HYDROCHLORIC ACID

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HYDROCHLORIC ACID: Lab Preparation

By heating sodium chloride with conc. sulphuric acid, the reaction starts in the cold and HCl gas is formed. But the gentle heating is necessary when it slackens (less reactive).

$NaCl + H_2SO_4 \rightarrow NaHSO_4 + HCl$ (On gentle heating)

$NaHSO_4 + NaCl \rightarrow NaSO_4 + HCl$ (On strong heating)

The apparatus is fitted as shown in the figure. The gas cannot be collected over water because of its high solubility. It is collected by upward displacement of air because it is heavier than air.

Drying- It is dried by passing through conc. sulphuric acid and is collected in a gas jar.

Preparation of aqueous hydrochloric acid (HCl)

HCl gas is highly soluble in water. Hence to prepare aq. HCl, care must be taken to see that water is not sucked back into the generating flask.

For that, an anti suction device should be made attaching an inverted funnel to the delivery tube with a rubber tube, such that the rim of the funnel just touches the surface of water in the beaker.

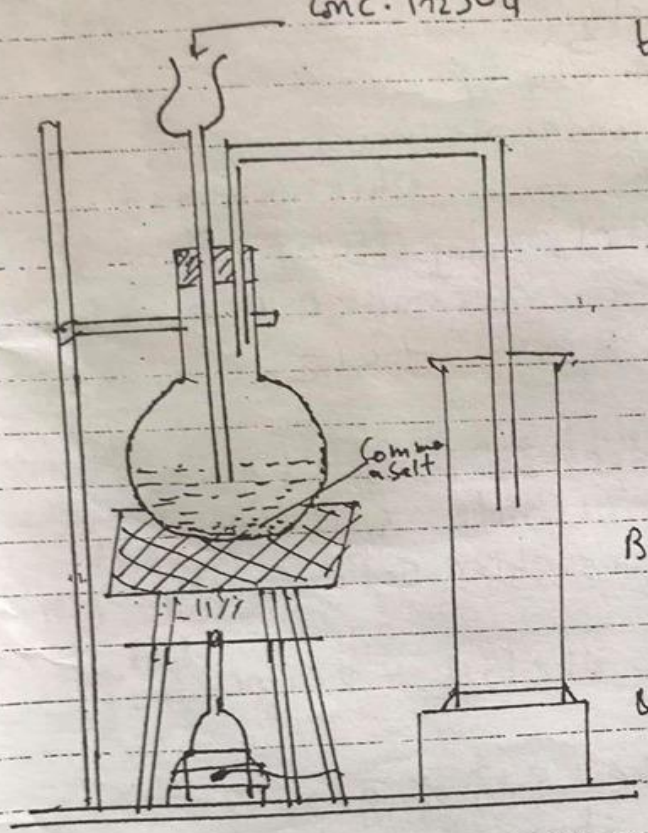

fig - Lab prep^{n} of Hcl gas.

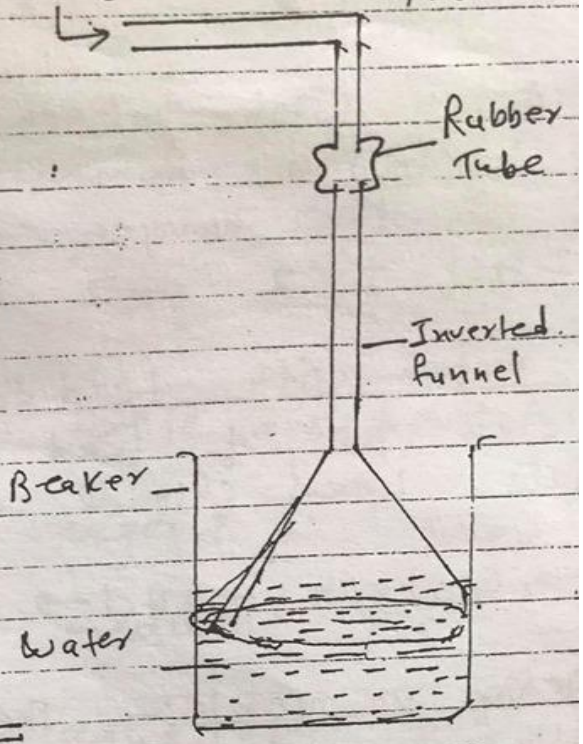

fig - Prep^{n} of Hydrochloric acid.

