# Chemical Fact Sheets

## Quinoline, $C_9H_7N$
## CAS No. 91-22-5

### WHAT IS QUINOLINE?

Quinoline is a colourless to brown gas with a penetrating odor.

### USES

Quinoline is used in the preparation of hydroxyquinoline sulfate (quinosol), niacin, and certain dyes. It is an anatomical specimen preservative and a solvent for resins & terpenes. It is produced as a chemical intermediate for both 8-hydroxyquinoline (a fungistat) and certain pharmaceuticals (eg, antiinfectives). In addition, quinoline is used as a corrosion inhibitor.

### SOURCES

Quinoline may enter the environment through atmospheric emissions and/or wastewater from petroleum, shale oil, coal processing and wood preservation industries. It may also be released as a result of its production and use in the above-mentioned industrial processes.

### ENVIRONMENTAL LEVELS AND EXPOSURE

Exposure to quinoline might include:
- Inhalation due to occupational exposure, cigarette smoke and particulates in urban air.

Ambient air concentrations of quinoline were not reported for Alberta in 1997 or 1998.

### ENVIRONMENTAL FATE AND BEHAVIOUR

- Upon release to the atmosphere, quinoline will react with hydroxyl radicals.
- Quinoline can be removed from the atmosphere via wet and dry deposition.
- If released to soil, quinoline will leach into groundwater and biodegrade.
- Hydrolysis, oxidation and volatilization do not appear to be significant fate processes.
- If released to water, quinoline is expected to rapidly biodegrade and photolyze.
- Volatilization from surface waters is not predicted to be significant; however, it has been suggested that volatilization rates from rivers during winter, in cold climates, may be significant compared with winter biodegradation and photolysis rates.
- Hydrolysis, oxidation, bioaccumulation and adsorption onto suspended solids and sediments are not likely to take place in water.

## TOXICITY

- Quinoline is toxic; inhalation, ingestion, or skin contact with material may cause severe injury or death.
- Contact with molten substance may cause severe burns to skin and eyes.
- Fire may produce irritating, corrosive and/or toxic gases.
- Clinical signs of toxicity include lethargy, respiratory distress, & prostration leading to coma.
- Quinoline is irritating to the skin and may cause pronounced permanent corneal injury.

## OBJECTIVES AND GUIDELINES

Ambient Air Quality Guidelines

| **Jurisdiction** | **Guidelines (μg/m$^3$)** | | | | |
|---|---|---|---|---|---|
| | **0.5hr** | **1hr** | **8hr** | **24hr** | **Annual** |
| Alberta | | | | | |
| Texas | | 5 | | | 0.5 |
| Ontario | | | | | |

Adapted from:
ChemBank HSDB, IRIS, RTECS toxicity profiles.

# RADIONUCLIDES

The attendees of the 2004 Priority Setting Workshop identified radionuclides as potential substances of concern. They have requested background information to determine whether an Ambient Air Quality Objective for radionuclides should be a priority.

## WHAT ARE RADIONUCLIDES?

Radionuclides are atoms with unstable nuclei that undergo radioactive decay to stable compounds. There are 2,300 identified nuclides, most of which are radioactive. Radiation emitted from radionuclides can be of three forms: alpha (α), beta (β) and gamma (γ). Radionuclides have half-lives that vary from billions of years to less than a second and they will decay, until they become a stable compound, such as lead.

**Table 1 Commonly encountered radionuclides (adapted from U.S. EPA)**

| Chemical Species | Most Common Isotope | Radiation Emitted* | Uses for Most Common Isotope |
|---|---|---|---|
| Americium (Am) | 241 | α, γ | Household smoke detectors |
| Cesium (Cs) | 137 | β, γ | Industry |
| Cobalt (Co) | 60 | β, γ | Sterilization of surfaces |
| Iodine (I) | 1294 | β, γ | Thyroid problem diagnoses |
| Plutonium (Pu) | 238 | α, β, γ | Pacemakers |
| Radon (Rn) | 222 | α | Specific medical applications, Radon spas (Russian and Central Europe) |
| Radium (Ra) | 226 | α, γ | Radiography, lightning rods |
| Strontium (Sr) | 90 | β | Radioactive tracers, portable power supplies, medical treatments |
| Technetium (Tc) | 99 | β, γ | Medical diagnoses |
| Tritium (H) | 3 | β | Thermonuclear weapons, reactors, self-luminescent devices |
| Thorium (Th) | 232 | α, γ | Welding rods, ceramic glazes, lantern mantles |
| Uranium (U) | 238 | α, γ | Nuclear power, Army weaponry and armour |

* radiation emitted from most common isotope

## USES AND SOURCES

Natural sources of radionuclides include; radioactive material found in rocks and soils and cosmic radiation. Artificial sources include; medical devices or clinical devices (x-ray machines, ultrasound devices, pacemakers); household products (microwave ovens, cellular telephones, smoke detectors); industrial equipment (telecommunication towers, nuclear power plants) and nuclear fallout from past military experimentation. People rarely encounter most radionuclides except those that are used routinely in medical or commercial purposes.

## RADIONUCLIDE EMISSIONS

From Health Canada: "Laws governing the use of radioactive materials, radiation emitting devices and ionizing radiation exposures exist in Canada at both the federal and provincial levels, and are generally applied at the source. The principal legal instruments at the federal level are the *Atomic Energy Control Act* and *Regulations*, and the *Radiation Emitting Devices Act* and *Regulations*. The *Atomic Energy Control Act* regulates, among other things, the use of radioactive and fissionable materials or processes that could be used in a nuclear chain reaction. This *Act* is administered by the AECB, which has the lead role in the regulation of nuclear facilities and the use of nuclear materials. The *Radiation Emitting Devices Act*, administered by Health Canada, pertains to specific classes of radiation emitting devices used both occupationally (e.g. X-ray equipment, lasers, ultrasound therapy devices) and residentially (e.g. microwave ovens, television receivers). Natural radiation is not covered under either *Act*."

### Emissions

The National Pollutant Release Inventory does not include radionuclides in its substance reporting. In the United States, industrial emissions account for only 0.1% of total radiation exposure. The remainder of this value is from naturally occurring radiation, e.g., cosmic and earth-generated; as well as nuclear testing, weapons and accidents. The most prevalent radionuclide in air is radon-222.

## RADIONUCLIDE EXPOSURE AND HEALTH EFFECTS

The average doses received by members of the public in Canada from natural sources are typically about 2 mSv per year including radon, and from routine exposures from regulated practices are about 0.0001 mSv per year.

### Health Effects on Humans

The threshold for observable early effects such as nausea or temporary blood cell changes is about 250-500 mSv in a short period of time. Health effects vary depending on the radionuclide and the form of exposure. Exposure can be either external (absorbed through the skin), or internal (ingested or inhaled). Externally, gamma radiation has a higher potential for harm because it has more penetrating ability; however, all forms can be harmful internally.

Radionuclides harm the body by moving from the lungs to the bloodstream or digestive tract and finally move in to tissues. Cell problems can be caused by radiation damage to DNA, lipids and proteins. Internally, both alpha and beta radiation have been shown to cause cancer. Polonium, a product in the radon decay chain, causes significant lung damage when inhaled and can cause lung cancer. Radon is the second highest cause of lung cancer.

## OTHER JURISDICTIONS

Under normal situations, radiation protection practices are concerned primarily with control at the source. Other jurisdictions use emission standards and not ambient air quality objectives to regulate radionuclides. Each radionuclide species has very different characteristics, thus, they are managed separately.

The Clean Air Act requires the EPA to regulate airborne **emissions** of hazardous air pollutants (HAPs) (including radionuclides) from a specific list of industrial sources called "source categories". Each source category that emits radionuclides in significant quantities must meet technology requirements to control them and is required to meet specific regulatory limits. These standards are the National Emission Standards for Hazardous Air Pollutants for Radionuclides.

| **Agency** | **Radionuclide Species** | **Objective/Guideline** | **Air Quality Guideline** | |
|---|---|---|---|---|
| | | | **1-hour ($\mu g\ m^{-3}$)** | **Annual** ($\mu g\ m^{-3}$) |
| Texas | Uranium – soluble compounds | Effects Screening Level | 0.5 | 0.05 |
| | Uranium – insoluble compounds | | 2 | 0.2 |

# RADON

The attendees of the 2004 Priority Setting Workshop identified radionuclides as a potential substance of concern. As Radon 222 is the most prevalent radionuclide in air, information on this substance was gathered to address potential questions.

## WHAT IS RADON?

Radon is a colorless, odourless, radioactive gas formed by the natural breakdown of uranium in soil, rock, and water. Radon's half life is 3.8 days and when radon decays, alpha particles and several radioactive products, called radon daughters, are emitted (Figure 1).

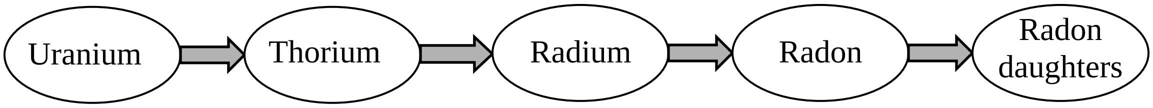

**Figure 1** **Production of radon and radon daughters from uranium from the Canadian Centre for Occupational Health and Safety**

**Table 1** **Properties of Radon**

| Property | Value |
|---|---|
| Chemical Formula | Rn |
| CAS Registry number | 10043-92-2 |
| Common Synonyms and Trade Names | Radon, Thoron (Radon 220), Actinon (Radon 219), Alphatron, Niton |
| Molecular Weight (g mol$^{-1}$) | 222 |
| Atomic Number | 86 |
| Physical State (at 298 K, approx. 25°C) | Gas |
| Melting Point (°C) | -71 |
| Boiling Point (°C) | -61.8 |
| Density (g cm$^{-3}$) at 101.3 kPa and 25°C | 9.73 |
| Solubility in Water (at 20°C) | 22.2 mL 100mL$^{-1}$ |

## USES

The chief use of radon is in the treatment of cancer by radiotherapy. In addition, radon is used to produce neutrons for research.

## SOURCES

Low levels of radon are everywhere but higher levels occur where the soil and rock are rich in uranium. Radon can also be present in tobacco smoke, which results from fertilizing the source tobacco with phosphate fertilizers that contain considerable concentrations of uranium.

The major source of indoor radon is normally the soil directly under the building. When radon enters an enclosed space, such as a home, it can sometimes accumulate to high levels. Radon typically enters homes and buildings through any place in which there are openings where the structure contacts the soil. Soil gases, including radon, enter through cracks or flaws in the construction. Sealing up cracks and repairing construction flaws will reduce the amount of radon gas to entering a home. However, it is important to ensure adequate ventilation and circulation of air in the home. Making a home airtight may actually increase the concentration of radon in a home.

## RADON EMISSIONS AND AMBIENT LEVELS

The National Pollutant Release Inventory (NPRI) does not include radionuclides, including radon, in its substance reporting.

Radon escapes from the ground into the outdoor air where it is diluted to very low concentrations of about 0.4 pCi/L or 10 Bq/m$^3$ (0.3 pCi/L). Health Canada advises that the concentration of radon gas in outdoor air is very small and does not pose a threat to human health.

Indoor radon levels typically range from about 30 to 100 Bq/m$^3$ (0.8 to 2.7 pCi/L) with an average concentration of 45 Bq/m$^3$ (1.2 pCi/L). Reducing indoor radon levels to be no more than outdoor levels is not yet technologically achievable, but most homes today can be reduced to 75 Bq/m$^3$ (2 pCi/L) or less. Health Canada recommends remedial measures be taken for any home that exceeds 200 Bq/m3 in the normal occupancy area.

