Gaseous carbon tetrahydride

CO_2 dilencongkan ke sini. Untuk kegunaan lain, lihat CO_2 (nyahkekaburan). Chemical compound with formula CO_2 Carbon dioxide Names Other names Carbonic acid gas Carbonic anhydride Carbonic dioxide Carbon(IV) oxide R-744 (refrigerant) R744 (refrigerant alternative spelling) Dry ice (solid phase) Identifiers CAS Number 124-38-9 Y 3D model (JSmol) Interactive imageInteractive image 3DMet B01131 Beilstein Reference 1900390 ChEBI CHEBI:16526 Y ChEMBL ChEMBL1231871 N ChemSpider 274 Y ECHA InfoCard 100.004.271 EC Number 204-696-9 E number E290 (preservatives) Gmelin Reference 989 KEGG D00004 Y MeSH Carbon+dioxide PubChem CID 280 RTECS number FF6400000 UNII 142M471B3J Y UN number 1013 (gas), 1845 (solid) CompTox Dashboard (EPA) DTXSID4027028 InChI InChI=1S/CO2/c2-1-3 YKey: CURLTUGMZLYLDI-UHFFFAOYSA-N YInChI=1/CO2/c2-1-3Key: CURLTUGMZLYLDI-UHFFFAOYAO SMILES O=C=OC(=O)=O Properties Chemical formula CO_2 Molar mass 44.009 g·mol−1 Appearance Colorless gas Odor Low concentrations : tiada kepekatan yang tinggi: tajam; ketumpatan 1562 kg/m3 (pepejal pada 1 atm dan −78.5 °C) 1101 kg/m3 (cecair pada tepu −37 °C) 1.977 kg/m3 (gas pada 1 atm dan 0 °C) Titik lebur − 56.6 °C; −69.8 °F; 216.6 K (tiga mata pada 5.1 ATM) Titik kritikal (T, P) 31.1 °C (304.2 K), 7.38 megapascals (73.8 bar) Sublimationconditions −78.5 °C; −109.2 °F; 194.7 K (1 atm) Kebolehpercayaan dalam air 1.45 g/L pada 25 °C (77 °F), 100 kPa Vapor tekanan 5.73 MPa (20 °C) Keasidan (pKa) 6.35, 10.33 Kecurigaan magnet (χ) −20.5·10−6 cm3/mol Kekonduksian Terma 0.01662 W·m−1· K−1 (300 K)[2] Indeks Refraktif (nD) 1.00045 Viscosity 14.90 μPa·s pada 25 °C[3] 70 μPa·s pada −78.5 °C Dipole momen 0 D Struktur Kristal struktur Trigonal Molekul bentuk Linear Thermochemistry Haba kapasiti (C) 37.135 J/K·mol Std molarentropy (So298) 214 J·mol−1· K−1 Std enthalpy offormation (ΔfH⦵298) −393.5 kJ·mol−1 Pharmacology ATC code V03AN02 (WHO) Hazards Safety data sheet See: data pageSigma-Aldrich NFPA 704 (fire diamond) [6][7] 0 2 0SA Lethal dose or concentration (LD, LC): LCLo (lowest published) 90,000 ppm (human, 5 min)[5] NIOSH (US health exposure limits): PEL (Permissible) TWA 5000 ppm (9000 mg/m3)[4] REL (Recommended) TWA 5000 ppm (9000 mg/m3), ST 30,000 ppm (54,000 mg/m3)[4] IDLH (Immediate danger) 40,000 ppm[4] Related compounds Other anions Carbon disulfide Carbon diselenide Carbon ditelluride Other cations Silicon dioxide Germanium dioxide Tin dioxide Lead dioxide Related carbon oxides Carbon monoxide Carbon suboxide Dicarbon monoxide Carbon trioxide Related compounds Carbonic acid Carbonyl sulfide Supplementary data page Structure andproperties Refractive index (n) ,Pemalar dielektrik (εr), dan lain-lain. Thermodynamicdata Fasa behavioursolid-cecair-gas Spectral data UV, IR, NMR, MS Kecuali di mana dinyatakan sebaliknya, materials in their standard state (at 25 °C [77 °F], 100 kPa). N confirmed (what is YN?) Carbon dioxide (CO_2 chemical formula) is a colorless gas with a coriander about 53% higher than dry air. Carbon dioxide molecules consist of covalently double carbon atoms bound to two oxygen atoms. It happens naturally in the Earth's atmosphere as a surih gas. Current density is approximately 0.04% (412 ppm) by number, after increasing from pre-industrial levels to 280 ppm. [8] Natural sources include volcanoes, hot springs and geysers, and they are freed from carbonate rock by dissolution in water and acid. Because carbon dioxide is soluble in water, it happens naturally in underground water, rivers and lakes, ice caps, glaciers and seawater. It is present in natural petroleum and gas deposits. Carbon dioxide has a sharp and acidid odor and generates a taste of soda water in the mouth. [9] However, in his habit of encountering sensitivity it does not smell. [1] As a source of carbon in the carbon cycle, atmospheric carbon dioxide is the main source of carbon for life on Earth and its sensitivity in earth's pre-industrial atmosphere since recently in Precambrian has been regulated by photosynthesis organisms and geological phenomena. Herbs, algae and cyanobacteria use light energy to photosynthesis carbohydrates from carbon dioxide and water, with oxygen produced as residual products. [10] CO_2 is produced by all aerobic organisms when they metabolize organic compounds to generate energy by breathing. [11] He was again watered through fish gills and into the air through the lungs of air-breathing land animals, including humans. Carbon dioxide is produced during the process of organic material damage and sugar exposure in bread, beer and winemaking. It is produced by burning wood and other organic materials and fossil fuels such as coal, peat, petroleum and natural gas. It is an unsused by-product in many large-scale oxidation processes, for example, in the production of acrylic acid (more than 5 million tons / year). [13] It is an all-round industrial material, used, for example, as a gas in welding and fire extinguishers, as a suppressing gas in air weapons and oil recovery, as a chemical livestock and as a supercritical liquid solvent in coffee decaffeination and supercritical drying. [15] It is added to drinking water and carbonated beverages including beer and sparkling wine to add to the emptiness. The solid form of frozen CO_2, known as dried ice is used as a fridge and as a melting in dry ice bursts. It is livestock for the synthesis of fuels and chemicals. [16] [17] [18] [19] dioxide is the most significant long-term greenhouse gas in Earth's atmosphere. Since the anthropogenic release of the Industrial Revolution - especially from the delayed use of fossil fuels and logging -- increase its concentration in the atmosphere, leading to global warming. Carbon dioxide also causes ocean acidification because it unchecks water to form carbonic acid. [20] The background of the dry ice dioxide carbon crystal structure was the first gas described as discriminatory substances. In about 1640,[21] Flemish chemist Jan Baptist van Helmont observed that when he burned charcoal inside a closed vessel, the resulting ash mass was lower than the original charcoal. His interpretation is that the whole charcoal has been translated into invisible substances he is termed as gas or wild spirits (spirits of sylvestris). [22] Carbon dioxide features were studied again in the 1750s by Scottish doctor Joseph Black. He finds that limestone (carbonate calcium) can be heated or treated with acid to produce gas called fixed air. He observes that regular air is compact out of the air and supported not to fire or animal life. Black also finds that when bubbled through a limewater (aqueous hydroxide calcium saturated solution), it will claim calcium carbonate. He used this phenomenon