OICA comments on the EVE-IWG status report to GRPE-73

(informal GRPE-73-23, GRPE-73 agenda item 10)

Electric Vehicles and the Environment (EVE IWG)

Method of Stating Energy Consumption
(Options & Recommendations)

EVE-IWG Status report to GRPE 73rd Session   Informal document GRPE-73-23:

- **Option A:** Recommend that the report and accompanying model meet the goal of information sharing as outlined in Part A of the EVE mandate, and results can be referred to as guidance documents

- **Option B:** Instruct the EVE IWG to continue development and refinement of the model as a specific work item under an extend mandate of EVE IWG (Part B), which could inform the potential development of SR or GTR at some point in the future.

- **Recommendation: To be determined, some support for each option, but more support for Option A at this time.**

OICA comments:

- OICA supports **Option A**
  - Energy production is not in the scope of GRPE or WP.29
  - Vehicle manufacturers are not responsible for Energy production
  - It is not acceptable that an identical car has different CO2 performance in different regions
  - If the Method of Stating Energy Consumption will be continued in another group outside WP.29, OICA has a neutral position on it

Electrified Vehicle Durability
(Options & Recommendations)

EVE-IWG Status report to GRPE 73rd Session **Informal document GRPE-73-23:**

- **Option A:** Recommend that a GTR is appropriate for electrified vehicle durability
- **Option B:** Extend the EVE mandate to continue active research into electrified vehicle durability, with goal of beginning GTR development when the system power determination GTR is complete
- **Option C:** Declare that it is premature at this time to work towards a GTR for electrified vehicle durability, but continue passively collecting information on the topic and revisit when the system power determination GTR is complete
- **Recommendation: To be determined, some support for all 3 options**

OICA comments:

- OICA supports **Option C**.
  - OICA acknowledges the wish to determine values for customer information, e.g. Range with an aged Battery, however
    - Battery durability and its effect on the vehicle durability is regulated by the market and the customer expectations and warranty
    - An aging procedure would be defined on the available knowledge and could limit potential promising future technologies
    - Customer behaviour will change in future due to developing infrastructure and increased range of EVs
    - **It is not appropriate at this stage to develop an reliable Battery aging process for Type Approval**