## RADON EXPOSURE AND HEALTH EFFECTS

Chronic (long-term) inhalation exposure to radon in humans has been linked to respiratory effects, such as chronic lung disease, pneumonia, fibrosis of the lung, and decreased lung function. When radon gas is inhaled and breaks down in the lungs, alpha particles are emitted. Energy released by these alpha particles is absorbed by nearby lung tissue, which results in cell death or damage and can potentially result in cancer. Radon is considered to be a human carcinogen.

When exposure to radon is combined with tabacco use, there is a much greater chance of developing lung cancer. Studies carried out by the National Academy of Sciences in the United States found that radon is the second most common cause of lung cancer after cigarette smoking.

More information on Radon can be found at the Health Canada Web site (current as of June 2009):
http://www.hc-sc.gc.ca/ewh-semt/air/in/index_e.html#radon

## OTHER JURISDICTIONS

Table 3 outlines some of the **indoor air quality guidelines** and recommendations from other jurisdictions.

**Table 3 Indoor air quality recommendations and guidelines for selected jurisdictions.**

| Agency | Guideline Description | Air Quality Guideline | |
|---|---|---|---|
| | | Bq $m^{-3}$ | pCi $L^{-1}$ |
| Health Canada | Recent scientific evidence of a health-based risk associated with radon exposure at 200 Bq/m³ | 200 | 5.4 |
| EPA | The U.S. Congress has set a long-term goal that indoor radon levels do not exceed outdoor levels. This is not yet technologically feasible, however, the lowest levels that can currently be achieved indoors is 2 pCi/L. | 148 | 4 |
| International Agency for Research on Cancer | Recommended action level for dwellings | 200* to 600* | 5.4 to 16.2 |
| World Health Organization | Recommended action level for existing buildings | 400* | 11 |
| Sweden | Level for existing buildings | 400* | 11* |
| | Remodelled or renovated houses | 200* | 5.4* |
| | New houses | 70* | 1.9* |

*Approximations based on conversion of WL to Bq/$m^3$ and pCi/L, where 1 WL = 100 pCi/L

# Chemical Fact Sheets

## Selenium,  Se
## CAS No. 7782-49-2

### WHAT IS SELENIUM?

Selenium is a metal commonly found in rocks and soil. In the environment, selenium is not often found in the pure form. Much of the selenium in rocks is combined with sulfide minerals or with silver, copper, lead, and nickel minerals. Selenium and oxygen combine to form several compounds.

Industrially produced hydrogen selenide is a colorless gas with a disagreeable odor. It is probably the only selenium compound that might pose a health concern in the workplace.

### USES

The compounds of selenium have a wide variety of uses. Selenium sulfide is a bright red-yellow powder used in anti-dandruff shampoo. Selenium dioxide is an industrially produced compound that dissolves in water to form selenious acid. Selenious acid can be found in gun blueing (a solution used to clean the metal parts of a gun).

### SOURCES

Selenium is found naturally in the environment, as a metal commonly found in rocks and soil. It is also emitted to the environment as a result of the manufacture, use or disposal of its compounds.

### ENVIRONMENTAL LEVELS AND EXPOSURE

Exposure to selenium might include:
- Inhalation of air that contains selenium or its compounds.
- Ingestion of food, drinking water, or dietary supplements that contain it.

### ENVIRONMENTAL FATE AND BEHAVIOUR

- Selenium particles in the atmosphere settle to the ground as dry or wet deposition.
- Soluble selenium compounds may runoff from soils in surface water.
- Selenium can collect in aquatic animals that live in water containing high levels of it.

## TOXICITY

- Acute exposure to selenium may cause dizziness, fatigue, irritation, collection of fluid in the lungs and severe bronchitis.
- Dermal contact may cause rashes, swelling and pain.
- Over-exposure to selenium via ingestion may result in brittle hair and deformed nails. A loss of feeling and control in the arms and legs may also occur.
- The US Department of Health and Human Services (DHHS) has determined that selenium sulfide can be reasonably anticipated to be a human carcinogen.

## OBJECTIVES AND GUIDELINES

Ambient Air Quality Objectives and Guidelines

| **Jurisdiction** | **Guidelines (μg/m$^3$)** | | | | |
|---|---|---|---|---|---|
| | **0.5hr** | **1hr** | **8hr** | **24hr** | **Annual** |
| Alberta | | | | | |
| Texas | | 2 | | | 0.2 |
| Ontario | 20 | | | 10 | |

Adapted from:
Selenium ToxFAQs. Agency for Toxic Substances and Disease Registry.
http://www.atsdr.cdc.gov/toxfaq.html.

# SELENIUM

The attendees of the 2004 Priority Setting Workshop identified selenium (Se) as a potential substance of concern. They have requested background information to determine whether an Ambient Air Quality Objective for selenium should be a priority.

## WHAT IS SELENIUM?

Selenium is a natural non-metallic element that is rarely found in a pure state; it is found as impurities in ores with other elements such as sulphides, nickel and copper. Pure selenium is found in three solid states at standard temperature and pressure; the most common is a grey, hexagonal form. This grey form is elemental selenium and red monoclinic and black amorphous states are also seen at standard conditions, but are much rarer.

Properties of selenium and selenium compounds are given in Table 1.

**Table 1 Properties of selenium**

| Property | Selenium |
|---|---|
| Chemical Formula | Se |
| CAS Registry number | 7782-49-2 |
| RTECS number | VS7700000 |
| UN number | UN 2658 |
| Common Synonyms and Trade Names | Elemental selenium, selenium base, selenium dust, colloidal selenium, selenium homopolymer, selenium alloy |
| Molecular Weight (g $mol^{-1}$) | 78.96 |
| Atomic Number | 34 |
| Oxidation States | -2, 0, +4, +6 |
| Physical State (at 298 K, approx. 25°C) | Solid |
| Melting Point (°C) | 221 (red), 220.5 (grey), 180 (black) |
| Boiling Point (°C) | 685 |
| Density (g $cm^{-3}$) at 101.3 kPa and 25°C | 4.39 (red), 4.81 (grey), 4.28 (black) |
| Specific Gravity | (water = 1) 4.5 (red), 4.8 (grey), 4.3 (black) |
| Solubility in Water | Insoluble |
| Comments | Grey, metallic form is the most stable. There are six major isotopes of selenium. |

## USES

Selenium and its compounds are often used in products such as anti-dandruff shampoos, vitamin supplements, paints and certain types of glass. Selenium is an essential nutrient to humans, and may cause disease when intake is lower or higher than recommended levels.

## SOURCES

Natural weathering of rock by wind and rain results in elemental selenium entering the atmosphere. Volcanic eruptions are considered to be the largest natural contributor of selenium to the atmosphere. A portion of natural selenium is released from selenium metabolism in plants and animals. Most living organisms produce a highly volatile species of selenium, dimethylselenide, through a metabolic pathway that consumes elemental selenium.

Humans generate half as much atmospheric selenium as natural sources do. Anthropogenic sources of selenium include burning of coal and fossil fuels. Coal burning accounts for 89% of anthropogenic selenium emissions, and this is released either as fine particulates or gaseous compounds. Selenium is a by-product of the copper extraction process, which produces a residual sludge that can be further refined into elemental selenium. In addition, gaseous compounds released from sewage sludge and municipal waste make up 10 to 25% of total selenium in the atmosphere.

## SELENIUM EMMISIONS AND AMBIENT LEVELS

### Emissions

The 2007 National Pollutant Release Inventory shows no reported selenium releases in Alberta. As a whole, Canada released 17 tonnes of selenium and selenium compounds to the air in 2007.

### Ambient Air Levels

There is little information on the levels of Se in the atmosphere in Canada. In the United States, ambient levels have been found to be low, generally in nanograms per cubic meter. The background level of selenium in the air is estimated to be 10 ng $m^{-3}$. Lee *et al.* (1994) found that measurements of selenium in the United Kingdom ranged from 0.9 to 16.7 ng $m^{-3}$, with urban sites having nearly twice the amount of ambient selenium as rural sites.

## ENVIRONMENTAL EFFECTS

A search of environmental databases did not produce any information on effects to plants resulting from plant uptake of selenium from the atmosphere.

## SELENIUM EXPOSURE AND HEATH EFFECTS

### Health Effects in Humans

Humans require selenium as a micronutrient and the recommended levels are 55 µg per day. Health Canada has estimated the daily intake of selenium from the atmosphere would be $6 \times 10^{-5}$ and $2.6 \times 10^{-5}$ mg for urban and rural populations, respectively. Estimates suggest that the total daily intake of selenium from food, air, and water for Canadian adults would be in the range of 0.05 to 0.2 mg; while children would have lower intakes. More than 98 percent of Se intake would come from food.

Inhalation of selenium at concentrations in excess of 0.2 mg $m^{-3}$ (200,000 ng $m^{-3}$) can cause headaches, gastrointestinal irritability, and pulmonary edema. Ingestion or exposure to levels ten to twenty times the recommended daily intake of selenium can result in selenosis, or selenium poisoning. Selenosis symptoms can include hair loss, fingernail weakening, discoloration of teeth, and paralysis. Selenium deficiency has serious health effects such as congestive heart failure. The International Agency for Research on Cancer places selenium and its compounds into group 3 along with other chemicals that are not classifiable for carcinogenicity in humans.

### Health Effects on Animals

Many of the inhalation effects observed in laboratory animals are similar to human symptoms, including pulmonary edema, congestion, and death. Fatty tissue accumulates selenium from both inhalation and ingestion; which can lead to selenosis.

**Table 2 Heath effects on other animals from exposure to selenium and selenium compounds via inhalation**

| Effects Reported | Concentration (mg $m^{-3}$) | Exposure Period | Animal Species | Selenium Species | Reference |
|---|---|---|---|---|---|
| NOAEL[1] (cardiac, renal, body weight) | 33 | 8 days<br>4h/2d | Guinea Pigs (males) | Elemental | Hall *et al.* 1951 cited in ATSDR 2003 |
| LOAEL[2] (congestion, pneumonitis, emphysema, central atrophy, fatty metamorphosis) | | | | | |
| NOAEL (cardiac, hepatic, renal, body weight) | 33 | 8 days<br>4h/2d | Rabbits (females) | | |
| Congestion, mild pneumonia | 33 | | | | |
| NOAEL (renal, endocrine, body weight) | 33 | 8 hours | Rats (females) | | |
| LOAEL (pulmonary haemorrhage, pneumonitis, congestion, central atrophy) | | | | | |

[1] No observed adverse effect level (NOAEL)
[2] Lowest observed adverse effect level (LOAEL)

## OTHER JURISDICTIONS

Few jurisdictions have created objectives for selenium. Objectives and guidelines are varied depending on location and the prevalence of industry in a given jurisdiction (Table 3). The Occupational Safety and Health Administration sets a workplace time-weighted average, 8 hours per day and 5 days per week, maximum exposure of total selenium compounds at 200 µg $m^{-3}$.

## Table 3 Current guidelines for selenium and selenium based compounds

| Agency | Guideline Description | Selenium Species | Air Quality Guideline ($\mu g\ m^{-3}$) | | |
|---|---|---|---|---|---|
| | | | 1 hour | 24 hour | Annual |
| British Columbia | Provincial Preliminary Screening Level | Selenium | | 0.1 | |
| Ontario | Point of Impingement Guideline | Selenium | 20 (30 minutes) | | |
| | Ambient Air Quality Criteria | Selenium | | 10 | |
| Texas | Effects Screening Level | Selenium and Compounds | 2 | | 0.2 |
| Rhode Island | Acceptable Ambient Level | Selenium and Compounds (Not including hydrogen selenide or selenium sulphide) | | | 20 |

# Chemical Fact Sheets

## Silicon dioxide, $SiO_2$

| | | |
|---|---|---|
| CAS No. | 7631-86-9 | amorphous powder |
| | 14808-60-7 | quartz |
| | 14464-46-1 | crystobalite |
| | 15468-32-3 | tridymite |

### WHAT IS SILICA?

Silicon dioxide or silica is a transparent crystal, or amorphous powder, that is both odorless and tasteless. It is the most abundant mineral in the earth’s crust.