to describe that carbon dioxide was produced by the breathing of animals and microbial fermentation. In 1772, English chemist Joseph Priestley published a paper entitled Impregnating Water with Fixed Air where he described the process of dripping sulfuric acid (or vitriol oil as Priestley knew) on cotton to produce carbon dioxide, and asked for gas to dissolve by a bowl of water with [23] Carbon dioxide first diluted (at high pressure) in 1823 by Humphry Davy and Michael Faraday. [24] The earliest descriptions of solid carbon dioxide (dry ice) were given by French creator Adrien-Jean-Pierre Thilorier, which in 1835 opened a container of carbon tracking of liquid dioxide, only to find that cooling produced by rapid evasion of liquid produces snow [25] [26] The structure and bonding of chemical and physical properties See also: Pictures of molecular orbital diagrams § Carbon dioxide Molecular dioxide is linear The length of the carbon-oxygen bond is 116.3 pm, significantly shorter than the length of a single C-O bond and shorter than most ground-bound C-O function groups. [27] Since it is centrosymmetric, molecules do not have an electric dipole. Stretch and bend the molecular swing of CO_2 carbon dioxide. Top left: symmetric stretch. Top right: antismetric stretching. Bottom line: degenerate a pair of bending modes. As a linear triatomic molecule, CO_2 has four vibration modes as shown in the diagram. However, the cinematic stretching mode does not create and vice versa not observed in the IR spectrum. Both bending modes deteriorate, which means that they match only one frequency. Thus, only two vibration bands are observed in the IR spectrum - an antisymmetric stretch mode in wavenumber 2349 cm−1 and a pair of degenerate bending modes at 667 cm−1 (wavelength 15 μm). There was also a mode of symmetric stretching at 1388 cm−1 which was only observed in the Raman spectrum. [28] As a result of two modes of bending, the molecule is only linear tight when the bending amount is zero. It was demonstrated by the theory[29] and by Coulomb's explosive imaging experiment. [30] that this was never true for both modes at once. In the sample of the carbon dioxide gas phase, there are no linear molecules due to the motion of vibration. However, molecular geometry is still described as linear, which describes the average atomic position that matches the potential minimum energy. This is also true for other linear molecules. In the aqueous see solution too: Carbonic acid dioxide dissolves in water, where it reversely forms H_2CO_3 (carbonic acid), which is a weak acid due to its ionizer in incomplete water. $CO_2 + H_2O \rightleftharpoons H_2CO_3$ Balance of carbonic acid catalysts is K h = [H 2 C O 3] [C 2 (q)] = 1.70 × 10 − 3 {\displaysty dile K_{\mathrm {h} }={\frac {\rm\H_{2}CO_{3}]}}{\rm[CO_{2}(aq)}}=1.70\times 10^{-3}} (at 25 °C). Therefore, the majority of carbon dioxide is not converted to carbonic acid, but remains a CO_2 molecule, not affecting the pH. The relative concentrations of CO_2, H_2CO_3, and the uninformed forms of HCO−3 (bikarbonate) and CO2−3 (carbonate) depend on the pH. As indicated in the Bjerrum plot, in neutral water or a little alkali (pH > 6.5), the form of bikarbonate dominates (>50%) be the most common (>95%) at pH seawater. In very alkaline water (pH > 10.4), the main one (>50%) forms are carbonate. The ocean, which is light alkali with a typical pH = 8.2-8.5, contains about 120 mg of bikarbonate per liter. Beproticised, carbonic acid has two acid blenders, the first for insults into bikarbonates (also called carbonate hydrogen) ions (HCO_3^-): $H_2CO_3 \rightleftharpoons HCO_3^- + H^+$ Ka1 = 2.5×10−44 /mol / Ll; pKa1 = 3.6 at 25 °C.[27] This is the real first acid marketer, defined as K a 1 = [H C O 3 −] [H +] [H 2 C O 3] {\displaystyle K_{a1}={\frac {\rm{[HCO_{3}^{-}][H^{+}]}}{\rm[H_{2}CO_{3}]}}}} , where the denominator only includes H_2CO_3 that is bound by alternity and excludes hydrated CO_2(aq). Smaller and often mentioned values near 4.16×10−7 are clearly calculated values on assumptions (incorrectly) that all CO_2 dissolved present as carbonic acid, so K a 1 - p a r n n t) = [H C O 3 −] [H +] [H 2 C O 3] + [C 2 (q)] {\displaysty K_{\mathrm {a1} HCO_{3} {{{{{{{{ . Since most dissolved CO_2 remains the molecule of CO_2, Ka1 (apparently) has a larger denominator and a smaller value than the real Ka1. [31] Bikarbonate ions are amphoteric species that can act as acids or as a basis, depending on the pH of the solution. At high pH, it distinguishes significantly into carbonate ions (CO_3^{2-}): $HCO_3^- \rightleftharpoons CO_3^{2-} + H^+$ Ka2 = 4.69×10−11 mol/L; pKa2 = 10.329 In carbonic acid production organisms are rated by enzymes, carbonic anhidras. Co2 CO_2 chemical reactions are potent electromethile that has electrophilic reactivity comparable to benzaldehyde or α,β-unsaturated carbonyl compounds. However, unlike similar reactivity electrophytes, the nucleophiles response with CO_2 is less favoured and is often found to be highly upside down. [32] Only very strong nukleophiles, such as carbanions provided by Grignard reagents and organolithic compounds respond with CO_2 to give carboxylates: $MR + CO_2 \rightarrow RCO_2M$ where M = Li or Mg Br and R = alkyl or aryl. In the metal carbon dioxide complex, CO_2 serves as a ligand, which can facilitate the conversion of CO_2 to other chemicals. [33] Co2 reductions to CO are usually difficult and slow reactions: $CO_2 + 2e^- + 2H^+ \rightarrow CO + H_2O$ Photoautotrophs (i.e. plants and cyanobacteria) use energy contained in sunlight to simple sugar photosynthesis from co2 that are inserted from CO_2 Air and water: $n\,CO_2 + n\,H_2O \rightarrow (CH_2O)_n + n\,O_2$ Potential redox for this response near pH 7 is about −0.53 V compared to Nickel-standard hydrogen contains the carbon monoxide enzyme dehydrogenase catalyst this process. [34] Physical properties Of More information: Carbon dioxide data of dry ice pellets, a common form of colorless carbon dioxide solid carbon dioxide. At low concentrations of gas do not smell; However, at a pretty high concentration, it has a sharp and courteous smell. [1] At standard temperature and pressure, carbon dioxide density was around 1.98 kg/m3, about 1.67 times air. Carbon dioxide does not have a fluid condition at pressure below 5.1 standard atpherics (520 kPa). At 1 atpheric (near mean sea level pressure), gas deposits continued to solid at temperatures below −78.5 °C (−109.3 °F; 194.7 K) and direct solid sublimes to gas above −78.5 °C. In its solid state, carbon dioxide is usually called dry ice. Diagrams of the carbon dioxide pressure phase of the carbon dioxide fluid only on pressure exceed 5.1 atms; The three-carbon dioxide point is approximately 5.1 bars (517 kPa) at 217 K (see phase diagram). The critical point is 7.38 MPa at 31.1 °C.