

Acetone

Acetone, or **propanone**, is an organic compound with the formula $(\text{CH}_3)_2\text{CO}$.^[15] It is the simplest and smallest ketone. It is a colourless, highly volatile and flammable liquid with a characteristic pungent odour.

Acetone is miscible with water and serves as an important organic solvent in its own right, in industry, home, and laboratory. About 6.7 million tonnes were produced worldwide in 2010, mainly for use as a solvent and production of methyl methacrylate and bisphenol A.^{[16][17]} It is a common building block in organic chemistry. Familiar household uses of acetone are as the active ingredient in nail polish remover and as paint thinner. While it has volatile organic compound (VOC) exempt status in the United States,^[18] it is considered by the EU as a contributor to environmental pollution.

Acetone is produced and disposed of in the human body through normal metabolic processes. It is normally present in blood and urine. People with diabetic ketoacidosis produce it in larger amounts. Reproductive toxicity tests show that it has low potential to cause reproductive problems. Ketogenic diets that increase ketone bodies (acetone, β -hydroxybutyric acid and acetoacetic acid) in the blood are used to counter epileptic attacks in infants and children who suffer from refractory epilepsy.^[19]

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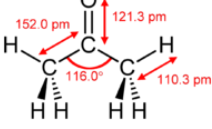
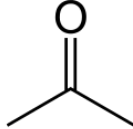
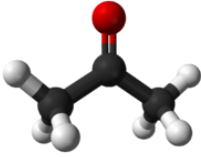
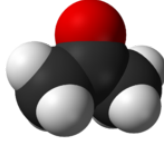


Acetone was first produced by Andreas Libavius in 1606 by distillation of Lead(II) acetate.^[20] ^[21]

In 1832, French chemist Jean-Baptiste Dumas and German chemist Justus von Liebig determined the empirical formula for acetone.^{[22][23]} In 1833, the French chemist Antoine Bussy named acetone by adding the suffix *-one* to the stem of the corresponding acid (viz, acetic acid).^[24] By 1852, English chemist Alexander William Williamson realized that acetone was methyl acetyl;^[25] the following year, the French chemist Charles Frédéric Gerhardt concurred.^[26] In 1865, the German chemist August Kekulé published the modern structural formula for acetone.^{[27][28]} Johann Josef Loschmidt had presented the structure of acetone in 1861,^[29] but his privately published booklet received little attention. During World War I, Chaim Weizmann developed the process for industrial production of acetone (Weizmann Process).^[30]

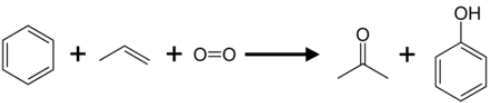
Production

In 2010, the worldwide production capacity for acetone was estimated at 6.7 million tonnes per year.^[31] With 1.56 million tonnes per year, the United States had the highest production capacity,^[32] followed by Taiwan and mainland China. The largest producer of acetone is INEOS Phenol, owning 17% of the world's capacity, with also significant capacity (7–8%) by Mitsui, Sunoco and Shell in 2010.^[31] INEOS Phenol also owns the world's largest production site (420,000 tonnes/annum) in Beveren (Belgium). Spot price of acetone in summer 2011 was 1100–1250 USD/tonne in the United States.^[33]

Current method

<div>Acetone^[1]</div>	
	
	
	