Silica occurs in nature as agate, amethyst, chalcedony, cristobalite, flint, quartz, sand and tridymite. Free silica is not combined with any other element or compound. The term "combined silica" originates from chemical analysis of naturally occurring rocks, clays & soils. Crystalline silica is the most widely occurring of all minerals.

### USES

Uses of silica include the manufacture of glass, water glass, refractories, abrasives, ceramics, and enamels; in scouring and grinding compounds; molds for castings; decolorizing and purifying oils and petroleum products. It is applied as a clarifying agent; in filtering liquids; the manufacture of heat insulators, fire brick, and fire- and acid-proof packing materials; paints; filler for paper, paints; adsorbent dynamite; in metal polishes, dentifrices; in nail polishes; and in chromatography. Silica is used as a food additive. It is also a post harvest additive to control insects in stored grain, beans, peas, & soybeans.

### SOURCES

Due to its high content in earth materials, silica is ubiquitous in the environment as a result of natural processes. It is also released to the environment as a result of industrial processes, in the form of dust produced during processes including rock cutting, drilling, crushing, grinding, mining, abrasive manufacture, pottery making, and processing of diatomaceous earth.

### ENVIRONMENTAL LEVELS AND EXPOSURE

Exposure to silica might include:

- Inhalation of ambient air.

- Inhalation of ambient air in the workplace, particularly where silica dust is produced by industrial processes.

## TOXICITY

- Silicosis is initiated by prolonged and extensive exposure to respirable free silica. Particles less than 5 µm in diameter appear to be most important.
- The US Department of Health and Human Services has determined that crystalline silica (respireable size) is a known human carcinogen.

## OBJECTIVES AND GUIDELINES

Ambient Air Quality Objectives and Guidelines

| **Jurisdiction** | **Guidelines (µg/m$^3$)** | | | | |
|---|---|---|---|---|---|
| | **0.5hr** | **1hr** | **8hr** | **24hr** | **Annual** |
| Alberta | | | | | |
| Texas – amorphous, quartz | | 10 | | | 1 |
| Texas – cristobalite, tridymite | | 0.5 | | | 0.05 |
| Ontario - Respireable, under 10 µm - quartz, cristobalite, tridymite | 15 | | | 5 | |

Adapted from:
ChemBank HSDB, IRIS, RTECS toxicity profiles.

# Chemical Fact Sheets

## Silver,  Ag

## CAS No. 7440-22-4

### WHAT IS SILVER?

Silver is a lustrous white metal, with a face-centered cubic structure.

Silver occurs naturally in the earth's crust at a concentration of 0.1 ppm, and is also present in seawater at a concentration of 0.01 ppm.  Principal ores are argentite, cerargyrite or horn silver (mixture of halides), proustite and pyrargyrite.  Silver is present in unpolluted freshwaters at concentrations up to 0.5 μg/l while sediments, soils, rocks, and minerals contain from 0.1 to 0.5 mg of silver/kg.

### USES

Uses of silver and its compounds include: photography; electrical and electronics products; sterlingware, electroplated ware, and jewelry; and brazing alloys and solders. Other uses include: as an ingredient in dental alloys; in processing foods and beverages; as a catalyst in hydrogenation and oxidation processes; in high capacity silver-zinc and silver-cadmium batteries; as a cloud seeding compound; in minted coins; and in the bearing linings of air-cooled aircraft engines.

### SOURCES

Silver occurs naturally in the earth's crust. It may be released into the air and water through natural processes such as the weathering of rocks. Some common industrial processes that lead to emissions of silver to the environment include smelting operations, cloud seeding operations, coal combustion, steel and iron production, cement manufacture, urban refuse incineration, and cigarette tobacco.

### ENVIRONMENTAL LEVELS AND EXPOSURE

Exposure to silver might include:

- Inhalation of emissions from smelting operations, cloud seeding operations, coal combustion, steel and iron production, cement manufacture, urban refuse incineration, and cigarette tobacco.
- Ingestion of trace amounts from fresh water, sea water and public drinking water supplies.
- Inhalation or dermal contact while carrying out activities such as jewelry-making, soldering, and photography.

Ambient air concentrations of silver and its compounds were not reported in 1997 or 1998 in Alberta.

## ENVIRONMENTAL FATE AND BEHAVIOUR

- In surface water, sorption and precipitation processes are effective in reducing the concentration of dissolved silver and result in higher concentrations in the bed sediments than in the overlying waters.
- Sorption by manganese dioxide and precipitation with halides are the dominant controls on the mobility of silver in seawater.
- Sorption appears to be the dominant process leading to partitioning into sediments. It appears that magnesium dioxide, ferric compounds, and clay minerals all have some degree of adsorptive affinity for silver and are involved in its deposition into sediments.
- Silver may be leached out of soil into the groundwater.
- Silver does not appear to concentrate to a significant extent in aquatic animals.

## TOXICITY

- Chronic exposure via inhalation may lead to the development of argyria, a poisoning by silver or a silver salt, which leads to a permanent ashen-grey discoloration of the skin, conjunctiva, and internal organs.
- Exposure to silver may be a cause of metal fume fever.

## OBJECTIVES AND GUIDELINES

Ambient Air Quality Objectives and Guidelines

| **Jurisdiction** | **Guidelines (μg/m$^3$)** | | | | |
|---|---|---|---|---|---|
| | **0.5hr** | **1hr** | **8hr** | **24hr** | **Annual** |
| Alberta | | | | | |
| Texas | | 0.1 | | | 0.01 |
| Ontario | 3 | | | 1 | |

Adapted from:
Silver ToxFAQs, ChemBank HSDB, IRIS, RTECS toxicity profiles.

# Chemical Fact Sheets

## Styrene, $C_8H_8$
## CAS No. 100-42-5

### WHAT IS STYRENE?

Styrene (also called vinylbenzene) is a flammable, oily liquid. It is colorless to yellowish in color and has a penetrating odor. Styrene does not occur naturally.

### USES

The largest users of styrene are chemical companies that make plastics, synthetic rubber, resins, and insulators. Acrylonitrile-butadiene-styrene plastics are used in business machines, luggage, and in construction materials. Acrylonitrile-styrene plastics are used in automotive and household goods and in packaging material. Food processing companies use small amounts of styrene as a flavoring agent in foods such as ice cream and candy.

### SOURCES

Sources of styrene include releases associated with its manufacture, cigarette smoke and automobile exhaust.

### ENVIRONMENTAL LEVELS AND EXPOSURE

Exposure to styrene may include:

- Workplace or environmental exposure following releases to air, water, land, or groundwater. This may involve inhalation of contaminated air and consumption of contaminated water or food. Absorption through the skin is less likely.
- Inhalation of cigarette smoke or automobile exhaust.

Annual Averages of Ambient Levels of Styrene in Alberta ($\mu g/m^3$)

| Station | 1999 | 2000 |
|---|---|---|
| Calgary Central | 0.2723 | 0.2727 |
| Edmonton Central | 0.3050 | 0.2521 |
| Edmonton East | 0.9104 | 0.9237 |

### ENVIRONMENTAL FATE AND BEHAVIOUR

- Most releases of styrene to the environment are to air. It can also evaporate from water and soil exposed to air.
- Styrene evaporates when exposed to air and subsequently breaks down to other chemicals.

- Styrene can contribute to smog formation when it reacts with other volatile substances in air.
- It dissolves only slightly when mixed with water.
- Microorganisms that live in water and soil can also break down styrene. Because it is a liquid that does not bind well to soil, styrene that makes its way into the ground can move through the ground and enter groundwater.
- Plants and animals are not likely to store styrene.

## TOXICITY

- Effects of styrene on human health and the environment depend on how much styrene is present and the length and frequency of exposure. Effects also depend on the health of a person or the condition of the environment when exposure occurs.
- Styrene vapor irritates the eyes, the nose, and the throat. Styrene vapor can also adversely affect the human nervous system, causing adverse eye effects. These effects are not likely to occur at levels of styrene that are normally found in the environment.
- Human health effects associated with breathing small amounts of styrene over long periods of time in the workplace include alterations in vision, hearing loss and increased reaction times. Other human health effects associated with exposure to small amounts of styrene over long periods of time are not known. Laboratory studies show that repeated oral exposure to large amounts of styrene adversely affects the blood and the liver of animals. Laboratory studies also show that repeated exposure to large amounts of styrene in air can damage the respiratory system of animals.
- The International Agency for Research on Cancer has determined that styrene is possibly carcinogenic to humans. Several studies of workers have shown that breathing styrene may cause leukemia. There is no information on the carcinogenicity of styrene in people who swallow it or get it on their skin. Studies in animals that breathed or swallowed styrene suggest that it is weakly carcinogenic.
- Styrene has moderate toxicity to aquatic life. Styrene by itself is not likely to cause environmental harm at levels normally found in the environment.

## OBJECTIVES AND GUIDELINES

Ambient Air Quality Objectives and Guidelines

| **Jurisdiction** | **Guidelines (μg/m$^3$)** | | | | |
|---|---|---|---|---|---|
| | **0.5hr** | **1hr** | **8hr** | **24hr** | **Annual** |
| Alberta | | 215 | | | |
| Texas | | 110 | | | 11 |
| Ontario | 400 | | | 400 | |

Adapted from:
Styrene OPPT Chemical Fact Sheets. United States Environmental Protection Agency.
http://www.epa.gov/docs/chemfact.

# SULPHUR HEXAFLUORIDE

The attendees of the 2004 Priority Setting Workshop identified sulphur hexafluoride ($SF_6$) as a potential substance of concern. They have requested background information to determine whether an Ambient Air Quality Objective for sulphur hexafluoride should be a priority.

## WHAT IS $SF_6$?

Sulphur hexafluoride ($SF_6$) is a colourless, odourless gas. This gas is non-flammable, non-toxic, non-corrosive, and non-reactive.

**Table 1 Properties of sulphur hexafluoride**

| **Property** | **Value** |
|---|---|
| Chemical Formula | $SF_6$ |
| CAS Registry number | 2551-62-4 |
| Common Synonyms and Trade Names | Sulfur Fluoride, Elegas |
| Molecular Weight (g $mol^{-1}$) | 146.06 |
| Physical State (at 298 K, approx 25˚C) | Gas |
| Melting Point (˚C) | -50.8 |
| Boiling Point (˚C) | -64 (Sublimes) |
| Density (g $cm^{-3}$) at 101.3 kPa and 0˚C | 1.56 |
| Specific Gravity (air = 1) | 5.1 |
| Solubility in Water (mg $L^{-1}$, 20˚C) | 40 |

## USES

Sulphur hexafluoride is used for insulation in electrical components. Since $SF_6$ has excellent electrical insulating properties, there are many high voltage applications for it. In magnesium casting, a layer of $SF_6$ provides protection against oxidation of the molten metals from the ambient air. $SF_6$ is also used in degassing molten aluminium, ultrasound of blood vessels, ventilation tracers and propulsion systems, and in the semi-conductor industry, as etching gases for plasma etching or as cleaning gases to clean the chambers after the etching process. Training shoes, tennis balls and high performance tires also have used this gas, but this use is being phased out due to its potential for climate change.

## SOURCES

- Can form spontaneously when reactive sulphur and fluorides come into contact
- Primary and secondary magnesium industries: largest source in Canada
- During its production, storage, shipping and use as an electrical insulator or a trace gas
- Leaks at circuit breakers, particularly in old equipment.

## $SF_6$ EMISSIONS AND AMBIENT LEVELS

### Emissions

In 2007, Alberta reported no $SF_6$ emissions to the National Pollutant Release Inventory (NPRI). Globally, emissions are estimated to increase at a rate of 5,800 tons per year, 4600 of which are expected from the electricity sector.

