

apropos

# Form- aldehyde

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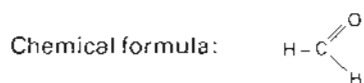
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The concept

Formaldehyde is the simplest compound from the group of aliphatic aldehydes (which in chemistry is the conventional classification of organic compounds according to their molecular structure). The name "formaldehyde" is a blend of formic acid and aldehyde. Other – less common – names for this compound are formalin, methanal, formic aldehyde and aldoforn.



A 35% aqueous solution of formaldehyde is called formalin or simply formaldehyde.

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Properties

Pure formaldehyde is a colourless, flammable gas with a strong pungent odour. It has a boiling point of  $-19^{\circ}\text{C}$ , a melting point of  $-117^{\circ}\text{C}$  and in Germany is ranked in water hazard class 3 (= "WGK 3").

Formaldehyde can form explosive mixtures with air (7–72% by volume formaldehyde). At low temperatures or in impure form formaldehyde tends to polymerise (i. e. react with itself) to form so-called paraformaldehyde, a white crystalline powder, which is also created when formalin is dried by evaporation.

Formaldehyde may be described as extremely reactive. Its many different applications can be attributed above all to the diverse possible reactions of the compound's carbonyl group ( $-\text{C}=\text{O}$ ).

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Occurrence in nature and biological significance

Scientists assume that formaldehyde played a part in chemical evolution. Whereas the simplest chemical elements are believed to have had their origin in the "big bang" some 7–20 billion years ago, the formaldehyde compound is thought to have already been present in the "primeval" atmosphere about 4 billion years ago.

Traces of natural formaldehyde can be detected wherever methane is decomposed with the help of oxygen.

Formaldehyde occurs, for example, as a quickly disintegrating intermediate:

- in swamps (marsh gas);
- in rice fields;
- in the decomposition of intestinal gases (in ruminants);
- in the decomposition of fermentation gases (e. g. septic tanks in sewerage works);
- in marine sediments;
- in the vicinity of termite nests;
- in the atmosphere;
- in incomplete combustion processes.

Formaldehyde occurs as a product of metabolism in micro-organisms and in warm-blooded animals. It is formed in the latter organisms from amino acids and compounds containing methyl groups. In most animal organisms formaldehyde is decomposed in 1 to 1½ minutes.

Fields of application and economic significance	<p>Owing to its properties as a disinfectant and high reactivity formaldehyde has a wide range of applications:</p> <ul style="list-style-type: none"> <li>○ formaldehyde resins, plastics, insulation foams;</li> <li>○ bonding agents for fibreboards and laminated wood products;</li> <li>○ disinfectant (against bacteria, fungi, spores, viruses);</li> <li>○ sterilising agent and preservative (technical, medical and hygienic);</li> <li>○ textile auxiliary (impregnation, processing, fabric care, dyeing);</li> <li>○ fertilisers;</li> <li>○ dyes;</li> <li>○ production of mirrors (silver nitrate reduction);</li> <li>○ vulcanisation mediator;</li> <li>○ photography (development);</li> <li>○ decontamination of effluents containing cyanide.</li> </ul> <p>Worldwide production of formaldehyde in 1988 totalled 10.33 million tonnes. In Germany in 1990 680,000 tonnes of the substance were produced, 74% of which was used in the manufacture of plastics and resins.</p>
Toxicity and effects	<p>Formaldehyde irritates the eyes and respiratory tract. Inhalation of concentrations in excess of 1 ppm (= parts per million = ml/m<sup>3</sup>) causes inflammation; concentrations above 10 ppm can lead to serious impairment of the respiratory system and liver metabolism. Inhalation of concentrations above 25 ppm can trigger potentially fatal toxic pulmonary oedema.</p> <p>Contact with formaldehyde in an aqueous solution can cause hardening of the skin (corium) and acid burns. Formaldehyde solution is very dangerous if swallowed: 10–20 ml of a 35% solution can be fatal. The half-life (= the time taken to break down 50% of the formaldehyde) is 3.3 hours. The LD50 (= the lethal dose for 50% of laboratory animals tested) is 800 mg/kg for rats.</p> <p>Owing to its ability to react with proteins containing the genetic code (DNA, RNA), formaldehyde can cause genetic mutations and cancer. For this reason German authorities classified formaldehyde as a Group IIIB carcinogenic substance under the MAK list (maximum allowable workplace concentration). Although mutagenic activity has been detected in mammal cell culture test systems, up to now no mutagenicity has actually been observed in test animals.</p>
Limits and analysis	<p>MAK (maximum allowable workplace concentration) values (1991):</p> <p>Germany: 0.6 mg/m<sup>3</sup> equivalent to 0.5 ml/m<sup>3</sup> (ppm)</p> <p>USA: 0.37 mg/m<sup>3</sup> equivalent to 0.3 ml/m<sup>3</sup> (ppm)</p> <p>The binding method can be used to determine the formaldehyde content of indoor air: small pumps attached to the body of a test person pump the room air through a test tube located near the subject's mouth. The presence of formaldehyde is shown by a colour reaction in the tube.</p> <p>Major sources of indoor emissions are fibreboards, laminated wood products, formaldehyde resins, insulation foam, sound-proofing material, tobacco smoke and flue gases.</p> <p>Permissible limits of 0.1 ppm for indoor air were laid down in Germany in the Fibreboard Guideline (1980) and the Hazardous Substances Ordinance (1986).</p>

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third-party liability insurance

There is always a potential for product-liability claims if traces of formaldehyde are likely to be found in a product. If legislators were to lower permissible limits for indoor emissions or maximum allowable workplace concentrations the result could be a flood of claims throughout the whole world in connection with the following products:

- o furniture and fittings (fibreboards, laminated wood);
- o plastic materials;
- o soundproofing materials;
- o dyes.

Since formaldehyde is also used for disinfection, sterilisation, preservation and as a textile auxiliary, residues of it may possibly be found in any products which have been treated or come into contact with it. If formaldehyde is also found to have allergising effects, limits may be imposed, conceivably triggering product liability claims in the future.

Formaldehyde emissions are primarily a health hazard, for example if absorbed from indoor air. But they also constitute a threat to the environment if formaldehyde enters drinking-water supplies through the subsoil. Formaldehyde has a toxic effect on both fish and the organisms they feed on. Thanks to its high reactivity, however, formaldehyde poses less of a threat as a long-term soil pollutant.

property insurance

Since it can form explosive mixtures with air, formaldehyde is an important factor for the fire insurance underwriter. However, this concerns almost exclusively the chemical industry as formaldehyde in its pure form is to be found only in chemical plants. When fighting fires involving formaldehyde, it is important to use only explosion-proof and solvent-resistant apparatus and to wear self-contained breathing equipment which makes the user independent of the ambient air.

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