EV battery additives

Dispersants for next-generation electric vehicle batteries

Cargill®

Lithium-ion battery dispersants

The automotive market is rapidly changing, and interest in vehicle electrification is growing as countries enact new emissions legislation to ban new sales of internal combustion engine (ICE) vehicles.

There is intense interest in improving lithium-ion batteries, including increasing energy density and charging speed, improving safety, extending useful life, and reducing costs.

Manufacturers are seeking to reduce battery costs to improve electric vehicle performance and create price competitive products to entice consumers away from ICE vehicles.

Lithium-ion battery formulations include conductive additives - mainly carbon black, but increasingly carbon nanotubes (CNTs), which are challenging to disperse.

Overview of lithium-ion battery cell

What we do

From our battery lab in Gouda, Netherlands, we develop and manufacture additives to improve the performance of lithium-ion batteries.

Our product effects and developments

Conductive carbon dispersants

Figure 1 gives an overview of the typical construction of a lithium-ion battery cell and where our products can be applied. Dispersants are used in the battery manufacturing process to optimize the viscosity of slurries. This makes the slurry easier to handle, reduces solvent requirement and improves the distribution of conductive carbon in electrodes. If the carbon additives are not evenly distributed in the electrode slurry, initial battery capacity, capacity retention and cycle life can be adversely affected in the finished battery cell.

As experts in chemical synthesis, we are developing new, higher performance dispersants that address the needs of future battery manufacturing. Our conductive carbon dispersants improve the distribution uniformity of conductive carbon particles in electrodes. This enhances capacity retention at high charge-discharge rates.

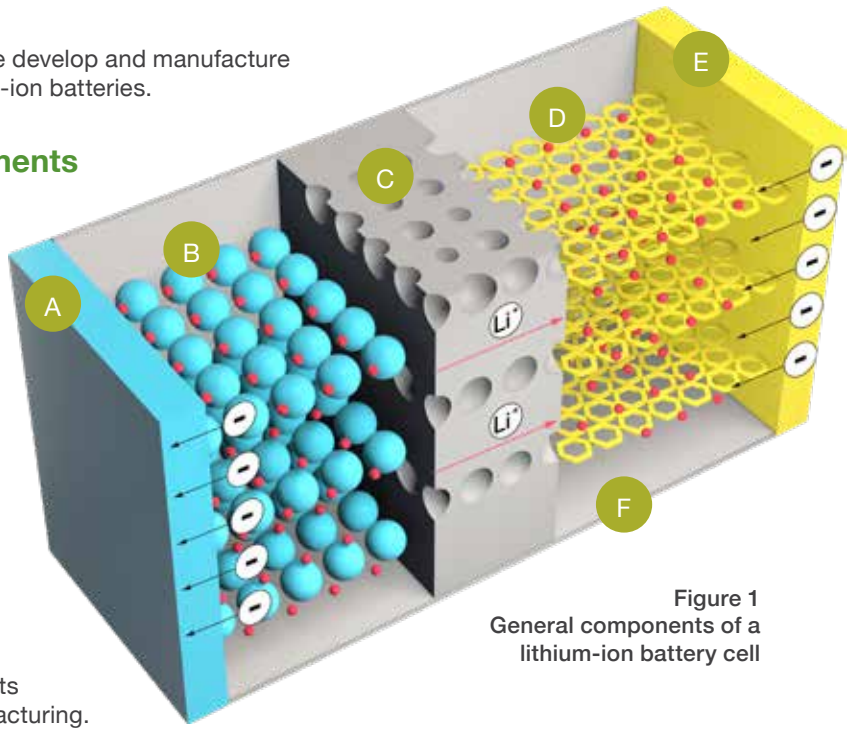


Figure 1
General components of a lithium-ion battery cell

Key	Description	Product focus area
A	Current collector (cathode)	
B	Cathode	Conductive carbon dispersants Plasticisers Binders
C	Separator	
D	Anode	Conductive carbon dispersants
E	Current collector (anode)	
F	Electrolyte (throughout the cell)	Temperature stability additives

Electrosperse™ 4000

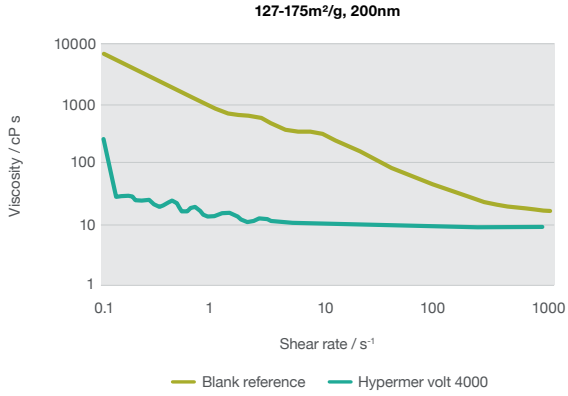
A polymeric amide dispersant designed to form concentrated carbon dispersions (slurries) in NMP (N-Methyl-2-pyrrolidone), the industry standard solvent used to manufacture battery electrodes.

- Excellent viscosity reduction in dispersions of many commercially available battery grade conductive carbons.
- Creates slurries with long term stability.
- Creates slurries with reduced NMP usage without affecting viscosity – reducing cost and solvent use.
- Improved cell capacity retention at high charge-discharge rates. This is especially effective in cathode materials made with lithium cobalt oxide (LCO), NMCE622 (a nickel-rich manganese cobalt cathode material) or LFP (Lithium iron phosphate).
- Non-hygroscopic for easier processing, handling, and storage.