### Ambient Air Levels

Levels of $SF_6$ in the 1980's were less than 1 ppt. These values have increased to 4 ppt in the United States (USEPA, 2006). Global average of ambient $SF_6$ is around 0.0091 µg $m^{-3}$, however, levels in Canada are unknown (Health Canada, 2006). The US EPA have estimated yearly increases in ambient air are to be around 7%.

## ENVIRONMENTAL EFFECTS

- The main impact of sulphur hexafluoride on the environment is as a greenhouse gas.
- The Canadian Environmental Protection Act presents no evidence of bioaccumulation or toxicity to aquatic organisms (2006).

## $SF_6$ EXPOSURE AND HEALTH EFFECTS

- There is no apparent chemical effect of acute or prolonged exposure to $SF_6$ on humans.
- However, $SF_6$ is much heavier than air and can cause asphyxiation if inhaled due to the displacement of air.
- $SF_6$ is considered physically inert in animals but, in both animals and humans, $SF_6$ can have narcotic effects; decreasing speed and accuracy in mental tasks.

## OTHER JURISDICTIONS

$SF_6$ is a greenhouse gas which must be reported under Alberta's *Specified Gas Reporting Regulation*. Alberta currently requires reporting from any industry producing over 100,000 tonnes or more of total carbon dioxide equivalent, including sulphur hexafluoride.

**Table 2 $SF_6$ objectives and guidelines in other jurisdictions**

| Agency | Guideline Description | Air Quality Guideline (µg $m^{-3}$) | | |
|---|---|---|---|---|
| | | 1 Hour | 24 Hour | Annual |
| Ontario | Point of Impingement | 1,800,000<br>(half-hour) | | |
| | Ambient Air Quality Criteria | | 600,000 | |
| Texas | Effects Screening Level | 600 | | 60 |
| **Occupational Limits** | | | | |
| Saskatchewan | Workplace Contamination Limits | 7,480,000<br>(15 mins) | 5,970,000<br>(8 hours) | |
| OSHA | Threshold Limit Value | | | 6,000,000<br>(TWA[1]) |

[1] Time Weighted Average (TWA) over an 8-hour workday and 40 hour workweek

# Chemical Fact Sheets

## Terpene

### WHAT IS TERPENE?

Terpenes occur naturally in almost all living plants. For example, the liquid derived from orange peel contains a monoterpene called limonene. A limited number of insects manufacture and excrete or emit terpenes as insecticides or sex pheromones. Terpenes, together with many other compounds found in living plants, are considered as derivatives of isoprene and they are classified according to the number of isoprene units in their carbon skeletons.

The term terpenes applies to all compounds containing isoprene units, including saturated or partially saturated compounds, alcohols (terpenoids), aldehydes and esters.

### USES

Terpenes are used in medicines, turpentine and other solvents. Terpene derivatives are used in perfumes and as flavouring and food additive compounds. Terpene resin is used as a base in chewing gum and as a moisture barrier in foods. Terpenes are also an important raw material for making pesticides.

### SOURCES

The two most important industrial sources of terpenes are turpentine [8006-64-2] and other essential oils. Turpenes are released when wood is processed under high temperature during the steam distillation of pine woods or the cooking of wood pulp.

Naturally, terpenes are emitted from tree leaves, particularly conifers. Terpenes may also be emitted from fried chicken, chickpea seeds, orange juice essence, mangos, roasted filberts, beaufort cheese and baked potatoes.

### ENVIRONMENTAL LEVELS AND EXPOSURE

Exposure to terpenes is through:
- Inhaling air contaminated with high levels of terpenes.
- Eating fruits or other plant products that contain terpenes.

### ENVIRONMENTAL FATE AND BEHAVIOUR

- Limonene is generally resistant to biodegradation under aerobic conditions..

- Limonene and isoprene exhibit low to moderate mobility in soil. Volatilization occurs readily from soil.
- In the atmosphere, limonene and isoprene are oxidized by hydroxyl radicals, ozone and nitrate radicals.
- Limonene and isoprene may bio-concentrate in fish and aquatic organisms.

## TOXICITY

- Although many monoterpenes are classified as safe food additives, exposure of terpenes at high levels could cause adverse health effects.
- Undiluted d-limonene and α-pinene have been reported to cause moderate skin irritation in primary dermal irritation studies with rabbits. However, diluted samples of α-pinene and β-pinene were found not to produce skin irritation in human volunteers

## OBJECTIVES AND GUIDELINES

Ambient Air Quality Objectives and Guidelines

| **Jurisdiction** | **Standards (μg/m$^3$)** | | | | |
|---|---|---|---|---|---|
| | **0.5hr** | **1hr** | **8hr** | **24hr** | **Annual** |
| Alberta | | | | | |
| Texas - 68956-56-9 terpene processing by-products | | 1,120 | | | 112 |
| Ontario | | | | | |

Adapted from:
Fu, Long. *Monoterpenes in the Ambient Air: A Literature R*eview. October 1995.

# Chemical Fact Sheets

## 1,1,2,2-Tetrachloroethane, $C_2H_2Cl_4$
## CAS No. 79-34-5

### WHAT IS 1,1,2,2-TETRACHLOROETHANE?

1,1,2,2-Tetrachloroethane is a manufactured, colorless chemical that does not burn easily. It is volatile and has a sweet odor.

### USES

In the past, it was used in large amounts to produce other chemicals and as a solvent, to clean and degrease metals, and in paints and pesticides. Commercial production of 1,1,2,2-tetrachloroethane for these uses has stopped. It presently is used only as a chemical intermediate in the production of other chemicals.

### SOURCES

No releases of 1,1,2,2-Tetrachloroethane in Alberta were reported to the NPRI in 2001.

### ENVIRONMENTAL LEVELS AND EXPOSURE

- Exposure to 1,1,2,2-Tetrachloroethane might include:
- Inhaling ambient air: 1,1,2,2-tetrachloroethane can be found at low levels in both indoor and outdoor air.
- It has rarely been found in public drinking water supplies, although in a few instances it has been found in private well water that may have been used for drinking.
- It has not been reported in food or soil.
- Limited exposure could occur from breathing in vapors or touching it due to spills or accidents in the workplace.

Annual Averages of Ambient Levels of 1,1,2,2-Tetrachloroethane in Alberta ($\mu g/m^3$)

| Station | 1999 | 2000 |
|---|---|---|
| Calgary Central | 0.0435 | 0.0513 |
| Edmonton Central | 0.0359 | 0.0547 |
| Edmonton East | 0.0419 | 0.0495 |

### ENVIRONMENTAL FATE AND BEHAVIOUR

- 1,1,2,2-tetrachloroethane eventually moves into the air or ground water.
- It does not attach to soil particles when released to land.

- When released to surface water, much of it will evaporate to the air while the rest may break down in the water.
- Breakdown of the chemical is slow: it takes about 13 months for half of the chemical to breakdown in the ground water and 2 months for half of the chemical to breakdown in the air.
- 1,1,2,2-tetrachloroethane does not build up significantly in the bodies of fish or other organisms.

## TOXICITY

- Breathing high levels of 1,1,2,2-tetrachloroethane in a closed room can cause fatigue, vomiting, dizziness, and possibly unconsciousness. However, most people recover from these effects once they are in fresh air.
- Breathing, drinking, or touching 1,1,2,2-tetrachloroethane can cause liver damage, stomachaches, or dizziness if you are exposed to large amounts for a long period of time.
- The health effects from long-term (365 days or longer) exposure to low levels of 1,1,2,2-tetrachloroethane are not known. It is also not known whether 1,1,2,2-tetrachloroethane will cause reproductive effects in people.
- Animal studies have shown effects on the lungs, liver, blood, and nervous system from breathing in 1,1,2,2-tetrachloroethane. Effects on the liver, kidneys, and nervous system were seen when animals ingested the chemical.
- It is not known whether 1,1,2,2-tetrachloroethane causes cancer in people.

## OBJECTIVES AND GUIDELINES

### Ambient Air Quality Objectives and Guidelines

| **Jurisdiction** | **Guidelines ($\mu g/m^3$)** | | | | |
|---|---|---|---|---|---|
| | **0.5hr** | **1hr** | **8hr** | **24hr** | **Annual** |
| Alberta | | | | | |
| Texas | | 70 | | | 7 |
| Ontario | | | | | |

Adapted from:
1,1,2,2-Tetrachloroethane ToxFAQs. Agency for Toxic Substances and Disease Registry. http://www.atsdr.cdc.gov/toxfaq.html.

# Chemical Fact Sheets

## Tin, Sn
## CAS No. 7440-31-5

### WHAT IS TIN?

Tin is a natural element in the earth's crust. It is a soft, white, silvery metal that doesn't dissolve in water.

### USES

Tin is used to make cans, brass, bronze, pewter and soldering materials. Tin may be combined with chlorine, sulfur, or oxygen to form inorganic tin compounds used in toothpaste, perfumes, soaps, coloring agents, and dyes. Tin may also be combined with carbon to form organotin compounds used to make plastics, food packages, plastic pipes, pesticides, paints, and pest repellents.

### SOURCES

Tin metal and related inorganic and organic tin compounds can be found in the air, water, and soil near places where tin compounds are naturally present in rock, or where the compounds are mined, manufactured, or used. Tin is also released into the environment by coal and oil combustion.

### ENVIRONMENTAL LEVELS AND EXPOSURE

Exposure to tin includes:

- The ingestion of tin through the consumption of food or drink packaged in tin containers.
- Breathing air that contains tin in the workplace or near hazardous waste sites.
- Touching substances that contain high levels of tin.

### ENVIRONMENTAL FATE AND BEHAVIOUR

- The residence time of tin compounds in air, water and soil differs for each compound.
- In the atmosphere, tin, which may be present in gases, attaches to dust particles.
- Some tin compounds dissolve in water. In water, tin attaches to the soil and sediments.
- Organotins build up in fish and plants.

## TOXICITY

- Ingested or inhaled inorganic tin compounds usually have minimal toxic effects due to their short residence times in the body. However, large amounts of these tin compounds may cause stomachaches, anemia, and liver and kidney problems.
- Inhalation or ingestion of organotin compounds can cause breathing problems, eye irritation, and impaired brain and nervous system function. Unusually high exposure can cause death.
- Rats exposed to some organotin compounds exhibit decreased immunity to disease. Comparable effects have not been observed in people.
- In contrast to inorganic tin compounds, organotin compounds impair proper reproductive function of exposed rats and mice. Offspring experience high rates of birth defects.
- There is very little information on the health effects caused by touching tin compounds. Exposure of skin and eyes to both organotin and inorganic tin compounds, results in irritation of the respective organ in both human and animal tests.
- The Department of Health and Human Services, the International Agency for Research on Cancer and the Environmental Protection Agency (EPA) have not classified tin for carcinogenicity.
- There is no evidence that tin or tin compounds cause cancer in humans. Animal studies show that inorganic tin compounds do not cause cancer in rats and mice. It is unknown whether organotin compounds cause cancer in animals.

## OBJECTIVES AND GUIDELINES

Ambient Air Quality Objectives and Guidelines

| **Jurisdiction** | **Guidelines (μg/m$^3$)** | | | | |
|---|---|---|---|---|---|
| | **0.5hr** | **1hr** | **8hr** | **24hr** | **Annual** |
| Alberta | | | | | |
| Texas | | 20 | | | 2 |
| Ontario | 30 | | | 10 | |

Adapted from:
Tin ToxFAQs. Agency for Toxic Substances and Disease Registry. http://www.atsdr.cdc.gov/toxfaq.html.

# Chemical Fact Sheets

## Titanium, Ti
## CAS No. 7440-32-6

### WHAT IS TITANIUM?

Titanium is a dark gray lustrous metal. Crystal packing is hexagonal below 882.5 degrees Celsius, but cubic above 882.5 °Celsius. It is the 9th most abundant (0.63% by wt) element in earth's crust.

