

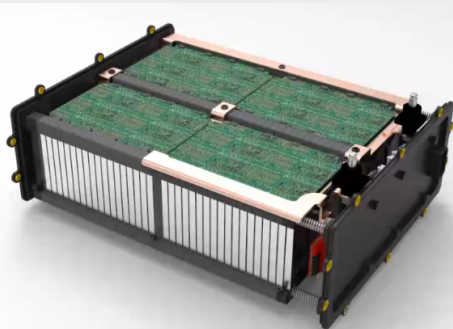
MAHLE Powertrain Ultra-fast Battery Charging

- > Lithium carbon battery cell technology
- Ultra-fast charging capability
- No rare-earth or exotic materials



Ultra-fast Battery Charging

MAHLE Powertrain and Allotrope Energy are investigating a concept for an ultra-fast charging battery system optimised for urban delivery vehicles. The target is to enable a full battery recharge to be achieved in a similar time to refuelling an internal combustion powered vehicle - this equates to 90 seconds for a moped and 2 - 5 minutes for a van. The battery is based on Allotrope Energy's lithium-carbon battery technology, which has similarities to supercapacitors, but with a greater energy storage capacity.



>> Optimised lithium-carbon battery pack with Allotrope Energy cells

Property	Units	EDLC	Lithium Carbon	Lithium-ion Capacitor
Power Density	kW/kg	70	15	8
Energy Density	Wh/kg	22	60	105
Energy Density	Wh/litre	26	80	200
Cycle Life	Cycles	>1 M	~100 K	1 - 2 K

>> Allotrope cell characteristics summary

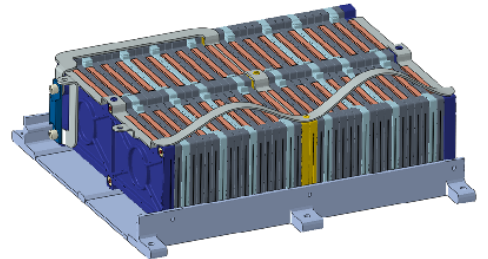
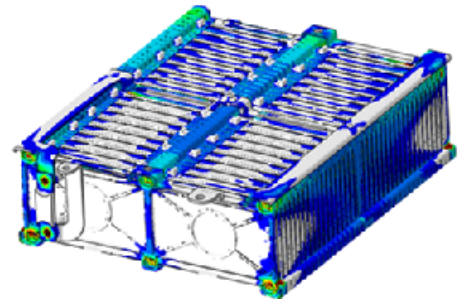
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Ultra-fast Battery Charging

Allotrope Energy's novel lithium-carbon battery cell technology combines the benefits of super capacitors with the energy storage capacity of lithium-ion cells which enable ultra-fast charging rates to be achieved. MAHLE Powertrain have used Allotrope's technology to design an ultra-fast charging, aggressively downsized battery pack for urban delivery eMoped and eVan applications. The battery pack concept design has been extensively analysed to ensure thermal stability and mechanical integrity.



>> Detailed analysis of cell arrangement

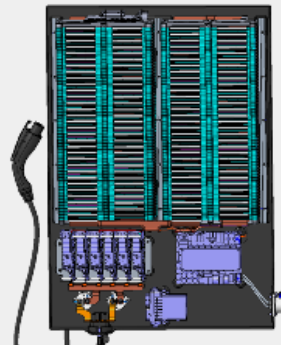
Parameter	Units	eMoped	eVan
Pack Capacity	kWh	0.50	10.5
Maximum Voltage	V	58	400
Minimum Voltage	V	38	280
Output Power	kW	1.5	100
Charging Power	kW	20	210
Charging Time	Seconds	90	180
Cell Mass	kg	9.5	120
Configuration	-	18S-4P	128S-2P

>> eMoped and eVan pack specifications

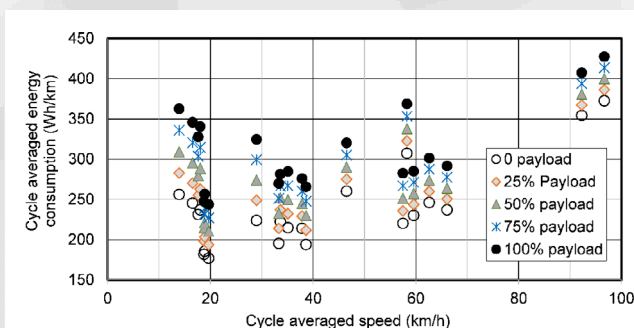
eMoped Charging System

To enable the eMoped pack to be charged rapidly, from a domestic supply, a bespoke charger concept has been developed.

The charger system contains in-built energy storage, using Allotrope's lithium-ion capacitor technology for ultra-long lifetime. This enables the vehicle to be charged at power levels of up to 20 kW, necessary to achieve the very fast target charging times (about 90 seconds), from a 7 kW domestic supply



>> Bespoke charger with lithium-ion capacitors



>> Battery energy consumption versus vehicle speed

Summary

Allotrope Energy's novel lithium-carbon battery cell technology combines the benefits of super capacitors with the energy storage capacity of lithium-ion cells which enable ultra-fast charging rates to be achieved.

MAHLE Powertrain have the engineering capability to design and develop optimised battery packs and supporting systems.

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