Experiment No. 5 Electrode potential of iron metal

I **Practical Significance**

Determination of electrode potential of metal enable the student to understand the position of metal in electrochemical series. This will help the student to design the structure using two dissimilar metal, to protect the metal corrosion that can be used in solving broad based engineering problems.

II **Relevant Program Outcomes**

PO3 Experiments and practice

PO4 Engineering tools

III **Relevant Course Outcomes**

e) Use corrosion preventive measures in industry.

IV **Practical Learning Outcome**

Determine the electrode potential of iron metal.

V **Practical Skills:**

1. Measurement
2. Calculation

VI **Relevant Affective domain related Outcomes:**

1. Follow safety practices.
2. Maintain tools and equipment.

VII **Minimum Theoretical Background:**

Due to reaction between metal and solution, an electrical double layer formed around the metal. It consequently sets up a potential difference between the metal and solution which is known as electrode potential.

Electrode potential is a measure of tendency of metal electrode to lose or gain electrons when it is in contact with its own salt solution of unit molar concentration at 25°C.

Oxidation Potential : The tendency of electrode to lose electrons is direct measure of its tendency to get oxidized.

Reduction Potential : The tendency of electrode to gain electrons is a direct measure of its tendency to get reduced.

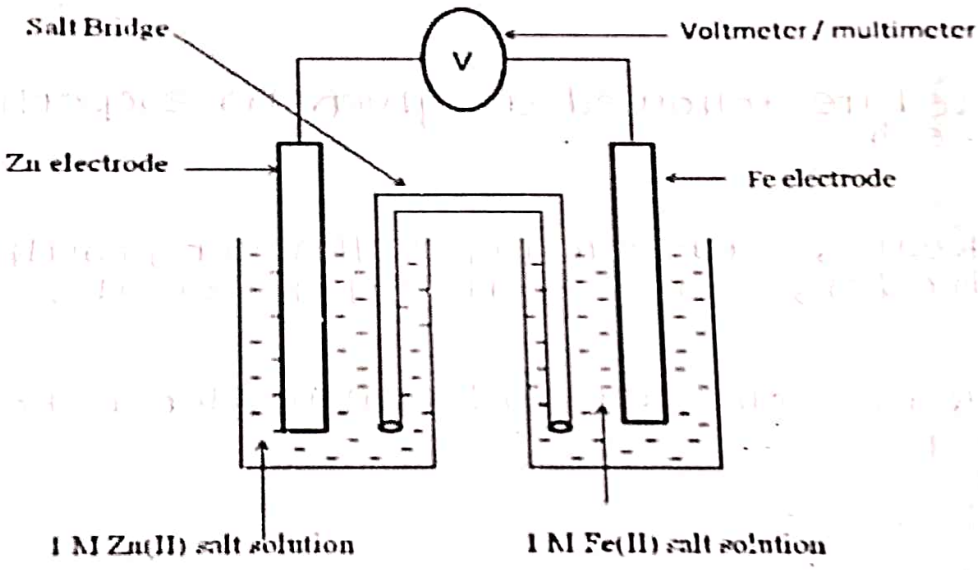
In the field of metal corrosion ,reference electrode such as hydrogen electrode, the zinc-zinc sulphate electrode, calomel, silver-silver chloride electrode etc. are used.

Electro-chemical Series

Potassium	-2.92
Calcium	-2.87
Sodium	-2.71
Magnesium	-2.37
Aluminium	-1.66
Zinc	-0.76
Iron	-0.44
Tin	-0.14
Lead	-0.13
Hydrogen	0.00
Copper	+0.34
Silver	+0.80
Mercury	+0.85

Metal activity increasing

VIII Circuit diagram / Experimental set-up / Work Situation:



IX Resources required

Sr. No.	Resources	Specifications	Quantity	Remark
1.	Beakers	Capacity -250 ml	2 each group	
2.	Salt Bridge / porous pot	'U' shaped glass tube with KCl solution	1 each group	
3.	Voltmeter / multimeter		1 each group	
4.	Electrodes	Zn(Rod/Plate), Fe(Rod/Plate)	1 each group	
5.	Sample material/chemicals -	Iron (II) salt solution, zinc(II) salt solution, connecting wires	As per requiremtn	