### USES

Titanium is used in aircraft, missiles, surgical implants, prostheses, casings for control wires in atomic reactors and in protective surface on mixers in the pulp-paper industry. Titanium is used for tubing and lining vessels used in the production of nitric acid and acetaldehyde. Titanium powder is used in pyrotechnics, vacuum engineering, surgical appliances, surgical acid for fracture fixation and medications for skin disorders. Titanium powder is also used in the manufacture of electrodes, lamp filaments, welding rods, paints and dyes. Titanium is also in various alloys. Titanium is combined with copper and iron to form titanium bronze. Titanium is added to steel to impart great tensile strength, and to aluminum to impart resistance to attack by salt solution and organic acids.

### SOURCES

Titanium sources are primarily electric furnaces

### ENVIRONMENTAL LEVELS AND EXPOSURE

Exposure to titanium might include:

- Inhaling urban air. Titanium was a contaminant of urban air at an average concentration of 0.04 $\mu g/m^3$ and maximum concentration of 1.10 $\mu g/m^3$ in 1964-1965.
- Exposure to titanium compounds, such as titanium dioxide, titanium carbide, or titanium tetrachloride. Exposure is usually in form of dust but exposure to fumes and vapors occur during handling of titanium tetrachloride. Exposure may also be due to titanium and titanium dioxide dust and fumes originating from electric furnace operations.
- Ingestion of contaminated food. Food is considered to be the principal source of titanium exposure for humans.

## TOXICITY

- Inhaled titanium tends to remain in lungs for long periods. It has been estimated that about 1/3 of inhaled titanium is retained in the lungs.
- Lack of toxicity by contact with skin & tissues has been demonstrated by its use in therapy of skin disorders and in surgical appliances.
- There is no evidence that titanium is carcinogenic in humans.
- The current extent of exposure to titanium of the general population is not thought to pose a health risk.

## OBJECTIVES AND GUIDELINES

### Ambient Air Quality Guidelines

| **Jurisdiction** | **Guidelines (μg/m$^3$)** | | | | |
|---|---|---|---|---|---|
| | **0.5hr** | **1hr** | **8hr** | **24hr** | **Annual** |
| Alberta | | | | | |
| Texas – particulate matter | | 50 | | | 5 |
| Ontario - particulate | 100 | | | 120 | |

Adapted from:
ChemBank HSDB, IRIS, RTECS toxicity profiles.

# Chemical Fact Sheets

## Toluene, $C_7H_8$
## CAS No. 108-88-3

### WHAT IS TOLUENE?

Toluene (also called methyl benzene) is a colorless, flammable liquid. It occurs naturally in petroleum crude oil.

### USES

Toluene is added directly to gasoline. Toluene is also used in the production of benzene. Companies also add toluene to aerosol spray paints, wall paints, lacquers, paint strippers, adhesives, printing ink, spot removers, cosmetics, perfumes, and antifreeze.

### SOURCES

Petroleum crude oil is the largest source of toluene. Most (up to a billion pounds each year) of this toluene is never isolated from crude oil.

### ENVIRONMENTAL LEVELS AND EXPOSURE

Exposure to toluene might include:

- Workplace or environmental exposures following releases to air, water, land, or groundwater.
- When people use gasoline and other products that contain toluene.
- When consumed with contaminated food or water.
- Absorption through the skin and respiratory tract.

Annual Averages of Ambient Levels of Toluene in Alberta ($\mu g/m^3$)

| Station | 1999 | 2000 |
|---|---|---|
| Calgary Central | 5.2156 | 5.3784 |
| Edmonton Central | 4.2031 | 5.2102 |
| Edmonton East | 3.4779 | 4.5433 |

### ENVIRONMENTAL FATE AND BEHAVIOUR

- Toluene evaporates when exposed to air.
- It dissolves only slightly when mixed with water.
- Most direct releases of toluene to the environment are to air.
- Once in air, toluene breaks down to other chemicals.

- Aquatic and soil microorganisms can break down toluene.
- Because it is a liquid that does not bind well to soil, toluene can contaminate groundwater.
- Plants and animals are not likely to store toluene.
- Toluene can contribute to the formation of photochemical smog when it reacts with other volatile organic carbon substances in the air.

## TOXICITY

- Effects of toluene on human health and the environment depend on how much toluene is present and the length and frequency of exposure. Effects also depend on the health of a person or the condition of the environment when exposure occurs.
- Breathing large amounts of toluene for short periods of time adversely affects the human nervous system, kidneys, liver, and heart. Effects range from unsteadiness and tingling in fingers and toes to unconsciousness and death. Direct, prolonged contact with toluene liquid or vapor irritates the skin and the eyes. Repeatedly breathing large amounts of toluene, such as when "sniffing" glue or paint, can cause permanent brain damage, resulting in impairment of speech, hearing, vision, muscle control, memory, and mental capacity.
- Human health effects associated with breathing or otherwise consuming smaller amounts of toluene over long periods of time are not known.
- Laboratory animal studies and, in some cases, human exposure studies show that repeated exposure to large amounts of toluene during pregnancy can adversely affect the developing fetus.
- Toluene by itself is not likely to cause environmental harm at levels normally found in the environment.
- The Department of Health and Human Services and the International Agency for Research on Cancer have not classified toluene for carcinogenic effects. Studies in workers and animals indicate that toluene does not cause cancer.

## OBJECTIVES AND GUIDELINES

Ambient Air Quality Objectives Guidelines

| **Jurisdiction** | **Guidelines (μg/m$^3$)** | | | | |
|---|---|---|---|---|---|
| | **0.5hr** | **1hr** | **8hr** | **24hr** | **Annual** |
| Alberta | | 1,880 | | 400 | |
| Texas | | 640 | | | 1,200 |
| Ontario | 2,000 | | | 2,000 | |

Adapted from:
Toluene OPPT Chemical Fact Sheets. United States Environmental Protection Agency. http://www.epa.gov/docs/chemfact.

# Chemical Fact Sheets

## 2,4-Toluene diisocyanate (TDI), $C_9H_6N_2O_2$
## CAS No. 584-84-9

### WHAT IS 2,4-TOLUENE DIISOCYANATE (TDI)?

2,4-toluene diisocyanate may be a colorless to pale yellow crystalline solid or a pale-white liquid, which turns straw-coloured upon standing.

### USES

TDI is used in polyurethane coatings in floor and wood finishes, sealers, paints, concrete sealers; aircraft and tank trucks; coated fabrics, clay-pipe seals, adhesives and nylon. It is also used in the manufacture of polyurethane foam.

### SOURCES

TDI sources are due to related industrial activities.

### ENVIRONMENTAL LEVELS AND EXPOSURE

Exposure to TDI is due to:
- Inhalation and dermal contact.

### ENVIRONMENTAL FATE AND BEHAVIOUR

- In the atmosphere, TDI reacts with hydroxyl radicals.
- TDI is removed from the atmosphere via dry deposition
- In soil, TDI reacts to form toluene diamines, which undergo a wide variety of biochemical transformations. This process occurs at a much faster rate than that at which TDI is consumed by microorganisms.

### TOXICITY

- TDI is classified as Group 2B: possibly carcinogenic to humans.
- TDI vapours are respiratory irritants and may cause asthma symptoms.
- Inhalation may result in immunological sensitization.
- Exposure to levels as low as 0.014 $mg/m^3$ (0.002 ppm) can result in chronic loss of pulmonary function.
- An acute, asthmatic type of bronchitis is not uncommon upon exposure.

# OBJECTIVES AND GUIDELINES

## Ambient Air Quality Objectives and Guidelines

| **Jurisdiction** | **Guidelines (μg/m$^3$)** | | | | |
|---|---|---|---|---|---|
| | **0.5hr** | **1hr** | **8hr** | **24hr** | **Annual** |
| Alberta | | | | | |
| Texas | | 0.4 | | | 0.04 |
| Ontario | 0.6 | | | 0.2 | |

Adapted from:
ChemBank HSDB, IRIS, RTECS toxicity profiles.

# Chemical Fact Sheets

## Total Reduced Sulphur
## CAS No.: None

There is no molecular formula for Total Reduced Sulphur.

### WHAT IS TOTAL REDUCED SULPHUR?

Total Reduced Sulphur is a general term for sulphur gases. These gases include hydrogen sulphide($H_2S$), dimethyl sulphide, dimethyl disulphide and methyl mercaptan, but exclude sulphur dioxide and sulphur trioxide. Hydrogen sulphide is a colourless flammable gas. Sulphur gases are the principle cause of the classic Kraft Pulp Mill odour.

### USES

$H_2S$ is used as an additive in natural gas. Methyl mercaptan is used as a jet fuel additive, in plastics and in pesticides.

### SOURCES

Natural gas refineries, oil fields and refineries, pulp and paper mills, food processing activities, coke ovens and tanneries are known sources of total reduced sulphur compounds. These compounds also are emitted naturally in volcanic gases and hot springs. Sulphur compounds are present in animal feces and are also released by bacterial breakdown of organic matter. Methyl mercaptan is present in some nuts and cheeses.

### ENVIRONMENTAL LEVELS AND EXPOSURE

Exposure to total reduced sulphur might include:
- Industrial exposure at natural gas refineries, oil fields and refineries, or pulp and paper mills.
- Breathing contaminated air near marshes or landfills.
- Consumption of certain nuts and cheese.

Ambient air concentrations of total reduced sulphur were not reported in 1997 and 1998 in Alberta.

### ENVIRONMENTAL FATE AND BEHAVIOUR

- Sulphur, which is an essential element for plants, is taken up through their root system.

- Methyl mercaptan is broken down by sunlight.
- When released into the air, hydrogen sulphide ($H_2S$) gas eventually forms sulfur dioxide and sulfuric acid, which are major components in acid rain
- Under atmospheric conditions, $H_2S$ is corrosive to materials.

## TOXICITY

- Inhaling large quantities $H_2S$ of may result in sudden nausea, knockdown or death
- Most people recover from non-fatal gassings with little or no long-term effects.
- Chronic exposure to low concentrations of $H_2S$ can result in eye irritation, a sore throat and cough, shortness of breath, and fluid in the lungs. Long-term, low-level exposure may result in fatigue, loss of appetite, headaches, poor memory, and dizziness
- In animals, exposure may lead to irritation of the eyes, nose and respiratory tract, and may lead to pulmonary oedema, coma, and death. Exposure may also cause interrupt intercellular respiration.
- Plants may respond to atmospheric sulphur exposure by biochemical and physiological changes, enhanced growth and yield or visible injury, decreased growth and yield.
- The Department of Health and Human Services (DHHS), the International Agency for Research on Cancer (IARC), and the EPA have not classified hydrogen sulfide or methyl mercaptan for carcinogenicity.

## OBJECTIVES AND GUIDELINES

### Ambient Air Quality Objectives and Guidelines

Alberta and Texas have elected to put in place objectives for one or more of the total reduced sulphur compounds.

| **Jurisdiction** | **Guidelines (μg/m$^3$)** | | | | |
|---|---|---|---|---|---|
| | **0.5hr** | **1hr** | **8hr** | **24hr** | **Annual** |
| Ontario - as hydrogen sulphide | | 40 | | | |

Adapted from:
Prior, Mike. Total Reduced Sulphur Science Assessment Document, Chapter 11. CEPA NAC WGAQOG. February 2000.

# Chemical Fact Sheets

## 1,1,2-Trichloroethane, $C_2H_3Cl_3$
## CAS No. 79-00-5

### WHAT IS 1,1,2-TRICHLOROETHANE?

1,1,2-Trichloroethane is a clear, colourless liquid with a pleasant sweet chloroform-like odour.

### USES

1,1,2-Trichloroethane is used in adhesives, production of Teflon tubing, in lacquer, and coating formulations. It is an intermediate in the production of vinyldiene chloride, and is a solvent for fats, oils, waxes, resins, and other products. It has applications in organic synthesis.