Names	
IUPAC name	
Acetone ^[6]	
Preferred IUPAC name	
Propan-2-one ^[7]	
Other names	
Acetone	
Dimethyl ketone ^[2]	
Dimethyl carbonyl	
β-Ketopropane ^[2]	
Propanone ^[3]	
2-Propanone ^[2]	
Pyroacetic spirit (archaic) ^[4]	
Ketone propane ^[5]	
Identifiers	
CAS Number	67-64-1 (https://commonchemistry.cas.org/detail?cas_rn=67-64-1) ✓
3D model (JSmol)	Interactive image (https://chemapps.stolaf.edu/jmol/jmol.php?model=CC(=O)C)
3DMet	B00058 (http://www.3dmet.dna.affrc.go.jp/cgi/show_data.php?acc=B00058)
Beilstein Reference	635680
ChEBI	CHEBI:15347 (https://www.ebi.ac.uk/chebi/searchId.do?chebiId=15347) ✓
ChEMBL	ChEMBL14253 (https://www.ebi.ac.uk/chembl/index.php/compound/inspect/ChEMBL14253) ✓
ChemSpider	175 (http://www.chemspider.com/Chemical-Structure.175.html) ✓
ECHA InfoCard	100.000.602 (https://echa.europa.eu/substance-information/-/substanceinfo/100.000.602) 
EC Number	200-662-2
Gmelin Reference	1466
KEGG	D02311 (https://www.kegg.jp/entry/D02311) ✓
MeSH	Acetone (https://www.nlm.nih.gov/cgi/mesh/2014/MB_cg)

Acetone is produced directly or indirectly from propylene. Approximately 83% of acetone is produced via the cumene process;^[17] as a result, acetone production is tied to phenol production. In the cumene process, benzene is alkylated with propylene to produce cumene, which is oxidized by air to produce phenol and acetone:



Other processes involve the direct oxidation of propylene (Wacker-Hoechst process), or the hydration of propylene to give 2-propanol, which is oxidized (dehydrogenated) to acetone.^[17]

Older methods

Previously, acetone was produced by the dry distillation of acetates, for example calcium acetate in ketonic decarboxylation.

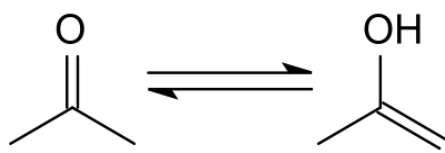
Ca(CH3COO)2 → CaO_(s) + CO2_(g) + (CH3)2CO (v)

After that time, during World War I, acetone was produced using acetone-butanol-ethanol fermentation with *Clostridium acetobutylicum* bacteria, which was developed by Chaim Weizmann (later the first president of Israel) in order to help the British war effort,^[17] in the preparation of Cordite.^[34] This acetone-butanol-ethanol fermentation was eventually abandoned when newer methods with better yields were found.^[17]

Chemical properties

Keto/enol tautomerism

Like most ketones, acetone exhibits the keto–enol tautomerism in which the nominal keto structure (CH₃)₂C=O of acetone itself is in equilibrium with the enol isomer (CH₃)C(OH)=(CH₂) (**prop-1-en-2-ol**). In acetone vapor at ambient temperature, only 2.4 × 10^{−7}% of the molecules are in the enol form.^[35] Yet the enol form is chemically important in some chemical reactions.



Aldol condensation

In the presence of suitable catalysts, two acetone molecules also combine to form the compound diacetone alcohol (CH₃)C=O(CH₂)C(OH)(CH₃)₂, which on dehydration gives mesityl oxide (CH₃)C=O(CH)=C(CH₃)₂. This product can further combine with another acetone molecule, with loss of another molecule of water, yielding phorone and other compounds.

Polymerisation

One might expect acetone to also form polymers and (possibly cyclic) oligomers of two types. In one type, units could be acetone molecules linked by ether bridges –O– derived by from the opening of the double bond, to give a polyketal-like (PKA) chain [–O–C(CH₃)₂–]_{*n*}. The other type could be obtained through repeated aldol condensation, with one molecule of water removed at each step, yielding a poly(methylacetylene) (PMA) chain [–CH=C(CH₃)–]_{*n*}.^[36]

