TECHNICAL BRIEF

4-Phenylcyclohexene — A Common Air Pollutant

Background

The compound known as 4-phenylcyclohexene (C_{12} H_{14}, CAS Number 4994-16-5)[1], or 4-PCH, is a colorless, volatile organic compound (VOC) that is often recognized as the "new carpet odor" in indoor environments. This chemical is an unintentional byproduct of the manufacturing of styrene butadiene latex used in some carpet backings and cushioning materials and, as a result, can outgas from those products.[2] 4-PCH has a very low odor threshold and can be detected in the air at about 6.5 µg/m^3 or 1 ppb.

4-PCH emission resulted in a well-publicized case of poor indoor air quality when new carpet was installed at the Environmental Protection Agency (EPA) headquarters building in 1987. Resulting from consumer concern, the Carpet Policy Dialogue among government, industry, and third-party experts led to the voluntary establishment of a green label program by the carpet, carpet cushion, and flooring adhesive industries. This program defined acceptable criteria for certain VOCs including 4-PCH. The current 4-PCH criteria is that products must not emit more than 27 µg/m^3 following 14 days after installation.[3] There are no regulated standards for 4-PCH from common governing bodies for indoor air quality, but acceptable levels of 4-PCH are in established building and product standards **(Table 1)**.

Health Concerns

Exposure to 4-PCH in the indoor air occurs through inhalation. Its presence at low levels can lead to acute irritation with headache, as well as eye, nose, and throat discomfort. It is a reactive VOC that may react specifically with ozone to produce formaldehyde, a known human respiratory irritant and carcinogen.

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 U.S. and global organizations with recommended exposure limits. **(Table 1).**

TABLE 1: *4-PCH EXPOSURE AND EMISSION STANDARDS*

Organization or Standard	Application	Exposure Limit	Additional Information
ANSI/ASHRAE/USGBC/ IES Standard 189.1-2020. Standard for the Design of High Performing Buildings	General air/ Indoor air	2.5 µg/m^3	Defines indoor air quality (IAQ) requirements for VOCs as general guidance for building design, diagnostics, and ventilation system design.
U.S. Green Building Council Leadership in Environment and Energy Design (LEED)	Indoor air	6.5 µg/m^3	The LEED rating system specifies maximum acceptable concentrations for the clearance testing of air levels before a building or school is occupied.
Ausschuss zur gesundheitlichen Bewertung von Bauprodukten (AgBB)	General air/ Indoor air	LCI = 300 µg/m^3	Ausschuss zur gesundheitlichen Bewertung von Bauprodukten (AgBB) sets Lowest Concentration of Interest (LCI) for VOC emissions from building products.

REFERENCES:

1. 4-Phenylcyclohexene. *PubChem*. National Library of Medicine. (accessed Nov 14, 2022).
2. NIEHS. Toxicological Summary for 4-Phenylcyclohexene. 2002.
3. CRI. *Green Label Plus Emissions Criteria*; GLP Emissions Criteria 2.01; 2017.

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