### SOURCES

The sources of the chemical are industrial in nature. The chemical may be formed by the breakdown of related compounds under conditions lacking air.

### ENVIRONMENTAL LEVELS AND EXPOSURE

Exposure to 1,1,2-trichloroethane might include:

- Breathing volatile emissions from landfills, breathing contaminated air during the use of the chemical as a solvent or during the manufacture of vinyldiene chloride
- Drinking contaminated water around wastewater discharge sites associated with solvent use, vinyldiene chloride production or landfills.

Annual Averages of Ambient Levels of 1,1,2-Trichloroethane in Alberta (μg/m$^3$)

| Station | 1999 | 2000 |
|---|---|---|
| Calgary Central | 0.0385 | 0.0415 |
| Edmonton Central | 0.0266 | 0.0445 |
| Edmonton East | 0.0366 | 0.0495 |

## ENVIRONMENTAL FATE AND BEHAVIOR

- 1,1,2-trichloroethane releases to water are primarily lost through evaporation
- In the atmosphere it breaks down slowly in the presence of sunlight by reaction with hydroxyl radicals. The half-life of 1,1,2-trichloroethane varies between 24-50 days in unpolluted air to a few days in polluted air.
- It is broken down by soil organisms very slowly.
- It dissolves relatively easily in water.
- It is not strongly attracted to soil surfaces, and it moves easily from soil into water.
- Bio-concentration is not a significant process.

## TOXICITY

- Dermal contact results in stinging and burning of the skin.
- In animal studies, inhalation and ingestion of the compound resulted in adverse affects on the stomach, blood, liver and kidneys and nervous system. Normal reproduction and development was also affected. Similar effects on humans are unknown.
- Ingestion of 1,1,2-trichloroethane resulted in an increase in liver cancer in mice, but not in rats.
- The International Agency for Research on Cancer (IARC) has determined that 1,1,2-trichloroethane is not classifiable as to its carcinogenicity to humans.

## OBJECTIVES AND GUIDELINES

Ambient Air Quality Objectives and Guidelines

| **Jurisdiction** | **Guidelines ($\mu g/m^3$)** | | | | |
|---|---|---|---|---|---|
| | **0.5hr** | **1hr** | **8hr** | **24hr** | **Annual** |
| Alberta | | | | | |
| Texas | | 550 | | | 55 |
| Ontario | | | | | |

Adapted from:
ChemBank HSDB, IRIS, RTECS toxicity profiles.

# Chemical Fact Sheets

## Trichloroethylene (TCE), $C_2HCl_3$
## CAS No. 79-01-6

### WHAT IS TRICHLOROETHYLENE?

Trichloroethylene is a nonflammable, colorless liquid with a somewhat sweet odor and a sweet, burning taste.

### USES

Trichloroethylene is used mainly as a solvent to remove grease from metal parts, but it is also an ingredient in adhesives, paint removers, typewriter correction fluids, and spot removers.

### SOURCES

Trichloroethylene is not thought to occur naturally in the environment. However, it is present in most underground water sources and many surface waters as a result of the manufacture, use, and disposal of the chemical.

### ENVIRONMENTAL LEVELS AND EXPOSURE

Exposure to Trichloroethylene might include:

- Breathing air in and around the home which has been contaminated with trichloroethylene vapors from shower water or household products, such as spot removers and typewriter correction fluid
- Drinking, swimming, or showering in contaminated water.
- Contact with contaminated soil near hazardous waste sites.
- Contact with the skin or breathing contaminated air while manufacturing trichloroethylene or using it at work to wash paint or grease from skin or equipment.

Annual Averages of Ambient Levels of Trichloroethylene in Alberta ($\mu g/m^3$)

| Station | 1999 | 2000 |
|---|---|---|
| Calgary Central | 0.1381 | 0.1567 |
| Edmonton Central | 0.1048 | 0.1310 |
| Edmonton East | 0.4932 | 0.3146 |

### ENVIRONMENTAL FATE AND BEHAVIOUR

- Trichloroethylene easily dissolves in water, and it remains there for a long time.

- Trichloroethylene quickly evaporates from surface water, so it is commonly found as a vapor in the air.
- Trichloroethylene evaporates less easily from the soil, where it may stick to particles and remain for a long time.
- Trichloroethylene may stick to particles in water, which will cause it to eventually settle to the bottom sediment.
- Trichloroethylene does not build up significantly in plants and animals.

## TOXICITY

- Breathing large amounts of trichloroethylene may cause impaired heart function, coma, and death. Breathing the chemical for long periods may cause nerve, lung, kidney, and liver damage.
- Breathing small amounts for short periods of time may cause headaches, lung irritation, dizziness, poor coordination, and difficulty concentrating.
- Drinking large amounts of trichloroethylene may cause nausea, liver and kidney damage, convulsions, impaired heart function, coma, or death. Drinking small amounts of trichloroethylene for long periods may cause liver and kidney damage, nervous system effects, impaired immune system function, and impaired fetal development.
- Skin contact with trichloroethylene for short periods may cause skin rashes.
- Some studies with mice and rats have suggested that high levels of trichloroethylene may cause liver or lung cancer.
- Some limited studies of people exposed over long periods to high levels of trichloroethylene in drinking water or in workplace air have found evidence of increased cancer. The International Agency for Research on Cancer (IARC) has determined that trichloroethylene is not classifiable as to human carcinogenicity.

## OBJECTIVES AND GUIDELINES

### Ambient Air Quality Objectives and Guidelines

| **Jurisdiction** | **Guidelines (μg/m$^3$)** | | | | |
|---|---|---|---|---|---|
| | **0.5hr** | **1hr** | **8hr** | **24hr** | **Annual** |
| Alberta | | | | | |
| Texas | | 540 | | | 54 |
| Ontario | 36 | | | 12 | |

Adapted from:
Trichloroethylene ToxFAQs. Agency for Toxic Substances and Disease Registry. http://www.atsdr.cdc.gov/toxfaq.html.

# 2,4,6-Trichlorophenol, $C_6H_3Cl_3O$
# CAS No. 88-06-2

## WHAT IS 2,4,6-TRICHLOROPHENOL?

2,4,6-trichlorophenol exists as solid yellow flakes or colorless needles. It has a strong, phenolic odor. It is not known to exist as a natural product.

## USES

2,4,6-Trichlorophenol is used currently in the manufacture of Prochloraz (a fungicide) and Chloranile (a bleaching agent). 2,4,6-trichlorophenol was also formerly used as a defoliant and herbicide.

## SOURCES

Significant amounts may be released to the environment as a result of the chlorination of phenol-containing wastewater or drinking water and from the bleaching process in pulp and paper mills.

## ENVIRONMENTAL LEVELS AND EXPOSURE

Exposure to 2,4,6-trichlorophenol might include:

- Skin absorption, which is thought to be the major route of exposure.
- Inhalation and dermal contact at workplaces where it is produced or used
- Ingestion of contaminated water sources.

## ENVIRONMENTAL FATE AND BEHAVIOUR

- Incineration of chlorophenol containing compounds may result in formation of polychlorinated dibenzodioxans and polychlorinated dibenzofurans.
- It is expected to exist solely in the vapour form in the atmosphere.
- In the atmosphere reactions occur with hydroxyl radicals. The half-life in the atmosphere is about 26 days.
- It sticks strongly to soils and will not move easily into groundwater.
- Volatilization from dry soil surfaces is negligible, but may occur slowly from moist soil surfaces.
- In soils, the chemical breaks down more quickly under aerobic conditions than anaerobic conditions. Half-lives vary from between 5 and 20 days.

- Dissociation occurs in water. The chemical also volatilizes slowly from surface waters. The half-life of the chemical due to volatilization varies between approximately 20 and 150 days for lakes and rivers, respectively.
- Half-lives of the compound due to microbial decomposition in water bodies varies between 3 to 70 days.
- The potential for accumulation in the bodies of organisms is high.

## TOXICITY

- Inhalation, ingestion, or skin contact with material may cause severe injury or death.
- Eye contact will cause severe irritation and lacrimation (increased production of tears).
- Effects of contact or inhalation may be delayed.
- The carcinogenicity classification of 2,4,6-trichlorophenol is B2: probable human carcinogen.
- In the United States the compound is listed as a Hazardous Air Pollutant generally known or suspected to cause serious health problems.

## OBJECTIVES AND GUIDELINES

### Ambient Air Quality Objectives and Guidelines

| **Jurisdiction** | **Standards (μg/m$^3$)** | | | | |
|---|---|---|---|---|---|
| | **0.5hr** | **1hr** | **8hr** | **24hr** | **Annual** |
| Alberta | | | | | |
| Texas | | 20 | | | 2 |
| Ontario | | | | | |

Adapted from:
ChemBank HSDB, IRIS, RTECS toxicity profiles.

# Chemical Fact Sheets

## Vanadium, V
## CAS No. 7440-62-2 (elemental V), 1314-62-1 (Vanadium pentoxide)

### WHAT IS VANADIUM?

Vanadium is a compound that occurs in nature as a white-to-gray metal, and is often found as crystals. Pure vanadium has no smell. It usually combines with other elements such as oxygen, sodium, sulfur, or chloride.

### USES

Vanadium is mostly combined with other metals to form alloys. Vanadium is mixed with iron to make important parts for aircraft engines. Vanadium in the form of vanadium oxide is a component in special kinds of steel that are used for automobile parts, springs, and ball bearings. Small amounts of vanadium are used in making rubber, plastics, ceramics and other chemicals.

### SOURCES

Vanadium and related compounds can be found in the earth's crust and in rocks, some iron ores, and crude petroleum deposits. Vanadium mainly enters the environment from natural sources and from the burning of fuel oils.

### ENVIRONMENTAL LEVELS AND EXPOSURE

Exposure to vanadium might include:
- Consumption of very low naturally-occurring levels in air, water and food.
- Inhalation of vanadium oxide released by fuel oil and coal burning activities.
- Working in industries that process or make products containing vanadium.
- Ingestion of water contaminated by landfill sites.
- Vanadium is not readily absorbed through the skin or gastrointestinal tract.

### ENVIRONMENTAL FATE AND BEHAVIOUR

- Stays in the air, water, and soil for a long time.
- Does not dissolve well in water.
- Combines with other elements and particles.
- Sticks to soil sediments.
- Low levels have been found in plants, but it is not likely to build up in the tissues of animals.

## TOXICITY

- Inhalation of high levels of vanadium result in eye and lung irritation, coughing, wheezing, chest pain, runny nose, and a sore throat. Symptoms disappear soon after inhalation of contaminated air stops. Similar effects have been observed in animal studies. Laboratory animals that inhaled small doses of vanadium over prolonged periods resulted in kidney and liver problems..
- The health effects due to ingestion are unknown. Laboratory animals fed small doses over prolonged periods developed kidney and liver problems. Animals fed large doses resulted in birth defects and death.
- No increase in tumors was noted in a long-term study of animals exposed to vanadium in their drinking water.
- The Department of Health and Human Services, the International Agency for Research on Cancer, and the US Environmental Protection Agency (EPA) have not classified vanadium as to its human carcinogenicity.

## OBJECTIVES AND GUIDELINES

Ambient Air Quality Objectives and Guidelines

| **Jurisdiction** | **Guidelines (μg/m³)** | | | | |
|---|---|---|---|---|---|
| | **0.5hr** | **1hr** | **8hr** | **24hr** | **Annual** |
| Alberta | | | | | |
| Texas – vanadium pentoxide | | 0.5 | | | 0.05 |
| Ontario | 5 | | | 2 | |

Adapted from:
Vanadium ToxFAQs. Agency for Toxic Substances and Disease Registry.
http://www.atsdr.cdc.gov/toxfaq.html.