[35][36] Another form of solid carbon dioxide observed at high pressure is solid like amorphous glass. [37] Glass shape called carbonia, produced by supercooling heated CO_2 at extreme pressures (40-48 GPa or or 400,000 atfera) in diamond anvil. This discovery confirms the theory that carbon dioxide can exist in glass conditions similar to other members of the family of elements, such as silicon (silica glass) and German dioxide. Unlike slika and German eye mirrors, however, carbonia glass is unstable at regular pressure and returns to the gas when pressure is released. At temperatures and pressures above critical points, carbon dioxide behaves as a supercritical liquid known as supercritical carbon dioxide. Carbon dioxide sequestration and production can be obtained by distillation from the air, but in efficient methods. Industrially, carbon dioxide is mostly an unre discovered residual product, produced by several methods that can be used at various scales. [38] The burning of all carbon-based fuels, such as methane (natural gas), petroleum distillates (petrol, diesel,rosene, propane), stone charcoal, wood and generic organic matter produce carbon dioxide and, except in the case of pure carbon, water. For example, the chemical response between methane and oxygen: $CH_4 + 2\,O_2 \rightarrow CO_2 + 2\,H_2O$ It is produced by the decomposition of limestone heat, CACO3 with heating (calcining) at approximately 850 °C (1,560 °F), in the manufacture of quicklime (calcium oxide, CaO), a compounds that have many industrial uses: $CaCO_3 \rightarrow CaO + CO_2$ Iron is reduced from oxide with coke in relau blast, producing pig iron and carbon dioxide :[39] Carbon dioxide is a by-product of hydrogen industry production by the renewal of the stim and the reaction of the transition of water gas in the production of ammonia. These processes begin with natural water and gas reactions (especially methane). [40] It is the main source of food grade carbon dioxide for use in beer and soft drink carbonation, and is also used for amazing animals such as chickens. In the summer of 2018 a shortage of carbon dioxide for this purpose arose in Europe due to the temporary closure of some ammonia loji for maintenance. [41] Acid frees CO_2 from most metal carbonates. Therefore, it can be obtained directly from natural carbon dioxide springs, where it is produced by the action of acidid water on limestone or dolomite. The reaction between hydrochloric acid and calcium carbonate (limestone or lime) is shown below: $CaCO_3 + 2\,HCl \rightarrow CaCl_2 + H_2CO_3$ Carbonic Acid (H_2CO_3) then disconnected to water and CO_2: $H_2CO_3 \rightarrow CO_2 + H_2O$ Such a reaction is accompanied by froth or froth or both, because the gas is released. They have widespread use in the industry as they can be used to neutralize the flow of residual acid. Carbon dioxide is a small result of sugar exposure in brewing, whisky and other alcoholic beverages and in bioethanol production. Yis sugar metabolism to produce CO_2 and ethanol, known as alcohol, as follows: $C_6H_{12}O_6 \rightarrow 2\,CO_2 + 2\,C_2H_5OH$ All aerobic organisms CO_2 when they oxidize carbohydrates, fatty acids, and proteins. A large number of responses involved are very complex and not explained easily. Refer to (cellular breathing, anaerobic breathing and photosynthesis). The equation for glucose breathing and other monosaccharides is: $C_6H_{12}O_6 + 6\,O_2 \rightarrow 6\,CO_2 + 6\,H_2O$ Anaerobic organisma knocked out organic matter producing methane and carbon dioxide together with other compounds. [42] Regardless of the type of organic material, gas production is according to a well-defined kinetic pattern. Carbon dioxide covers about 40-45% of the gases that are sourced at waste disposal sites (termed disposal gases). Most trays of 50-55% are methane. [43] Carbon dioxide applications are used by the food industry, oil industry, and chemical industry. [38] It has different commercial uses but one of its greatest uses as a chemical is in the production of carbonated beverages; it provides sparks in carbonated beverages such as soda water, beer and sparkling wine. The precursor to the chemicals of this section requires development. You can help by adding it. (July 2014) In the chemical industry, carbon dioxide is mainly eaten as an ingredient in urea production, with smaller fractions used to produce methanol and a variety of other products. [44] Some carboxylic acid derivatives such as sodium salicylate are provided using CO_2 by the Kolbe-Schmitt reaction. [45] In addition to conventional processes using CO_2 for chemical production, electrochemical methods are also being explored at the research stage. In particular, the use of renewable energy for the production of fuels from CO_2 (such as methanol) is interesting as this can lead to fuels that can be transported easily and used in conventional combustion technology but do not have a clean CO_2 release. [46] Carbon dioxide foods bubble in soft drinks. Carbon dioxide is a food addition used as a propellant and keasidan regulatory guard in the food industry. It was approved for use in the EU[47] (listed as number E290), US[48] and Australia and New Zealand[49] (listed by number INS 290). A candy called Pop Rocks is pressed with carbon dioxide gas[50] at approximately 4 × 106 Pa (40 bar, 580 psi). When placed in the mouth, it dissolves (just like other hard candles) and releases gas bubbles with a pop that can be heard. Agents that leave cause doh to increase by producing carbon dioxide. [51] Yis Baker produces carbon dioxide by exposing sugar in adunan, while chemical leaves such as powdered powder and baking soda release carbon dioxide when heated or if exposed to acid. Drinks dioxide is used to produce carbonated soft drinks and soda water. Traditionally, the carbonation of sparkling beer and wine comes through natural appeposition, but many carbonate producers of this drink with carbon carbon recovery from the fermentation process. In the case of bottled beer and kegged, the most commonly used method is carbonation with recycled carbon dioxide. With the exception of the british actual arm, draught beer is usually moved from kegs in cold rooms or basement rooms to dispense pipes on bars using depressed carbon dioxide, sometimes mixed with nitrogen. Soda water taste (and related flavor sensations in other carbonated drinks) is the effect of dissolved carbon dioxide foam rather than a gas-ruptured bubble. Carbonic anhidrase 4 converts to carbonic acid that leads to sour taste, and even dissolved carbon dioxide