Topic ⇒ Conductance, Specific Conductance, cell constant.

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Conductance

The ease with which electricity flows through a solution is called the conductance of the sol^{n}.

The reciprocal of the electrical resistance is called the conductance.

It is usually represented by C. Thus

$$C = \frac{1}{R}$$

units ⇒ It is expressed in the unit called reciprocal ohm (ohm^{-1} or Ω^{-1})

In SI system, the unit of conductance is Siemen (S).

($1S = 1\,\Omega^{-1}$)

Specific Conductance

It is found that resistance (R) of a conductor is

(i) directly proportional to its length (l)

(ii) Inversely proportional to its area of cross-section (a)

i.e. $$R \propto \frac{l}{a}$$

or $$R = \rho \frac{l}{a} \quad \text{——— (1)}$$

Where ρ is a constant of proportionality, called

Specific Resistance or Resistivity. Its value depends upon the material of the conductor.

The reciprocal of resistivity is known as specific conductivity or simply conductivity.

It is denoted by K. Thus, if K is the specific conductivity and C is the conductance of the solution, then

$$R = \frac{1}{C} \quad \text{and} \quad \rho = \frac{1}{K}$$

Substituting the values of R and ρ in eqn. (1)

$$\frac{1}{C} = \frac{1}{K} \times \frac{l}{a}$$

or $$K = C \times \frac{l}{a}$$

Now if $l = 1$ cm. and $a = 1$ sq cm. then

$$K = C$$

Hence, specific conductivity of a solution is defined as the conductance of a solution of 1 cm length and having 1 sq cm as the area of cross-section.

Alternatively, the conductance of one centimeter cube of the solution of the electrolyte is called specific conductance.

If the volume of the soln. is V cm^3, the specific conductivity of such a soln. at this dilution V is written as K_V

Units ⇒ Resistivity or specific resistance (ρ),

$$\rho = R\frac{a}{l} = \text{ohm}\frac{(cm)^2}{cm} = \text{ohm cm} \quad \text{or ohm m in SI unit}$$

Specific conductivity $K = \frac{1}{\rho} = \frac{1}{\text{ohm cm}}$

$= \text{ohm}^{-1}\,cm^{-1}$ or $\Omega^{-1}cm^{-1}$ or Scm^{-1} or Sm^{-1} in S.I unit.

Cell Constant

The ratio of length to the cross-sectional area is called the cell constant (G^*).

$$\text{Cell constant } (G^*) = \frac{l}{A}$$

Cell Constant is a characteristic parameter of conductivity of cell used for the experiment.

The Cell Constant of the conductivity cell is determined by measuring the resistance of a solution of an electrolyte of known conductivity at a given temperature.

Evidently, the factor l/A is the cell constant. l is the distance in m between the electrode and A is the cross-sectional area of the electrodes in m^2.

obviously, the unit of cell constant is m^{-1}.