# Chemical Fact Sheets

## Vinyl chloride, $C_2H_3Cl$

## CAS No. 75-01-4

### WHAT IS VINYL CHLORIDE?

Vinyl chloride is a colorless, flammable gas at normal temperatures with a mild, sweet odor. Vinyl chloride is also known as chloroethene, chloroethylene, and ethylene monochloride.

### USES

Vinyl chloride is a manufactured substance that is used to make polyvinyl chloride (PVC). PVC is used to make a variety of plastic products, including pipes, wire and cable coatings, and furniture upholstery.

### SOURCES

Vinyl chloride may be released due to plastic manufacturing and the breakdown of other substances, such as trichloroethane, trichloroethylene and tetrachloroethylene.

### ENVIRONMENTAL LEVELS AND EXPOSURE

Exposure to vinyl chloride might include:

- Breathing vinyl chloride that has leaked from plastics industries, hazardous waste sites, and landfills
- Breathing vinyl chloride in air or during contact with skin or eyes in the workplace
- Drinking water from contaminated wells

Annual Averages of Ambient Levels of Vinyl chloride in Alberta ($\mu g/m^3$)

| Station | 1999 | 2000 |
|---|---|---|
| Calgary Central | 0.0197 | 0.0209 |
| Edmonton Central | 0.0308 | 0.0281 |
| Edmonton East | 0.0357 | 0.0305 |

### ENVIRONMENTAL FATE AND BEHAVIOUR

- Liquid vinyl chloride evaporates easily into the air. Vinyl chloride, if it is near the surface of soil or water, can also evaporate.
- Vinyl chloride in the air can break down within a few days to other substances, some of which can be harmful.
- Small amounts of vinyl chloride can dissolve in water.

- Vinyl chloride is unlikely to build up in plants or animals.

## TOXICITY

- Inhalation of high levels may cause dizziness and sleepiness. Extremely high levels can cause death.
- Inhalation of elevated levels for long periods of time can result in structural changes in the liver.
- Occupational exposure may result in nerve damage and immune reactions. Some workers have experienced impaired blood flow and bone degeneration in the hands.
- Animal studies have shown that long-term (365 days or longer) exposure to vinyl chloride can damage the sperm and testes.
- It has not been proven that vinyl chloride causes birth defects in humans, but animal studies have shown that breathing vinyl chloride can harm fetuses and may increase miscarriage rates.
- Skin contact results in numbness, redness and blisters.
- The Department of Health and Human Services (DHHS) has determined that vinyl chloride is a known human carcinogen. Exposure results in liver cancer.

## OBJECTIVES AND GUIDELINES

Ambient Air Quality Objectives and Guidelines

| **Jurisdiction** | **Guidelines (μg/m$^3$)** | | | | |
|---|---|---|---|---|---|
| | **0.5hr** | **1hr** | **8hr** | **24hr** | **Annual** |
| Alberta | | 130 | | | |
| Texas | | 130 | | | 13 |
| Ontario | 3 | | | 1 | |

Adapted from:
Vinyl chloride ToxFAQs. Agency for Toxic Substances and Disease Registry.
http://www.atsdr.cdc.gov/toxfaq.html.

# VINYL ACETATE

The attendees of the 2004 Priority Setting Workshop identified vinyl acetate ($C_4H_6O_2$) as a potential substance of concern. They have requested background information to determine whether an Ambient Air Quality Objective for vinyl acetate should be a priority.

## WHAT IS VINYL ACETATE?

Vinyl acetate is a clear, colourless liquid with a sweet, pleasant fruity smell that is noticeable at levels of at least 0.5 ppm in the air. It is highly volatile, soluble, and is a very mobile compound. All known sources are man-made. The following table provides chemical information about vinyl acetate.

**Table 1 Properties of vinyl acetate**

| Property | Value |
|---|---|
| Chemical Formula | $CH_3COOCH=CH_2$ |
| CAS Registry number | 108-05-4 |
| RTECS number | AK0875000 |
| UN number | UN 1301 |
| Common Synonyms and Trade Names | Acetic acid ethenyl ester; acetic acid ethylene ester; acetic acid vinyl ester; 1-acetoxyethylene; ethanoic acid; ethenyl ester; ethenyl acetate; ethenyl ethanoate; vinyl A monomer; vinyl ethanoate; VA; VAC; vinyl acetate HQ; VYAC; ZESET T |
| Molecular Weight (g $mol^{-1}$) | 86.09 |
| Physical State (at 298 K, approx. 25°C) | Liquid |
| Melting Point (°C) | -93.2 |
| Boiling Point (°C) | 72.7 |
| Density (g $cm^{-3}$) at 101.3 kPa and 25°C | 0.932 |
| Specific Gravity (water = 1) | 0.934 |
| Solubility in Water | 2 g 100 $mL^{-1}$ |
| Comments | Highly volatile, mobile, very flammable and has a strong odour |

## USES AND SOURCES

Many chemical facilities generate vinyl acetate as a by-product of manufacturing processes. It may also be produced to be used raw or in polymerized form. Vinyl acetate can be polymerized to polyvinyl acetate, or can be used to form copolymers such as polyvinyl alcohols. The copolymers may be used to make oil additives, adhesives, water-based paints, chewing gum, textiles, paper coatings and inks. All of these products may emit small amounts of vinyl acetate to the indoor environment. Vinyl acetate may also migrate from plastic food wraps into the food it touches; it is US Food and Drug Administration approved.

Vinyl acetate is a very unstable, reactive monomer that has a half-life of six hours in the air. It forms radicals and quickly dissociates into acetaldehyde and acetic acid in the atmosphere. Vinyl acetate is highly mobile and is easily transferred between air and water.

## EMISSIONS AND AMBIENT LEVELS

The 2007 National Pollutant Release Inventory states that 113,070 tonnes of vinyl acetate were released into the atmosphere in Alberta. Canadian releases were 121,000 tonnes. Manufacturers and factories that utilize vinyl acetate are the largest contributor to emissions. Indoors, vinyl acetate may be released from consumer products such as vinyl coated wall panelling.

Ambient air measurements are not readily available for vinyl acetate in Canada. Ambient levels are usually taken as a part of total volatile organic compounds. In industrial areas near Houston, Texas the ambient level of vinyl acetate has been found to be 0.07 to 0.57 ppm. It was not considered to be a realistic baseline measurement as monitoring was near vinyl acetate manufacturers. Atmospheric measurements taken at a disposal site in Edison, New Jersey were at ambient levels of 0.14 ppb.

## ENVIRONMENTAL EFFECTS

There is little to no information about the effects of vinyl acetate on the environment, as transfer between soil, water and air is very efficient. The metabolites of vinyl acetate, include acetaldehyde and acetic acid.

Vinyl acetate is slightly to moderately toxic in aquatic systems (DOW, 2006). Matheson Tri-Gas, Inc. (2007) found that the lethal concentration of 50% ($LC_{50}$) for a population of fathead minnows was 14,000 µg $L^{-1}$ per 96-hour study period. However, the Canadian Environmental Protection Act has no evidence of acute aquatic toxicity at levels up to 330 mg $L^{-1}$. Algae have been shown to stop growing at concentrations of 9,500 µg $L^{-1}$ of vinyl acetate in the water over 48 hours. This chemical is unlikely to bioaccumulate due to the ease in which it breaks down.

## VINYL ACETATE EXPOSURE AND HEALTH EFFECTS

### Heath Effects on Humans

Inhaled vinyl acetate can have mild to moderate effects on the respiratory system. Blisters and irritation of the eyes and respiratory tract are the most commonly observed effects. Based on laboratory no-observed-adverse-effect level (NOAEL) values for mice and rats, the equivalent NOAEL concentration for humans is 1.4 ppm. Workers exposed to averages of 8.6 ppm over 15 years have shown no negative effects due to exposure.

Although not clinically shown to be carcinogenic in humans, vinyl acetate can cause cancer in laboratory animals. Due to the uncertainty of the cancer-causing potential of vinyl acetate, it is currently at an unknown carcinogen status. The International Agency for Research on Cancer has listed vinyl acetate as a 2B substance, possibly carcinogenic to humans, due to the carcinogenic status of acetaldehyde. Acetaldehyde is a product of biological vinyl acetate metabolism; therefore, is related to the carcinogenicity of vinyl acetate. Vinyl acetate is only likely to cause cancer under unusual routes of entry or high exposure levels.

**Table 2 Health effects on humans related to inhalation of vinyl acetate**

| Effects Reported | Air Concentration (ppm) | Exposure Period |
|---|---|---|
| Throat irritation | 4 | 2 minutes |
| Coughing, hoarseness, eye irritation | 72 | 30 minutes |
| Upper respiratory tract irritation, coughing, hoarseness | 21.6 | Chronic |
| NOAEL (Cardiovascular, respiratory, haematological, renal) | 8.6 | 15.2 years |

## Health Effects on Animals

Table 3 shows results of studies on health effects of vinyl acetate on animals, with effects ranging from mild, such as slight irritation of the eyes, to cancer and death. Vinyl acetate is a proven respiratory carcinogen in rats, but not mice. Oral ingestion of vinyl acetate causes gastrointestinal forms of cancer in both species.

**Table 3 Health effects on other animals from exposure to vinyl acetate via inhalation**

| Effects Reported | Air Concentration (ppm) | Exposure Period | Species |
|---|---|---|---|
| NOAEL (respiratory system) | 50 | 3 months<br>5d/week<br>6h/day | Mice |
| Rhinitis, metaplasia or hyperplasia of the trachea, bronchitis, bronchiolitis, bronchiostania, bronchial epithelial metaplasia | 1000 | | |
| NOAEL (respiratory system) | 200 | 3 months<br>5d/week<br>6h/day | Rats |
| LOAEL* (respiratory system) | 200 | 3 months<br>5d/week<br>6h/day | Mice |
| Nasal cavity tumours | 600 | 3 months<br>5d/week<br>6h/day | Rats |
| Death | 600 | | |
| Death | 600 | 3 months | Mice |

| | | | |
|---|---|---|---|
| | | 5d/week<br>6h/day | |
| Death ($LC_{50}$) | 5,210 | 4 hours | Guinea Pigs |
| Death ($LC_{50}$) | 2,760 | 4 hours | Rabbits |

*Lowest observed adverse effect level (LOAEL)

## OTHER JURISDICTIONS

Although vinyl acetate is listed as a hazardous substance, relatively few ambient air objectives or guidelines are in effect (Table 5), but many workplace standards have been created to protect workers in direct contact with this chemical (Table 6). Currently, the Environmental Protection Agency only requires reporting of spills of vinyl acetate of 5,000 kilograms or more.

**Table 5 Current vinyl acetate air objectives and guidelines**

| Agency | Objective/Guideline Description | Air Quality Guideline (µg $m^{-3}$) | | |
|---|---|---|---|---|
| | | 1 Hour Average | 24 Hour Average | Annual Average |
| Texas | Effects Screening Level | 150 | | 15 |
| Rhode Island | Acceptable Ambient Level | | 200 | 20 |

**Table 6 Current occupational vinyl acetate air objectives and guidelines***

| Agency | Air Quality Guideline | Description of Guideline |
|---|---|---|
| Occupational Health and Safety Administration | 4 ppm per 15 minutes | Occupational Exposure Limit |
| National Institute for Occupational Safety and Health | 4 ppm per 15 minutes | Occupational Exposure Limit |
| Federal – Australia, Belgium, Finland, France, Sweden, Switzerland, Turkey, Denmark, Mexico | 10 ppm Time-Weighted average | Occupational Exposure Limit |
| Federal – Australia, Belgium, Finland, Switzerland, Mexico | 20 ppm | Short-Term Occupational Exposure Limit |
| Mine Safety and Health Administration | 10 ppm Time-Weighted average | Workplace Standard |

*Adapted from ATSDR, 1992 and The Registry of Toxic Effects of Chemical Substances, 2006.