prompts somatosensory reactions. [52] Dry ice winchaking was used to maintain the grapes after the lives. Carbon dioxide in the form of dry ice is often used during the cold soaking phase in winemaking to cool the grape cluster quickly after opting to help prevent spontaneous fermentation by wild yeans. The main advantage of using dry ice over water ice is that it cools the grapes without adding any extra water that may reduce the concentration of sugar in grapes must be, and therefore the concentration of alcohol in finished wine. Carbon dioxide is also used to create a hypoxic environment for carbonic macerization, a process used to produce Beaujolais wine. Carbon dioxide is sometimes used to add bottles of wine or other storage vessels such as barrels to prevent oxidation, although it has problems that can be dissolved into wine, making wine previously still a little fizzy. For this reason, other gases such as nitrogen or argon are prioritised for this process by professional wine makers. Amazing animals Carbon dioxide are often used to stun animals before slaughter. [53] Amazingly may be a misunderstanding, since the animal is not immediately knocked out and may have distress. [54] Inert gas It is one of the most commonly used compressed gases for pneumatic (depressed gas) systems in portable pressure tools. Carbon dioxide is also used as an atmosphere for welding, even in welding arcs, it responds to oxidizing most of the metal. Consumption in the automotive industry is common despite important evidence that welding made in carbon dioxide is more fragile than those made in deeper atmospheres. [citation required] It is used as a welding gas mainly because it is cheaper than deeper gases such as argons or helium. [citation required] When used for MIG welding, CO_2 consumption is sometimes referred to as MAG welding, for Metal Active Gas, since CO_2 can respond at this high temperature. It tends to produce puddles warmer than the atmosphere absolutely enter, improve the flow characteristics. Although, this may be due to the atmospheric reaction that occurs on the puddle site. This is usually the opposite of the desired effect when welding, since it tends to sow the site, but may not be a problem for general, general, general steel welding, Ultimate purity is not a major concern. It is used in many consumer products that require depressed gas because it is cheap and unpredictable, and since it undergoes a phase shift from gas to liquid at room temperature at pressure that can be reached about 60 bars (870 psi, 59 ATMs), allowing far more carbon dioxide to fit in a particular container than other life jackets often contain carbon dioxide canisers to fit in certain containers than other carbon dioxide canisers often contain The CO_2 aluminum capsule is also sold as a compressed gas supply for air guns, paintball/mild markers, inflatable bicycle tires, and to make carbonated water. The rapid vaporization of liquid carbon dioxide is used for explosions in coal mines. [citation required] High concentrations of carbon dioxide can also be used to kill pests. Carbon liquid dioxide is used in supercritical drying of certain food products and technological materials, in the preparation of specimens to scan electron microscopy[56] and in the decaffeination of coffee beans. Fire extinguisher Use of extinguisher API CO_2. Carbon dioxide can be used to extinguish the fire by flooding the surrounding environment with gas. It does not respond to fire extinguishment, but starved the fire of oxygen by moving it. Some fire extinguishers, especially those designed for electric fire, contain carbon liquid dioxide under pressure. Carbon dioxide extinguishers work well on small flammable liquids and electric fires, but not on common flammable fires, since although it does not include oxygen, it does not cool down burning materials significantly and when carbon dioxide disperses them free to catch fire when exposed to oxygen atmospheric. Their disconnectability in electrical fires stems from the fact that, unlike water or other chemical-based methods, Carbon dioxide will not cause a short circuit, leading to more damage to the equipment. Because it is a gas, it is also easy to keep a large amount of gas automatically in the rooms of IT infrastructure, where the fire itself may be difficult to achieve by a more immediate method because it is behind the shelf door and in case. Carbon dioxide has also been widely used as an extinguishing agent in a fixed fire protection system for local wear of certain hazards and the amount of flooding of space covered. [57] International Maritime Organization standards also recognize carbon dioxide systems for fire protection ship holdings and engine rooms. Carbon dioxide-based fire protection systems have been linked to several deaths, since it can cause drowning in high enough concentrations. A review of the CO_2 system identified 51 incidents between 1975 and report (2000), resulting in 72 deaths and 145 injuries. [58] Supercritical CO_2 as solvent See too: Carbon supercritical carbon dioxide fluid is a good solvent for many lipophilic lipophilic compounds and are used to remove caffeine from coffee. [15] Carbon dioxide has attracted attention in the pharmaceutical and other chemical processing industries as a less toxic alternative to more traditional solvents such as organoclorida. It is also used by some dry cleansers for this reason (see green chemistry). It is used in the preparation of several aerogels due to its supercritical carbon dioxide properties. Agricultural Plants need carbon dioxide to carry out photosynthesis. The greenhouse atmosphere can (if the size is large, must) be enriched with extra CO_2 to maintain and increase the growth rate of the plant. [59] [60] At very high concentrations (100 times the atmospheric concentration, or greater), carbon dioxide can be toxic to the life of animals, so increase concentrations to 10,000 ppm (1%) or higher for several hours will eliminate pests such as white flies and spider mites in the greenhouse. [61] Medical and pharmacological uses In medicine, up to 5% carbon dioxide (atmospheric concentration 130 times) are added to oxygen for respiratory stimulation after apnea and to stabilize the O_2/CO_2 balance in the blood. Carbon dioxide can be mixed with up to 50% oxygen, forming inhalable gas; This is known as Carbogen and has a wide range of medical and research uses. Energy Fossil Carbon dioxide fuel recovery is used in enhanced oil recovery where it is injected into or adjacent to produce oil wells, usually in supercritical conditions, when it becomes perverted with oil. This approach can improve the recovery of the original oil by reducing the