

EXPERIMENT NO-8

E.C.E. OF COPPER

OBJECT:

To determine the Electro – Chemical Equivalent (ECE) of copper using a Tangent galvanometer.

APPARATUS REQUIRED:

Copper voltmeter, Tangent galvanometer, Rheostat, one way key, Battery, Commutator, Stop watch, Sand paper and connecting wire.

FORMULA USED:

The electrochemical equivalent of copper is determined by

$$\frac{m}{\theta} = \frac{4\pi^2 r^2 n^2}{10^7 B H t}$$

Where, n = No. of turns in each coil used

m = Mass of the copper deposited on cathode

r = Radius of coil

B = Horizontal component of earth's magnetic field

t = Time taken in depositing m gm copper

θ = Deflection in Helmholtz coil

THEORY :

According to Faraday's law of electrolysis if m gm of copper is deposited on cathode plate of copper voltameter in t second while a constant current of I ampere passes through its copper solution, then

$$(1)$$

Where Z is constant and is called the Electro – Chemical Equivalent of copper.

$$\frac{m}{I t} = Z$$

If the same current is passed through the Helmholtz-galvanometer whose coil is properly adjusted in magnetic meridian and connected in series with copper voltameter then the deflection of the magnetic needle of the galvanometer is given by

$$\theta = \frac{4\pi^2 r^2 n^2 I}{10^7 B H}$$

(2)

Where k is the reduction factor of the Helmholtz-galvanometer.

From equations (1) and (2), we get

$$Z = \frac{m}{It} \frac{32\pi nm}{(50\sqrt{5})rHt \tan\theta} \text{ gm/Coulomb}$$

(3)

Equation (3) is the required expression for E C E of Copper.

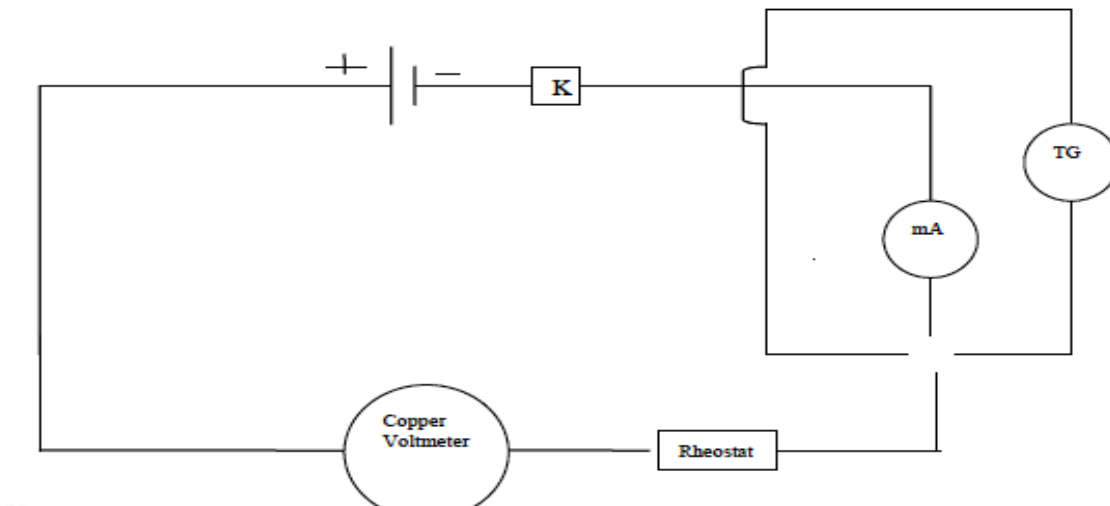


Figure.1 Experimental Arrangement of Experimental set-up for ECE of copper

PROCEDURE:

1. Draw a neat diagram indicating the scheme of the connections as shown in fig.
2. Clean the cathode plate with a piece of sand paper and weigh it accurately.
3. Place the coil of Helmholtz-galvanometer in magnetic meridian. Rotate the compass box to make the pointer read zero-zero.
4. Suspend an extra copper plate in the copper voltmeter for the cathode and complete the circuit containing an accumulator, rheostat and an ammeter.
5. Using copper test plate as cathode, allow a current to flow in circuit and read the deflection. Now reverse the current with help of commutator and again read the deflection if the two deflections are the same then the coil are in the magnetic meridian otherwise rotate slightly the coil till the two deflection are same. The pointer should read zero when no current is passed.

6. Using rheostat adjust the deflection (in the range 40^0 - 50^0).
7. Switch of the current and remove the test plate and place weighed plate as cathode.
8. Now switch on the current and immediately start stop watch. Take the deflection reading after every 5 minutes and keep it constant using rheostat. Remove the copper plate and immerse it in water and dry it and weigh it with physical balance.
9. Measure the diameter of the coil and calculate radius by equating to $2\pi r$. Both external and internal circumference should be measured and then mean of the radius.

OBSERVATION:

1. Radius (r) of the coil = -----cm
2. Number of turns (n) in each coil = -----
3. Horizontal component of earth's magnetic field(H) = ----- Oersted
4. Mass of copper plate before deposition of copper (m_1) = ----- gm.
5. Mass of copper plate before deposition of copper (m_2) = ----- gm.
6. Mass of copper deposited $m = m_1 - m_2$ = ----- gm
7. Initial reading of stop watch (t_1) = ----- second
8. Final reading of stop watch (t_2) = ----- second
9. Total time taken $t = t_1 - t_2$ = ----- second

TABLE FOR THE DETERMINATION OF DEFLECTION:

S. No.	Time (Minutes)	Deflection of Pointer		Mean: $\frac{\theta_1 + \theta_2}{2}$	$\tan\theta$
		Left Pointer(θ_1)	Right Pointer(θ_2)		
1.	0				
2.	5				
3.	10				
4.	15				
5.	20				
6.	25				
7.	30				
8.	35				
9.	40				

CALCULATIONS:

The electrochemical equivalent of copper is calculated by

$$Z = \frac{32\pi nm}{(50\sqrt{5})rHt \tan\theta} = \quad \quad \quad gm/Coulomb$$

RESULT:

The electro-chemical equivalent of copper is = ----- *gm/Coulomb*

STANDARD RESULT:

The electro-chemical equivalent of copper is = 3.295×10^{-4} *gm/Coulomb*

PERCENTAGE ERROR:

% Error = -----

PRECAUTIONS:

1. Galvanometer should set in magnetic meridian.
2. All the magnetic materials and current carrying conductors should be at considerable distance from the apparatus.
3. The copper plate on which the deposit has to be made should be scrupulously clean.
4. The deflection of the galvanometer should be kept constant with help of rheostat.
5. As far as possible the deflection should be kept as nearly equal to 45° .

