

Charge Peak Absorption

How robust is voltage quality assured?

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Background

Safety virtue of the lead-acid battery by absorbing short high-current charge transients while keeping the voltage low (i.e., usually below 18V and up 21V for 100A pulses).

Safety Function which other storage technologies can't achieve - they need costly safety hardware additions.

Objective: Understand and specify what we are relying on for Functional Safety assessment.

Experimental

- AGM (LN3) battery
- Pretests: overcharge (14.4V, 60°C, 12 w)
- Pulses: 10...50A for 10sec, under overcharge (14.7V)
- Temperature: 25°C and -30°C
- Monitoring of battery voltage, cell voltage, current, half-cell potentials vs. Hg-Hg₂SO₄ reference electrode

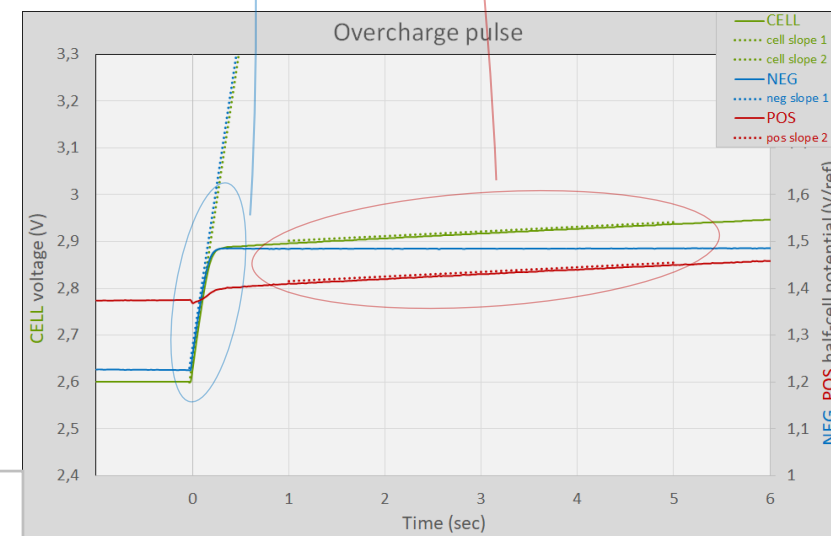
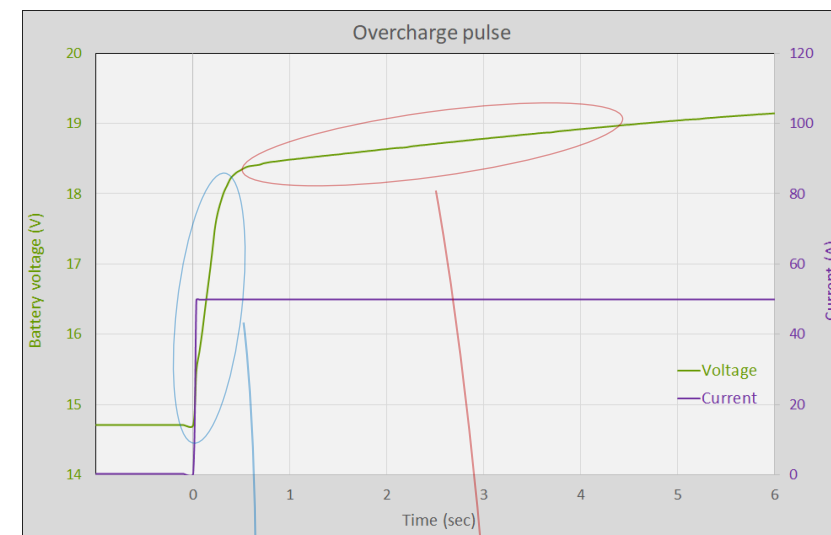
Charge pulse superimposed to overcharge

(Example of curves)