satumption of waste oil between 7% to 23% in addition to the main extraction. [62] It acts as an urgent agent and, when dissolved into underground crude oil, significantly reduces its viscousness, and changes the surface chemistry that allows the oil to flow faster through the reservoir into removal well. [63] In the field of mature oil, a wide network of pipes was used to bring carbon dioxide to the injection point. In the rehabilitation of enhanced coal bed methane, carbon dioxide will be pumped into coal seams to keep methane away, as opposed to current methods that mainly rely on water removal (to reduce stress) to make coal seams release trapped methane. [64] Biodiversity became the main article of fuel: Capture and carbon consumption It has been suggested that CO_2 from power generation is hurled into a pond to stimulate algae growth that can then be converted into biodiesel fuel. [65] The cyanobacterium strain of Synechococcus elongatus has been genetically engineered for isobutyraldehyde fuels and isobutanol from CO_2 using photosynthesis. [66] Comparison of carbon dioxide phase (red) and water (blue) phase diagrams as log-lin charts with phase transition points on 1 athsphere of liquid and solid carbon dioxide is an important refrigerator, especially in foods where they work during transportation and storage of ice cream and other frozen foods. Solid carbon dioxide is called dry ice and is used for small shipments where refrichant equipment is not practical. Solid carbon dioxide is always below −78.5 °C (−109.3 °F) at normal atmospheric pressure, regardless of air temperature. Carbon liquid dioxide (industrial nomenclature R744 or R-744) is used as a refrigerator before the R-12 discovery and may enjoy renaissance as R134a contributes to climate change of more than CO_2. Its physical properties are very profitable for cooling, cooling, and heating purposes, have a high volumetric cooling capacity. Due to the need to operate at pressure up to 130 bars (1880 psi), the CO_2 system requires highly resistant components that have been developed for mass production in many sectors. In car air conditioning, in more than 90% of all driving conditions for latitudes higher than 50°, R744 operates more efficiently than the system using R134a. Its environmental advantage (GWP 1, not cut ozone, non-toxic, non-compromise) can make it a future work fluid to replace HFC while in cars, supermarkets, and heat pump water heaters, among other things. Coca-Cola has fielded CO_2-based beverage cooling and the U.S. Army is interested in co2 refriishing and heating technology. [67] [68] The global car industry is expected to decide the next generation refrigerator in the air conditioning of the car. CO_2 is one of the options discussed. (see Sustainable automotive air conditioner) Minor uses carbon dioxide laser. Carbon dioxide is a laser medium in carbon dioxide lasers, which is one of the earliest types of lasers. Carbon dioxide can be used as a means of controlling the pH of the swimming pool,[69] by continuing to add gas to the water, thereing which keeps the pH from rising. Among its advantages is to avoid handling acid (more dangerous). Similarly, it is also used in maintaining a coral reef aquarium, where it is commonly used in calcium reactors to lower while the pH of water is passed on calcium carbonate to allow calcium carbonate to dissolve into the water more freely where it is used by some corals to build their skeletons. Used as a major coolant in the British advanced gas-cooled reactors for nuclear power generation. Carbon dioxide induction is commonly used for euthanasia animal research laboratories. Methods for administering CO_2 include putting animals directly into a closed, filled room containing CO_2, or exposure to CO_2 concentrations gradually increasing. In 2013, the American Society of Veterinary Medicine issued new guidelines carbon dioxide induction, stating that a disposal rate of 30% to 70% of the total gas chamber per minute is optimal for small humane euthanisation However, there is opposition to the practice of using carbon dioxide for this, arguing it is cruel. [55] Carbon dioxide is also used in several cleaning techniques and the preparation of related surfaces. In the Earth's atmosphere The main article: Carbon dioxide in the Earth's atmosphere and the Carbon Lengkung Kengkung cycle of atmospheric CO_2 concentrations measured at mauna Loa Observatory Carbon dioxide in the Earth's atmosphere is trace gas, Currently (beginning 2020) has a global average concentration of 412 parts per million by volume[71][72][73] (or 622 parts per million by mass). Atmospheric concentrations of carbon dioxide fluctuate slightly with the season, falling during the spring of the Northern Hemisphere and summer as plants take gas and increase during the northern and winter falls as the plants go dormant or die and rot. Concentrations also vary by region, the strongest near the ground with a smaller variation of aloft. In urban areas concentrations are generally higher[74] and inside their homes can reach 10 times the level of background. Atmospheric CO_2 annual increase: In the 1960s, the average annual increase was 35% from the 2009-2018 average. [75] Carbon dioxide concentrations have increased due to human activity. [76] The burning of fossil fuels and deforestation of electricity has led to an atmospheric concentration of carbon dioxide increasing by about 43% since the beginning of industrial age. [77] Most carbon dioxide from human activity was discharged from burning coal and other fossil fuels. Other human activities, including deforestation, biomass burning, and cement production also produce carbon dioxide. Human activity produces about 29 billion tons of carbon dioxide a year, while volcanoes emit between 0.2 and 0.3 billion tons. [78] [79] Human activity has led to CO_2 rising above levels not seen in hundreds of thousands of years. Currently, about half of the carbon dioxide discharged from the burning of fossil fuels remains in the atmosphere and is not induceed by vegetables and oceans. [80] [82] Despite being transparent to visible light, carbon dioxide is a greenhouse gas, absorbing and removing infrared radiation on two active infrared vibration frequencies (see structural parts and tie-ups above). The release of light from the surface of the earth is the most intense in the inffared region between 200 and 2500 cm−1,[84] compared to the earlier emissions of light from the hotter sun in the visible region. Absorption of infrared light on the vibration frequency of atmospheric carbon dioxide traps near the surface, heats the lower surface and atmosphere. Less energy achieving the upper atmosphere, which it is cooler