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From Sciencemadness Wiki Hydrogen chloride is the anhydride of hydrochloric acid. It has the chemical formula HCl. At room temperature, it is a colorless gas, which forms white fumes of hydrochloric acid upon contact with atmospheric humidity. Hydrogen chloride gas and hydrochloric acid are important in technology and industry. Hydrochloric acid, the aqueous solution of hydrogen chloride, is also commonly given the formula HCl (aq), though the use of "(aq)" is only required to indicate the reaction solvent, in this case water, and often HCl is sufficient. Properties Chemical HCl is a diatomic gas consisting of hydrogen and chlorine. The much greater electronegativity of chlorine causes the gas to be very polar. Due to it's polarity, it is highly soluble it water, and the gas is hygroscopic. Upon contact, H2O and HCl combine to form hydronium cations H3O+ and chloride anions Cl– through a reversible chemical reaction: HCl + H2O → H3O+ + Cl– A simple test for hydrogen chloride fumes involves holding an open container of aqueous ammonia in a suspected area. If sufficient amounts of hydrogen chloride is present, it will react with the ammonia gas to form a dense white fog of ammonium chloride. Physical HCl is a colorless gas, which forms white fumes of hydrochloric acid in the presence of moisture. It has a strong, pungent smell and taste. HCl is extremely soluble in water (720 g/L at 20 °C), and more so at lower temperatures, as well as other solvents such as methanol, ethanol, diethyl ether, THF, but less soluble in non-polar solvents such as benzene, chloroform, carbon tetrachloride. It has a boiling point of −85.05 °C and a melting point of −114.22 °C. Availability Anhydrous hydrogen chloride is only available to industrial consumers. In US it is considered DEA List II chemical. Preparation Direct synthesis: Industrially, HCl (and sodium hydroxide) is made from the chlor-alkali process, brine (mixture of sodium chloride and water) solution is electrolyzed producing chlorine (Cl2), sodium hydroxide, and hydrogen (H2). The pure chlorine gas can be combined with hydrogen to produce hydrogen chloride in the presence of UV light. Cl2(g) + H2(g) → 2 HCl(g) As the reaction is exothermic, the installation is called an HCl oven or HCl burner. The resulting hydrogen chloride gas is absorbed in deionized water, resulting in chemically pure hydrochloric acid. This reaction can give a very pure product, e.g. for use in the food industry. This reaction occurs explosively in the presence of light. Small amounts of HCl gas for laboratory use can be generated in a HCl generator by dehydrating hydrochloric acid with either sulfuric acid or anhydrous calcium chloride. The latter however, required lots of anhydrous calcium chloride. [1] Alternatively, HCl can be generated by the reaction of sulfuric acid with sodium chloride: NaCl + H2SO4 → NaHSO4 + HCl This reaction occurs at room temperature. Provided there is salt remaining in the generator and it is heated above 200 °C, the reaction proceeds to; NaCl + NaHSO4 → HCl + Na2SO4 For such generators to function, the reagents must be dry. Projects Make hydrochloric acid Anhydrous metal chloride synthesis Trichlorosilane synthesis Handling Safety Hydrogen chloride forms corrosive hydrochloric acid on contact with water found in body tissue. Inhalation of the fumes can cause coughing, choking, inflammation of the nose, throat, and upper respiratory tract, and in severe cases, pulmonary edema, circulatory system failure, and death. Skin contact can cause redness, pain, and severe skin burns. Hydrogen chloride may cause severe burns to the eye and permanent eye damage. The gas, being strongly hydrophillic, can be easily scrubbed from the exhaust gases of a reaction by bubbling it through water, producing useful hydrochloric acid as a byproduct. Any equipment handling hydrogen chloride gas must be checked on a routine basis; particularly valve stems and regulators. The gas requires the use of specialized materials on all wetted parts of the flow path, as it will interact with or corrode numerous materials hydrochloric acid alone will not; such as stainless and regular polymers. The Occupational Safety and Health Administration and the National Institute for Occupational Safety and Health have established occupational exposure limits for hydrogen chloride at a ceiling of 5 ppm (7 mg/m3). Storage Hydrogen chloride cylinders should be kept away from any heat or light source. A special acid cabinet can be used, which should be lined with a scrubbing material to remove any leaking hydrogen chloride. The cylinders must be inspected periodically for any signs of corrosion. Disposal Hydrogen chloride, like hydrochloric acid can be neutralized by reacting it with a base or a carbonate. Calcium hydroxide or carbonate are cheap and effective. Fumes can be neutralized with ammonia, though this method has the disadvantage of producing a a very thick mist of ammonium chloride that tends to persist. References ↑ Relevant Sciencemadness threads DRY HYDROGEN CHLORIDE GAS Share — copy and redistribute the material in any medium or format for any purpose, even commercially. Adapt — remix, transform, and build upon the material for any purpose, even commercially. The licensor cannot revoke these freedoms as long as you follow the license terms. Attribution — You must give appropriate credit , provide a link to the license, and indicate if changes were made . You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use. 