PKA type

The conversion of acetone to a polyketal (PKA) would be analogous to the formation of paraformaldehyde from formol, and of trithioacetone from thioacetone. In 1960, Kargin, Kabanov and others observed that the thermodynamics of this process is unfavourable for liquid acetone, so that it (unlike thioacetone and formol) is not expected to polymerise spontaneously, even with catalysts. However, they observed that the thermodynamics became favourable for crystalline solid acetone at the melting point (−96 °C). They claimed to have obtained such a polymer (a white elastic solid, soluble in acetone, stable for several hours at room temperature) by depositing vapor of acetone, with some magnesium as a catalyst, onto a very cold surface.^[37]

In 1962, Wasaburo Kawai reported the synthesis of a similar product, from liquid acetone cooled to −70 to −78 °C, using n-butyl lithium or triethylaluminium as catalysts. He claimed that the infrared absorption spectrum showed the presence of –O– linkages but no C=O groups.^[38] However, conflicting results were obtained later by other investigators.^[36]

PMA type

The PMA type polymers of acetone would be equivalent to the product of polymerisation of propyne, except for a keto end group.^[36]

Biochemistry

Biosynthesis

Small amounts of acetone are produced in the body by the decarboxylation of ketone bodies. Certain dietary patterns, including prolonged fasting and high-fat low-carbohydrate dieting, can produce ketosis, in which acetone is formed in body tissue. Certain health conditions, such as alcoholism and diabetes, can produce ketoacidosis, uncontrollable ketosis that leads to a sharp, and potentially fatal, increase in the acidity of the blood. Since it is a byproduct of fermentation, acetone is a byproduct of the distillery industry.

Acetone can be produced from the oxidation of ingested isopropanol, or from the spontaneous/enzymatic breakdown of acetoacetate (a ketone body) in ketotic individuals.

Metabolism

Although some biochemistry textbooks and current research publications^[39] indicate that acetone cannot be metabolized, there is evidence to the contrary. It can then be metabolized either by CYP2E1 via methylglyoxal to D-lactate and pyruvate, and ultimately glucose/energy, or by a different pathway via propylene glycol to pyruvate, lactate, acetate (usable for energy) and

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PubChem CID	180 (https://pubchem.ncbi.nlm.nih.gov/compound/180)
RTECS number	AL3150000
UNII	1364PS73AF (https://fdasis.nlm.nih.gov/srs/srsdirect.jsp?regno=1364PS73AF) ✓
UN number	1090
CompTox Dashboard (EPA)	DTXSID8021482 (https://comptox.epa.gov/dashboard/DTXSID8021482) ✚
<div><div>InChI</div><div><div><div><div><div></div></div></div><div><div><div></div></div><div><div></div></div></div><div><div><div></div></div><div><div></div></div></div></div></div><div>InChI=1S/C3H6O/c1-3(2)4/h1-2H3 ✓<div>Key: CSCPPACGZOOCGX-UHFFFAOYSA-N ✓</div></div></div>	
<div><div>InChI=1/C3H6O/c1-3(2)4/h1-2H3</div><div>Key: CSCPPACGZOOCGX-UHFFFAOYAF</div></div>	
SMILES	
<div> CC(=O)C </div>	
Properties	
Chemical formula	C ₃ H ₆ O
Molar mass	58.080 g·mol ^{−1}
Appearance	Colourless liquid
Odor	Pungent, irritating, floral, cucumber like
Density	0.7845 g/cm ³ (25 °C)
Melting point	−94.7 °C (−138.5 °F; 178.5 K) ^[12]
Boiling point	56.05 °C (132.89 °F; 329.20 K) ^[12]
Solubility in water	Miscible
Solubility	Miscible in <u>benzene</u> , <u>diethyl ether</u> , <u>methanol</u> , <u>chloroform</u> , <u>ethanol</u> ^[8]
log <i>P</i>	−0.16 ^[9]
Vapor pressure	9.39 kPa (0 °C) <div></div> 30.6 kPa (25 °C) <div></div> 374 kPa (100 °C) <div></div> 2.8 MPa (200 °C) ^[2]
Acidity (p <i>K</i> _a)	19.16 (H ₂ O) ^[10] <div></div> 26.5 (DMSO) ^[11]
Magnetic susceptibility (<i>χ</i>)	−33.78·10 ^{−6} cm ³ /mol
Refractive index (<i>n</i> _D)	1.3588 (<i>V</i> _D = 54.46)
Viscosity	0.295 mPa·s (25 °C) ^[8]
Structure	
Coordination geometry	Trigonal planar at C2
Molecular shape	Dihedral at C2
Dipole moment	2.91 D
Thermochemistry	
Heat capacity (<i>C</i>)	125.45 J/(mol·K)
Std molar entropy (<i>S</i> [∘] ₂₉₈)	200.4 J/(mol·K)
Std enthalpy of formation (<i>Δ</i> _f <i>H</i> [∘] ₂₉₈)	(−250.03) – (−248.77) kJ/mol
Std enthalpy of combustion (<i>Δ</i> _c <i>H</i> [∘] ₂₉₈)	−1.772 MJ/mol
Hazards	
Safety data sheet	<i>See: data page</i>
GHS pictograms	<div><div></div><div></div></div>
GHS Signal word	Danger
GHS hazard statements	H225, H319, H336, H373
GHS precautionary statements	P210, P235, P260, P305+351+338
NFPA 704 (fire diamond)	<div><div><div><div><div></div></div><div><div></div></div></div><div><div><div></div></div><div><div></div></div></div><div><div><div></div></div><div><div></div></div></div><div><div><div></div></div><div><div></div></div></div></div></div> <div>1 3 0</div>
Flash point	−20 °C (−4 °F; 253 K)
	465 °C (869 °F; 738 K)