because of this absorption. [85] Increased atmospheric density of CO_2 and other long-term greenhouse gases such as methane, nitrous oxide and ozone has confirmed the absorption and release of their infrared radiation, leading to an increase in average global temperatures since the mid-20th century. Carbon dioxide is the biggest concern because it affects overall warming greater than all other gases combined and because it has a long atmospheric life span (hundreds to thousands of years). CO_2 in earth's atmosphere if half of the release of global warming is not absorbed. [80] [81] [82] [83] (NASA computer simulation). Not only does increasing carbon dioxide density lead to an increase in global surface temperatures, but increasing global temperatures also leads to increased carbon dioxide density. This results in positive feedback for changes caused by other processes such as orbital cycles. [86] Five hundred million years ago the density of carbon dioxide was 20 times greater than today, decreasing to 4-5 times during the Jurassic period and then slowly decreasing with a very quick reduction occurred 49 million years ago. [87] The local density of carbon dioxide can reach high values near powerful sources, especially those isolated by the surrounding earth. In the Bossoleto hot spring near Rapolano Terme in Tuscany, Italy, located in a bowl-shaped depression about 100 m (330 ka) in diameter, the density of CO_2 increases to over 75% overnight, enough to kill insects and small animals. After sunrise the gas is dispersed by convection. [89] The high density of CO_2 produced by lake water disturbances in tepu with CO_2 is thought to have caused 37 deaths in Lake Monoun, Cameroon in 1984 and 1700 prey in Lake Nyos, Cameroon in 1986. [90] In the main article of the oceans: The Pterapod shell carbon cycle was dissolved in seawater in harmony with the ocean chemistry that was retired for 2100. Carbon dioxide is respothed in the oceans to form carbonic acid (H_2CO_3), bicarbonate (HCO_3^-) and carbonate (CO_3^{2-}). There are approximately fifty times as much carbon dioxide dissolved in the oceans as exists in the atmosphere. The oceans act as large carbon sinks, and have taken about one-third of the CO_2 emitted by human activity. [91] When carbon dioxide density increases in the atmosphere, the increase in carbon dioxide collection into the oceans leads to a measurable decrease in the pH of the oceans, referred to as ocean icy and oceans. This reduction in pH affects the biological system in the oceans, especially organisms thinking of the oceans. These effects include the food chain of autotrophs heterotrophs and include organisms such as coccolithophores, coral reefs, foraminifera, echinoderms, crustaceans and mollusks. Under normal circumstances, calcium carbonate is stable in surface waters carbonate ions are at supersaturating density. However, when the pH of the ocean falls, so does the density of these ions, and when carbonate becomes less fertile, the structure of the calcium carbonate is prone to liquidation. [92] Corals,[93][94][95] algae coccolithophore,[96][97][98][99] coralline algae,[96][99] coralline algae,[96][98][99] coralline algae,[96][99]99] Foraminifera,[101] clams[102] and pteropods[103] experienced reduced calculations or enhanced liquidation when exposed to high CO_2. Gas adaptability decreases as water temperatures rise (except when both pressures exceed 300 bars and temperatures above 393 K, only discovered near the deep geothermal entour)[104] and therefore the intake rate from the atmosphere decreases as ocean temperatures rise. Most of the CO_2 is taken by the ocean, which is about 30% of the total amount emitted to the athacil,[105] forms carbonic acid in balance with bikarbonates. Some of these chemical species are consumed by photosynthetic organisms that remove carbon from cycles. The increase in CO_2 in the atmosphere has led to an alkali decrease in seawater alkali, and there are concerns that this could affect the organism living in water. In particular, with reduced alkali, the carbonate availability to form shells decreases,[106] despite evidence of increased shell production by certain species under increased CO_2 content. [107] NOAA stated in May 2008 the State sheet of science facts for ocean acidification that: Oceans have absorbed about 50% of carbon dioxide (CO_2) removed from fossil fuel burning, causing a chemical reaction that lowers ocean pH. This has resulted in an increase in hydrogen ions (acidity) about 30% since the beginning of the industrial age through a process known as ocean acidification. More and more studies have shown adverse effects on marine organisms, including: The rate at which reef building corals produce their frames decreasing, while the production of various types of jelly increases. The capabilities of marine algae and zooplankton swim freely to keep protective shells reduced. The survival of larval marine species, including commercial fish and shell fish, was reduced. Also, the Intergrownity Panel on Climate Change (IPCC) wrote in Climate Change 2007: Synthesis Report:[108] Anthropogenic carbon intake since 1750 has led the ocean to become more acidic with an average decrease of 0.1 units. Increase atmospheric CO_2 concentration leads to further acidification ... Although the effects of ocean acidification observed on marine biospheres are as yet undocumented, progressive ocean acidification is expected to negatively affect marine shell-forming organisms (e.g. corals) and their dependent species. Some marine soothing organisms (including coral reefs) have been eliminated by major research agencies, including NOAA, the OSPAR, NANOOS and IPCC commissions, due to their most recent research that ocean acidification should be expected to negatively affect them. [109] Carbon Carbon also introduced into the ocean through lohong hydrotherma. The Champagne hydrothermal hole, found in the Northwestern Eifuku volcano in the Marianas Trench, produced almost pure carbon liquid dioxide, one of only two known sites in the world in 2004, the other being in okinawa's Trough. [110] The discovery of a liquid dioxide submarine lake in Okinawa's Trough was reported in 2006. [111] The biological role of Carbon dioxide is the end product of cellular breathing in organisms that gain energy by breaking sugars, fats and amino acids with oxygen as part of their metabolism. This includes all herbs, algae and animals and aerobic and bacterial kulat. In vertebrates, carbon dioxide moves in the blood from body tissue to the skin (for example, amfalbia) or gill (for example, fish), from which it dissolves in water, or the lungs from which it is exhibited. When photosynthesis is