



Toluene

This fact sheet describes the Canadian Soil Quality Guidelines for toluene to protect environmental and human health. It is part of the series *Guidelines at a Glance*, which summarizes information on toxic substances and other parameters for which there are Canadian Environmental Quality Guidelines.

The National Guidelines and Standards Office of Environment Canada coordinates the development of Canadian Environmental Quality Guidelines in cooperation with the Canadian Council of Ministers of the Environment (CCME).

Where does toluene come from?

Toluene is a colourless liquid used in paints, lacquers, adhesives, inks, and cleaning materials. It is also used in the production of dyes, perfumes, plastics, pharmaceuticals, and pesticides. Toluene exists naturally in petroleum, and therefore it is found in gasoline. In Ontario, toluene is typically 6.7% of regular unleaded gasoline and 11.3% of premium unleaded gasoline. Sources of toluene to the atmosphere include petroleum and coal refining, vehicle emissions, and evaporation from solvents and thinners. Toluene is released to the soil and water from leaking underground petroleum storage tanks, landfill sites, spills during transportation, pesticide use, and discharges of industrial and municipal waste. Natural sources of toluene are forest fires, volcanic eruptions, and volatile emissions from vegetation.

Toluene is related to two other compounds, ethylbenzene and xylene, which are also found in gasoline. Together, the three compounds are often referred to as TEX.

What happens to toluene released into the environment?

Toluene can be very mobile when released into the environment. There are four main routes that toluene takes: (i) Toluene easily evaporates from soil into the atmosphere, depending on factors such as temperature and humidity. (ii) Toluene binds well to some soils, especially soils rich in organic matter. Clay minerals also bind toluene. (iii) Toluene is converted into carbon dioxide and water when soil microbes degrade it. Degradation occurs in both oxygen-rich and oxygen-poor conditions. (iv) Toluene is moderately soluble in water, so rainwater leaching through the ground can carry toluene with it into groundwater aquifers.

Toluene has only a weak attraction to fats so has low potential to accumulate in animals.

What effects can toluene have on terrestrial forms of life?

Toluene toxicity has been found in a limited number of studies of soil microbes, invertebrates, plants, and mammals. In a study of soil microbes, respiration rates decreased when microbes were first exposed to very high levels of toluene. Several days after the exposure, however, the effects disappeared. Earthworms exposed to toluene in artificial soil changed in appearance, an effect that may be related to toluene's ability to dissolve fat and damage cell membranes. Earthworms also grew more slowly when exposed to toluene, and at high levels, they died. Plants exposed to toluene in the air, water, and soil turned yellow and grew more slowly. A study of barley, carrot, and tomato seedlings found that the process of forming roots was hindered as toluene levels increased. Lettuce and radish seeds exposed to toluene in the soil were also less likely to emerge as seedlings. Toluene in the soil reduced the growth of alfalfa shoots and of early northern wheatgrass roots.

In humans, toluene decreases nerve system functions and irritates the airways with repeated exposure, but these effects disappear when exposure stops. In laboratory studies, rats lost weight when exposed to high levels of toluene in the air. Toluene exposure does not cause mutations or cancer in mice, rats, or rabbits. There are no studies of the effects of benzene on livestock, wildlife, or birds.



Guidelines at a Glance

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What levels of toluene are safe for humans and for plants and animals that live in or on Canadian soils?

The Canadian Soil Quality Guidelines (CSoQG) depend on the type of land and its use. The four land uses considered are agricultural, residential and parkland, commercial, and industrial. The guidelines also distinguish soil textures (coarse and fine) and soil depths (surface soil: ≤ 1.5 metres deep, and subsoil: > 1.5 metres deep). The guidelines are based on a number of toxicity studies that examined the effects of soil contact on plants and animals that live in or on our soils. In the case of agricultural land, the effects of soil and food ingestion are also considered. Studies on laboratory mammals are used to assess the effects of ingestion, inhalation, and dermal contact on humans.

The CSOQG to protect environmental and human health for all land uses and for both surface soils and subsoils is 0.37 milligrams of toluene per kilogram of coarse-textured soil and 0.08 milligrams of toluene per kilogram of fine-textured soil.

If the level of toluene measured in soil is less than the respective guideline, one would not expect to see adverse effects. In places where the CSOQG for toluene is exceeded, adverse effects will not necessarily occur. Whether effects will occur depends on the amount by which the guideline level is exceeded and on the plants and animals that live there. Further investigation is needed at a particular site to determine whether or not there is a negative impact.

How do levels of toluene in Canadian soils compare to the guidelines?

Very little information is available on the levels of toluene in Canadian soils. Soil samples taken from undisturbed parklands in Ontario are considered to represent the background level of toluene. This level was 0.0013 milligrams of toluene per kilogram of soil, which is within the guidelines for both coarse- and fine-textured surface soils and subsoils on all land types.

How can CSOQGs be used to make a difference?

In general, Canadian Soil Quality Guidelines can be used by Canadian federal, provincial, and territorial governments on a voluntary basis to set local guidelines and clean-up targets. CSOQGs are most commonly used in environmental assessments as benchmarks or yardsticks to which measured levels are compared. Anyone can use the guidelines to determine if the level of toluene measured in a soil sample has the potential to cause adverse environmental effects.

For more information, contact us at:

National Guidelines and Standards Office
Environment Canada
Ottawa ON K1A 0H3

T: (819) 953-1550 F: (819) 956-5602
E-mail: ceqg-rcqe@ec.gc.ca
website: www.ec.gc.ca/ceqg-rcqe/



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