propionaldehyde.^{[40][41][42]}

Uses

Industrial

About a third of the world's acetone is used as a solvent, and a quarter is consumed as acetone cyanohydrin, a precursor to methyl methacrylate.^[16]

Solvent

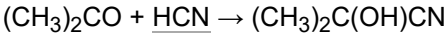
Acetone is a good solvent for many plastics and some synthetic fibers. It is used for thinning polyester resin, cleaning tools used with it, and dissolving two-part epoxies and superglue before they harden. It is used as one of the volatile components of some paints and varnishes. As a heavy-duty degreaser, it is useful in the preparation of metal prior to painting or soldering, and to remove rosin flux after soldering (to prevent adhesion of dirt and electrical leakage and perhaps corrosion or for cosmetic reasons), although it attacks many electronic components (for example polystyrene capacitors) so it is unsuitable for cleaning many circuit boards.

Acetylene carrier

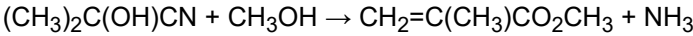
Although itself flammable, acetone is used extensively as a solvent for the safe transportation and storage of acetylene, which cannot be safely pressurized as a pure compound. Vessels containing a porous material are first filled with acetone followed by acetylene, which dissolves into the acetone. One litre of acetone can dissolve around 250 litres of acetylene at a pressure of 10 bar.^{[43][44]}

Chemical intermediate

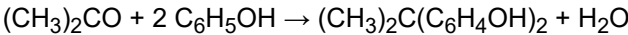
Acetone is used to synthesize methyl methacrylate. It begins with the initial conversion of acetone to acetone cyanohydrin:



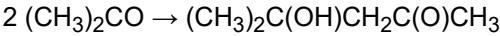
In a subsequent step, the nitrile is hydrolyzed to the unsaturated amide, which is esterified:



The third major use of acetone (about 20%)^[16] is synthesizing bisphenol A. Bisphenol A is a component of many polymers such as polycarbonates, polyurethanes, and epoxy resins. The synthesis involves the condensation of acetone with phenol:



Many millions of kilograms of acetone are consumed in the production of the solvents methyl isobutyl alcohol and methyl isobutyl ketone. These products arise via an initial aldol condensation to give diacetone alcohol.^[17]



Condensation with acetylene gives 2-methylbut-3-yn-2-ol, precursor to synthetic terpenes and terpenoids.

