

## **XYLENES**

### **Characteristics**

Xylenes are monocyclic aromatic compounds with two methyl groups attached to the benzene ring. There are three forms of xylene, which will here be treated as a group. Xylenes are clear, colourless, volatile, flammable liquids under standard conditions whose odour is described as sweet and aromatic. Xylenes are a naturally occurring minor component of all petroleum products. Also, they are formed during combustion of organic materials. Man-made xylenes are primarily produced during refining of petroleum products. The major use of xylenes is as an additive to gasoline during blending to enhance the fuel's octane rating. Xylenes are widely used in the production of paints, varnishes and other coatings, pesticide formulations, vitamins, pharmaceuticals, printing inks, dyes, adhesives, sealants, cleaning agents, degreasing agents, paint removers, for chemical extractions and as feedstocks in chemical manufacturing.

The major sectors in Alberta that release xylenes to air are the oil and gas sector (including oil sands operations, some gas plants and petroleum refineries), cement manufacturing, fabricated metal products manufacturing and aluminum product manufacturing. Depending on the facility, fugitive emissions, stack emissions and releases during storage and handling can all be large sources of xylenes to the atmosphere. Xylenes are measured in Alberta by gas chromatography and mass spectrometry of a canister-captured sample with an overall detection limit of  $0.050 \mu\text{g m}^{-3}$ . From 1993 to 2003, the Edmonton East air quality monitoring station (at 17 St. and 105 Ave.) recorded 24-hour average xylene concentrations ranging from  $0.31 \mu\text{g m}^{-3}$  to  $111.09 \mu\text{g m}^{-3}$ , with an average of  $4.62 \mu\text{g m}^{-3}$ .

### **Effects**

Xylenes are rapidly and extensively absorbed by inhalation and quickly distributed throughout the body, preferentially to fatty tissues. The available controlled-exposure human studies indicate that concentrations around  $435$  to  $870 \text{ mg m}^{-3}$  ( $100$  to  $200 \text{ ppm}$ ) are close to the threshold level for short-term reversible neurological and irritation effects (U.S. EPA, 2003; ATSDR, 1995). Such effects include: 1) irritation of the nose, throat and eyes; and 2) central nervous system (CNS) effects such as headache, nausea, dizziness, difficulty concentrating, impaired memory, slurred speech, lack of muscle coordination, fatigue, agitation, confusion, tremors, laboured breathing, impaired reaction time, alterations in equilibrium and body balance and sensitivity to noise. In animals, reported effects include: unconsciousness, immobilization, lack of muscle coordination, tremors, muscular spasms, laboured breathing, behavioural changes, hyper-reactivity to stimuli, altered brain response to visual stimuli, elevated auditory thresholds, and hearing loss. In animals, xylenes also altered brain chemistry in a way suggestive of effects on motor control, sleep and memory maintenance. Other symptoms of short-term xylene exposure in experimental animals include irritation of the respiratory tract; and lung problems such as: fluid build-up, bleeding, and inflammation. These short-term exposure effects are most pronounced at levels in excess of  $4,350 \text{ mg m}^{-3}$  ( $1,000 \text{ ppm}$ ). Tests have shown that barley exposed to toluene at  $20,000 \text{ mg m}^{-3}$  for four hours suffer damage, within 24 hours,

to 80% of leaves (Currier, 1951; Currier and Peoples, 1954). Therefore, an objective that is protective of human health should also be protective of vegetation.

Neurological effects and irritation of the eyes and respiratory tract are the most commonly reported symptoms following long-term inhalation exposure to xylenes. Persistent neurological impairment of the CNS is the most commonly reported and sensitive effect of long-term inhalation exposure for experimental animals. In long-term studies, measurable effects on several neurobehavioral endpoints begin at concentrations as low as  $435 \text{ mg m}^{-3}$  (100 ppm) and manifest themselves before other toxic endpoints. Long-term vegetation effects were not mentioned in the assessment report.

## Objectives in Other Jurisdictions

Available ambient air quality objectives are derived from a number of different sources, including various toxicological and epidemiological studies, the American Conference of Governmental Industrial Hygienists Threshold Limit Value–Time Weighted Average of  $434 \text{ mg m}^{-3}$  (100 ppm) and odour threshold values, all adjusted by the specific agency with various modifying and uncertainty factors. Reported odour thresholds for xylenes are highly variable and range from 0.3 to  $174 \text{ mg m}^{-3}$  (0.07 to 40 ppm). Agencies reviewed in the assessment report have set a variety of objectives:  $1,500 \text{ } \mu\text{g m}^{-3}$  (345 ppb) for quarter-hour,  $2,300 \text{ } \mu\text{g m}^{-3}$  (530 ppb) for half-hour, 1,900 to  $65,000 \text{ } \mu\text{g m}^{-3}$  (438 to 14,969 ppb) for 1-hour,  $10,300 \text{ } \mu\text{g m}^{-3}$  (2,372 ppb) for 8-hour, 11.8 to  $43,427 \text{ } \mu\text{g m}^{-3}$  (2.7 to 10,001 ppb) for 24-hour, and 11.8 to  $1,040 \text{ } \mu\text{g m}^{-3}$  (2.7 to 240 ppb) for annual.

## Alberta Ambient Air Quality Objectives

Alberta ambient air quality objectives are issued by Alberta Environment, under Section 14 (1), the *Environmental Protection and Enhancement Act*, 1992 (EPEA). Based upon the available information, Alberta hereby adopts:

- From Ontario, an Alberta Ambient Air Quality Objective for xylene of  $2300 \text{ } \mu\text{g m}^{-3}$  (529 ppb) as a 1-hour average concentration
- From California, an Alberta Ambient Air Quality Objective for xylene of  $700 \text{ } \mu\text{g m}^{-3}$  (161 ppb) as a 24-hour average concentration

## Reference

ATSDR (Agency for Toxic Substances and Disease Registry). 1995. Toxicological profile for xylene. URL: <http://www.atsdr.cdc.gov/toxprofiles/tp71.html>

Cantox Environmental Inc. in conjunction with RWDI West Inc., 2004: *Assessment Report on Xylenes for Developing Ambient Air Quality Objectives*. Prepared for Alberta Environment. Edmonton, Alberta, Canada. 104 pp.

Currier, H.B. 1951. Herbicidal properties of benzene and certain methyl derivatives. *Hilgardia*, 20: 383-406.

Currier, H.B. and Peoples, S.A. 1954. Phytotoxicity of hydrocarbons. *Hilgardia*, 23: 155-173.

U.S. EPA. 2003. Toxicological Review of Xylenes. (CAS No. 1330-20-7). In Support of Summary Information on the Integrated Risk Information System (IRIS). January, 2003. U.S. Environmental Protection Agency, Washington, D.C. EPA 635/R-03/001.