Hydrogen chloride Gas and Hydrochloric Acid

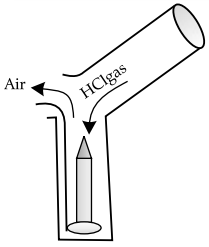
Basic introduction to HCl

It has a polar covalent bond

Some experiments to demonstrate density & Solubility

Experiment to demonstrate density

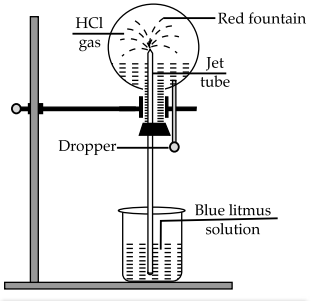
Since HCl gas is heavier than air, it can be shown by this experiment



The candle gets extinguished because HCl gas being heavier occupies the lower portion of jar and forces the air out of it.

Experiment to demonstrate solubility

Fountain experiment



- Reason: As water goes in the flask from the dropper, HCl gas present in the flask dissolve with water and lowering the pressure inside.
- The outside pressure being higher, pushes the blue lilmus solution inside, through the jet tube.
- The blue litmus solution turn red due to the acidic nature of hydrogen chloride gas.

Precautions during preparing of HCl gas

- The lower end of the thistle funnel must be dipped in conc. sulphuric acid.
- Delivery tube should be dipped in drying agents. ie. concH_2SO_4
- Temperative is maintained at nearly 200°C, because at higher temperature the glass apparatus can crack.

Occurrence

- Hydrogen chloride gas occurs in free state in volcanic emissions.
- Hydrochloric acid (0.2 - 0.4)% is present in gastric juice of mammals and it helps in digestion.

Physical properties of HCl gas

- Colourless gas.
- Pungent choking smell.
- Sour (acidic) in tube.
- Corrosive in nature.
- Heavier than air.
- Boling point - 83 °C
- Melting point - 113 °C

Chemical properties of HCl gas.

- The gas is neither combustible nor supporter of combustion.
- On heating at 500°C, it dissociates.
  $2HCl \xrightarrow{>500\,^{\circ}C} H_2 + Cl_2$
- With metals on heating it liberates hydrogen gas.
  $2Na + 2HCl \longrightarrow 2NaCl + H_2\uparrow$
  $Zn + 2HCl \longrightarrow ZnCl_2 + H_2\uparrow$
- It reacts with ammonia to form white ammonium chloride.
  $NH_3(g) + HCl(g) \longrightarrow NH_4Cl(g)$

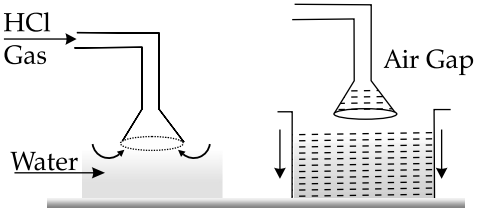
Hydrochloric acid

Preparation

Hydrogen chloride gas is dissolved in water, hydrochloric acid is formed.

Laboratory preparation

- The gas is passed into water until no more gas is absorbed. The product is concentrated and contains about 36% of hydrogen chloride by mass.
- The procedure in lab is a funnel arrangement



Advantage of Funnel arrangement

- Back suction of HCl gas may occur so, funnel arrangement minimizes it.
- Provides the large surface area for absorption of HCl gas.

Physical Properties

- Colourless acid.
- Pungent choking smell.
- Conc. acid is corrosive on skin.
- Readily soluble in water.
- Boiling point is 110°C (Volatile acid).

$2P_2O_5 + 3HCl \longrightarrow POCl_3 + 3HPO_3$
$CaO + 2HCl \longrightarrow CaCl_2 + H_2O$

Chemical properties

- Aqueous solution is strongly acidic
  - Moist litmus turns from blue to red.
  - Methyl orange turns pink from orange.

$Ca + 2HCl \longrightarrow CaCl_2 + H_2\uparrow$
$Mg + 2HCl \longrightarrow MgCl + H_2\uparrow$

Dil. HCl react with lead alkali and mercury (I)nitrate

$Pb(NO_3)_2 + 2HCl \longrightarrow PbCl_2 + 2HNO_3$
$Hg_2(NO_3)_2 + 2HCl \longrightarrow Hg_2Cl_2 + 2HNO_3$

- Forms aqua regia
  $3HCl + HNO_3$

Collection

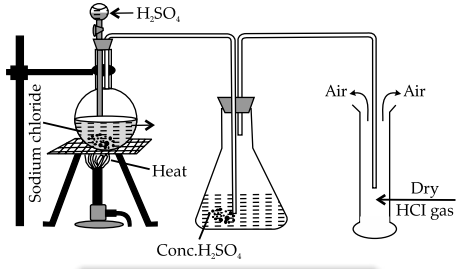
- HCl gas is collected by the downward delivery (upward displacement of air) as it is 1.28 times heavier than air.
- Not collected over water because it is highly soluble in water.

Purification of HCl gas

It is dried by passing through conc. sulphuric acid.

Facts

The other drying agents like P_2O_5 and CaO cannot be used for drying of HCl gas because it reacts with these drying agents.



Reactions.

$NaCl + H_2SO_4 \xrightarrow{<200\,^{\circ}C} NaHSO_4 + HCl\uparrow$

$NaHSO_4 + NaCl \xrightarrow{above\ 200\,^{\circ}C} Na_2SO_4 + HCl\uparrow$

or

$2NaCl + H_2SO_4 \xrightarrow{above\ 200\,^{\circ}C} Na_2SO_4 + HCl\uparrow$ (conc.)

Identification of HCl gas

- To know the jar of gas is full. Bring a rod dipped in ammonium hydroxide near its mouth.
  $HCl + NH_4OH \longrightarrow NH_4Cl + H_2O$
- When HCl gas is exposed in air, it gives white fumes due to formation of hydrochloric acid on reacting with atmospheric water vapour.

General preparation of Hydrogen chloride gas.

Initially obtained

It was first prepared by Glauber in 1648 by heating Common Salt (NaCl) with Concentrated Sulphuric acid.

Facts

- Lavoisier named it muriatic acid.
- In 1810, Davy named it as Hydrochloric acid.

1.By synthesis

- Moist hydrogen gas combines with chlorine in the presence of diffused sunlight.
  $H(g) + Cl_2(g) \xrightarrow[sunlight]{Diffused} 2HCl(g)$
- This reaction is explosive in direct sunlight but negligible in the dark.

By heating metallic chloride with Conc. H_2SO_4

$NaCl + H_2SO_4 \xrightarrow{<200\,^{\circ}C} NaHSO_4 + HCl(g)$

$2NaCl + H_2SO_4 \xrightarrow{abone\ 200\,^{\circ}C} Na_2SO_4 + HCl(g)$

$CuCl_2 + H_2SO_4 \xrightarrow{\Delta} CuSO_4 + 2HCl(g)$

Laboratory preparation

- Reactants:. Sodium chloride and conc. sulphuric acid.
- Procedure. Setup the apparatus.

Trace the Mind Map

First Level · Second Level · Third Level