



ENGINEERING CHEMISTRY

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Energy storage devices – Numericals



Class content:

- ***Numericals***
 - ***Battery Characteristics***

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1. A battery using Zn as anodic material lasts for 2 hours when a constant current of 1.25 A is drawn from it. What weight of Zn is present in the battery if the reaction at the anode is

If the electricity storage density of the battery is 180 As/g, determine the weight of the entire battery.

(Given : molar mass of Zn = 65 g, F = 96500 C/mol)

Sol.

$$C = I \times t = 1.25 \times 2 \times 60 \times 60 = 9000 \text{ As}$$

$$C = \frac{WnF}{M} \quad W = \frac{C \times M}{n \times F} = \frac{9000 \times 65}{2 \times 96500} = 3.03 \text{ g of Zn}$$

$$\text{ESD} = \frac{\text{Capacity}}{\text{Weight of the battery}}$$

$$\text{Weight of the battery} = \frac{\text{Capacity}}{\text{Electricity storage density}} = \frac{9000}{180} = 50 \text{ g}$$



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2. Calculate the electricity storage density of lithium battery which stores 2.0 g of lithium. The total weight of the battery is 65 g. Give the answer in Ah/kg.

(Given : Atomic mass of lithium is 7)

Sol.

$$C = \frac{WnF}{M} = \frac{2 \times 1 \times 96500}{7} = 27571.428 \text{ As} = 7.658 \text{ Ah}$$

$$\text{Electricity storage density} = \frac{\text{Capacity}}{W} = \frac{7.658}{65 \times 10^{-3}} = 117.8 \text{ Ah/kg}$$



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3. Calculate the energy density and power density of 20 kg lead acid battery which contains 5 kg anode material and discharges constant current for 10 hours. The voltage of the battery is 2 V.
(Given : Atomic mass of lead is 207.2, number of electrons transferred in the redox reaction is 2, F= 96500 C/mol)

Sol.

$$C = \frac{WnF}{M} = \frac{5 \times 10^3 \times 2 \times 96500}{207.2} = \frac{4657335.9}{3600} = 1293.7 \text{ Ah}$$

$$\text{Energy density} = \frac{I \times t \times V}{W} = \frac{1293.7 \times 2}{20} = 129.4 \text{ Wh/kg}$$

$$\text{Power density} = \frac{\text{Energy density}}{\text{time}} = \frac{129.4}{10} = 12.9 \text{ W/kg}$$



THANK YOU
