Electrolyter-1005: A Bioinstrument Made from Electrical Waste

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ABSTRACT

We can’t imagine present world without electrical and electronic devices. After their use they may treat as waste material, these are thread to environment and our planet. In this present study we used, electrical waste like mobile charger, unused pH electrode, unused plastic box and wares and we have designed an instrument Electrolyter-1005. Electrolyter-1005 is based on Faraday’s 1st law of electrolysis. Electrolyter 1005 is an analytical instrument having the capacity to electrolyze the electrolyte. The Faraday’s first law of electrolysis stated that “weight of the substance librated at the electrode as a result of electrolysis is directly proporsional to the quantity of electricity passed through the electrolyte.” It is an alternative of ion analyzer. The making cost of this instrument was Rs.300.

PRINCIPLE

This instrument is based on the theory of the Faraday’s first Law of the electrolysis.

According to the principle mathematically we can write that

\[ W \propto Q \]
\[ Q = ct \]
\[ W \propto ct, W = Zct \]
\[ i.e. Z = W/ct \]

Where

- \( W \) - Weight of the substance liberated
- \( Q \) - Quantity of the electricity in coulombs
- \( C \) - Current in ampere
- \( t \) - Time in second
- \( Z \) - Electrochemical equivalent

Here \( Z \) is the weight of the substance liberated when 1 coulomb of electricity passed through the electrolyte in 1 second.

When 1 Faraday (96500 c) electricity passed through the electrolyte 1 gm equivalent substance deposited.

We can also write as

If the strength of the current passed (c) ampere for (t) second then quantity of electricity is \( Q = ct \) coulomb

Equivalent mass of the substance = \( \text{atomic weight/valency} \times X \)

I. INTRODUCTION

We can’t imagine present world without electrical and electronic devices. After their use they may treat as waste material, these are thread to environment and our planet. In this present study we used, electrical waste like mobile charger, unused pH electrode, unused plastic box and wares and we have designed an instrument Electrolyter-1005. Electrolyter is an analytical instrument having the capacity to electrolyze the electrolyte. This instrument is based on the theory of the Faraday’s first Law of the electrolysis(1). The Faraday’s first law of electrolysis stated that ‘weight of the substance librated at the electrode as a result of electrolysis is directly proporsional to the quantity of electricity passed through the electrolyte.” It is an alternative of ion analyzer. The making cost of this instrument was Rs.300.

Keywords-------- Electrolyter-1005, Faraday’s law, metal estimation, pollution tracking.
We know that 96500 c electricity produced X gm of substance.

Q c electricity will produce the substance

\[ \text{i.e.(} \frac{X}{96500} \times Q \text{)} \text{ gm substance} \]

Weight of the substance liberated = \( \frac{X}{96500} \times ct \) gm 

\[ \text{……….(INSTRUMENT FORMULA)} \]

**EXAMPLE**

1. Find the weight of Cu deposited from CuSO₄ solution by a current of 0.25 Amp. follow 1 hour.

Ans.: Here \( c=0.25 \text{ amp} \)

\( T=1 \text{ hr}=3600 \text{ sec} \)

\[ \text{Quantity of electricity } Q=ct=0.25 \times 3600=900 \text{ c} \]

Atomic weight of Cu=63

Valency=2

It implies equivalent weight of Cu=\( 63/2=31.5 \)

Using instrument formula, Weight of the substance liberated = \( \frac{X}{96500} \times ct \) gm

Cu deposited= 31.5 \times 96500 \times 900=0.2937 gm.

**II. CONDUTIVITY OF SOLUTION**

Conductance \( C \) is reciprocal of resistance.

Thus, \( C=1/R \)

\( R \) measured in ohms, conductance express in mhos. We can measure \( R \) using this instrument.

Specific conductance \( K \) is reciprocal of specific resistance.

Thus \( K \) of 1 cm cube of the material, \( K=1/S \)

We know

\[ R=\frac{1}{a} \text{ or } \frac{1}{a} R \text{ where } l=\text{length of conductor, } a=\text{area of cross section.} \]

\[ \frac{1}{a}=K \times l \]

Thus \( K=la \times \text{ conductance in Ohm}^{-1} \text{ cm}^{-1} \)

\( l \) is cell constant

\( K= \text{cell const. } \times \text{ conductance} \)

For measuring of conductance, equivalent conductivity is a significant term.

Equivalent conductance is defined as conducting power of all the ions produced by one gram equivalent of an electrolyte in a given solution. It is denoted by \( ^{\text{e}} \)

\[ ^{\text{e}}=\frac{K}{V} \text{ where } V \text{ is volume in c.c. containing one gram equivalent of solution.} \]

Equivalent conductance \( ^{\text{e}} \) is denoted in Ohtm⁻¹cm²/gm eq.
IV. APPLICATION

1- Quantitative estimation of metals.
2- Estimation of ions.
3- Water analysis and soil analysis.
4- Electroplating.
5- Navigator helps to detect the direction.
6- It is also used for measure conductivity of the solution.
7- It can be used as a teaching model for demonstration of electrolysis at school level.
8- It also used for detecting metal absorption capacity of cyanobacteria by OAEAGPS method which is an important point of consideration in cyanobacterial bioremediation research (Mishra et al. 2014).

V. HOW TO USE ELECTROLYTER

1- Plug the power cord 230V AC, A stabilizer gives better result.
2- Put the sensor & black reference electrode in solution.
3- Rotate the knob to 200 mA.
4- Note the time for t in seconds.
5- Note the display C in mA and wait for constant value.
6- Convert mA to Ampere.
7- Put the value of ampere & second in instrument formula.
8- For measurement of conductance rotated the knob to Ω and this gives us R, 1/R gives us conductance in mhos.
9- A software is a future aspect to the advancement to this instrument to calculate the value very easily.

VI. CONCLUSION

Electrolyter-1005 is a low cost instrument made from electrical waste. It is easy to operate. The main application of the instrument are quantitative estimation of metals, estimation of ions, water analysis and soil analysis, metal absorption capacity of cyanobacteria which is an important point of consideration in cyanobacterial bioremediation research. This instrument posses a wide range of application from school level to research level so it may use full in the field of teaching & research in developing country.

REFERENCES