Sulfur hexafluoride molar mass calculation

Content - SulfurXAFLUORIDE Sulfur Exafluoride Index (SF6) provides high-precision thermodynamic properties for sulfur hexafluoride (molar mass =146,054 g/mole) using the fundamental equation of state, as described by: Span, R. and Wagner, W. Equations of State for Technical Applications: II Results for Non-Polar Fluids Int.M. 11, 1990, pp. 189-199 Reference state h = 0 kJ/kg, s = 0 kJ/kg-K at 273.15 K, 101.325 kPa. The reference state can be changed using the $Reference directive. Applicability range for the equation of state: 222.38 K < T < 750 K 0 < P < 60 MPa Thermoconductivity and viscosity correlations were suitable for tabular data provided in: Handbook of Physical Properties of Liquids and Gases Natan B. Vargaftik, Yurii K. Vinogradov and Vadim S. Yargin 3rd Augmented and Revised Edition Begell House, Inc Range of applicability for transport function correlations: Viscosity in the gas phase: viscosity from 222 K to 750K Liquid phase: 222 K to 318,7 K Thermal conductivity in the gas phase: from 220 K to 750 K Thermal conductivity in the liquid phase: from 222 K to 318.7 K Surface voltage data are provided using information in: Mulero , A., Cachadina, I, and Parra, M. Recommended correlations for surface tension of J.Phys common fluids. , No.4, 2012 Fluid Property Information Sulfur hexafluoride is an inorganic gas consisting of sulfur and fluoride. Sulfur hexafluoride is one of the most stable gases known. Sulfur hexafluoride is a very dense gas, so it will reside mainly in the lower layers of air. The exhibition will be mainly professional. Sulfur hexafluoride is a weaker eluent than carbon dioxide and difficult to obtain in adequate purity. It provides high dielectric strength and excellent arc quenching properties. the high heat absorption capacity makes sulphur hexafluoride a strong greenhouse gas with a contribution equivalent to CO2 to global warming potential. Other names – hexafluoro-λ6-sulfane SF6 Sulphur hexafluoride density 6.17 kg/m³ Molecular weight/ Molar mass 146.06 g/mol Boiling point −50.8 °C Melting point −64 °C Chemical Formula SF6 Structure Sulfur hexafluoride - SF6 Physical properties of sulfur hexafluoride - Odorless appearance of the odour SF6 Colorless gas Covalent-glued unit 1 Hydrogen bond acceptor 6 Complexity 62.7 Water-soluble solubility and easily soluble in non-polar organic solvents. Chemical properties of sulfur hexafluoride - SF6 sulfur hexafluoride dissolves in the forms of sulphuric acid and hydrogen sulfide water. The chemical equation is as follows. SF6 + 4H2O → H2SO4 + 6HF Sulfur hexafluoride reacts base such as sodium hydroxide forms sodium sulfate, sodium fluoride and water. The chemical equation is as follows. SF6 + 8NaOH → Na2SO4 + 6NaF + 4H2O Uses of sulfur hexafluoride – SF6 Used in magnesium production as a cover gas and in some semiconductor production. Used as a dating tool and as a tracer of igneous and volcanic fluids in groundwater. Used as electrical insulation, arc quenching and cooling medium in electrical panels, transformers and sub-installations. Used as an engraving gas for plasma engraving or as a cleaning gas for cleaning chambers after the engraving process in the semiconductor industry. Greenhouse gas Sulphur hexafluoride Names IUPAC name Sulphur hexafluoride Systematic name IUPAC Hexafluoro-λ6-sulfane[1] Other names Elagas Esaflon Sulphur(VI) sulphur fluoride CAS identifiers Number 2551-62-4 Model Y 3D (JSmol) Interactive image Ch Ch EBI CHEBI:30496 Y ChemSpider 16425 Y ECHA InfoCard 100.018.050 EC Number 219-854-2 Gmelin Reference 2752 KEGG D05962 N MeSH Sulfur+Hexafluoride PubChem CID 17 RTECS Number 358 WS4900000 UNII WS7LR3I1D6 N N A Number 1080 CompTox Dashboard (EPA) DTXSID8029656 InChI InChI=1S/F6S/c1-7(2,3,4,5)6 YKey: SFZCNBIFKDRMGX-UHFFFAOYSA-N Y SMILES FS(F)(F)(F)(F)F Chemical Formula Property SF6 Molar Mass 146.06 g/mol Appearance Colorless Gas Odour[2] Density 6.17 g/L Melting Point −64 °C; −83 °F; 209 K Boiling point −50.8 °C (−59.4 °F; 222.3 K) Critical point (T, P) 45.51±0.1 °C, 3,749±0.01 MPa[3] Water solubility 0.003% (25 °C)[2] Slightly water-soluble solubility, very soluble in ethanol, hexane, benzene Steam pressure 2.9 MPa (at 21.1 °C) Magnetic susceptibility (χ) −44.0×10−6 cm3/mol