

The temporary hardness of water is due to the ..

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- 3. Metallic or interstitial hydrides :** The transition elements and rare earth metals combine with hydrogen to give interstitial hydrides. They exhibit metallic properties and are powerful reducing agents. They are non stoichiometric compounds and their composition varies with temperature and pressure.
eg. LaH_{2.76}, TiH_{1.73}
- 4. Polymeric hydrides :** These are solids containing molecules, linked together in two or three dimensions by hydrogen bridge bonds. e.g.: (BeH₂)_n, (MgH₂)_n and (AlH₃)_n

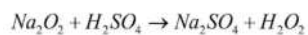
HYDROGEN PEROXIDE

Discovery : French chemist The nard 1818.

Occurrence : Traces in air, rain and plants.

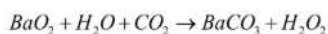
PREPARATION OF HYDROGEN PEROXIDE

1. Lab method : From true peroxide by the action of ice cold dil. H₂SO₄



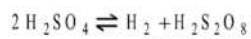
(HNO₃ is not used since it will oxidise H₂O₂).

2. Merck process : By passing CO₂ through a suspension of BaO₂ in ice cold water.

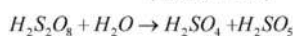


MANUFACTURE OF HYDROGEN PEROXIDE

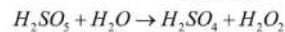
1. By electrolysis of 50% ice cold H₂SO₄



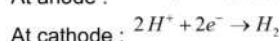
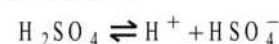
Persulphuric acid (Marshall's acid)



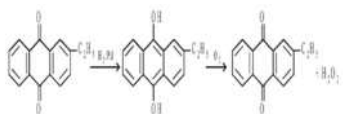
Perronosulphuric acid (Caro's Acid)



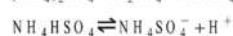
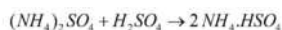
Mechanism :



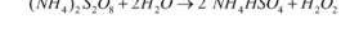
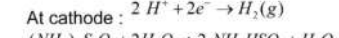
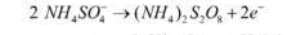
2. Auto oxidation : Most recent method used in America. In this method the anthraquinone is reduced to anthraquinol by dissolving in an organic solvent and passing hydrogen in presence of Pd. On frothing, the anthraquinol derivative with air, 20% solution of H₂O₂ is obtained and anthraquinone is regenerated.



3. By electrolysis of ammonium sulphate solution and sulphuric acid. When aqueous solution of ammonium sulphate and sulphuric acid in equimolar proportion is electrolysed at low temperature ammonium persulphate is formed. The latter on distillation with sulphuric acid gives 30% solution of hydrogen peroxide.



At anode : $2NH_4SO_4^- \rightarrow (NH_4)_2S_2O_8 + 2e^-$



CONCENTRATION OF HYDROGEN PEROXIDE

• It is very carefully concentrated since it decomposes on heating or on standing.

• Decomposition is catalysed by Cu, Ag, Pt, Co, Fe, MnO₂ etc.

The methods employed for concentration are

1. Evaporation: By careful evaporation of solution on a water bath (50% H₂O₂ is obtained).

2. Dehydration in vacuum desiccator : The 50% H₂O₂ is dehydrated in a vacuum desiccator in presence of conc. H₂SO₄ when 90% H₂O₂ is obtained.

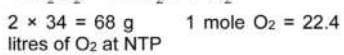
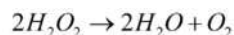
3. Vacuum distillation : The 90% H₂O₂ obtained in step (ii) is distilled under reduced pressure to get 100% H₂O₂

4. Cooling : The traces of water left are removed by freezing in a freezing mixture when

crystals of hydrogen peroxide separate out.

STRENGTH OF HYDROGEN PEROXIDE

The strength of hydrogen peroxide is indicated in terms of the volume of oxygen at NTP that 1 volume of H₂O₂ gives on heating. For example "20 volume H₂O₂" means 1 volume of H₂O₂ at NTP will give 20 volume of oxygen. The normality and percentage strength of H₂O₂ can be calculated as follows



22.4 litres of O₂ at NTP are evolved from 68g of H₂O₂

x litres of O₂ at NTP would be evolved

$$\frac{68}{22.4} \times x \text{ g of } H_2O_2 \text{ from } \frac{68 \times x}{22.4} \text{ g/litre}$$

where x is volume strength of H₂O₂

Hence strength of x volume of H₂O₂ = $\frac{68 \times x}{22.4}$ g/litre

• where 17 is the equivalent weight of H₂O₂

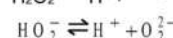
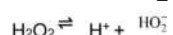
• where 17 is the equivalent weight of H₂O₂

STORAGE OF HYDROGEN PEROXIDE

• It is stored in presence of traces of alcohol, acetanilide or sodium pyrophosphate which slow down the rate of decomposition of hydrogen peroxide.

