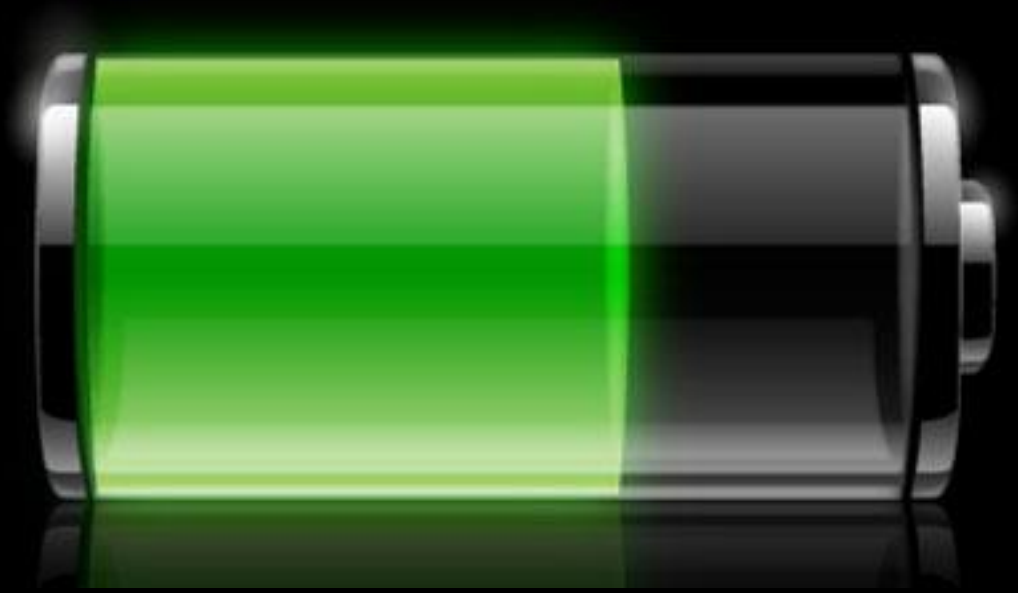
PV Systems - Components and Concepts

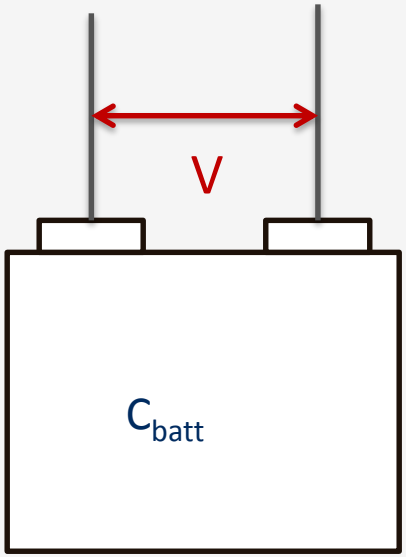
Batteries II - Battery Parameters

Week 7.5.2

Arno Smets, Nishant Narayan



Battery characteristics

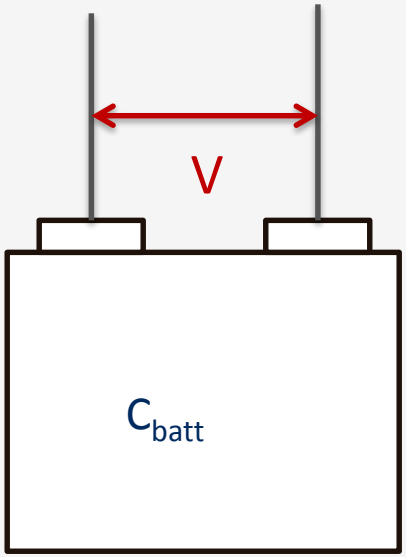


Rated voltage (lead acid): 12V, 24V, 48V, …

Rated capacity: Ah, mAh

$$I = \frac{Q}{t} \qquad 1Ah = \frac{1C}{s}h = 3600C$$

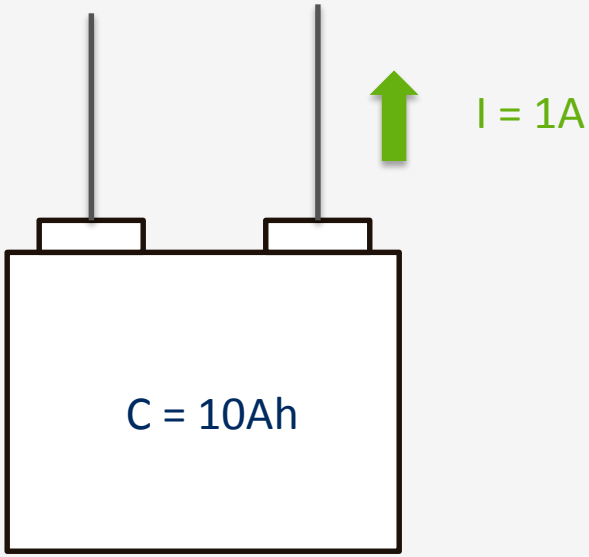
Battery characteristics



$$E_{batt} = C_{batt} V$$

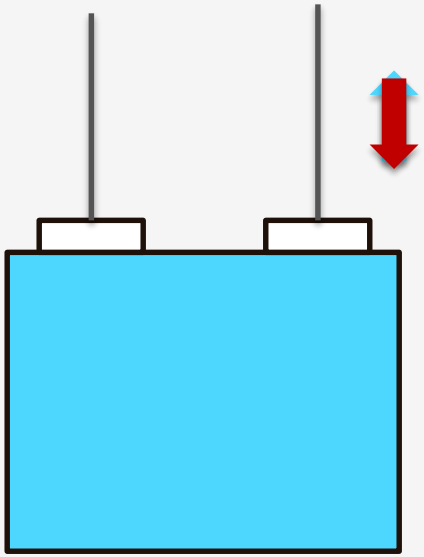