Conductivity thermal 13.45 mW/(m·K) at 25 °C[4] 11.42 mW/(m·K) at 0 °C Viscosity 15.23 μPa·s[1 5] Structure Crystalline structure Orthorombic, oP28 Spatial group Oh Coordination of hexagonal geometry Ottahedral molecular form Ottahedral dipole moment 0 D Thermochemical thermal capacity (C) 0.097 kJ/(mol· K) (constant pressure) Std molarentropy (So298) 292 J·mol−1· K−1[6] Std enthalpy of training (ΔfH⦵298) −1209 kJ·mol−1[6] ATC code of pharmacology V08DA05 (WHO) EU EMA license data: from esa Sulphurfluoride Hazards Safety data sheet External (obsolete) MSDS phrases S S38 NFPA 704 (fire diamond) 0 1 0SA NIOSH (US health exposure limits): PEL (allowed) TWA 1000 ppm (1 000 ppm 6000 mg/m3)[2] REL (Recommended) TWA 1000 ppm (6000 mg/m3)[2] IDLH (Immediate Danger) N.D.[2] Related Compounds Fluorides of sulphur Disulfide decafluoride Sulphur tetrafluoride Related compounds Selenium hexafluoride Sulphur fluoride Tellurium hexafluoride Dipolonium Unless otherwise indicated, data are provided for standard materials (at 25 °C [77 °F], 100 kPa). Y verification (which Yn ?) Infobox refers to sulphur hexafluoride (SF6) or sulphur sulfur (British orthography), is an extremely powerful and persistent man-made greenhouse gas that is mainly used as an electrical insulation and arc suppressor. It is inorganic, colorless, odorless, non-flammable and non-toxic. SF6 has an ottahedric geometry, consisting of six fluorine atoms attached to a central sulfur atom. It's a hypervalent molecule. Typical of a non-polar gas, SF6 is poorly soluble in water but quite soluble in non-polar organic solvents. It has a density of 6.12 g/L under sea level conditions, considerably higher than air density (1,225 g/L). It is generally transported as liquefied compressed gas. Synthesis and SF6 reactions can be prepared from the elements through exposure from S8 to F2. This was also the method used by discoverers Henri Moissan and Paul Lebeau in 1901. Some other sulfur fluorides are co-generated, but these are removed by disproportionately heating any S2F10 (which is highly toxic) and then rubbing the product with NaOH to destroy the remaining SF4. Alternatively, using bromine, sulfur hexafluoride can be synthesized from SF4 and CoF3 at lower temperatures (e.g. 100 °C), as follows:[8] 2 CoF3 + SF4 + [Br2] → SF6 + 2 CoF2 + [Br2] There is virtually no reaction chemistry for SF6. A major contribution to SF6 inertia is the steric obstacle of the sulfur atom, while its heavier group 16 counterparts, such as SeF6, are more reactive than SF6 due to less steric obstacle (see example of hydrolysis). [9] It does not react with molten sodium below its boiling point,[10] but reacts exothermically with lithium. Mauna Loa sulfur hexafluoride times. Atmospheric concentration of SF6 compared to similar man-made gases (right graph). Note the log scale. According to the Intergovernmental Panel on Climate Change, SF6 is the most powerful greenhouse gas it has evaluated, with a global warming potential of 23,900 times that of CO2 compared to a 100-year period. Sulfur hexafluoride is inert in the troposphere and stratosphere and is extremely long-lived, with an estimated atmospheric life of 800-3,200 years. Measurements by SF6 show that its average global mixing ratio reached over 10 parts per trillion (ppt) in April 2020 and is increasing by about 0.35 ppt (3.5 percent) per year. [13] Global average concentrations of SF6 increased by about seven% per year in the 1980s and 1990s, mainly due to its use in magnesium production and by electric utilities and electronics manufacturers. Given the small amounts of SF6 released compared to carbon dioxide, it is estimated that its overall individual contribution to global warming is lower 0.2%,[15] however, the collective contribution of it and similar haogenated gases produced by man reached about 10% in December 2020. [16] The alternatives are being tested. [17] In Sf6 is part of the F-Gas Directive which prohibits or controls its use for different applications. As of January 1, 2006, SF6 has been banned as a tracer gas and in all applications except high-voltage switchgear. In 2013, it was reported that a three-year effort by the U.S. Department of Energy to identify and repair leaks in its laboratories in the United States such