

Molecular formula for methyl alcohol

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Methanol, also known as methyl alcohol, carbinol, wood alcohol, wood naphtha or wood spirits, is a chemical compound with chemical formula CH3OH (often abbreviated MeOH). It is the simplest alcohol, and is a light, volatile, colourless, flammable, poisonous liquid with a distinctive odor that is somewhat milder and sweeter than ethanol (ethyl alcohol). At room temperature it is a polar liquid and is used as an antifreeze, solvent, fuel, and as a denaturant for ethyl alcohol. It is also used for producing biodiesel via transesterification reaction. Methanol is produced naturally in the anaerobic metabolism of many varieties of bacteria. As a result, there is a small fraction of methanol vapor in the atmosphere. Over the course of several days, atmospheric methanol is oxidized by oxygen with the help of sunlight to carbon dioxide and water. Methanol burns in air forming carbon dioxide and water: 2 CH3OH + 3 O2 --> 2 CO2 + 4 H2O
A methanol flame is almost colorless, causing an additional safety hazard around open methanol flames. Uses
Because of its poisonous properties, methanol is frequently used as a denaturant additive for ethanol manufactured for industrial uses this addition of a poison economically exempts industrial ethanol from the rather significant "liquor" taxes that would otherwise be levied as it is the essence of all potable alcoholic beverages. Methanol is often called wood alcohol because it was once produced chiefly as a byproduct of the destructive distillation of wood. It is now produced synthetically by a multi-step process: natural gas and steam are reformed in a furnace to produce hydrogen and carbon monoxide; then, hydrogen and carbon monoxide gases react under pressure in the presence of a catalyst. An entire methanol economy, based on methanol as a primary energy-storage medium and fuel, has been seriously proposed. Methanol is a common laboratory solvent. It is especially useful for HPLC and UV/VIS spectroscopy due to its low UV cutoff. Feedstock
The largest use of methanol by far, is in making other chemicals. About 40% of methanol is converted to formaldehyde, and from there into products as diverse as plastics, plywood, paints, explosives, and permanent press textiles. Also in early 1970s Methanol to gasoline process was developed by Mobil, which produces gasoline ready for use in vehicles. One such industrial facility was built in New Zealand in the 1980s. In the 1990s, large amounts of methanol were used in the United States to produce the gasoline additive methyl tert-butyl ether (MTBE), though leakage has led to many states banning it. In addition to direct use as a fuel, methanol (or less commonly, ethanol) is used as a component in the transesterification of triglycerides to give a form of biodiesel. Other chemical derivatives of methanol include dimethyl ether, which has replaced chlorofluorocarbons as an aerosol spray propellant, and acetic acid. Automotive fuel
Methanol is used on a limited basis to fuel internal combustion engines, mainly by virtue of the fact that it is not nearly as flammable as gasoline. Pure methanol is required by rule to be used in Champcars, USAC sprint cars (as well as midgets, modifieds, etc.), and other dirt track series such as World of Outlaws. Methanol is also used in radio controlled model airplanes (required in the "glow-plug" engines that primarily power them), cars and trucks. Drag racers and mud racers also use methanol as their primary fuel source. Methanol is required with a supercharged engine in a Top Alcohol Dragster and, until the end of the 2005 season, all vehicles in the Indianapolis 500 had to run methanol. Mud racers have mixed methanol with gasoline and nitrous oxide to produce more power than gasoline and nitrous oxide alone. One of the drawbacks of methanol as a fuel is its corrosivity to some metals, including aluminium. When produced from wood or other organic materials, the resulting organic methanol (bioalcohol) has been suggested as renewable alternative to petroleum-based hydrocarbons. However, one cannot use pure methanol in modern petroleum cars without modification, due to potential damage to metal piping and rubber seals. Other applications
Methanol is a traditional denaturant for ethanol, thus giving the term methylated spirit.Methanol is also used as a solvent, and as an antifreeze in pipelines and windshield washer fluid.In some wastewater treatment plants, a small amount of methanol is added to wastewater to provide a food source of carbon for the denitrifying bacteria, which convert nitrates to nitrogen.During World War II, methanol was used as a fuel in several German military rocket designs, under name M-Stoff, and in a mixture as C-Stoff.Methanol is used as a denaturing agent in polyacrylamide gel electrophoresis.Direct-methanol fuel cells are unique in their low temperature, atmospheric pressure operation, allowing them to be miniaturized to an unprecedented degree. This, combined with the relatively easy and safe storage and handling of methanol may open the possibility of fuel cell-powered consumer electronics, such as for laptop computers.[1] Health and safety
