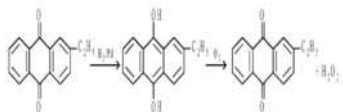


The temporary hardness of water is due to the ..

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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. $\text{LaH}_{2.76}$, $\text{TiH}_{1.73}$
- 4. Polymeric hydrides :** These are solids containing molecules, linked together in two or three dimensions by hydrogen bridge bonds. e.g.: $(\text{BeH}_2)_n$, $(\text{MgH}_2)_n$ and $(\text{AlH}_3)_n$



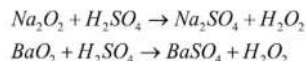
HYDROGEN PEROXIDE

Discovery : French chemist The nard 1818.

Occurrence : Traces in air, rain and plants.

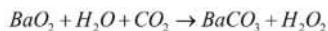
PREPARATION OF HYDROGEN PEROXIDE

1. Lab method : From true peroxide by the action of ice cold dil. H_2SO_4



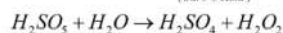
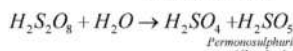
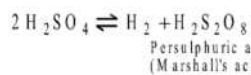
(HNO_3 is not used since it will oxidise H_2O_2).

2. Merck process : By passing CO_2 through a suspension of BaO_2 in ice cold water.

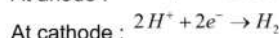
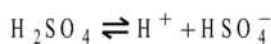


MANUFACTURE OF HYDROGEN PEROXIDE

1. By electrolysis of 50% ice cold H_2SO_4

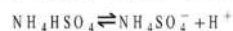
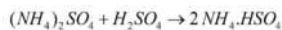


Mechanism :

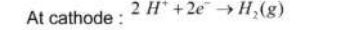
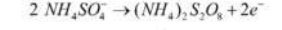


2. Auto oxidation : Most recent method used in America. In this method the anthraquinone is reduced to anthraquinol by dissolving in an organic solvent and passing hydrogen in presence of Pd. On frothing, the anthraquinol derivative with air, 20% solution of H_2O_2 is obtained and anthraquinone is regenerated.

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 : $2\text{NH}_4\text{SO}_4^- \rightarrow (\text{NH}_4)_2\text{S}_2\text{O}_8 + 2e^-$



CONCENTRATION OF HYDROGEN PEROXIDE

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

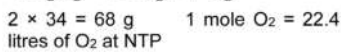
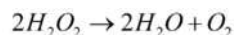
Decomposition is catalysed by Cu, Ag, Pt, Co, Fe, MnO_2 etc. The methods employed for concentration are

- 1. Evaporation:** By careful evaporation of solution on a water bath (50% H_2O_2 is obtained).
- 2. Dehydration in vacuum desiccator :** The 50% H_2O_2 is dehydrated in a vacuum desiccator in presence of conc. H_2SO_4 when 90% H_2O_2 is obtained.
- 3. Vacuum distillation :** The 90% H_2O_2 obtained in step (ii) is distilled under reduced pressure to get 100% H_2O_2
- 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 H_2O_2 gives on heating. For example "20 volume H_2O_2 " means 1 volume of H_2O_2 at NTP will give 20 volume of oxygen. The normality and percentage strength of H_2O_2 can be calculated as follows



22.4 litres of O_2 at NTP are evolved from 68g of H_2O_2

x litres of O_2 at NTP would be evolved from $\frac{68}{22.4} \times x$ g of H_2O_2

where x is volume strength of H_2O_2
Hence strength of x volume of $\text{H}_2\text{O}_2 = \frac{68 \times x}{22.4}$ g/litre

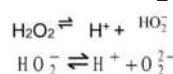
where 17 is the equivalent weight of H_2O_2

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. ($K_a = 1.57 \times 10^{-12}$ at 293 K). It ionises in two steps $\text{H}_2\text{O}_2 \rightleftharpoons \text{H}^+ + \text{HO}_2^-$

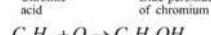
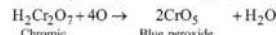
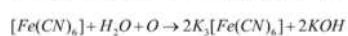
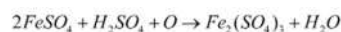
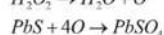
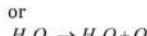
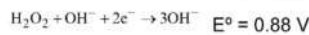
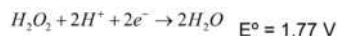


Hence it forms two series of salts eg. NaHO_2 sodium hydroperoxide and Na_2O_2

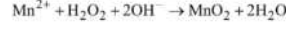
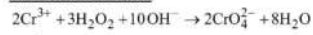
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(Sodium peroxide)

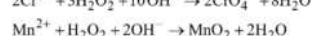
2. Oxidising agent : It is strong oxidising agent in acidic as well as in basic medium.



In basic medium

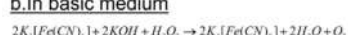
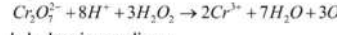


In basic medium

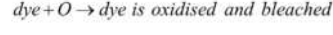
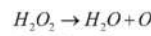


3.Reducing agent :

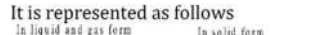
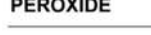
a.In acidic medium



b.In basic medium



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

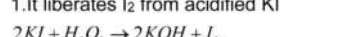


STRUCTURE OF HYDROGEN PEROXIDE

It is represented as follows

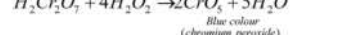
In liquid and gas form

In solid form

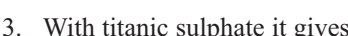


TEST OF HYDROGEN PEROXIDE

1. It liberates I_2 from acidified KI

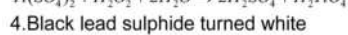


2. Perchromic acid :



(acidified H_2O_2 + amyl alcohol + $\text{K}_2\text{Cr}_2\text{O}_7$) \rightarrow blue colour

3. With titanous sulphate it gives orange red pertitanic acid



4. Black lead sulphide turned white



USES OF HYDROGEN PEROXIDE

It is used as a bleaching agent, disinfectant, source of power (90% H_2O_2 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**
 - a. Flowing water - streams and rivers
 - b. 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. : Ca^{2+} , Mg^{2+} , Fe^{2+} , Al^{3+} , Na^+ , K^+ traces of Zn^{2+} and Cu^{2+} (cations) and Cl^- , F^- etc. (anions)Gases eg.: CO_2 , N_2 , O_2 , oxides of nitro gen, H_2S etc.Organic salts
- Suspended impurities :
- Inorganic : eg.: sand and clay
 - Organic : eg.: animal matter, vegetable etc.
- 3. Colloidal impurities :** Finely divided clay, $\text{Al}(\text{OH})_3$, $\text{Fe}(\text{OH})_3$ 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.

K. Bharathi
 Co-founder
 The Scholar
 Ed-tech for IIT/NEET
 foundation
 Ph:8309335876