CHEMICAL PROPERTIES OF HYDROGEN PEROXIDE

1. Acidic nature : It is weakly acidic in nature and pure hydrogen peroxide turns blue litmus into red. (K_a = 1.57 × 10⁻¹² at 293 K). It ionises in two steps H₂O₂ ⇌ H⁺ + HO₂⁻

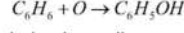
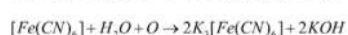
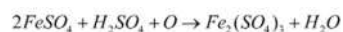
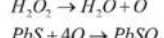
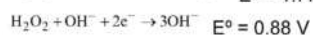
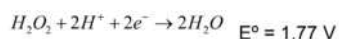


• Hence it forms two series of salts eg. NaHO₂ sodium hydroperoxide and Na₂O₂

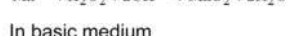
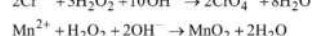
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(Sodium peroxide)

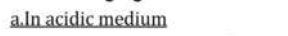
2. Oxidising agent : It is strong oxidising agent in acidic as well as in basic medium.



In basic medium

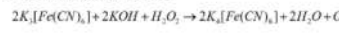


In basic medium



3.Reducing agent :

a.In acidic medium



b.In basic medium



4.Bleaching properties : Its bleaching action is due to oxidation reaction.



STRUCTURE OF HYDROGEN PEROXIDE

It is represented as follows



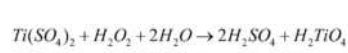
TEST OF HYDROGEN PEROXIDE

1. It liberates I₂ from acidified KI
 $2KI + H_2O_2 \rightarrow 2KOH + I_2$

2. Perchromic acid :
 $H_2Cr_2O_7 + 4H_2O_2 \rightarrow 2CrO_5 + 5H_2O$

(acidified H₂O₂ + amyl alcohol + K₂Cr₂O₇) → blue colour

3. With titanous sulphate it gives orange red pertitanic acid



4. Black lead sulphide turned white
 $PbS + 4H_2O_2 \rightarrow PbSO_4 + 4H_2O$

USES OF HYDROGEN PEROXIDE

• It is used as a bleaching agent, disinfectant, source of power (90% H₂O₂ as fuel in submarines, rockets and helicopters), in restoration of old paintings in which lead oxide is used as white paint.

WATER

Water is one of the most abundant substances in nature. The 4/5th of the earth surface is covered with water.

SOURCES OF WATER

The sources of water are

- 1.Surface water**
 - Flowing water - streams and rivers
 - Still water - ponds, lakes and reservoirs
- 2.Underground water - water from wells**
- 3.Rain water**
- 4.Sea water**

TYPES OF IMPURITIES PRESENT IN WATER

- Dissolved impurities
- Inorganic salts eg. : Ca²⁺, Mg²⁺, Fe²⁺, Al³⁺, Na⁺, K⁺ traces of Zn²⁺ and Cu²⁺ (cations) and Cl⁻, F⁻ etc. (anions) Gases eg.: CO₂, N₂, O₂, oxides of nitro gen, H₂S etc. Organic salts
- Suspended impurities :
- Inorganic : eg.: sand and clay
 - Organic : eg.: animal matter, vegetable etc.

3. Colloidal impurities : Finely divided clay, Al(OH)₃, Fe(OH)₃ colouring matter etc.

4. Bacterial impurities : Micro-organisms and bacteria

Effect of impurities : The impurities effect the followings

- Colour
- Taste
- Hardness
- Alkalinity
- Turbidity
- Odour

SOFT AND HARD WATER

• The water which produces large amount of lather with soap is known as soft water and which forms a scum with soap is known as hard water.

TYPES OF HARDNESS OF WATER

• Temporary hardness: It is due to the presence of bicarbonates of calcium or magnesium or both.

• Permanent hardness : It is due to the presence of chlorides and sulphates of calcium and magnesium.

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