CELL CHARACTERISTICS :

Cell Characteristics

The suitability of a battery system for a particular application is decided based on certain performance characteristics of the battery or the cells constituting the battery system. Some of the important characteristics are briefly discussed below:

(i) Voltage: The voltage available from a battery depends upon the emf of the cells which constitute the battery system. The emf of the cell depends on the free energy change in the overall cell reaction. As given by Nernst equation,

$$E_{cell} = E^{o}_{cell} - \frac{2.303\ RT}{nF} \log Q,$$

where $E_{cell} = E_{cathode} - E_{anode}$, and Q is the reaction quotient for the cell reaction at any stage of the reaction, which is the ratio of the product of molar concentration of the reaction product molecules to that of the reactants.

As it is evident from the above equation, emf of the cell and also the voltage available from the battery is dependent on standard electrode potential difference between the cathode and the anode, temperature and the extent of the cell reaction.

- If the difference in the standard electrode potential is more, higher is the emf of the cell.
- As the temperature increases the emf of the cell decreases.
- As the value of Q increases, i.e., when current is drawn from the cell and cell reaction proceeds, the emf of the cell decreases marginally.
- Also, high cell potential is possible when the cell is with low resistance, i.e., with a high conductivity electrolyte.

CONTD--

(ii) Current: Current is a measure of the rate at which the battery is discharging. High current can be delivered without excessive voltage penalty if there is rapid electron transfer reaction.

(iii) Capacity: The capacity is the charge or the amount of electricity that may be obtained from the battery and is given in ampere hours (Ah). Capacity depends on the size of the battery, and is given by Faraday's relation

$$C = (wnF) / M$$

Where, w is the mass and M is the molar mass of active material. The ability of the cell to continue to deliver the expected capacity at increased discharge rates is an important battery property.

(iv) Electricity storage density: Electrical storage density is the amount of electricity per unit weight which the storer can hold, i.e., it is the capacity per unit weight of the battery.

(v) Power density: Power density is the power per unit weight of battery and is given by iE_{cell} per unit weight of battery. The power density decreases during discharge.

(vi) Cycle life: Primary batteries are designed for single discharge, but a secondary battery is rechargeable. The cycle life is the number of charge / discharge cycles that are possible before failure occurs. The cycle life of a storage battery must be high.

(vii) Energy efficiency: The energy efficiency of a secondary battery is given by

$$\%\text{Energy efficiency} = \frac{\text{energy released on discharge}}{\text{energy required for charge}} \times 100$$

Higher the energy efficiency, better is the battery.

(viii) Shelf life: It is essential for most batteries to be stored, sometimes for many years, without self discharge or corrosion of current collectors, causing a loss of performance.