$$Wh = Ah \cdot V$$

Significance of Amp hours



$$\frac{10Ah}{1A} = 10h$$

Charging and discharging



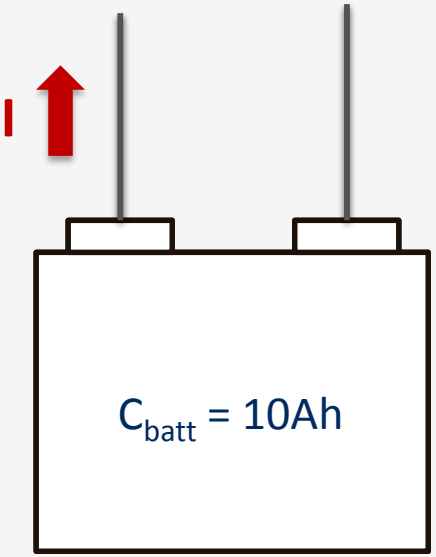
Capacity

$$Pb + PbO_2 + 2HSO_4^- + 2H^+ \rightleftharpoons 2PbSO_4 + 2H_2O$$

C-rates

$$C-rate = \frac{I}{C_{batt}/1h}$$

C_{batt}/t

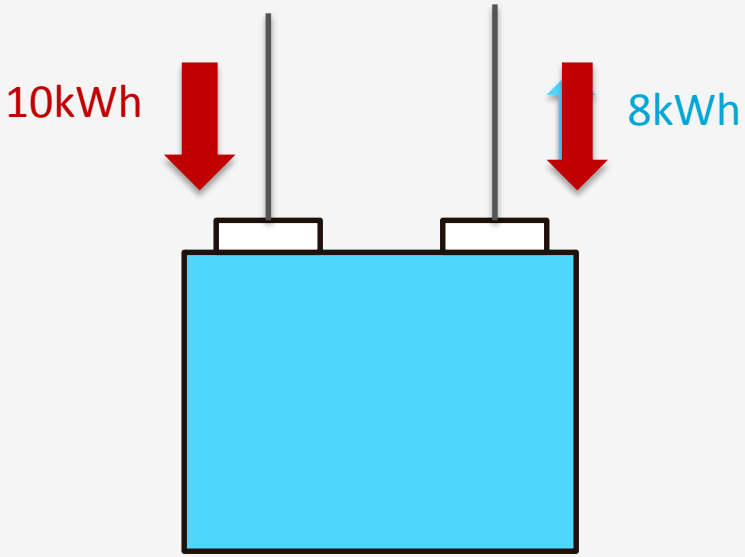


$$I = C-rate * C_{batt}/1h = 1 * 10Ah/1h = 10A$$ 1h, 1C

$$I = C-rate * C_{batt}/\frac{1h}{t} = \frac{C_{batt}}{C_{batt}/1h} = \frac{10Ah}{2} = 5A$$ 0.5h, 2C