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InChI=1S/ClH/h1HInChIKeyInChIKey=VEXZGXHMUGYJMC-UHFFFAOYSA-NSMILESClCanonical SMILESClOther Names for this SubstanceHydrochloric acidAnhydrous hydrochloric acidChlorohydric acidDilute hydrochloric acidHydrogen chlorideDeleted or Replaced CAS Registry Numbers113962-65-5, 51005-19-7, 61674-62-2, 218625-68-4 As a hydrogen halide, the compound hydrogen chloride has the chemical formula HCl. It is a colourless gas at ambient temperature that emits white fumes of hydrochloric acid when it comes into contact with air-water vapour. In technology and industry, hydrogen chloride gas and hydrochloric acid are critical. Hydrochloric acid, an aqueous solution of hydrogen chloride, is also known as HCl. Dissolving gaseous hydrogen chloride in water yields hydrochloric acid. Because of the acid's corrosive nature, ceramic, glass, or occasionally tantalum apparatus is usually employed. Hydrochloric acid is often sold as a solution containing 28–35 % hydrogen chloride by weight, sometimes known as concentrated hydrochloric acid. Although anhydrous liquid hydrogen chloride is accessible, its application is limited due to the large and expensive containers necessary to store it. Below mentioned is the structure of HCl: Structure of HClPreparation of HClGlauber created hydrogen chloride for the first time in 1648 by heating sodium chloride with concentrated H2SO4. Davy demonstrated in 1840 that HCl is a combination of chlorine and hydrogen. Muriatic acid is another term for hydrochloric acid. Warming NaCl crystals with concentrated H2SO4 produces muriatic acid (Sulphuric acid).NaCl+H2SO4→NaHSO4+HCl As a byproduct, we obtain sodium bisulphate, which is insoluble. As a result, we add additional sodium chloride to it. This mixture must be heated to a higher temperature of around 823K. It produces soluble sodium sulphate and HCl gas. This HCl is dried by treating it with strong sulphuric acid. HCl is not dried in the presence of phosphorus pentoxide or vigorous lime. This is due to the fact that it reacts with both of these molecules.NaHSO4 + NaCl → Na2SO4 + HCl Typically, the majority of the hydrogen chloride/hydrochloric acid produced is a byproduct of other chemical reactions. The chlorination of hydrocarbons also produces HCl.Dissolving gaseous hydrogen chloride in water yields hydrochloric acid. Because of the acid's corrosive nature, ceramic, glass, or occasionally tantalum apparatus is usually employed.Chemical Properties of HClIn an aqueous solution, the chemical dissociates extensively into a hydronium ion (H3O+) and a chloride ion (Cl-).Because it is monoprotic, it can only emit one proton.In water, it can entirely dissociate to generate hydrogen and chloride ions.Noble metals react at a 1:3 ratio with a mixture of nitric acid and hydrochloric acid. This is referred to as aquaregia.The salts of weaker acids react with hydrochloric acid. Sodium carbonate, sodium bicarbonate, and other salts are examples.When hydrochloric acid combines with sodium carbonate and sodium bicarbonate, it produces sodium chloride, carbon dioxide, and water.It also converts sodium sulphate to sodium chloride, sulphur dioxide, and water.Reaction with Sodium CarbonateNa2CO3 + 2HCl → 2NaCl + CO2↑ + H2O Reaction with Sodium BicarbonateNaHCO3 + HCl → NaCl + CO2↑ + H2O Reaction with Sodium SulphateNa2SO3 + 2HCl → 2NaCl + SO2↑ + H2O Physical Properties of HClHydrogen chloride is a colourless, pungent-smelling gas.The gas smells in damp air due to its high solubility.Dissociation is essentially complete in dilute liquids. As a result, hydrochloric acid is a powerful acid.Hydrochloric acid is a hydrogen chloride aqueous solution.It liquefies at 189K to create a colourless liquid and freezes at159K to form a white solid.Hydrochloric acid is non-corrosive in the presence of glass.Hydrochloric acid is extremely corrosive, attacking metals such as platinum, gold, silver, mercury, tantalum, and others.Organic Synthesis The industrial manufacture of hydrogen chloride is frequently integrated by creating fluorinated and chlorinated organic chemicals, such as Freon, Teflon, and other CFCs, and chloroacetic acid, PVC, and so on. The manufacture of hydrochloric acid is frequently combined with its captive on-site consumption. In the case of chemical reactions, hydrogen atoms on the hydrocarbon can be replaced by chlorine atoms, and the freed hydrogen atom recombines with the spare atom from the chlorine molecule to form hydrogen chloride. Fluorination is defined as the following reaction of chlorine-replacement that results in the production of hydrogen chloride, with the chemical reaction being as follows: R−H + Cl2 → R−Cl + HCl R−Cl + HF → R−F + HCl The resulting hydrogen chloride can be absorbed in water or reused immediately, yielding industrial or