X Procedure

1. Make surface of zinc rod and iron rod smooth by using polish paper, then clean with dilute HCl and then with water..
2. Take 1 M zinc(II) salt solution and 1 M Iron (II) salt solution solutions in two different beakers.
3. Place zinc rod in zinc(II) salt solution and iron rod in Iron (II) salt solution.
4. Connect zinc rod to negative terminal (anode) and iron rod to positive terminal (cathode) of digital multimeter.
5. Place salt bridge in both the solutions.
6. Note down the cell EMF (E_{cell}) in volts displayed by the digital multimeter.
7. Calculate electrode potential of copper as per the given calculations.

XI Precautions

1. While making connections take proper precautions whether wires are properly connected.
2. Check the voltmeter or multimeter before using.

XII Actual procedure followed

procedure followed as given in experiment no. 5th

XIII Resources used (with major specifications)

Beakears, salt Bridge, (voltmeter, multimeter) electrodes, sample material chemicals.

XIV Precautions followed

check the voltmeter and multimeter before using

XV Observations and Calculations

Observations

1) Temperature = 27 °C.

2) Theoretical value of reduction potential of Zn = - 0.76 volts.
3) Electrode potential of cell = ...2..... V

Calculations

Calculation for reduction potential of copper electrode (E_{Cu})

$E_{Cell} = E_{Reduction\ (Fe)} + E_{Oxidation\ (Zn)}$

$\therefore E_{Reduction\ (Fe)} = E_{Cell} - E_{Oxidation\ (Zn)}$

$\therefore E_{Reduction\ (Fe)} = 0.32 - (+0.76)$

(∵ Oxidation potential of Zn = + 0.76 Volts)

$\therefore E_{Reduction\ (Fe)} = 0.32 - 0.76$

$\therefore E_{Reduction\ (Fe)} = 0.44$ .....Volts

XVI RESULT

1. Reduction electrode potential of Fe = 0.44 Volts.
2. Reduction electrode potential of Zn = 0.76 Volts.

XVII Interpretation of result

In electrochemical series zinc is placed above (above/below) the iron metal.

XVIII Conclusions and Recommendations (if any)

Zinc is less (more/less) electropositive than iron. Hence fe (Zn/Fe) under goes corrosion.

XIX Practical Related Questions

1. State the chemical reactions taking place at cathode and anode in the electrochemical cells formed in the experiment.
2. State the relation between reduction electrode potential of metal electrode and its tendency towards corrosion.
3. Write the criteria required to decide the cathode and anode in the given electrochemical cell.

XX References / Suggestions for further Reading

Sr. No.	Title of Book	Author	Publication
1.	Applied Chemistry :Theory and practice	O.P.Vermani,A.K.Narula	New age International Publication New Delhi 2005 ISBN 8122408141
2.	Experiments and calculations in engineering chemistry	Dr.Dara, S. S.	S.Chand. Publication, New Delhi, 2011, ISBN:8121908647
3.	Practical chemistry	Dr. N.K.Varma	Laxmi Publication New Delhi ISBN:8170085942
4.	Engineering chemistry	Shashi Chavla	S. Chand publication New Delhi 2013 ISBN.: 1234567155036

XXI Assessment Scheme

Process related assessment scheme

Sr. No.	Process related	Weightage(60%)
1.	Cleaning of cathode and anode	20%
2.	Assembly set up	30%
3.	Reading of electrode potential	10%

Product related assessment scheme

Sr. No.	Product related	Weightage(40%)
1.	Calculation for electrode potential of copper	20%
2.	Answer to sample questions	10%
3.	Submission of report in time	10%

List of Student Team Members

1. .....
2. .....
3. .....
4. .....

Marks Obtained			Dated Signature of Teacher
Process Related (15)	Product Related (10)	Total (25)	
14	09	23	

[Space to Write Answers]

1. At anode $Fe^{+2} + 2e$ (oxidation)

cathode $Zn^{+2} + 2e \longrightarrow Zn$ (reduction)

$Zn^{+2} + 2e^- \longrightarrow Fe^-$

2. State the relation between reduction electrode potential of metal electrodes and its tendency towards corrosion.

As the reduction electrode potential of a metal increases. It's corrosion increases.