Laboratory

Chemical research

In the laboratory, acetone is used as a polar, aprotic solvent in a variety of organic reactions, such as S_N2 reactions. The use of acetone solvent is critical for the Jones oxidation. It does not form an azeotrope with water (see azeotrope tables).^[45] It is a common solvent for rinsing laboratory glassware because of its low cost and volatility. Despite its common use as a supposed drying agent, it is not effective except by bulk displacement and dilution. Acetone can be cooled with dry ice to -78 °C without freezing; acetone/dry ice baths are commonly used to conduct reactions at low temperatures. Acetone is fluorescent under ultraviolet light, and its vapor can be used as a fluorescent tracer in fluid flow experiments.^[46]

Acetone is used to precipitate proteins.^[47] Alternatives for protein precipitation are trichloroacetic acid or ethanol.

Cleaning

Low-grade acetone is also commonly used in academic laboratory settings as a glassware rinsing agent for removing residue and solids before a final wash.^[48] Acetone leaves a small amount of residue on a surface when dried that is harmful to surface samples.

Low-temperature bath

A mixture of acetone and dry ice is a popular cooling bath that maintains a temperature of $-78\text{ }^{\circ}\text{C}$ as long as there is some dry ice left.

Histology

Acetone is used in the field of pathology to find lymph nodes in fatty tissues for tumor staging (such as looking for lymph nodes in the fat surrounding the intestines).^[49] This helps dissolve the fat, and hardens the nodes, making finding them easier.^[50]

Acetone also used for destaining microscope slides of certain stains.^[51]

Lewis base properties

Acetone is a weak Lewis base that forms adducts with soft acids like I_2 and hard acids like phenol. Acetone also forms complexes with divalent metals. ^{[52][53]}

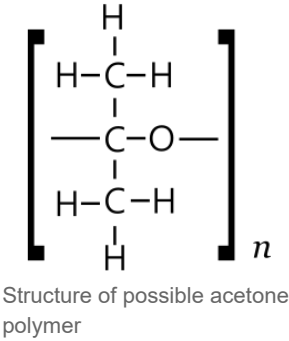
Medical

Drug solvent and excipient

Acetone is used as a solvent by the pharmaceutical industry and as a denaturant in denatured alcohol.^[54] Acetone is also present as an excipient in some pharmaceutical drugs.^[55]

Skin defatting

<u>Autoignition temperature</u>	
<u>Explosive limits</u>	2.6–12.8% ^[13]
<u>Threshold limit value (TLV)</u>	1185 mg/m ³ (TWA), 2375 mg/m ³ (STEL)
Lethal dose or concentration (LD, LC):	
<u>LD₅₀ (median dose)</u>	5800 mg/kg (rat, oral) 3000 mg/kg (mouse, oral) 5340 mg/kg (rabbit, oral) ^[14]
<u>LC₅₀ (median concentration)</u>	20,702 ppm (rat, 8 h) ^[14]
<u>LC_{Lo} (lowest published)</u>	45,455 ppm (mouse, 1 h) ^[14]
NIOSH (US health exposure limits):	
<u>PEL (Permissible)</u>	1000 ppm (2400 mg/m ³) ^[5]
<u>REL (Recommended)</u>	TWA 250 ppm (590 mg/m ³) ^[5]
<u>IDLH (Immediate danger)</u>	2500 ppm ^[5]
<u>Related compounds</u>	
<u>Related compounds</u>	<u>Butanone</u> <u>Isopropyl alcohol</u> <u>Formaldehyde</u> <u>Urea</u> <u>Carbonic acid</u> <u>Carbonyl fluoride</u>
<u>Supplementary data page</u>	
<u>Structure and properties</u>	<u>Refractive index (n)</u> , <u>Dielectric constant (ε_r)</u> , etc.
<u>Thermodynamic data</u>	<u>Phase behaviour</u> solid–liquid–gas
<u>Spectral data</u>	<u>UV</u> , <u>IR</u> , <u>NMR</u> , <u>MS</u>
Except where otherwise noted, data are given for materials in their <u>standard state</u> (at 25 °C [77 °F], 100 kPa).	
<div>✓ <u>verify</u> (what is ✗ ?)</div>	
<div> <u>Infobox references</u></div>	