$$I = C-rate * C_{batt}/1h = 0.5 * 10Ah/1h = 5A$$ 2h, 0.5C

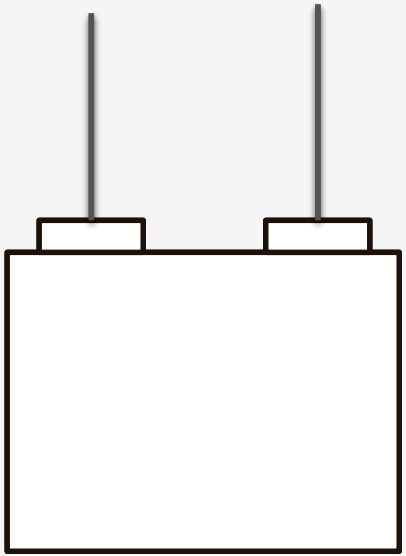
Efficiency of storage



$$\eta = \frac{E_{out}}{E_{in}} \times 100$$

$$\eta = \frac{8kWh}{10kWh} \times 100 = 80\%$$

Battery efficiency

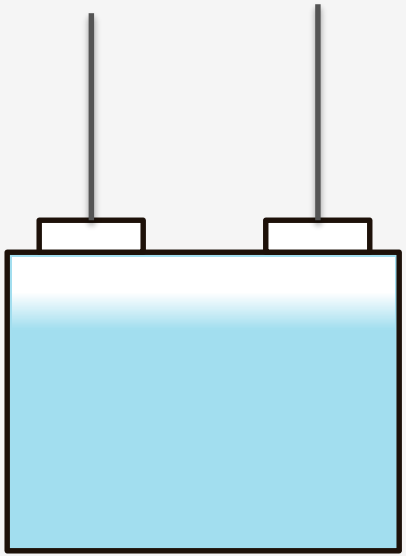


$$\eta_V = \frac{V_{discharge}}{V_{charge}} \times 100$$

$$\eta_C = \frac{Q_{discharge}}{Q_{charge}} \times 100$$

$$\eta_{batt} = \eta_V \eta_C$$

SOC and DOD



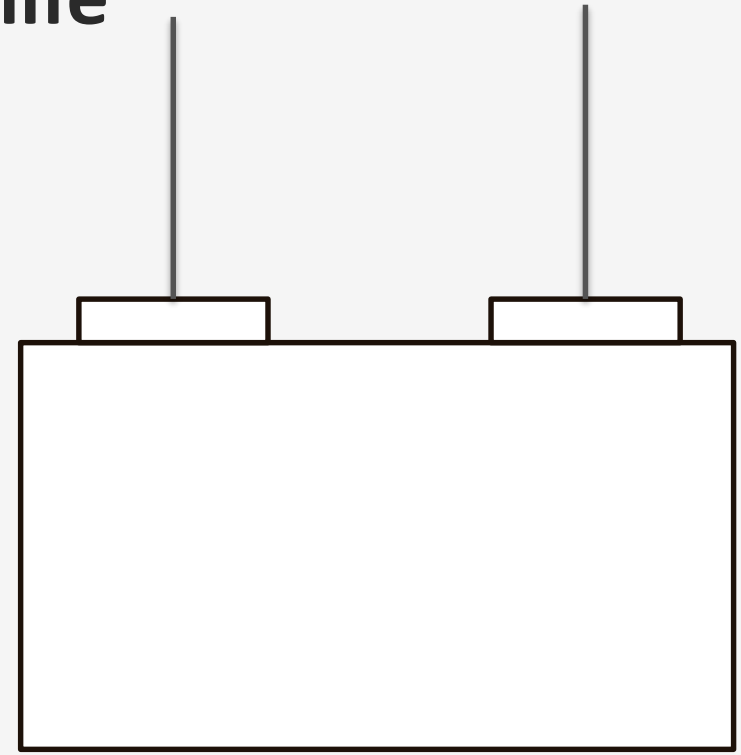
$$SOC = \frac{E_{available}}{C_{batt}V} \times 100$$