Methanol is toxic by two mechanisms. Firstly, methanol (whether it enters the body by ingestion, inhalation, or absorption through the skin) can be fatal due to its CNS depressant properties in the same manner as ethanol poisoning. Secondly, it is toxic by its breakdown (toxication) by the enzyme alcohol dehydrogenase in the liver by forming formic acid and formaldehyde which cause permanent blindness by destruction of the optic nerve.[2] Fetal tissue will not tolerate methanol. Dangerous doses will build up if a person is regularly exposed to vapors or handles liquid without skin protection. If methanol has been ingested, a doctor should be contacted immediately. The usual fatal dose is 100-125 mL (4 fl oz). Toxic effects take hours to start, and effective antidotes can often prevent permanent damage. This is treated using ethanol or fomepizole.[3] Either of these drugs acts to slow down the action of alcohol dehydrogenase on methanol by means of competitive inhibition, so that it is excreted by the kidneys rather than being transformed into toxic metabolites. The initial symptoms of methanol intoxication are those of central nervous system depression: headache, dizziness, nausea, lack of coordination, confusion, drowsiness, and with sufficiently large doses, unconsciousness and death. The initial symptoms of methanol exposure are usually less severe than the symptoms resulting from the ingestion of a similar quantity of ethyl alcohol. Once the initial symptoms have passed, a second set of symptoms arises 10-30 hours after the initial exposure to methanol: blurring or complete loss of vision, together with acidosis. These symptoms result from the accumulation of toxic levels of formate in the bloodstream, and may progress to death by respiratory failure. The ester derivatives of methanol do not share this toxicity. Ethanol is sometimes denatured (adulterated), and thus made undrinkable, by the addition of methanol. The result is known as methylated spirit or "meths" (UK use). (The latter should not be confused with meth, a common abbreviation for methamphetamine.) See Also: Methane Ethanol Ethane Methanol Butane Decane Hexane Octane Propane Pentane Methanol IUPAC name methanol Other names hydroxymethanemethyl alcoholmethyl hydratewood alcoholcarbinol Identifiers CAS number 67-56-1 RTECS number PC1400000 SMILES CO Properties Molecular formula CH3OH Molar mass 32.04 g/mol Appearance colourless liquid Density 0.7918 g/cm³, liquid Melting point −97 °C (176 K) Boiling point 64.7 °C (337.8 K) Solubility in water Fully miscible Acidity (pKa) ~ 15.5 Viscosity 0.59 mPa·s at 20 °C Dipole moment 1.69 D (gas) Hazards EU classification Flammable (F)/Toxic (T) NFPA 704 R-phrases R11, R23/24/25, R39/23/24/25 S-phrases (S1/2), S7, S16, S36/37, S45 Flash point 11 °C Related Compounds Related alkanols ethanolbutanol Related compounds chloromethanemethoxymethane Except where noted otherwise, data are given for materials in their standard state(at 25 °C, 100 kPa)Infobox disclaimer and references
Methanol, also known as methyl alcohol, carbinol, wood alcohol, wood naphtha or wood spirits, is a chemical compound with chemical formula CH3OH (often abbreviated MeOH). It is the simplest alcohol, and is a light, volatile, colourless, flammable, poisonous liquid with a distinctive odor that is somewhat milder and sweeter than ethanol (ethyl alcohol). At room temperature it is a polar liquid and is used as an antifreeze, solvent, fuel, and as a denaturant for ethyl alcohol. It is also used for producing biodiesel via transesterification reaction. Methanol is produced naturally in the anaerobic metabolism of many varieties of bacteria. As a result, there is a small fraction of methanol vapor in the atmosphere. Over the course of several days, atmospheri methanol is oxidized by oxygen with the help of sunlight to carbon dioxide and water. Methanol burns in air forming carbon dioxide and water: 2 CH3OH + 3 O2 → 2 CO2 + 4 H2O