technical grade hydrochloric acid. Uses of Hydrogen ChlorideChlorine, aqua regia, and other chlorides are all made using HCl.It's used to dissolve noble gases as a solvent.In laboratories, it is used as a reagent.Pickling of steel is a procedure that uses weak hydrochloric acid to remove rust or iron oxide from steel or iron before it is processed into wire, sheet and strip coating, and tin mill products.Organic compound manufacturing: HCl is beneficial in the production of organic compounds such as vinyl chloride and dichloromethane, both of which are used to make PVC. It also manufactures organic substances such as ascorbic acid and pharmaceuticals.Inorganic compound synthesis: HCl is beneficial in the synthesis of compounds that can be used as water treatment chemicals. Polyaluminium chloride (PAC), ferric acid, and aluminium carbohydrate, for example, are effective in water treatment. It is also beneficial in the regeneration of ion-exchange resins, particularly in the precipitation of cations from the resins.Gastric Acid: Hydrochloric acid is an essential component of gastric juice in the body, which aids digestion. In the stomach, hydrochloric acid turns inactive pepsinogen into active pepsin, which aids digestion by disrupting the links that link amino acids. This is known as proteolysis. Gastric Acid: Hydrochloric acid is a vital part of gastric juice in the body that helps indigestion. Inactive pepsinogen converts into active pepsin by hydrochloric acid in the stomach which helps digestion by breaking the bonds linking amino acids. This process is Proteolysis. Harmful effects of HCl The digestive fluids of the human stomach contain hydrochloric acid.Excessive acid secretion produces stomach ulcers, whereas a substantial deficit hampers digestion and is sometimes the primary cause of deficiency anaemias.A few minutes of exposure to 0.1% by volume hydrogen chloride gas in the environment can result in death.Burns and skin irritation are caused by concentrated hydrochloric acid. Safety from HCl: When hydrogen chloride comes into touch with water in bodily tissue, it produces caustic hydrochloric acid. Inhaling the fumes can induce coughing, choking, nose, throat, and upper respiratory tract inflammation, and, in severe cases, pulmonary edoema, circulatory system failure, and death. Contact with the skin might result in redness, discomfort, and serious chemical burns. Hydrogen chloride can cause serious eye burns and lasting eye damage. Sample Questions Question 1: Which acid is used in the preparations of hydrogen chloride gas? Answer: In the production of Hydrogen Chloride gas, concentrated sulfuric acid is employed. Question 2: Give two examples of colourless gases that mix to form a white solid. Answer: When hydrogen chloride and ammonia combine, they form a white solid. Question 3: Why can't dilute hydrochloric acid be concentrated by boiling beyond 22.2%? Answer: It cannot be concentrated further than 22.2 percent by boiling because the molecules of dilute hydrochloric acid HCl (g) combine with water vapour. Question 4: What are the physical properties of hydrogen chloride gas? Answer: It is an odourless and colourless gas.It has a sour flavour and a strong odour.It dissolves readily in water and other non-polar solvents.HCl gas has a boiling point of -83°C and a melting point of -113°C.It is caustic in nature, causing irritation, pain, and inflammation, as well as coughing, sneezing, and choking sensations when inhaled. Question 5: How to convert Hydrochloric acid to nascent chlorine? Explain with a balanced equation. Answer: By combining three parts concentrated hydrochloric acid and one part concentrated nitric acid, hydrochloric acid can be transformed to nascent chlorine. Hydrogen chloride is an inorganic chemical compound from the group of hydrogen halides. The aqueous HCl solutions are called hydrochloric acid.Molar mass36.458 (g/mol)CAS registry number7647-01-0EC number EINECS231-595-7InChI KeyVEXZGXHMUGYJMC-UHFFFAOYSA-NSystematic nameChloraneOther names, synonymsHydrochloric acid gas; Hydrochloric gasClH oder HClMr = 36.458 g/molChloraneSMILES: ClHydrogen chloride is present in its pure form (anhydrous) as a colorless, non-flammable gas that has a sharp, pungent smell and produces a lot of smoke in moist air. HCl dissolved in water is known as hydrochloric acid. The HCl bond distance in the molecule is 127.4 pm.solubility:+ Soluble in water (720 g/L at 20 °C), methanol, alcohol, ether. partition coefficient logP = 0.25.melting point-144.22 °Cboiling point-85.05 °Cvapor pressure4.26 MPa at 20 °C viscosity0.311 cP at -100 °C refractive indexnD = 1.0004456 (gas)standard enthalpy of formation-92.312 kJ/mol at 25 °Cstandard entropie186.902 J/(K mol) at 25 °Centhalpy of combustion-95.31 kJ/mol at 25 °Cheat capacity0.7981 J/(K g)dipole moment1.1086(3) D permittivity1.0046 (Gas) at 25 °C (dielectric constant)Mass-related elemental composition and isotope proportions of the compound Hydrogen chloride - ClH - calculated based on molecular mass.SymbolElement ENumber xof atoms ExData of the elementand isotopes *Percentagesof isotopesPercentage ofEx in formula massClChlorine1ΣAr = 35.45 u36Cl: 35.96831 u [