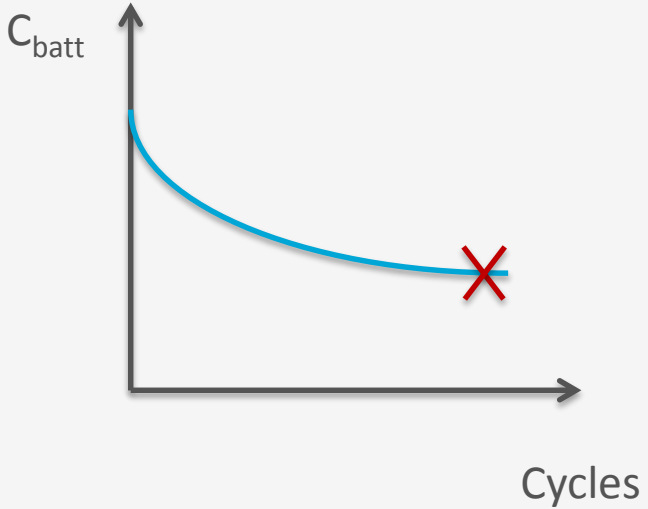
$$DOD = \frac{E_{discharged}}{C_{batt}V} \times 100$$

10 Ah - 2Ah → SOC = 80%

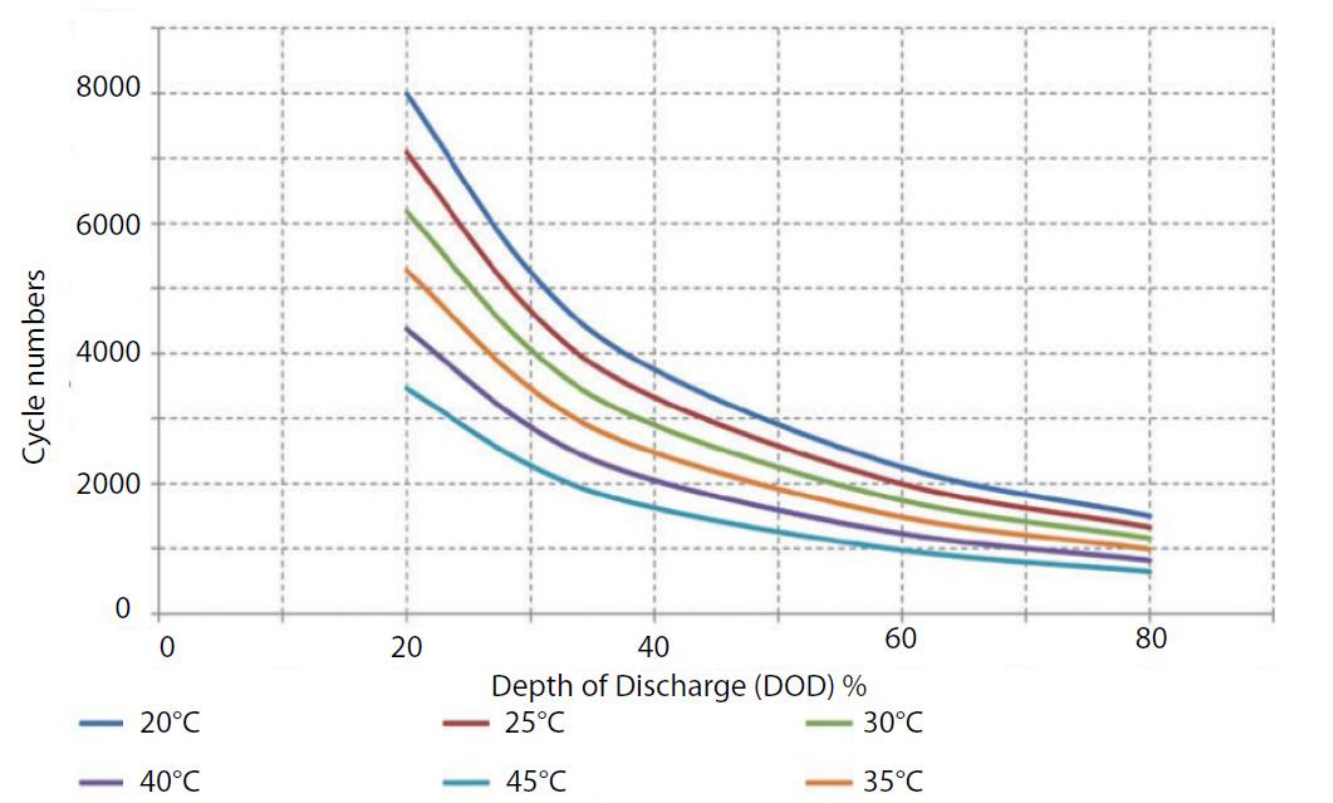
→ DOD = 20%

Cycle life