Properties:
Physical properties

i) It is a colourless gas,
ii) It is heavier than air with pungent suffocating smell.
ii) It has melting point - 114.8˚C and boiling point -84.9˚C.
iii) It is extremely soluble in water.

Chemical properties

i) Combustibility- It is neither combustible nor a supporter of combustion.

ii) Acidic Nature

a) It turns blue litmus red.

b) It neutralizes oxides and hydroxides of metals.

$NaOH + HCl \rightarrow NaCl + H_2O$

$Fe(OH)_3 + 3HCl \rightarrow FeCl_3 + 3\ H_2O$

$2CaO + 4HCl \rightarrow 2CaCl_2 + 2H_2O$

Chemical properties of HCl contd..

iii) Action with Ammonia

Hydrogen Chloride gas combines with NH_3 to give dense white fume of ammonium chloride.

$$HCl + NH_3 \rightarrow NH_4Cl \text{ (white fumes)}$$

iv) Action with oxidizing agents

HCl is quite stable and oxidized to Cl_2 by oxidizing agents like MnO_2, $KMnO_4$, $K_2Cr_2O_7$, PbO_2.

a) $MnO_2 + 2HCl \rightarrow MnCl_2 + H_2O + [O]$

$2HCl + [O] \rightarrow H_2O + Cl_2$

$MnO_2 + 4HCl \rightarrow MnCl_2 + 2HCl + Cl_2$

Action with oxidizing agents contd..

b) $2KMnO_4 + 4HCl \rightarrow 2KCl + MnCl_2 + 2H_2O + 6[O]$

$2HCl + [O] \rightarrow H_2O + Cl_2$] x 6

$2KMnO_4 + 16HCl \rightarrow 2KCl + MnCl_2 + 8H_2O + 6Cl_2$

c) $K_2Cr_2O_7 + 14HCl \rightarrow 2KCl + 2CrCl_3 + 7H_2O + 3Cl_2$

d) $PbO_2 + 4HCl \rightarrow PbCl_2 + Cl_2 + 2H_2O$

Chem. Prop. Contd..

v) Action with $AgNO_3$ (precipitation rxn)

It forms a white ppt. of silver chloride with $AgNO_3$. The ppt. is soluble in NH_3 and insoluble in HNO_3.

$HCl + AgNO_3 \rightarrow AgCl \downarrow + HNO_3$

vi) Formation of Aqua regia

HCl forms aqua regia with HNO_3 when mixed with in the ratio 3:1. Aqua regia is used to dissolve noble metal like gold and platinum.

$3HCl + HNO_3 \rightarrow NOCl + 2Cl + 2H_2O$

$Au + 3Cl \rightarrow AuCl_3$

$AuCl_3 + HCl \rightarrow HAuCl_3$ (Chloroauric acid)

Chem. Prop. Contd..

vii) Action with halogens

Chlorine gas is liberated from HCl by fluorine but no other halogen can decompose it.

$2HCl + F_2 \rightarrow 2HF + Cl_2$

viii) Action with lead acetate

HCl gives a white ppt. of lead chloride with lead acetate. Lead chloride is soluble in hot water.

$(CH_3COO)_2Pb + 2HCl \rightarrow PbCl_2\downarrow + 2CH_3COOH$

Chem. Properties of HCl contd..

ix) Action on metals

The solution of gas is highly acidic and one of the strongest acids. It reacts with metals like iron, zinc, sodium, potassium etc forming corresponding chlorides with the evolution of H_2.

$Fe + 2HCl \rightarrow FeCl_2 + H_2\uparrow$

$Zn + 2HCl \rightarrow ZnCl_2 + H_2\uparrow$

x) Action with Salts of weaker acids

$Na_2S + 2HCl \rightarrow 2NaCl + H_2S$

$NaSO_3 + 2HCl \rightarrow 2NaCl + SO_2 + H_2O$

$NaS_2O_3 + 2HCl \rightarrow 2NaCl + SO_2 + S$

xi) Action with air

In presence of heated cuprous chloride, HCl reacts with air as follows.

$4HCl + O_2 \rightarrow 2H_2O + Cl_2$

Uses of HCl

i) HCl is used in the manufacture of chlorides and chlorine,
ii) It is used in the textile and dye industries.
iii) Used as important reagent in the lab.
iv) It is used as medicine for digestion in stomach.
v) Used to prepare aquaregia , used to dissolve noble metal like gold and platinum.