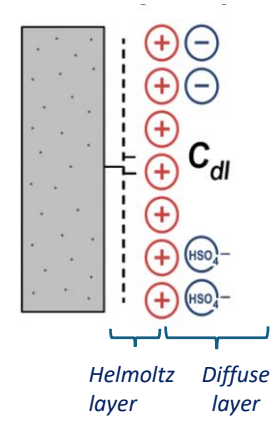
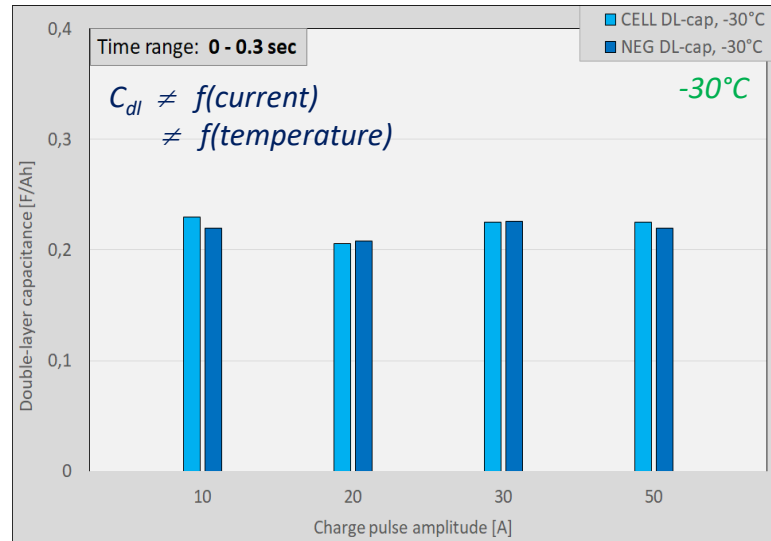
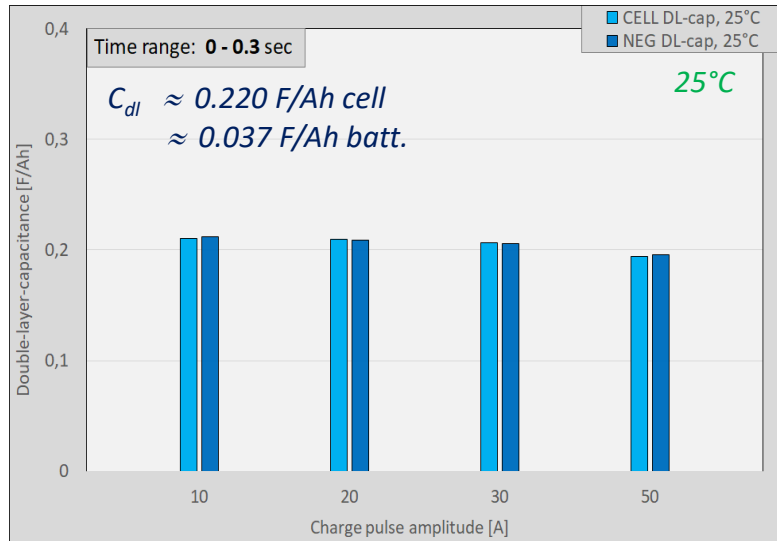
- *Current*
- *Batt. Voltage:*
 - linear in [0 – 0.5 sec]*
 - linear in [1 – 5 sec]*

- *NEG pot: linear in [0 – 0.5 sec]*
→ “DL-capacitor”
- *POS pot: linear in [1 – 5 sec]*
→ “Pseudo-capacitor”
- *Pseudo-cap. is reversible*
(under Charge & Discharge).

$$C = I / (dU/dt)$$

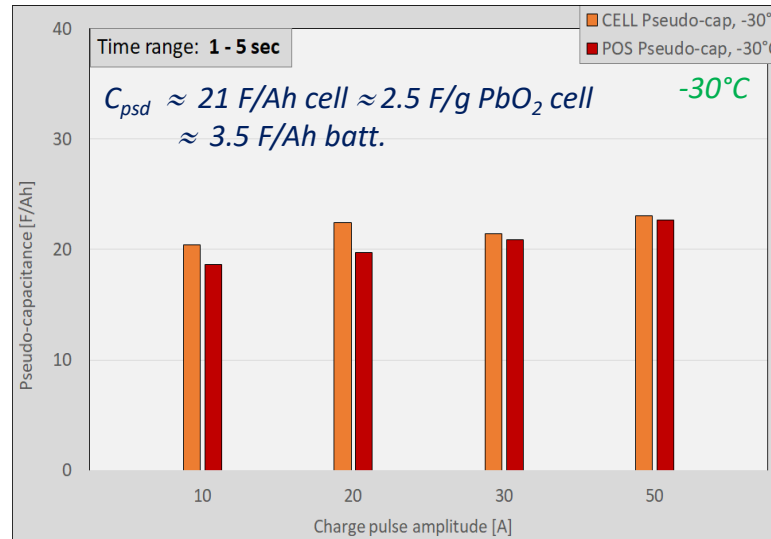
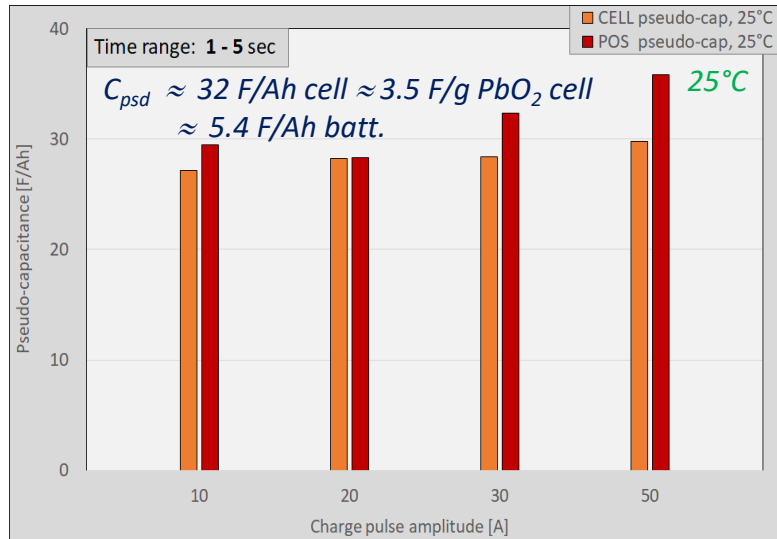


Pb negative electrode double-layer capacitance (0 – 0.3 sec)



DL-capacitor: reversible non-faradaic, electrostatic processes, at the electrode surface.

PbO₂ positive electrode pseudo-capacitance (1 – 5 sec)



Pseudo-capacitor: reversible, (part.) faradaic near to the surface or in the bulk.

i. Sub-stoichiometry:



ii. Hydrated amorphous gel zones:



iii. Specific adsorption of SO_4^{2-} :

