

Xylene – A Common Air Pollutant

Background

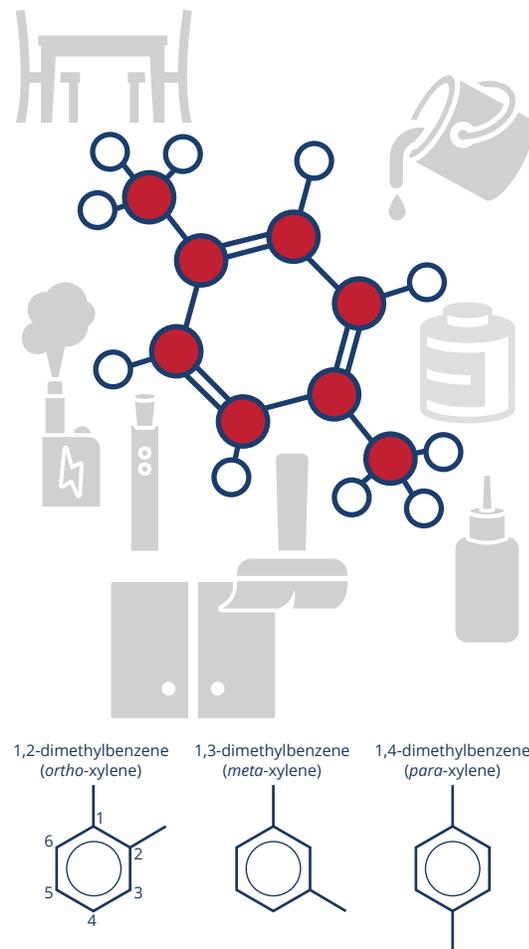
Xylene ($(\text{CH}_3)_2\text{C}_6\text{H}_4$, CAS Number 1330-20-7), also known as dimethylbenzene or xylol, encompasses a group of three distinct chemical isomers (*ortho*-xylene, *meta*-xylene, and *para*-xylene) that can be classed together generally as xylenes. They are flammable, with flash points ranging from 17°C (*ortho*-xylene) to 30°C (xylene mixture), colorless, and have a slightly sweet odor with a lower odor threshold of about 0.05 ppm (220 $\mu\text{g}/\text{m}^3$). Xylene (and its various isomers) is one of the most frequently found chemicals in newly constructed buildings and indoor environments with levels reaching greater than 300 $\mu\text{g}/\text{m}^3$ after new construction. Major sources of xylene include construction and finishing materials used with furniture and cabinetry. Xylene in the indoor air is primarily associated with adhesives, coatings, and some industrial strength cleaners. Xylenes can also be associated with combustion sources including environmental tobacco smoke (ETS) and vaping and can be released from some materials during 3D printing. Typical indoor air levels of xylene range from 10-150 $\mu\text{g}/\text{m}^3$, and other aromatic VOCs such as toluene and ethylbenzene are often present.

Health Concerns

Common indoor air health effects from exposure to xylene include headache, dizziness, nausea as well as eye, nose, throat, and lung irritation. It primarily affects the central nervous system, and chronic exposure can lead to more severe responses including depression and impaired memory. Xylene also penetrates the skin causing irritation and dryness, often resulting in greater permeability to other chemicals. There is insufficient data to link carcinogenic and reproductive effects to humans.

Acceptable Exposure Levels

There are no regulated standards for acceptable indoor levels in nonindustrial environments such as our homes, offices, and schools. Below is a list of some US and global organizations with recommended exposure limits/odor thresholds (Table 1).



