



Australian Government

Department of the Environment
and Water Resources

Total Volatile Organic

Compounds (TVOCs)

Unranked

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 total volatile organic compounds (TVOCs) emissions in Australia.

This fact sheet provides information about TVOCs. It describes how you might be exposed to these substances, how exposure might affect you and the environment, common uses, and physical and chemical properties.

For more information on the 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

Health effects

What effect might TVOCs have on my health?

The health effects depend on the specific composition of the volatile organic compounds (VOCs) present, their concentration and the length of exposure. General effects of exposure to VOCs include: irritation to the eyes, nose and throat; headaches; loss of coordination; nausea; and damage to the liver, kidney and central nervous system. Some VOCs can cause cancer in animals, and some are suspected or are known to cause cancer in humans. Build up of VOCs in indoor environments have been associated with 'sick building syndrome'.

How might TVOCs enter my body?

TVOCs are present as a gas or vapour and can enter the body by inhalation.

How might I be exposed to TVOCs?

Exposure to TVOCs occurs by breathing contaminated air. TVOCs may build up in indoor environments as a result of the greater number of sources and lower rates of ventilation.

What are the TVOCs health guidelines?

Workplace exposure:

TVOCs are a group of compounds. Workplace exposure standards exist for individual substances, but not for the group.

Australian drinking water guidelines:

No drinking water guidelines have been established for TVOCs.

Environmental effects

What effect might TVOCs have on the environment?

TVOCs are a known causative agent of photochemical smog. Other environmental effects depend on the composition of the VOCs, the concentration and length of exposure. Some VOCs can have serious effects on animals and plants. Effects may also occur due to secondary impacts, such as the impacts of smog. In liquid form TVOCs may also impact on water and soil.

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How might TVOCs enter the environment?

TVOCs are carried by air. TVOCs generally refer to compounds in vapour or gas phase.

Where in the environment does TVOCs end up?

TVOCs cover a large number of substances and have varying fates in the environment. TVOCs are degraded by sunlight and eventually break down to simpler compounds. TVOCs are essential for smog formation and they react with oxides of nitrogen to produce ozone.

What are the TVOCs environmental guidelines?

The following ambient air quality standards were established for photochemical oxidants (as ozone) in 1999:

Averaging period of 1 hour, a maximum of 0.10 parts per million, with a maximum allowable exceedence of 1 day per year.

Averaging period of 4 hours, a maximum of 0.08 parts per million, with a maximum allowable exceedence of 1 day per year.

Common uses

“Total volatile organic compounds” as the group of compounds are not generally used. TVOC is a grouping of a wide range of organic chemical compounds to simplify reporting when these are present in ambient air or emissions. Many substances, such as natural gas, could be classified as volatile organic compounds (VOCs). VOCs are reserved for characterisation of such substances in polluted air, that is, VOCs generally refer to vapours of gases given off by compounds rather than the liquid phase.

Sources

Industry sources

TVOCs are produced from a wide range of industrial processes. Significant sources are processes producing or using solvents, paints or use of chemicals. Major point sources of TVOCs in Australian cities are petrol refining, fuel storage and the manufacturing industry, including: industrial machinery, vehicles and transport equipment; iron, steel and other metals; chemical products; wood products; plastic products; paper products; cement, lime and plaster products; ceramic products; oil, fat, petroleum and coal products; glass products; leather products; textiles and woven fabrics; electrical equipment and appliances; and food preparation.

Diffuse sources

TVOCs are released from painted surfaces, fabrics, carpets, printed paper and material, household cleaners, cosmetics and fibreboard products. Petrol stations are significant emitters of TVOCs.

Transport sources

TVOCs are produced from vehicle exhausts and from fuel tanks.

Natural sources

TVOCs are produced from a wide range of biological processes.

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Consumer products that contain TVOCs

TVOCs may be emitted from fabrics, carpets, fibreboard, plastic products, glues, solvents, household cleaners, printed material, methylated spirits, paints and paint products (such as thinners or varnishes), disinfectants, cosmetics, degreasing products, hobby products and in fuels.

Comparison to other substances

NPI rank

Currently, the NPI considers 93 substances for reporting purposes.

The Technical Advisory Panel (TAP) assessed the hazards and risks associated with a number of volatile organic compounds, but did not provide overall health or environmental hazard scores, or an overall rank for TVOCs. However, the TAP determined that inclusion of TVOCs on the reporting list would not, in any serious way, go against its advice.

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>

Physical and chemical properties

Substance name TVOCs

Synonyms volatile organic compounds (VOC), non-methane volatile organic compounds (NMVOC).

Chemical properties

The chemical properties of TVOCs vary widely.

Physical properties

The NPI definition of a VOC is any chemical compound based on carbon chains or rings with a vapour pressure greater than 2mm of mercury (0.27 kPa) at 25° C.

These compounds may contain hydrogen, oxygen, nitrogen and other elements, but specifically excluded are methane, carbon monoxide, carbon dioxide, carbonic acid, metallic carbides and carbonate salts. At normal temperatures, such compounds are likely to be present as a vapour or a gas.

Substances included in the VOC category include (but are not specific to):

- Acetaldehyde (ethanal)
- Acetic acid (ethanoic acid)
- Acetone
- Acetonitrile
- Acrylic acid
- Acrylonitrile (2-propenenitrile)
- Aniline (benzeneamine)
- Benzene
- 1,3-Butadiene
- Chloroform
- Ethyl butyl ketone
- Ethyl chloride (chloroethane)
- Ethylene oxide
- Formaldehyde (methyl aldehyde)
- Glutaraldehyde
- n-Hexane
- Methanol (methyl alcohol)
- 2-Methoxyethanol
- 2-Methoxyethanol acetate
- Methyl ethyl ketone

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- Cumene (isopropyl benzene)
- Cyclohexane
- 1,2-Dibromoethane
- 1,2-Dichloroethane
- Dichloromethane
- Ethanol (ethyl alcohol)
- 2-Ethoxyethanol
- 2-Ethoxyethanol acetate
- Ethyl acetate
- Ethyl benzene
- Methyl isobutyl ketone
- Methyl methacrylate
- Styrene (ethenylbenzene)
- 1,1,1,2-Tetrachloroethane
- Tetrachloroethylene
- Toluene (methyl benzene)
- 1,1,2-Trichloroethane
- Trichloroethylene
- Vinyl Chloride Monomer
- Xylenes (individual compounds and the mixture of isomers)

Sources used in preparing this fact sheet

- Intergovernmental Panel on Climate Change (2001), Climate Change: Working Group 1: The Scientific Basis (Chapter 4), accessed July 2007.
- National Pollutant Inventory (1999), Contextual Information.
- National Pollutant Inventory (2006), NPI Definition for Volatile Organic Compounds.
- Office of the Australian Safety and Compensation Council, Exposure Standards: total volatile organic compounds, accessed July 2007.
- Technical Advisory Panel 1999, Final Report to the National Environment Protection Council.

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/database/substance-info/sources.html>

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