A methanol flame is almost colorless. Care should be exercised around burning methanol to avoid burning oneself on the almost invisible fire. Because of its poisonous properties, methanol is frequently used as a denaturant additive for ethanol manufactured for industrial uses— this addition of a poison economically exempts industrial ethanol from the rather significant 'liquor' taxes that would otherwise be levied as it is the essence of all potable alcoholic beverages. Methanol is often called wood alcohol because it was once produced chiefly as a byproduct of the destructive distillation of wood. It is now produced synthetically by a multi-step process. In short, natural gas and steam are reformed in a furnace to produce hydrogen and carbon monoxide; then, hydrogen and carbon monoxide gases react under pressure in the presence of a catalyst. In their embalming process, the ancient Egyptians used a mixture of substances, including methanol, which they obtained from the pyrolysis of wood. Pure methanol, however, was first isolated in 1661 by Robert Boyle, who called it spirit of box, because he produced it via the distillation of boxwood. It later became known as pyroxylic spirit. In 1834, the French chemists Jean-Baptiste Dumas and Eugène Peligot determined its elemental composition. They also introduced the word methylene to organic chemistry, forming it from Greek methy = "wine" + hylē = wood (patch of trees). Its intended origin was "alcohol made from wood (substance)," but it has Greek language errors. The term "methyl" was derived in about 1840 by back-formation from methylene, and was then applied to describe "methyl alcohol." This was shortened to "methanol" in 1892 by the International Conference on Chemical Nomenclature. The suffix -yl used in organic chemistry to form names of radicals, was extracted from the word "methyl." In 1923, the German chemist Matthias Pier, working for BASF developed a means to convert synthesis gas (a mixture of carbon oxides and hydrogen) into methanol. This process used a zinc chromate catalyst, and required extremely vigorous conditions—pressures ranging from 30–100 MPa (300–1000 atm), and temperatures of about 400 °C. Modern methanol production has been made more efficient through use of catalysts (commonly copper) capable of operating at lower pressures. The use of methanol as a motor fuel received attention during the oil crises of the 1970s due to its availability and low cost. Problems occurred early in the development of gasoline-methanol blends. As a result of its low price, some gasoline marketers over-blended. Others used improper blending and handling techniques. In 2006 astronomers using the MERLIN array of radio telescopes at Jodrell Bank Observatory discovered a large cloud of methanol in space, 300 billion miles across. Today, synthesis gas is most commonly produced from the methane component in natural gas rather than from coal. Three processes are commercially practiced. At moderate pressures of 1 to 2 MPa (10–20 atm) and high temperatures (around 850 °C), methane reacts with steam on a nickel catalyst to produce syngas according to the chemical equation: CH4 + H2O → CO + 3 H2 This reaction, commonly called steam-methane reforming or SMR, is endothermic and the heat transfer limitations place limits on the size of the catalytic reactors used. Methane can also undergo partial oxidation with molecular oxygen to produce syngas, as the following equation shows: 2 CH4 + O2 → 2 CO + 4 H2 this reaction is exothermic and the heat given off can be used in-situ to drive the steam-methane reforming reaction. When the two processes are combined, it is referred to as autothermal reforming. The ratio of CO and H2 can be adjusted by using the water-gas shift reaction, CO + H2O → CO2 + H2, to provide the appropriate stoichiometry for methanol synthesis. The carbon monoxide and hydrogen then react on a second catalyst to produce methanol. Today, the most widely used catalyst is a mixture of copper, zinc oxide, and alumina first used by ICI in 1966. At 5–10 MPa (50–100 atm) and 250 °C, it can catalyze the production of methanol from carbon monoxide and hydrogen with high selectivity CO + 2 H2 → CH3OH It is worth noting that the production of synthesis gas from methane produces 3 moles of hydrogen for every mole of carbon monoxide, while the methanol synthesis consumes only 2 moles of hydrogen for every mole of carbon monoxide. One way of dealing with the excess hydrogen is to inject carbon dioxide into the methanol synthesis reactor, where it, too, reacts to form methanol according to the chemical equation CO2 + 3 H2 → CH3OH + H2O Although natural gas is the most economical and widely used feedstock for methanol production, other feedstocks can be used. Where natural gas is unavailable, light petroleum products can be used in its place. The South African firm Sasol produces methanol using synthesis gas from coal. Methanol is a common laboratory solvent. It is especially useful for HPLC and UV/VIS spectroscopy due to its low UV cutoff. Feedstock
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