active, plants can absorb more carbon dioxide from the atmosphere than they release in breathing. Photosynthesis and Carbon Repair Overall picture of photosynthesis and breathing. Carbon dioxide (on the right), together with water, forms oxygen and organic compounds (on the left) by photosynthesis, which can be inspired into water and (CO_2). The overall picture of calvin cycles and carbon determination is a biochemical process in which atmospheric carbon dioxide is combined by plants, algae and (cyanobacteria) into energy-rich organic molecules such as glucose, thus realizing their own food by photosynthesis. Photosynthesis uses carbon dioxide and water to produce sugar from which other organic compounds can be built, and oxygen is produced as a small product. Ribulose-1,5-bisphosphate karboxylase oxygenase, usually abbreviated to RuBisCO, is an enzyme involved in the first major step of carbon determination, the production of two 3-phosphoglycerate molecules from CO_2 and rubisco bisphosphate is considered the most single protein on Earth. [112] Photostrof uses their photosynthesis products as an indoor food source and as raw materials for the biosynthesis of more complex organic molecules, such as polysaccharist, nucleic acids and proteins. It is used for their own growth, and also as the basis of food chains and web feeding to other organisms, including animals like ourselves. Some important phototrof, coccolithophores synthesize the scale of hard calcium carbonate. [113] A significant species of coccolithophore on a global level is Emiliania huxleyi whose calcium scale has formed the basis of many sedimentary rocks such as limestone, where what was previously a carbon atmosphere could remain on a geological time scale. Plants can grow as much as 50 percent more at a density of 1,000 ppm of CO_2 when compared to ambient conditions, although this does not consider climate change and does not on other nutrients. [114] High CO_2 levels resulted in an increase in growth reflected in trashable crop yields, with wheat, rice and soybean nuts all showing a 12-14% increase in revenue below CO_2 high in FACE experiments. [115] The increase in atmospheric CO_2 concentrations resulted in fewer stomata growing over plants[117] leading to reduced water consumption and increased water consumption efficiency. [118] Studies using FACE have shown that CO_2 enrichment leads to a decrease in micronutrient concentrations in crop plants. [119] This may have a knock-on effect on other parts of the ecosystem as herbivores need to eat more food to get the same amount of protein. [120] Secondary metabolite concentrations such as phenylpropanoids and flavonoids can also be changed in plants exposed to high concentrations of CO_2. [122] Plants also manufacture CO_2 during breathing, and therefore the majority of plants and algae, which use C3 photosynthesis, only clean absorbents during the day. While growing forests will absorb many tonnes of CO_2 each year, mature forests will produce as much as CO_2 from breathing and deployment of dead specimens (for example, falling branches) as used in photosynthesis in growing plants. [123] Contrary to the old view that they are carbon neutral, mature forests can continue to accumulate carbon[124] and remain valuable carbon sinking, helping to maintain the carbon balance of Earth's roof. In addition, and it is important to live on earth, photosynthesis by phytoplankton uses CO_2 in the upper ocean and thus promotes the absorption of CO_2 from the atmosphere. [125] Toxicity See also: Carbon dioxide poisons the main symptoms of carbon dioxide toxicity, by increasing the percentage of volume in the air. [126] Carbon dioxide content in the fresh air (average between sea level and 10 kPa, which is about 30 km (19 mi) of altitude) varies between 0.036% (360 ppm) and 0.041% (412 ppm), depending on location. [127] [Explanation required] CO_2 is an asphyxiation gas and is not classified as toxic or dangerous in accordance with the Global Harmony Classification System and the Labeling of Chemical Standards of the United Nations Economic Commission for Europe by using the OECD Guidelines for Chemical Testing. In concentrations of up to 1% (10,000 ppm), it will make some people feel sleepy and give the lungs a clogged feeling. [126] Concentrations of 7% to 10% (70,000 to 100,000 ppm) can cause drowning, even with the presence of adequate oxygen, shown as dizziness, headaches, visual dysfunction and hearing, and unconscious within minutes to an hour. [128] Effects acute carbon dioxide exposure is grouped together under the term hypercapnia, a subset of asphyxiation. Because it is heavier than air, in locations where gases look from the ground (due to volcanic activity or sub-surface geothermal) inside without the effect of dispersing the wind, it can accumulate in sheltered/pocket locations below the average level of the soil, causing the animal to lie in it drowning. The carion feeder attracted to the carcass was later also killed. Children have been killed in the same way near the town of Goma by CO_2 emissions from a volcano near Mt. Nyiragongo. [129] The term Swahili for this phenomenon is 'mazuku'. Rising CO_2 levels threatened the Apollo 13 astronauts who had to adjust the cartridges from the command module to supply carbon dioxide in the lunar module, which they used as live boats. Adaptation to increased concentration of CO_2 occurs in humans, including modified breathing and kidney biconbonate production, to combalance the effects of acidosis. Some studies suggest that 2.0 percent of inspired concentrations can be applied to closed airspace (e.g. submarines) because adaptation is physiological and reversible, since performance deterioration or regular physical activity does not occur at this level of exposure for five days. [130] However, other studies showed a decrease in cognitive function even at a lower level. [132] Also, with continuous respiratory acidosis, adaptation or compensation mechanism will not be able to reverse the situation. Below 1% There are several studies of the health effects of long-term continuous CO_2 exposure on humans and animals at below 1%. The co2 employment exposure limit was set in the United States at 0.5% (5000 ppm) for an eight-hour period. [134] At this CO_2 concentration, the International Space Station crew suffered headaches, fatigue, mental slowness, emotional irritation, and sleep disturbances. [135] Studies in animals at 0.5% CO_2 have shown kidney calculations and bone loss after eight weeks of exposure. [136] A human study exposed in the 2.5-hour session showed a significant negative impact on cognitive abilities at concentrations as low as 0.1% (1000 ppm) of CO_2 may be