Performance

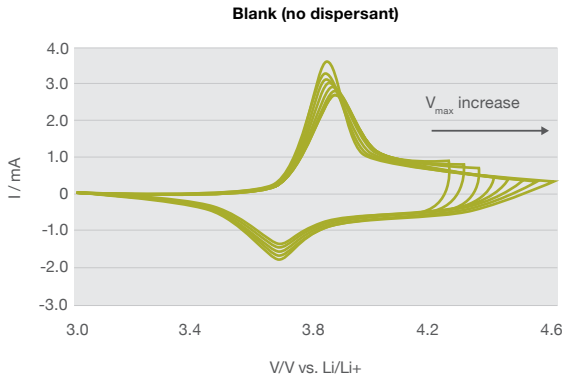
Viscosity

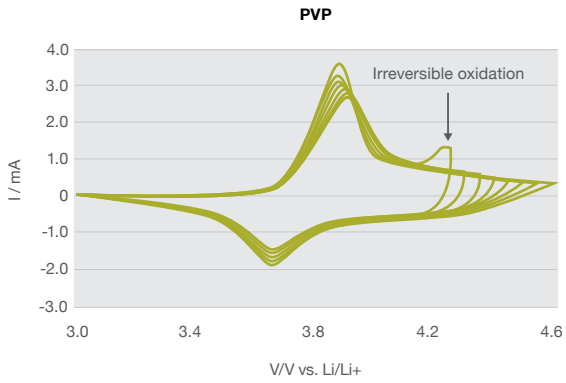
Viscosity of the carbon-NMP slurry was reduced using Electrosperse 4000. The slurry contained 1% Electrosperse 4000, 94% NMP and 5% carbon black. The carbon black was a commercially available grade, with a surface area of 68m² g^{-1} and an average particle size of 35nm.

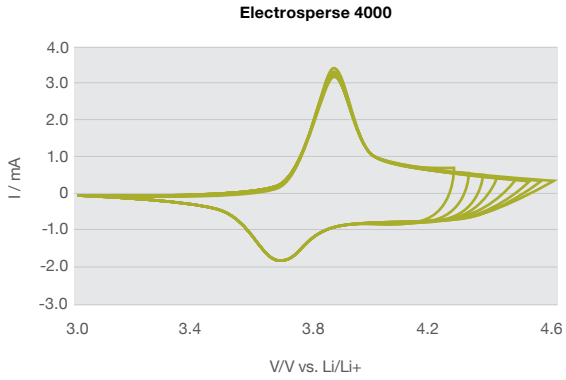


Electrochemical stability

Electrosperse 4000 shows improved stability vs. the industry standard, Polyvinylpyrrolidone (PVP). A pronounced oxidation peak upon the first anodic sweep was observed for the NMC622 cathode prepared using PVP, whilst the cathode prepared with Hypermer Volt 4000 did not exhibit an oxidation peak.

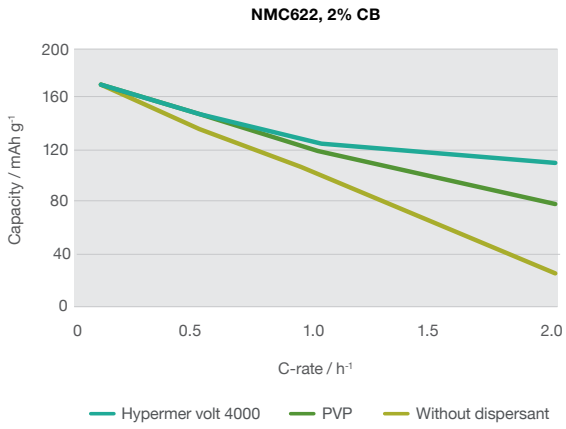






C-rate performance

Discharge rate capability of half cells were compared. For NMC622 cathodes containing 2 w/w% carbon black, Electrosperse 4000 results in a higher discharge capacity. This was compared with cathode formulations prepared with PVP and without dispersant.



Cargill battery laboratory

From carbon slurry creation, through to the manufacture of test cells, our battery laboratory offers state of the art manufacturing and testing facilities including:

Mixing, milling and characterisation

We have the ability to mix, mill and disperse conductive carbons using our high shear mixers. Rheometry is used to understand the effect our dispersants have on slurry rheology. We use Turbiscan to assess the long-term stability of carbon slurries, as well as particle sizing to assess distribution.

Sample cell creation

Laboratory scale coating is performed to create electrodes and assemble coin cells under argon in a glove box.

Cell testing

We have the ability to test up to 24 cells at a time to assess performance between -40°C to +100°C. We analyse electrochemical performance, including charge-discharge cycling, total capacity and capacity retention, cyclic voltammetry and impedance spectroscopy and more.

Further product developments for EVs

We are developing a portfolio of products for electric vehicle applications, including:

Battery technologies

Water-compatible dispersants for electrodes and current collector coatings.

PVDF plasticizers for improved coating flexibility

Na

Dispersants for sodium-ion batteries

Cooling and lubrication technologies

Low viscosity dielectric coolants for immersion cooled EV batteries and drivetrains

Low viscosity, low traction fluids for the next generation of lubricants for efficient EV gearboxes, transmissions, and e-axles

Traction reducing co-base fluids

Who we are?

The Energy Technologies business in Cargill Bioindustrial creates, makes and sells specialty chemicals and additives for the global energy market. Working in close collaboration with our customers, we apply sustainable concepts and deep scientific expertise so that together we can efficiently power the world of tomorrow.

For those who dare to imagine a brighter future, we establish long lasting relationships and create bespoke industry solutions through our integrated research & development and global manufacturing capabilities. Being both global and local, you have direct access to our network of technical experts. We look forward to talking to you.

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Further information

Cargill Bioindustrial sales and distribution are coordinated through an extensive worldwide network of technical and commercial experts. For further information or guidance please contact us:

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