Advisory Panel report:

http://www.npi.gov.au/publications/tap/pubs/npi-tap-report.pdf

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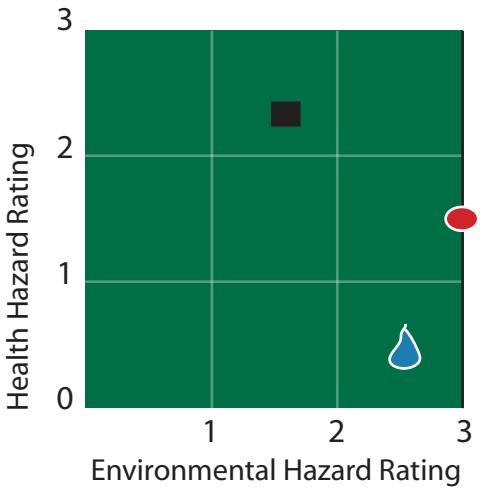
Oxides of nitrogen
Total hazard score: 4.5
NPI Rank: 1

Arsenic and compounds
Total hazard score: 4.0
NPI Rank: 10

Total phosphorus (in solution)
Total hazard score: 3.0
NPI Rank: 27



Physical and chemical properties

Substance name	Oxides of nitrogen
CAS number	N/A
Molecular formulae	NO, NO_2, N_2O and N_2O_5
Synonyms	NO: nitric oxide, nitrogen oxide, nitrogen monoxide, mononitrogen monoxide
	NO_2: nitrogen dioxide
	N_2O: dinitrogen monoxide, nitrous oxide, laughing gas, hyponitrous acid anhydride, dinitrogen oxide, factitious air, and
	N_2O_5: dinitrogen pentoxide, dinitrogen pentoxide, nitric anhydride.

Physical properties

NO: sharp, sweet-smelling, colourless gas

Melting point (°C): -163.6

Boiling point (°C): -151.8

Relative Density (air = 1): 1.04

NO_2: reddish-brown gas with irritating odour.

Melting point (°C): -9.3

Boiling point (°C): 21.15

Vapour Density (air = 1): 1.58

N_2O: colourless gas with sweetish odour and taste.

Melting point (°C): -90.81

Boiling point (°C): -88.46

Vapour Density (air = 1): 1.53

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Chemical properties

NO only burns when heated with hydrogen, and forms nitric acid (a strong acid) when dissolved in water.

NO_2 is sparingly soluble in water to form nitrous acid (a weak acid).

N_2O is non-flammable and has anaesthetic properties.

Sources used in preparing this fact sheet

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Other information that may be useful in understanding some of the issues surrounding the NPI can be found on our web site: http://www.npi.gov.au/index.html