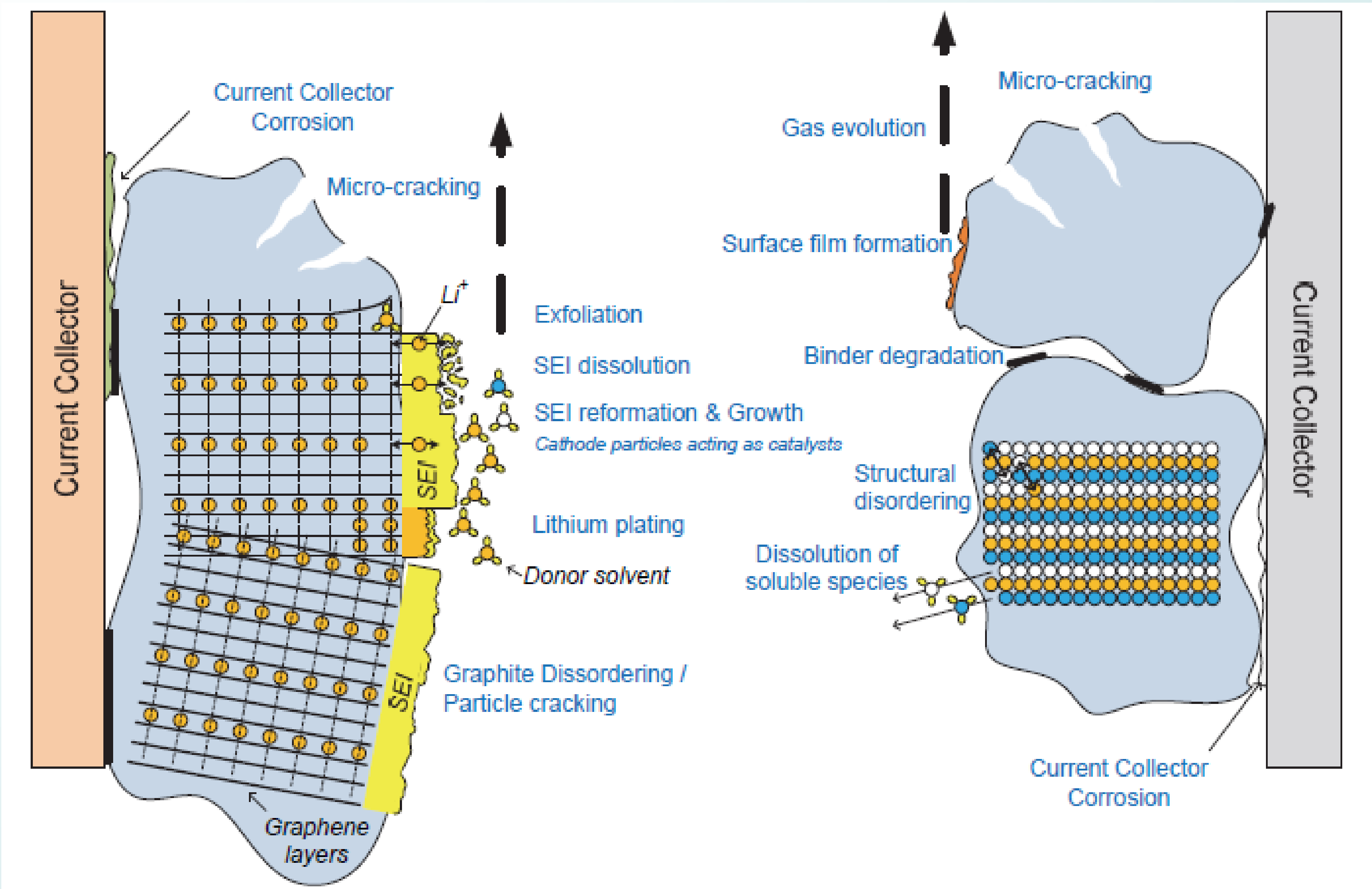
Appendix

Effects of aging on battery performance

- Degradation is manifested as loss of available capacity, power fade or reduced power efficiency
  - For PEV and PHEV capacity fade is often the most critical performance characteristic
  - For HEV maximum power and power efficiency have direct impact on fuel consumption
- Aging mechanisms are complex and strongly dependent on operating conditions
  - Electrical aging – electrical load cycles for charge and discharge
  - Calendar aging –time induced degradation processes, e.g. corrosion
  - Mechanical aging – degrading effects of physical strain caused by e.g. vibration, shock, etc
  - Additional factors that impact on aging rate and type of aging include but are not limited to temperature, user patterns, component quality and system integration factors, cell design and dimensions

Performance loss	**Degradation cause**	**Description and examples of degradation mechanisms**
Capacity fade	Loss of electroactive material	Compositional and structural changes of the electrode surface, particle fragmentation, delamintion and blocking of electrode surface with insulating deposits reduces the electroactive area and reaction sites available for charge/discharge reactions
	Loss of cycleable lithium	Li ions are consumed by parasitic reactions. Main contributing factors are SEI film formation and growth as well as Li plating
Power fade / Reduced power efficiency	Loss of conductivity and Impedance increase	Polarization effects caused by restrictions in activation of electrohemical reactions, material transfer resistance and loss of conductivity. Contact resistance and Ohmic potential drop in the electrolyte are main contributors. Maximum power capability and power efficiency do not have degrade at the same rate.