due to an increase in cerebral blood flow. [132] Another study saw a decrease in the level of basic activity and the use of information at 1000 ppm, when compared to 500 ppm. [133] The ventilation CO_2 concentration meter using nondispersive Poor inhramergic sensor ventilation is one of the main causes of excessive CO_2 concentration in closed spaces. Carbon dioxide differential above external concentrations at stable conditions (when the operation of the occupancy system and ventilation is long enough that co2 concentrations have been stable) are sometimes used to estimate the ventilation rates of each person. [citation required] Higher concentration of CO_2 is associated with deterioration in health, comfort and performance of the occupants. [137] [138] ASHRAE 62.1–2007 ventilation rates may cause internal concentrations of up to 2,100 ppm beyond the external conditions of the atmosphere. Therefore, if Concentration is 400 ppm, internal concentrations may reach 2,500 ppm with ventilation rates that meet the industry's consensus standards. Concentrations in bad ventilation space are available higher than this (range 3,000 or 4,000). Miners, which are particularly vulnerable to gas exposure due to inadequate ventilation, refer to a mixture of carbon dioxide and nitrogen as blackdamp, damp choke or stythe. Before more effective technologies are developed, miners often monitor dangerous levels of blackdamp and other gases in mine shame by bringing sanctuary canary with them as they work. Canary is more sensitive to asphyxiated gases than humans, and because it becomes unconscious will stop altogeccans and fall from its perch. Davy's lights can also detect high levels of blackdamp (which is sinking, and collect near the floor) by burning less brightly, while methane, another drowning risk of gas and explosions, will make the light burn more brightly. In February 2020, three people died from drowning at a party in Moscow when dried ice (frozen co2) was added to the swimming pool to cool down. [139] Human physiology Reference Content range or average for semi-carbon dioxide pressure (abbreviation pCO_2) kPa mmHg Venous carbon dioxide blood 5.5–6.8 41-51[140] Alveolar pulmonarygas pressure 4.8 5 36 Carbon blood artery dioxide 4.7–6.0 35-45[140] The body produces approximately 2.3 pounds (1.0 kg) of carbon dioxide per day,[141] containing 0.63 pounds (290 g) of carbon. In humans, this carbon dioxide is carried out through a venous system and breathes out through the lungs, causing lower concentrations in the arteries. The carbon dioxide content of the blood is often given as partial pressure, which is that the carbon dioxide pressure will have if it alone occupies the volume. [142] In humans, blood carbon dioxide content is shown in the adjacent table: Transportation in CO_2 blood is carried in blood in three different ways. (The exact percentage varies depending on whether it is artery or venous blood). Mostly (about 70% to 80%) converted to HCO bikarbonate ion−3 by carbonic anhydrase enzyme in red blood cells,[143] by co2+ H_2O → H_2CO_3 reaction → H^+ + HCO_3^-. 5-10% dissolved in plasma[143] 5-10% tied to hemoglobin as carbamino compounds[143] Hemoglobin, the molecule brings major oxygen in red blood cells, bringing both oxygen and carbon dioxide. However, CO_2 is tied to hemoglobin not tying to the same site as oxygen. Instead, it merged with terminal group N on a chain of four globines. However, due to the alloy effect on hemoglobin molecules, the CO_2 tie-up reduces the amount of oxygen bound for semi-oxygen pressure that This is known as the Haldane Effect, and is important in the transport of carbon carbon from tissues to the lungs. On the other hand, increased partial pressure of CO_2 or lower pH will cause oxygen unloundering of the hemoglobin, known as the Bohr effect. Breathing rules This section requires additional quotes for verification. Please help improve this article by adding quotes to reliable sources. Unsourced materials can be challenged and removed. (June 2014) (Learn how and when to remove this template message) Carbon dioxide is one of the local autoregulation intermediaries of blood supply. If the concentration is high, the capilary develops to allow greater blood flow to the tissue. Ion bikarbonate is essential to regulate blood pH. A person's respiratory rate affects the levels of CO_2 in their blood. Breathing is too slow or shallow to cause respiratory acidosis, while overwhelming breathing leads to hyperventilation, which can cause respiratory alkalosis. Although the body needs oxygen for metabolism, low levels of oxygen usually do not stimulate breathing. On the other hand, breathing is boosted by higher levels of carbon dioxide. As a result, breathing low pressure air or oxygen-free gas mixtures altogether (such as pure nitrogen) can cause loss of consciousness without ever suffering from air hunger. This is particularly dangerous for high altitude fighter pilots. It is also why flight attendants instruct passengers, in case of losing cabin pressure, to apply oxygen masks to themselves first before helping others; otherwise, a risk of loss of consciousness. [143] The respiratory center tries to maintain 40 mm Hg. ARTERY CO_2 pressure With inflicted hyperventilation, the co2 content of artery blood can be lowered to 10-20 mm Hg (blood oxygen content is slightly affected), and the respiratory drive decreases. This is why one can breathe a person longer after hyperventilating than without hyperventilating. This carries the risk that unconsciousness can cause before the need to breathe into warm, which is why hyperventilation is very dangerous before free diving. See also The Bosch gas blood artery Chemical Portal Response Bottle Gas - Ingredients that gas at standard temperature and pressure and have been compressed and stored in carbon dioxide gas cylinders of carbon sequel sensors - Long-term capture and storage of atmospheric cave dioxide Dogs - Caves near Naples, Italy Standard emissions indoor air quality - Air quality in and around buildings and structures of Rich Identity - Identity on the carbon discharge of anthropogenic dioxide Of Lake Kivu - Meromic Lake in the East African Rift valley List of power stations most efficient carbon list of countries by carbon emissions Meromictic Lake - Coated lake remains with non-intermix layer of PCO_2 water - Semi-carbon carbon pressure often used in reference to the blood of Gilbert Plass (early work on CO_2 and climate change) Sabatier Reaction - The process of carbon dioxide metanation with HYDROGEN NASA's Orbiting Carbon Observatory 2 Greenhouse Gases Satellite Reference ^ b Carbon Dioxide (PDF). 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