Electrolyte degradation – Additives and their impacts on cell performance

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Abstract

A previous study investigated different additive compositions in terms of capacity retention during cyclic ageing [1]. In this work cells with NMC622 cathodes and graphite anodes using different electrolyte additives (VC & FEC) are compared under cyclic and calendaric ageing, focussing on changes in pulse-resistance.

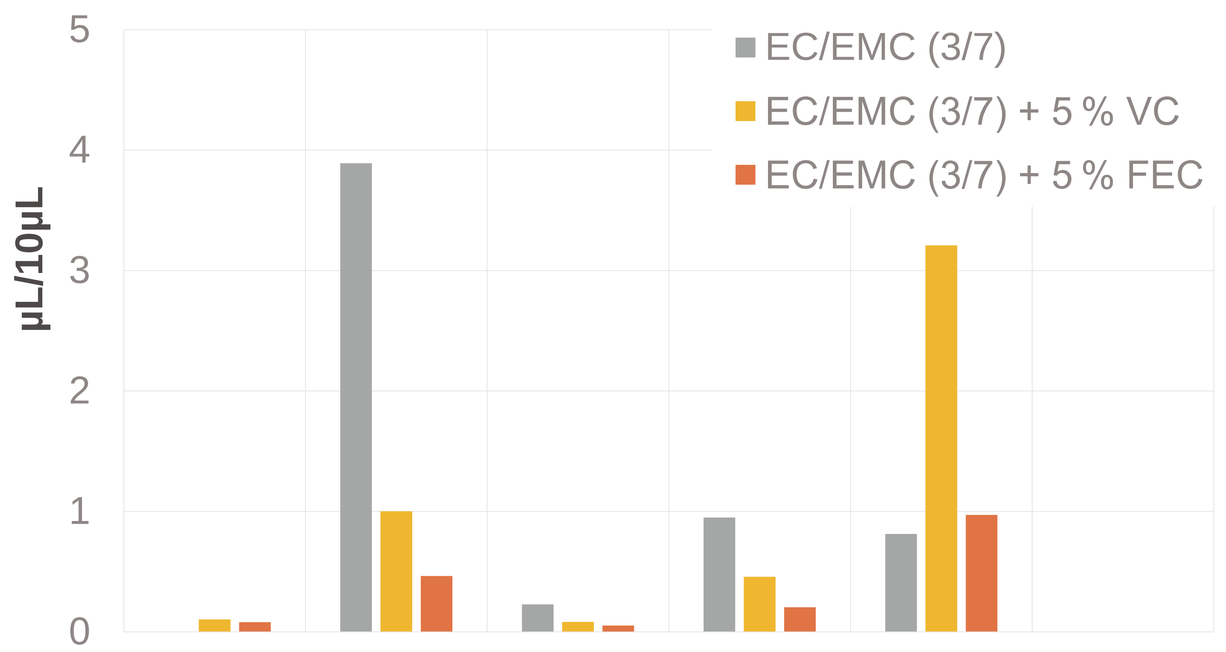
Hildenbrand, F. et al. (no date) 'Selection of Electrolyte Additive Quantities for Lithium-Ion Batteries Using Bayesian Optimization', Batteries & Supercaps, n/a(n/a). doi:10.1002/batt.202200038.