# Chemical Fact Sheets

## Vinylidene chloride, $C_2H_2Cl_2$
## CAS No. 75-35-4

### WHAT IS VINYLIDENE CHLORIDE?

Vinylidene chloride is an industrial chemical that is not found naturally in the environment. It is a colorless liquid with a mild, sweet smell.

### USES

Vinylidene chloride is used in flame retardant coatings for fiber and carpet backings, steel pipe coatings, adhesives and certain plastics, including flexible food wraps and packaging materials.

### SOURCES

All sources are anthropogenic.

### ENVIRONMENTAL LEVELS AND EXPOSURE

Exposure to vinylidene chloride might include:
- Occupational exposure in industries that make or use vinylidene chloride.
- Food that is wrapped in plastic wrap may contain very low levels.
- A small percentage (3%) of the drinking water supplies may contain very low levels.
- Inhalation of air near production sites or hazardous waste sites.

Averages of Ambient Levels of Vinylidene Chloride in Alberta ($\mu g/m^3$)

| Station | 1997 | 1998 |
|---|---|---|
| Calgary Central | 0.0238 | 0.0106 |
| Edmonton Central | 0.0284 | 0.0097 |
| Edmonton East | 0.0310 | 0.0063 |

### ENVIRONMENTAL FATE AND BEHAVIOUR

- Vinylidene chloride evaporates very quickly from water and soil to the air.
- In the air, it takes about 4 days for it to break down.
- Vinylidene chloride breaks down very slowly in water.
- In soil, the chemical is slowly transformed to other less harmful chemicals.
- It does not accumulate appreciably in fish or birds.

## TOXICITY

- Contact with skin and eyes causes irritation.
- Breathing high levels may cause loss of breath, fainting and impairment of the central nervous system.
- Breathing low levels over prolonged periods may damage the nervous system, liver, and lungs. Workers exposed to vinylidene chloride have reported a loss in liver function.
- Inhalation and ingestion of the compound caused liver, kidney, and lung damage in animal studies. Inhalation, but not ingestion of the compound caused greater rates of birth defects.
- The US Environmental Protection Agency has determined that vinylidene chloride is a possible human carcinogen.

## OBJECTIVES AND GUIDELINES

Ambient Air Quality Objectives and Guidelines

| **Jurisdiction** | **Guidelines (μg/m$^3$)** | | | | |
|---|---|---|---|---|---|
| | **0.5hr** | **1hr** | **8hr** | **24hr** | **Annual** |
| Alberta | | | | | |
| Texas | | 210 | | | 102 |
| Ontario | 30 | | | 10 | |

Adapted from:
Vinylidene Chloride ToxFAQs. Agency for Toxic Substances and Disease Registry.
http://www.atsdr.cdc.gov/toxfaq.html.

# Chemical Fact Sheets

## Xylene, $C_8H_{10}$
## CAS No. 1330-20-7

### WHAT IS XYLENE?

Xylene is a colorless, sweet-smelling flammable liquid.

### USES

Chemical industries produce xylene from petroleum. It's one of the top 30 chemicals produced in the United States in terms of volume. Xylene is used as a solvent and in the printing, rubber, and leather industries. It is also used as a cleaning agent, a thinner for paint, and in paints and varnishes. It is found in small amounts in airplane fuel and gasoline.

### SOURCES

Xylene occurs naturally in petroleum and coal tar and is formed during forest fires. Xylene has been found in waste sites and landfills when discarded as used solvent, varnish, paint, or paint thinners.

### ENVIRONMENTAL LEVELS AND EXPOSURE

Exposure to xylene might include:
- Inhalation of xylene contaminated air from landfill sites, workplace air, automobile exhaust and cigarette smoke.
- Absorption through the skin, resulting from contact with gasoline, paint, paint removers, varnish, shellac, and rust preventatives.
- Drinking contaminated water or breathing air near waste sites and landfills that contain xylene.

Annual Averages of Ambient Levels of o-Xylene in Alberta ($\mu g/m^3$)

| Station | 1999 | 2000 |
|---|---|---|
| Calgary Central | 1.6811 | 1.7000 |
| Edmonton Central | 1.3458 | 1.5513 |
| Edmonton East | 0.9332 | 1.1514 |

Annual Averages of Ambient Levels of m- and p-Xylene in Alberta (μg/m$^3$)

| Station | 1999 | 2000 |
|---|---|---|
| Calgary Central | 4.7939 | 4.8025 |
| Edmonton Central | 3.8522 | 4.4185 |
| Edmonton East | 2.6934 | 3.3240 |

## ENVIRONMENTAL FATE AND BEHAVIOUR

- It evaporates quickly from the soil and surface water into the air.
- In the air, it is broken down by sunlight into other less harmful chemicals.
- It is broken down by microorganisms in soil and water.
- Only a small amount of it builds up in fish, shellfish, plants, and animals living in xylene-contaminated water.

## TOXICITY

- Exposure to high levels can cause irritation of the skin, eyes, nose, and throat, headaches, lack of muscle coordination, dizziness, confusion, and changes in one's sense of balance, breathing complications, delayed reaction time, memory difficulties, stomach discomfort and changes in the liver and kidneys. Exposure to extremely high levels can result in death.
- Animal studies show that high concentrations may cause delayed growth and development and death of fetuses. Similar effects in humans are unknown.
- The International Agency for Research on Cancer (IARC) has determined that xylene is not classifiable as to its carcinogenicity in humans; human and animal studies are inconclusive.

## OBJECTIVES AND GUIDELINES

Ambient Air Quality Objectives and Guidelines

| **Jurisdiction** | **Standards (μg/m$^3$)** | | | | |
|---|---|---|---|---|---|
| | **0.5hr** | **1hr** | **8hr** | **24hr** | **Annual** |
| Alberta | | 2,300 | | 700 | |
| Texas | | 3,700 | | | 370 |
| Ontario | 3,000 - 10 min | | | | |
| Ontario | 2,200 | | | 730 | |

Xylene ToxFAQs. Agency for Toxic Substances and Disease Registry.
http://www.atsdr.cdc.gov/toxfaq.html.

# Chemical Fact Sheets

## Zinc, Zn
## CAS No. 7440-66-6

### WHAT IS ZINC?

Zinc is one of the most common elements in the earth's crust. It's found in air, soil, and water, and is present in all foods. Pure zinc is a bluish-white shiny metal.

Zinc combines with other elements to form zinc compounds. Common zinc compounds found at hazardous waste sites include zinc chloride, zinc oxide, zinc sulfate, and zinc sulfide.

### USES

Zinc has many commercial uses as coatings to prevent rust, in dry cell batteries, and mixed with other metals to make alloys like brass and bronze. A zinc and copper alloy is used to make pennies in the United States. Zinc compounds are widely used in industry to make paint, rubber, dye, wood preservatives, and ointments.

### SOURCES

Some zinc is released into the environment by natural processes, but most zinc comes from human activities, such as mining, steel production, coal burning, and burning of waste.

### ENVIRONMENTAL LEVELS AND EXPOSURE

Exposure to zinc might include:

- Ingesting small amounts present in your food and water
- Drinking contaminated water near manufacturing or waste sites
- Drinking water from zinc-coated pipes or drinking beverages stored in zinc-lined metal cans.
- Consuming dietary supplements that contain zinc
- Breathing zinc particles in the air at manufacturing sites.

### ENVIRONMENTAL FATE AND BEHAVIOUR

- Zinc attaches to soil, sediments, and dust particles in the air.
- Rain and snow remove zinc dust particles from the air.
- Zinc compounds can move into the groundwater and into lakes, streams, and rivers.
- Most of the zinc in soil stays bound to soil particles.

- Zinc can accumulate in fish.

## TOXICITY

- Zinc is an essential element in our diet. Too little zinc can cause health problems, but too much zinc is also harmful.
- The recommended dietary allowance (RDA) for zinc is 15 mg/day for men , 12 mg/day for women; 10 mg/day for children; and 5 mg/day for infants. Not enough zinc in your diet can result in a loss of appetite, a decreased sense of taste and smell, slow wound healing and skin sores, or a damaged immune system. Young men who don't get enough zinc may have poorly developed sex organs and slow growth. Lack of zinc during pregnancy may result in impaired growth of fetuses.
- Excessive intake of zinc can also be damaging to your health. Harmful health effects generally begin at levels from 10-15 times the RDA (in the 100 to 250 mg/day range). Eating large amounts of zinc, even for a short time, can cause stomach cramps, nausea, and vomiting. Consumption of large quantities over extended periods can cause anemia, pancreatic damage, and lower levels of high density lipoprotein cholesterol (the good form of cholesterol).
- Breathing large amounts of zinc (as dust or fumes) can cause a specific short-term disease called metal fume fever. This is believed to be an immune response affecting the lungs and body temperature. Long-term effects of breathing high levels of zinc are unknown.
- It is not known if high levels of zinc affect human reproduction or cause birth defects. Rats that were fed large amounts of zinc became infertile or had smaller babies.
- Irritation was observed on the skin of rabbits, guinea pigs, and mice when exposed to some zinc compounds. Skin irritation is likely to occur in people.
- The Department of Health and Human Services, the International Agency for Research on Cancer, and the Environmental Protection Agency (EPA) have not classified zinc for carcinogenicity.

## OBJECTIVES AND GUIDELINES

Ambient Air Quality Objectives and Guidelines

| **Jurisdiction** | **Guidelines ($\mu g/m^3$)** | | | | |
|---|---|---|---|---|---|
| | **0.5hr** | **1hr** | **8hr** | **24hr** | **Annual** |
| Alberta | | | | | |
| Texas – particulate matter | | 50 | | | 5 |
| Ontario | 100 | | | 120 | |

Adapted from:
Zinc ToxFAQs. Agency for Toxic Substances and Disease Registry.
http://www.atsdr.cdc.gov/toxfaq.html.

# Chemical Fact Sheets

## Zirconium, Zr
## CAS No. 7440-67-7

### WHAT IS ZIRCONIUM ?

Zirconium is a bluish-black, amorphous powder or grayish-white lustrous metal (platelets or flakes) of hexagonal lattice below 865 °C and body-centered cubic above 865 °C. Zirconium may also exist as a soft, malleable, ductile solid or gray to gold, amorphous powder.

### USES

Zirconium is used in the manufacture of cast iron, steel and rayon spinnerets. The compound is used as a polishing powder for lens and television tubes, as a pigment in plastics, as a tanning agent, as a catalyst in organic reactions and as a reflective surface agent on satellites. Zirconium is used in arc lamps, flash bulbs, superconductors, surgical appliances, non-corrosive chemical apparatus, pyrotechnics, metal-to-glass seals and special welding fluxes. Zirconium is particularly valued as a containment material in atomic reactors and acid-manufacturing plants.

### SOURCES

Sources of pure zirconium are almost exclusively due to its use in manufacturing. Zirconium occurs in combined states with other elements in fluvial deposits of igneous origin.

### ENVIRONMENTAL LEVELS AND EXPOSURE

Exposures to Zirconium might include:

- Inhaling dust & fume of zirconium during milling and other industrial processes.

### ENVIRONMENTAL FATE AND BEHAVIOUR

- Less than 1% is excreted in urine .
- Absorbed zirconium is either sequestered in the skeleton or excreted very rapidly.

### TOXICITY

- Oral toxicity is low. No evidence of industrial diseases related to exposure has been documented.

- Zirconium & its salts generally have low systemic toxicity.
- Zirconium poisoning may occur due to excessive exposure to zirconium salts.

## OBJECTIVES AND GUIDELINES

### Ambient Air Quality Objectives and Guidelines

| **Jurisdiction** | **Guidelines (μg/$m^3$)** | | | | |
|---|---|---|---|---|---|
| | **0.5hr** | **1hr** | **8hr** | **24hr** | **Annual** |
| Alberta | | | | | |
| Texas | | 50 | | | 55 |
| Ontario | | | | | |

Adapted from:
ChemBank HSDB, IRIS, RTECS toxicity profiles.