as the Princeton Plasma Physics Laboratory, where gas is used as a high-voltage insulation, had been productive, cutting annual losses by 1,030 kilograms (2,280 pounds). This was done by comparing purchases with inventory, assuming the difference was leaked, then identifying and repairing leaks. Applications More than 10,000 tons of SF6 are produced per year, most of which (over 8,000 tons) is used as a gaseric medium in the electrical industry. Other main uses include an inert gas for magnesium melting and as an inert filling for isolated glazing windows. The SF6 dielectric medium is used in the electrical industry as a gaseric dielectric medium for high voltage circuit breakers, electrical panels and other electrical equipment, often replacing oil-filled circuit switches (OCBs) that may contain harmful PCBs. SF6 gas under pressure is used as an insulation in gas-insulated electrical panels (GIS) because it has a much higher dielectric resistance than air or dry nitrogen. The high dielectric force is the result of high electronegativeness and gas density. This property allows you to significantly reduce the size of electric gears. This makes GIS more suitable for certain purposes such as internal positioning, as opposed to air-insulated electric gears, which takes up much more space. Gas-insulated electric gears are also more resistant to the effects of pollution and climate, as well as being more reliable in long-term operation due to its controlled operating environment. Exposure to an arc chemically breaks down SF6 although most decomposition products tend to rapidly reform SF6, a process called self-healing. [21] The arc or crown can produce disulfide decafluoride (S2F10), a highly toxic gas, with phosgene-like toxicity. S2F10 was considered a potential chemical warfare agent in World War II because it does not produce tearing or skin irritation, thus providing little warning of exposure. SF6 is also commonly encountered as a high-voltage dielectric in high-voltage supplies of particle accelerators, such as van de Graaff and Pelletrons generators and high voltage electron microscopes. Search for the in Wiktionary, the free dictionary. Alternatives to SF6 as dielectric gas include several fluoroketones. [22] Medical use SF6 is used to provide a buffer or plug of a retinal hole in retinal detachment repair operations[24] in the form of a gas bubble. It is inert in the glass chamber[25] and initially initially its volume in 36 hours before being absorbed into the blood in 10-14 days. Sf6 is used as a contrast agent for ultrasonic imaging. Sulfur hexafluoride microbubbles are administered in injection solution into a peripheral vein. These microbubbles improve the visibility of blood vessels to ultrasound. This application has been used to examine the vascularization of tumors. It remains visible in the blood for 3-8 minutes and is exhaled from the lungs. [28] Sulfur hexafluoride composed of tracer was the tracer gas used in the first calibration of the roadway air dispersion model; This research program was sponsored by the U.S. Environmental Protection Agency and conducted in Sunnyvale, California on U.S. Highway 101. Gaseous SF6 is used as a tracer gas in short-term experiments on ventilation efficiency in buildings and internal enclosures and to determine infiltration rates. Two main factors recommend its use: its concentration can be measured with satisfactory accuracy at very low concentrations, and the Earth's atmosphere has a negligible concentration of SF6. Sulphur hexafluoride was used as a non-toxic test gas in an experiment at St. John's Wood Tube station in London, United Kingdom, on 25 March 2007. The gas was released throughout the station and monitored as it moved. The aim of the experiment, which was announced in early March by Transport Secretary Douglas Alexander, was to investigate how toxic gas could spread to all London Underground stations and buildings during a terrorist attack. Sulfur hexafluoride is also routinely used as a tracer gas in laboratory smoke hood containment tests. The gas is used in the final stage of qualifying the ASHRAE 110 suction hood. Inside the suction hood a gas plume is generated and a test battery is performed while a gas analyzer arranged outside the hood