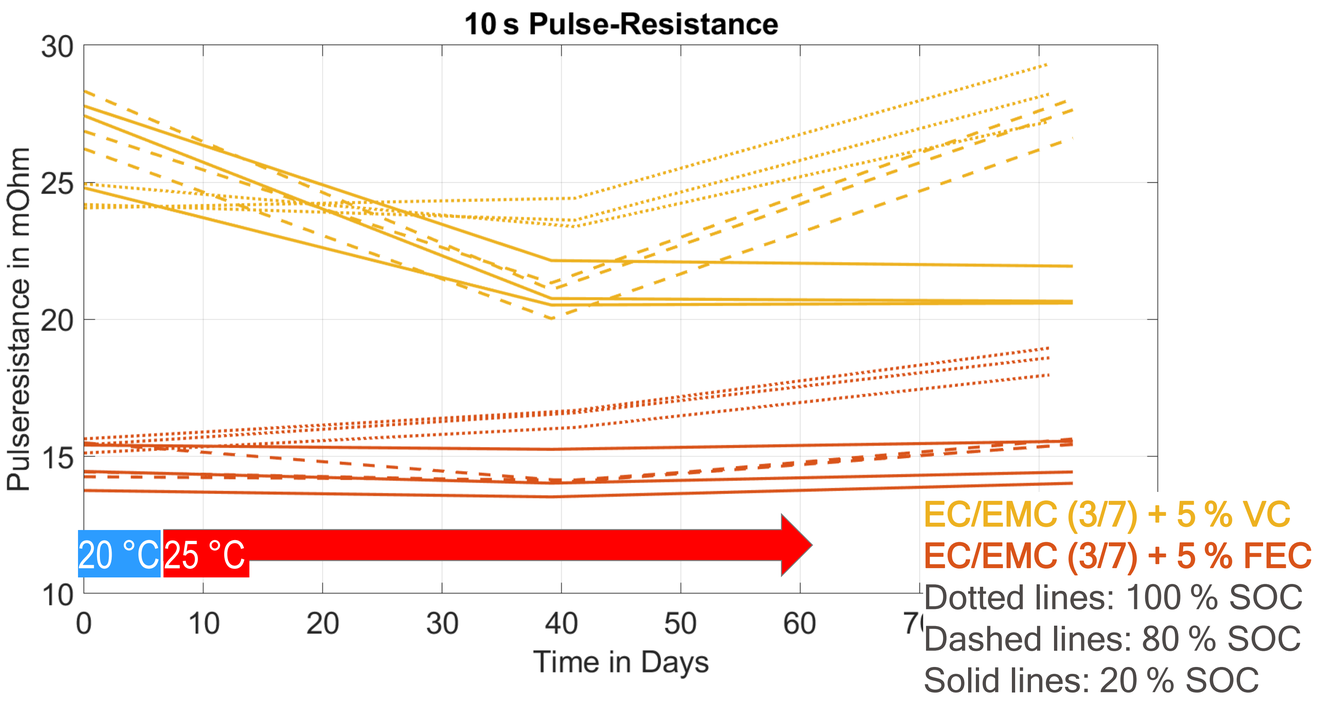
Conclusion

The comparison of cells with VC or FEC additive reveals that VC leads to an increased pulse-resistance, possibly due to forming a thicker film. Resistance increases mostly at 100% SOC. For VC-containing electrolytes resistance also increases substantially at 80% SOC. The tests are still running, with long-term results to be published once available

Cell formation & gas analysis

- 5 Ah NMC622/Gr cells
- Different Electrolytes
  - EC/EMC (3/7)
  - EC/EMC (3/7) + 5% VC
  - EC/EMC (3/7) + 5% FEC
- Gassing during formation
  - CO_2 found only in cells containing additives
  - Ethylene, CO and Alkanes are found in all gas-samples



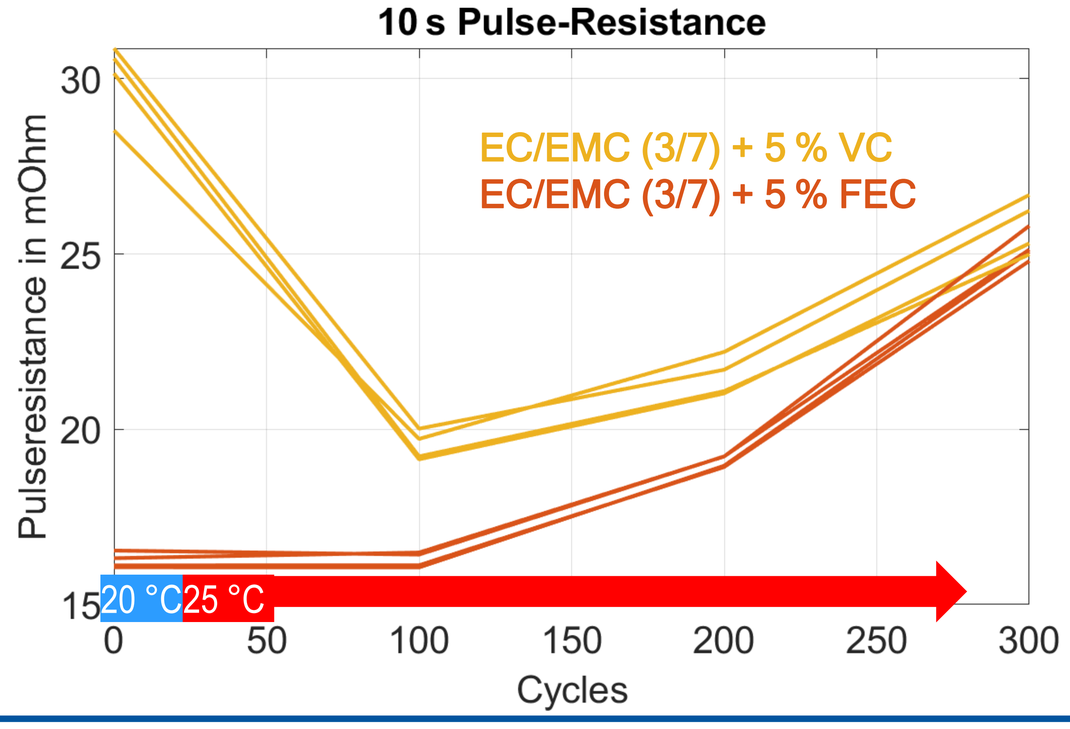


Calendaric Ageing

- Pulse-Resistance (1 C @70 % SOC)
  - Initial Checkup conducted at slightly lower Temperature for all cells (20 °C instead of 25 °C)
  - High SOC (80-100 %)
    - Stronger rise for VC-containing cells
    - Resistance also rises substantially at 80 % SOC when electrolyte contains VC
  - No rise of Pulse-Resistance at low SOC

Cyclic Ageing

- Pulse-Resistance (1C @70 % SOC)
  - Slightly stronger rise for FEC-containing cells
- Capacity
  - Slightly higher initial capacity retention for FEC-containing cells
- Initial Checkup conducted at slightly lower temperature for all cells (20 °C instead of 25 °C)
  - Potentially stronger temperature-dependency for VC-containing cells



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Battery Modelling, Analytics and Lifetime Prediction

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