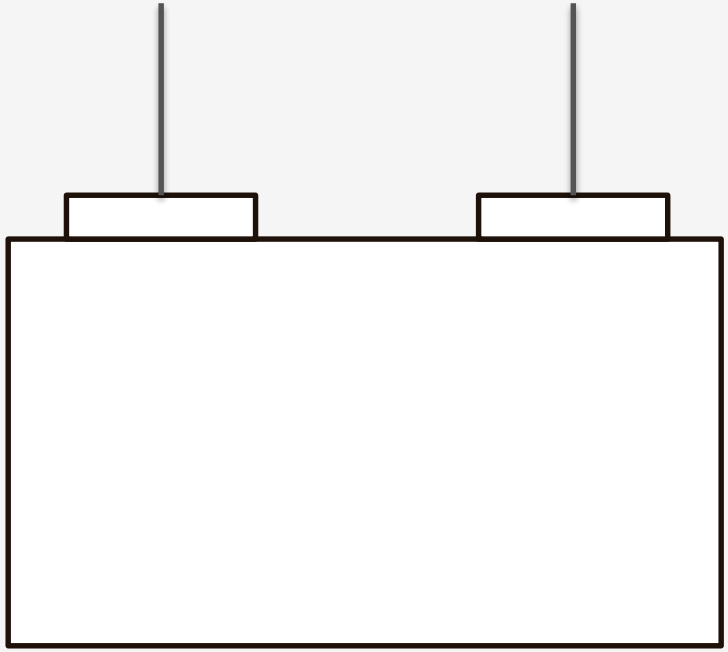


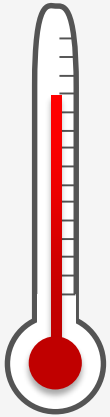


Cycle life vs. DOD

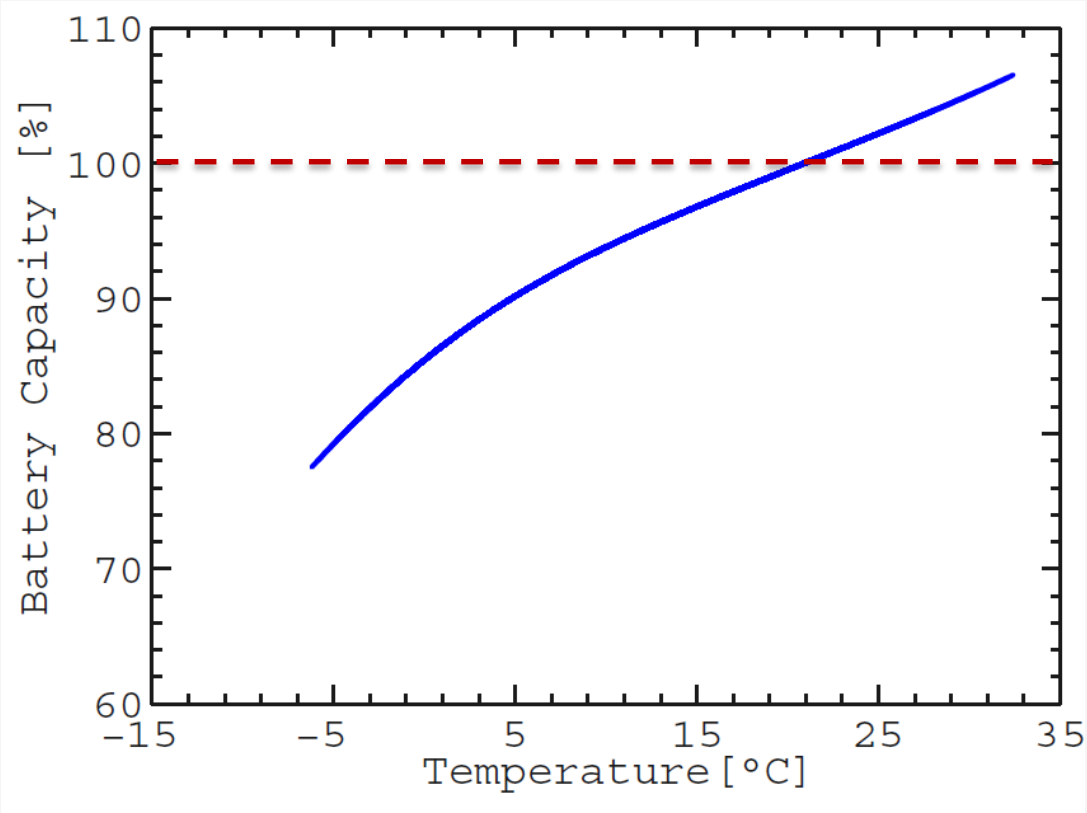


Battery overheating



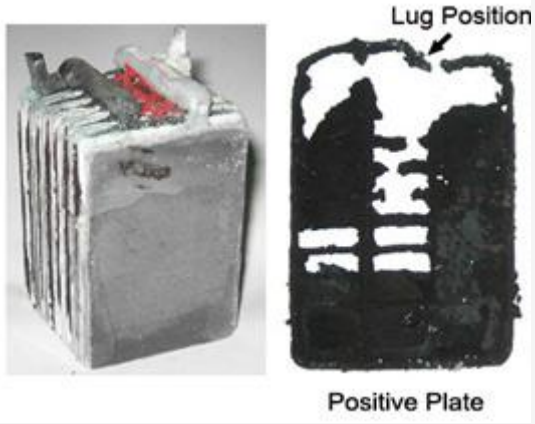


Battery capacity vs. Temperature

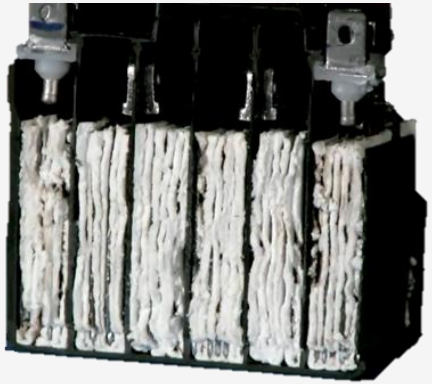


Ageing of lead acid batteries

Sulphation



Electrode Corrosion



Drying

Batteries : Hoppeke

Thank you for your attention!