Main aging mechanisms on cell level



Vetter *et al (2005) J Power Sources, 147, pp 269-281.*

Sensitivity to path – aging is application specific

Symmetric CC charge/discharge cycling

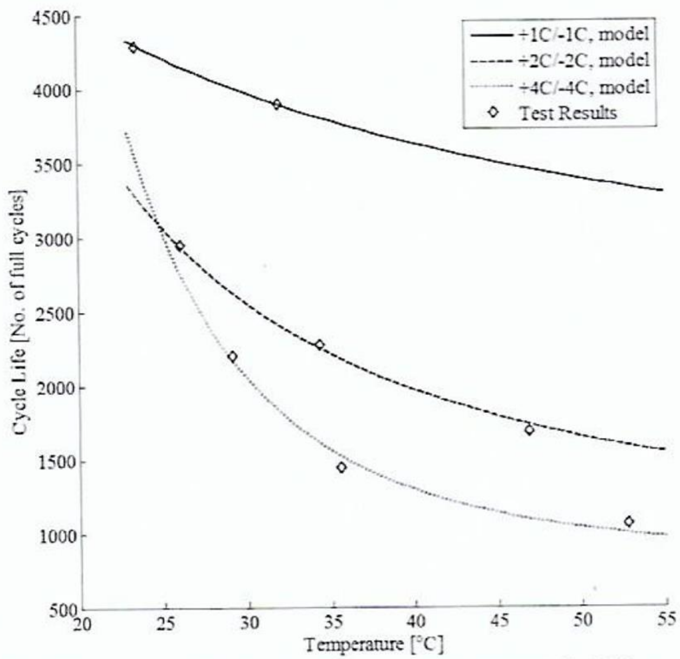


Figure 21 Cycle life of the $LiFePO_4$/graphite cells for symmetric cycles at 1, 2 and 4C-rate and the fitted empirical cycle life relation as a function of temperature and current rate (EOL = 20% capacity fade)

Assymmetric CC charge/discharge cycling

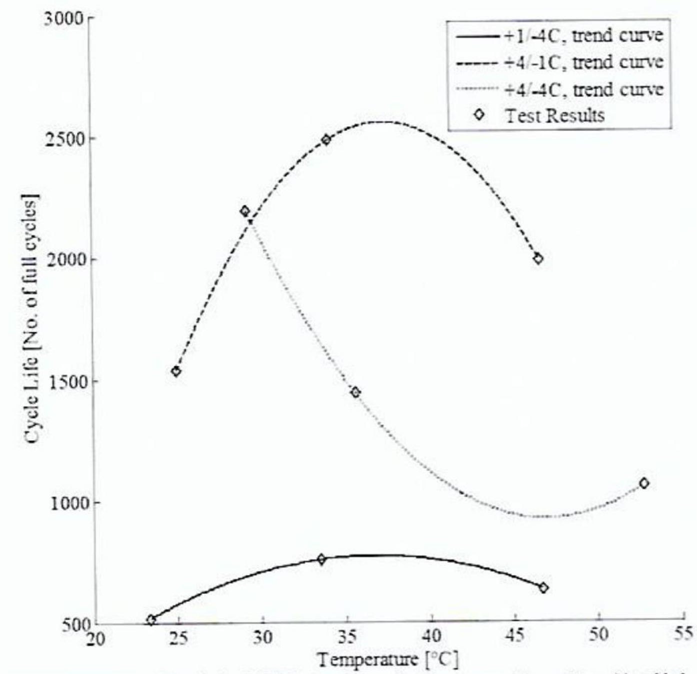


Figure 22 Cycle life of the $LiFePO_4$/graphite cells for asymmetric cycles with added polynomial trend curves as a function of temperature (EOL = 20% capacity fade)

- Aging mechanisms are known to be non-linear and interdependent, hence, accelerated testing of cycle life has proved to be very difficult
- Previous experience of a battery type in a given application is not transferable to another battery in the same application nor for the same battery to a different application

Groot *et al.* (2015) J. Power Sources, 286, pp. 475-487.