Dermatologists use acetone with alcohol for acne treatments to chemically peel dry skin. Common agents used today for chemical peeling are salicylic acid, glycolic acid, 30% salicylic acid in ethanol, and trichloroacetic acid (TCA). Prior to chemexfoliation, the skin is cleaned and excess fat removed in a process called defatting. Acetone, Septisol, or a combination of these agents is commonly used in this process.

Anticonvulsant

Acetone has been shown to have anticonvulsant effects in animal models of epilepsy, in the absence of toxicity, when administered in millimolar concentrations.^[56] It has been hypothesized that the high-fat low-carbohydrate ketogenic diet used clinically to control drug-resistant epilepsy in children works by elevating acetone in the brain.^[56] Because of their higher energy requirements, children have higher acetone production than most adults – and the younger the child, the higher the expected production. This indicates that children are not uniquely susceptible to acetone exposure. External exposures are small compared to the exposures associated with the ketogenic diet.^[57]

Domestic and other niche uses

Acetone is often the primary component in cleaning agents such as nail polish and superglue removers. It will attack some plastics, however.

Make-up artists use acetone to remove skin adhesive from the netting of wigs and mustaches by immersing the item in an acetone bath, then removing the softened glue residue with a stiff brush.

Acetone is often used for vapor polishing of printing artifacts on 3D-printed models printed with ABS plastic. The technique, called acetone vapor bath smoothing, involves placing the printed part in a sealed chamber containing a small amount of acetone, and heating to around 80 degrees Celsius for 10 minutes. This creates a vapor of acetone in the container. The acetone condenses evenly all over the part, causing the surface to soften and liquefy. Surface tension then smooths the semi-liquid plastic. When the part is removed from the chamber, the acetone component evaporates leaving a glassy-smooth part free of striation, patterning, and visible layer edges, common features in untreated 3D printed parts.^[58]

Safety

Flammability

The most hazardous property of acetone is its extreme flammability. Acetone burns with bright yellow flames. At temperatures greater than acetone's flash point of −20 °C (−4 °F), air mixtures of between 2.5% and 12.8% acetone, by volume, may explode or cause a flash fire. Vapors can flow along surfaces to distant ignition sources and flash back. Static discharge may also ignite acetone vapors, though acetone has a very high ignition initiation energy point and therefore accidental ignition is rare. Even pouring or spraying acetone over red-glowing coal will not ignite it, due to the high concentration of vapour and the cooling effect of evaporation of the liquid.^[59] It auto-ignites at 465 °C (869 °F). Auto-ignition temperature is also dependent upon the exposure time, thus at some tests it is quoted as 525 °C. Also, industrial acetone is likely to contain a small amount of water which also inhibits ignition.

Acetone peroxide

When oxidized, acetone forms acetone peroxide as a byproduct, which is a highly unstable, primary high explosive compound. It may be formed accidentally, e.g. when waste hydrogen peroxide is poured into waste solvent containing acetone. Due to its instability, it is rarely used, despite its simple chemical synthesis.

