BASIC AIM:-

In this project our basic aim is to study the electrolysis of products of Potassium Iodide (KI).

APPARATUS USED:-

U-Tube stand , electrodes , KI solution , battery eliminator.

THEORY:-

Electrolysis-

It is defined as a process of decomposition of an electrolyte by the passage of electricity through its aqueous solution or molten (fused) state.

Mechanism of Electrolysis-

Whenever an electrolyte is dissolved in water or is taken in the molten state, the electrolyte dissociates to produce Positively and Negatively charged ions. On passing electric current, the positively charged ions move towards the cathode and hence are called cations, whereas the negatively charged ions move towards the anode and hence are called anions. On reaching their respective electrodes, ions lose their charge and become neutral. The cations accept electrons from the cathode to become neutral species. Thus, oxidation occurs at the anode while reduction reduction takes place at the anode. The conversion of ions into neutral species at their respective electrodes is called Primary change. The product formed as a result of primary change may be collected as such or it may go under a Secondary change to form the final products.

Quantitative Aspects Of Electrolysis-

Michael Faraday was the first scientist who described the quantitativeaspects of electrolysis.

Faraday's Laws Of Electrolysis-

First Law:-

The amount of chemical reaction which occurs at any electrode during electrolysis by a current is proportional to the quantity of electricity passed through the electrolyte (solution or melt).

Second Law :-

The amounts of different substances liberated by the same quantity of electricity passing through the electrolytic solution are proportional to their chemical equivalent weights (atomic mass of metal – number of electrons required to reduce the cation).

Products Of Electrolysis –

Products of electrolysis depend on the nature of material being and the type of electrodes being used .If the electrode is inert, it does not participate in the chemical reaction and acts only as source or sink for electrons. On the other hand, if the electrode is reactive, it participates in the electrode reaction. Thus, the products of electrolysis may be different for reactive and inert electrodes. The products of electrolysis depend on the different oxidizing and reducing species present in the electrolytic cell and their standard electrode potentials. Moreover, some of the electrochemical processes although feasible, are so slow kinetically that at lower voltages these do not seem to take place and extra potential (called overvoltage) has to be applied, which makes such processes more difficult to occur.

Reactions involved:-

In the electrolysis of an aqueous solution of KI, I ions are oxidized at the anode preferentially to water molecules. Possible reactions at anode are as follows:-

$2\ I^{-}\ (aq) \rightarrow I_2\ (g) + 2\ e^{-}$ .....(1)

$2\ H_2O\ (l) \rightarrow 4\ H^{+}\ (aq) + O_2 + 4e^{-}$ .....(2)

Reaction (1) occurs in preference to reaction (2) due to standard electrode potential value of the following reaction.

$I_2\ (g) + 2\ e^{-} \rightarrow 2\ I^{-}\ (aq)$ .....(3)

E^{o}/volt = + 0.53V $4\ H^{+}\ (aq) + O2\ (g) + 2e^{-} \rightarrow 2\ H_2O\ (l)$ .....(4)

E^{o}/volt = + 1.53V Possible cathode reactions are: $K^{+}\ (aq) + e^{-} \rightarrow K\ (s)$ .....(5)

E^{o}/volt = – 2.92V $2\ H_2O\ (l) + 2e^{-} \rightarrow H_2\ (g) + 2\ OH^{-}\ (aq)$ .....(6)

E^{o}/volt = – 0.83V

E^{o} value of reduction reaction (5) is much smaller than that of reaction (6). Thus, reaction (6) occurs competitively over reaction (5) at cathode .Thus, violet colour of anode is due to formation of iodine and its subsequent reaction with starch Pink colour at cathode is due to formation of OH– ions which also render the solution alkaline. OH–ions give pink colour with phenolphthalein.

Procedure :-

Prepare 0.1M solution of potassium iodide. Fix a U- shaped tube in a stand and insert two graphite electrodes into both ends of the U- tube through the corks. Assemble the apparatus as shown in the figure. Take about 30ml of 0.1M solution of potassium iodide in a 100ml beaker add five or six drops of phenolphthalein solution and five to six drops of freshly prepared starch solution. Stir the solution and transfer it into an electrolysis – tube fitted with graphite electrodes. Pass electric current through the electrolyte and observe the appearance of colour. A pink colour appears at the cathode and a violet colour appears at the anode. Bubble formation also occurs on the surface of the cathode.

Observations:-

TEST SOLUTIONS	OBSERVATIONS	INFERENCE
Aqueous solution of potassium iodide with five drops of phenolphthalein and five drops of starch solution	At the anode, violet colour. At the cathode: (i)Pink colour (ii)Formation of bubbles	Free iodine is evolved. (i)OH– ion is formed (ii)Hydrogen is evolved

Precautions:-

1. Both the electrodes should be loosely fixed into the U- tube so as to allow the escape of evolved gasses.
2. Electrodes should be cleaned before use.

Conclusion:-

In the electrolysis of an aqueous solution of potassium iodide, I– ions are oxidized at the anode preferentially to water molecules. Violet colour at anode is due to iodine. Pink colour at cathode is due to formation of OH– ions which renders the solution alkaline. OH– ions give pink colour with phenolphthalein.

Bibliogrphy:

1. Experiments on formal level topics in chemistry.
2. Chemistry – a textbook for class XII.
3. www.thechemistryguru.com