



2-Butoxyethanol – A Common Air Pollutant

Background

The compound 2-butoxyethanol ($C_6H_{14}O_2$, CAS number: 111-76-2) is a glycol ether also known as ethylene glycol monobutyl ether (EGBE) and butyl cellosolve. It has a mild, fruity odor and is commonly found in the indoor air of newly constructed and furnished buildings and recently cleaned buildings. 2-Butoxyethanol can be found in hard surface cleaners including glass cleaners, paint strippers, paints and coatings for wood furniture, and dyes and inks as a resin. Over half of all commercial furniture has been found to emit 2-butoxyethanol, likely resulting from finishing varnishes and coatings. Recently cleaned and polished hard surface flooring can contribute up to $600 \mu\text{g}/\text{m}^3$ to the air. Other studies have found 2-butoxyethanol in the indoor air ranging from approximately 10 to $6000 \mu\text{g}/\text{m}^3$ and recent studies have found it in the emissions of 3D printers.



Health Concerns

2-Butoxyethanol exposure commonly occurs through inhalation and dermal transfer. It has a moderate acute toxicity and is a suspected human carcinogen (IARC Group 3).

It can cause irritation of eyes, skin, and upper respiratory tract and lead to headaches, vomiting, and slowing down of the central nervous system (CNS depression).

Large amounts of exposure can cause kidney damage. People who ingest large amounts of 2-butoxyethanol through cleaning products can display breathing problems, low blood pressure, low levels of hemoglobin, blood in their urine, and high levels of acidity in their body. Some occupations may have a higher level of exposure to 2-butoxyethanol than the general population including people who work in furniture production and finishing, housekeeping, silk-screening, and printing.



Acceptable Exposure Levels

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

TABLE 1: 2-BUTOXYETHANOL EXPOSURE AND EMISSION STANDARD

Organization or Standard	Application	Exposure Limit	Additional Information
Ausschuss zur gesundheitlichen Bewertung von Bauprodukten (AgBB)	General air/ Indoor air	LCI = 1600 $\mu\text{g}/\text{m}^3$	Ausschuss zur gesundheitlichen Bewertung von Bauprodukten (AgBB) sets Lowest Concentration of Interest (LCI) for VOC emissions from building products.
California Office of Environmental Health Hazard Assessment (OEHHA)	General air/ Indoor air	REL = 82 $\mu\text{g}/\text{m}^3$ (chronic), REL = 164 $\mu\text{g}/\text{m}^3$ (8 hr), REL = 4700 $\mu\text{g}/\text{m}^3$ (acute)	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.
CDC's Agency for Toxic Substances and Disease Registry (ATSDR)	General air/ Indoor air	MRL Inhalation: 6 ppm or 29 mg/m^3 (acute), 3 ppm or 14.5 mg/m^3 (intermediate), 0.2 ppm or 970 $\mu\text{g}/\text{m}^3$ (chronic) MRL Oral: 0.4 (acute), 0.07 (intermediate) $\text{mg}/\text{kg}/\text{day}$	The CDC's Agency for Toxic Substances and Disease Registry (ATSDR) has developed Minimal Risk Levels (MRLs) which estimates the daily level to which a person may be exposed to a substance 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 United States Environmental Protection Agency (U.S. EPA)	Inhalation and oral exposure	RfC: 1.6 mg/m^3 RfD: 0.1 $\text{mg}/\text{kg}/\text{day}$ for hemosiderin deposition in the liver	The U.S. EPA maintains the Integrated Risk Information System (IRIS), a database on information on non-cancer and cancer health effects that may result from exposure to various substances in the environment, based on toxicological reviews. IRIS has a reference concentration for inhalation exposure (RfC) and a reference dose for oral exposure (RfD). RfD is an estimate of a daily exposure to the human population that is likely to be without an appreciable risk of deleterious effects during a lifetime.
National Institute of Occupational Safety and Health (NIOSH)	Occupational	REL = 5 ppm (24.2 mg/m^3)	NIOSH recommended exposure limits (RELs) are intended to limit exposure to hazardous substances in workplace air to protect worker health.

Organization or Standard	Application	Exposure Limit	Additional Information
California The Division of Occupational Safety and Health (Cal/OSHA)	Occupational	PEL = 20 ppm (96.7 mg/m ³)	California has the most extensive list of occupational exposure limits of all states in the US reported as permissible exposure limit (PEL).
American Conference of Governmental Industrial Hygienists (ACGIH)	Occupational	TLV = 20 ppm (96.7 mg/m ³)	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.
Occupational Safety and Health Administration (OSHA)	Occupational	TWA = 50 ppm (242 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: 15-minute time-weighted average not to be exceeded (STEL) or an 8-hour total weight average (TWA), which is an average value of exposure over an eight-hour work shift.

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