Toxicity

Acetone has been studied extensively and is believed to exhibit only slight toxicity in normal use. There is no strong evidence of chronic health effects if basic precautions are followed.^[60] It is generally recognized to have low acute and chronic toxicity if ingested and/or inhaled.^[61] Acetone is not currently regarded as a carcinogen, a mutagenic chemical nor a concern for chronic neurotoxicity effects.^[59]

Acetone can be found as an ingredient in a variety of consumer products ranging from cosmetics to processed and unprocessed foods. Acetone has been rated as a generally recognized as safe (GRAS) substance when present in beverages, baked foods, desserts, and preserves at concentrations ranging from 5 to 8 mg/L.^[61]

Acetone is however an irritant, causing mild skin irritation and moderate to severe eye irritation. At high vapor concentrations, it may depress the central nervous system like many other solvents.^[62] Acute toxicity for mice by ingestion (LD₅₀) is 3 g/kg, and by inhalation (LC₅₀) is 44 g/m³ over 4 hours.^[63]

EPA Classification

In 1995, the United States Environmental Protection Agency (EPA) removed acetone from the list of "toxic chemicals" maintained under Section 313 of the Emergency Planning and Community Right to Know Act (EPCRA). In making that decision, EPA conducted an extensive review of the available toxicity data on acetone and found that acetone "exhibits acute toxicity only at levels that greatly exceed releases and resultant exposures", and further that acetone "exhibits low toxicity in chronic studies".

- Genotoxicity.** Acetone has been tested in more than two dozen in vitro and in vivo assays. These studies indicate that acetone is not genotoxic.
- Carcinogenicity.** EPA in 1995 concluded, "There is currently no evidence to suggest a concern for carcinogenicity". (EPCRA Review, described in Section 3.3). NTP scientists have recommended against chronic toxicity/carcinogenicity testing of acetone because "the prechronic studies only demonstrated a very mild toxic response at very high doses in rodents".
- Neurotoxicity and Developmental Neurotoxicity.** The neurotoxic potential of both acetone and isopropanol, the metabolic precursor of acetone, have been extensively studied. These studies demonstrate that although exposure to high doses of acetone may cause transient central nervous system effects, acetone is not a neurotoxicant. A guideline developmental neurotoxicity study has been conducted with isopropanol, and no developmental neurotoxic effects were identified, even at the highest dose tested. (SIAR, pp. 1, 25, 31).
- Environmental.** When the EPA exempted acetone from regulation as a volatile organic compound (VOC) in 1995, EPA stated that this exemption would "contribute to the achievement of several important environmental goals and would support EPA's pollution prevention efforts". 60 Fed. Reg. 31,634 (June 16, 1995). 60 Fed. Reg. 31,634 (June 16, 1995). EPA noted that acetone could be used as a substitute for several compounds that are listed as hazardous air pollutants (HAP) under section 112 of the Clean Air Act.

Environmental effects

Although acetone occurs naturally in the environment in plants, trees, volcanic gases, forest fires, and as a product of the breakdown of body fat,^[64] the majority of the acetone released into the environment is of industrial origin. Acetone evaporates rapidly, even from water and soil. Once in the atmosphere, it has a 22-day half-life and is degraded by UV light via photolysis (primarily into methane and ethane.^[65]) Consumption by microorganisms contributes to the dissipation of acetone in soil, animals, or waterways.^[64]

The LD₅₀ of acetone for fish is 8.3 g/L of water (or about 1%) over 96 hours, and its environmental half-life in water is about 1 to 10 days. Acetone may pose a significant risk of oxygen depletion in aquatic systems due to the microbial consumption.^[66]

Extraterrestrial occurrence

On 30 July 2015, scientists reported that upon the first touchdown of the *Philae* lander on comet 67P's surface, measurements by the COSAC and Ptolemy instruments revealed sixteen organic compounds, four of which were seen for the first time on a comet, including acetamide, acetone, methyl isocyanate, and propionaldehyde.^{[67][68][69]}

References

1.

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External links

- International Chemical Safety Card 0087 (https://www.ilo.org/dyn/icsc/showcard.display?p_lang=en&p_card_id=0087&p_version=2)
- NIOSH Pocket Guide to Chemical Hazards (https://www.cdc.gov/niosh/npg/npgd0004.html)
- Acetone Safety Data Sheet (SDS) (https://web.archive.org/web/20200318085127/http://sdsdata.org/244731)
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