samples for SF6 to check the containment properties of the fume hood. It has been successfully used as a tracer in oceanography to study diapicnal mixing and air-sea gas exchange. Other uses The U.S. Navy's Mark 50 closed rankine cycle propulsion system is powered by sulfur hexafluoride in an exothermic reaction with solid lithium. SF6 plasma is also used in the semiconductor industry as an engraver. A small fraction of SF6 breaks down into sulfur and fluorine plasma, with fluorine ions performing a chemical reaction with silicon. The magnesium industry uses large amounts of SF6 as an inert gas to fill out the melting modules. wave guides in high-power microwave systems. The gas isolates the wave guide, preventing the inner arc. It has been used in electrostatic speakers due to its high dielectric strength and high molecular weight. It was used to fill Nike Air bags in all their shoes from 1992 to 2006. [35] Raw material for production desulphuride decafluoride of the weapon. For entertainment purposes, when breathed, SF6 causes the voice to become significantly deeper, due to its much higher air density, as seen in this video. This is related to the best-known effect of breathing low-density helium, which causes someone's voice to become much higher. Both of these effects should only be attempted with caution, as these gases move the oxygen that the lungs are trying to extract from the air. Sulfur hexafluoride is also slightly anesthetic. [36] For scientific demonstrations/magic such as invisible water since a boat of light sheets can be floated in a tank, as well as an air-filled balloon Physiological effects and precautions Such as xenon, sulfur hexafluoride is a non-toxic gas, but moving oxygen into the lungs, it also carries the risk of asphyxiation if too much is inhaled. Since it is denser than air, a significant amount of gas, once released, will settle in low areas and present a significant risk of asphyxiation if the area is inserted. This is particularly relevant for its use as an insulation in electrical equipment, as workers can be in trenches or wells below equipment containing SF6. As with all gases, the density of SF6 affects the resonance frequencies of the vocal tract, thus drastically changing the vocal sound qualities, or timbre, of those who inhale it. It does not affect the vibrations of the vocal folds. The density of sulfur hexafluoride is relatively high at room temperature and pressure due to the large molar mass of the gas. Unlike helium, which has a molar mass of about 4 g/mol and raises its voice, SF6 has a molar mass of about 146 g/mol, and the speed of sound through the gas is about 134 m/s at room temperature, causing the voice to drop. By comparison, the molar mass of air, which is about 80% nitrogen and 20% oxygen, is about 30 g/mol leading to a sound speed of 343 m/s.[39] Sulfur hexafluoride has an anesthetic power slightly lower than nitrogen oxide; Sulfur hexafluoride is classified as mild anesthetic. [41] See also Selenium Hexafluoride Tellurium hexafluoride Uranium hexafluoride Hypervalent molecule Alocarbon - another group of major greenhouse gases References ^ Sulfur hexafluoride - PubChem Public Chemical Database. Mr PubChem. National Centre for Biotechnological Information. Originally released November 3, 2012. Accessed February 22, 2013. ^ a b c d and NIOSH Pocket Guide to Chemical Hazards. #0576. National Institute for Safety and Health at Work (NIOSH). ^ Horstmann, Sven; Fischer, Kai; Gmehling, Jürgen (2002). Measurement and calculation of critical points for mixtures e ternarie. Diario AIChE. 48 (10): 2350–2356. doi:10.1002/aic.690481024. ISSN 0001-1541. ^ Assael, M. J.; Koini, I. A.; Antoniadis, K. D.; M. L. Huber; Abdulagatov, .M.; R. A. Perkins (2012). Riferimento Riferimento thermal conductivity of sulphur hexafluoride from triple to 1000 K and up to 150 MPa. Journal of Physical and Chemical Reference Data. 41 (2): 023104–023104–9. doi:10.1063/1.4708620. 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External Links Fluoride and Compounds Fact Sheet - National Pollutant Inventory High GWP Gases and Climate Change from the U.S. EPA International Conference on SF6 and the Environment (related archive) CDC - NIOSH Pocket Guide to Chemical Hazards Retrieved from