NAFEMS UK Regional Conference 2018 - Abstract Submission

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Name	Mrs. Leonie Upton
Job Title	Marketing Manager
Company	Siemens
Please identify the event for which your submitting?	NAFEMS UK Conference 2018
Will you be the presenting author?	No
Presenting Author	Mr. Gaetan Damblanc
Presenting Author Company	Siemens
Presenting Author Job Title	Manager
Presenting Author Email	gaetan.damblanc@siemens.com
Presenting Author City, State/Province	Lyon France
Presentation Title	Fast Charging – an attractive option for EVs owners with range anxiety
Relevant Themes / Keywords	powertrain, autonomous driving, battery, modelling

Abstract (plain text)	The automotive industry is undergoing a significant mutation with the development of autonomous driving and powertrain electrification. The latter is becoming more common on the market and projections show a constant increase of these vehicles in the future. However it is not a rapid take over from conventional cars as their price tag is still an impediment to their large adoption by consumers, even if incentives exist in many countries. Nevertheless they present many advantages such as little to no tailpipe emissions. Another reason for their slow expansion is the rather low drive range these vehicles offer. The longest range available on the market is 300km in real driving conditions. Although this would be sufficient for the usual daily commute from home to office, people have the feeling this is not enough for the few times a year they have to drive 500 km (over 310 miles). This is known as range anxiety. This means that for this type of journey one would have to stop at the service to recharge the batteries. And this may take a while. Alternatively, one could benefit from a fast charge station, where it is claimed the battery can be charged up to 50% of its full capacity in 20 min. However fast charge can be harmful to the battery if not controlled and managed correctly. Indeed fast charging a battery implies using a high current charge which has several effects on the battery. On the first hand it generates a lot of heat, which increases the battery temperature. In this case it is critical for safety matters that the temperature remains below 45 oC. Above, the temperature could lead to reactions which could damage the battery or set the all vehicle on fire. Secondly, the high current can lead to dendrite formation. Lithium metal is deposited on the anode electrode surface and grows slowly towards the cathode. At the point where the dendrite is in contact with the cathode, a short circuit occurs. It damages the cell, but also could lead to hazardous situation, which again could lead to set the vehicle on fire. This presentation introduces a new way of designing Li-ion battery cells, by using numerical modeling, to understand and predict how a cell behaves under fast charge conditions. We introduce how the Li-ion battery cell design and performance modelling is carried out using the software Battery Design Studio, and we present a study in which simulations of a cell in various fast charge conditions are performed. We look at the effect of the ambient temperature but also the variation current applied for fast charge. It is then possible to analyze the Li-ion cell temperature rise and estimate if dendrites are growing on the surface of the anode. After problems with fast charge have been identified, the study suggest solutions to these problems by applying design changes to the cell components. A design exploration study is carried out to vary the different design parameters which would ensure that the cell charging capacity is maximized in 20 min. However this is only valid if the temperature safety limit is never reached and no dendrites are growing. This study presents a valid design and is compared to the original one used in the first part of the presentation. This presentation was also used in a blog news on our website at the following address for more details: https://community.plm.automation.siemens.com/t5/Cd-Adapco-Blog/Fast-Charging-an-imperative-option-for-EVs/ba-p/434302
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