1,2-dimethylbenzene
(*ortho*-xylene)



1,3-dimethylbenzene
(*meta*-xylene)



1,4-dimethylbenzene
(*para*-xylene)



Table 1: Xylene Exposure and Emission Standards

Organization or Standard	Application	Exposure Limit	Additional Information
CA 01350 Specification	Product emissions	350 $\mu\text{g}/\text{m}^3$	CDPH SM 01350 requires that emission levels for combined xylenes from building products and materials be equal to or less than 350 $\mu\text{g}/\text{m}^3$ within 14 days after installation. Certification programs like CHPS and GREENGUARD gold have adopted this requirement.
AgBB	Product emissions	500 $\mu\text{g}/\text{m}^3$	Ausschuss zur gesundheitlichen Bewertung von Bauprodukten (AgBB) sets Lowest Concentration of Interest (LCI) for VOC emissions from building products. LCI for mixture of and individual xylene is 500 $\mu\text{g}/\text{m}^3$.
California Office of Environmental Health Hazard Assessment (OEHHA)	General air/ Indoor air	700 $\mu\text{g}/\text{m}^3$	Reference exposure levels (RELs) address non-cancer health effects of volatile organic compounds (VOCs) and provide concentrations below which these health effects have been observed in studies. Mixture of and individual xylene acute REL: 22000 $\mu\text{g}/\text{m}^3$, and chronic REL: 700 $\mu\text{g}/\text{m}^3$.

Table 1 Continued: Xylene Exposure and Emission Standards

Organization or Standard	Application	Exposure Limit	Additional Information
U.S. Green Building Council Leadership in Environment and Energy Design (LEED)	Indoor air	700 µg/m ³	The LEED rating system specifies a maximum acceptable concentration of combined xylenes for the clearance testing of air levels before a building or school is occupied, which is 700 µg/m ³ .
CDC's Agency for Toxic Substances and Disease Registry (ATSDR)	General air/ Indoor air	Inhalation: 2 ppm (acute), 0.6 ppm (intermediate), 0.05 ppm or 220 µg/m ³ (chronic) Oral: 1 (acute), 0.4 (intermediate), 0.2 (chronic) mg/kg/day	The CDC's Agency for Toxic Substances and Disease Registry (ATSDR) has developed Minimal Risk Levels (MRLs) which estimate the daily level to which a substance may be exposed without the likelihood of adverse, non-cancer health effects. MRLs are derived for acute (1 - 14 days), intermediate (>14 - 364 days), and chronic (365 days and longer) exposure durations. The combined xylenes MRL is 2 ppm (8.7 mg/m ³) for acute, 0.6 ppm (2.6 mg/m ³) for intermediate, 0.05 ppm (220 µg/m ³) for chronic inhalation exposure, and 0.4 mg/kg/day for oral intermediate exposure.
National Institute of Occupational Safety and Health (NIOSH)	Occupational	100 ppm (435 mg/m ³) ST: 150 ppm	NIOSH has a recommended exposure limit (REL) of 100 ppm for combined xylenes with a short-term exposure limit (ST) of 150 ppm.
Occupational Safety and Health Administration (OSHA)	Occupational	100 ppm (435 mg/m ³)	Permissible exposure limits (PELs) are how OSHA defines the maximum concentration of chemicals to which a worker may be exposed. PELs are defined in two ways: STEL (15-minute time-weighted average not to be exceeded) or an eight-hour TWA, which is an average value of exposure over an eight-hour work shift. The OSHA TWA PEL for combined xylenes is 100 ppm based on an 8-hour day, 40-hour workweek.
California The Division of Occupational Safety and Health (Cal/OSHA)	Occupational	100 ppm (435 mg/m ³) ST: 150 ppm C: 300 ppm	Ceiling permissible exposure limit (PEL) for xylenes is 100 ppm, short term exposure limit (ST) of 150 ppm, and ceiling of 300 ppm.
American Conference of Governmental Industrial Hygienists (ACGIH)	Occupational	100 ppm (435 mg/m ³) ST: 150 ppm	Threshold Limit Values (TLV®s) are guidelines for the level of exposure that the typical worker can be exposed to without adverse health effects. They are not quantitative estimates of risk at different exposure levels or by different routes of exposure. The combined xylenes TLV-8-hr time weighted average is 100 ppm with a short-term exposure limit (ST) of 150 ppm.



References

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