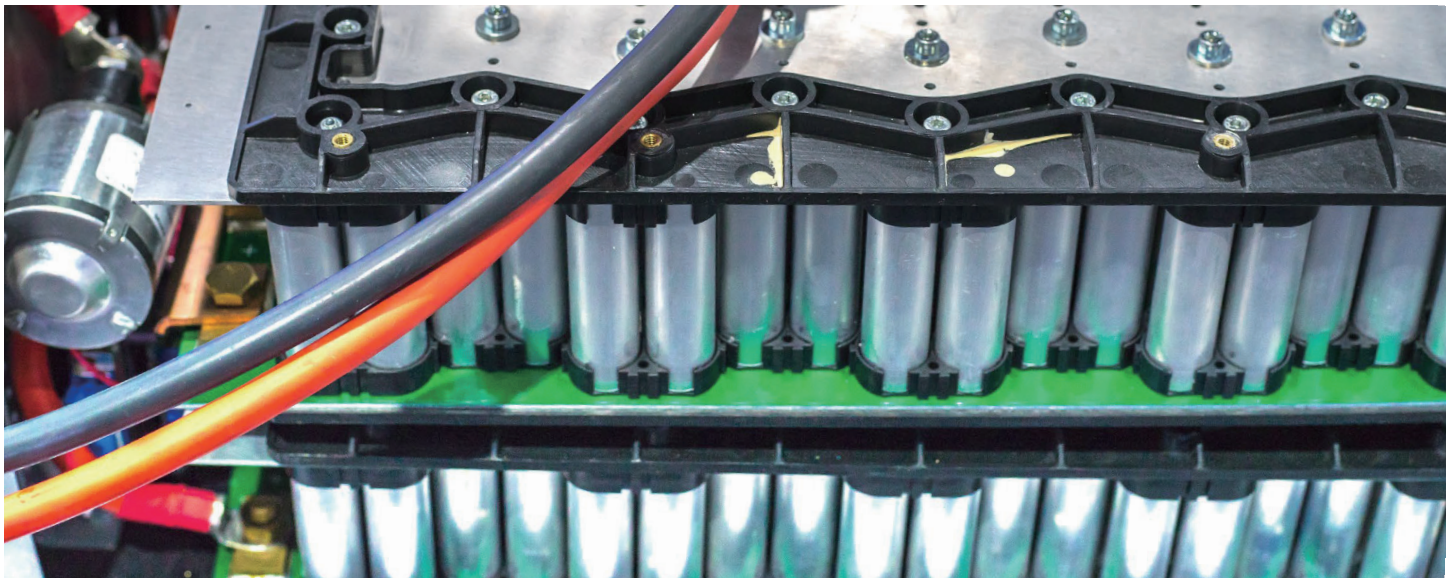
Thermal management – VORATRON™ Polyurethane Systems

We have you covered.



Reliability, ease of manufacture and good mechanical stability make cylindrical cell designs a popular option for hybrid/electric vehicle (H/EV) batteries. They typically burn less energy than pouch and prismatic designs, resulting in higher battery range, and can be very durable when utilized correctly. Of course, there's always room for improvement—and that's where we come in.

MobilityScience™—Dow's platform for driving innovation in the transportation/mobility industry—is helping OEMs and tier suppliers navigate the complex, rapidly growing H/EV industry with a broad range of materials and services that can help improve performance, processability and sustainability.

VORATRON™ Systems for battery pottants and encapsulants

In the large cylindrical cell battery designs used for H/EVs, each cell needs to be surrounded by a pottant (or encapsulant) to offer isolation for individual cells and the entire battery in the case of a thermal event and tolerate mechanical stress in battery.

VORATRON™ Polyurethane Systems for potting/encapsulation are designed to offer fire resistance, high strength, thermal insulation, and structure to the cells and battery. These semi-rigid to rigid, room temperature curing foams can also help slow thermal runaway propagation in lithium-ion (Li-ion) battery systems.

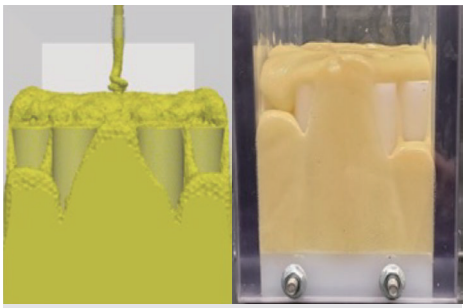
To ensure each cell is well encapsulated, VORATRON™ systems have custom-designed rheological characteristics (ex: low viscosity) and cure kinetics (ex: open time) that enable dispensing and filling of intricate geometries and space within the cylindrical cell case. The dispensed foam expands, closing all gaps and preventing voids that may lead to failure in case of a runaway issue.

The cured foam is firm, yet flexible; tough, yet lightweight. The right elasto-mechanical properties for efficient assembly and performance help keep the cells and battery in place while providing excellent thermal and mechanical isolation to the cells.

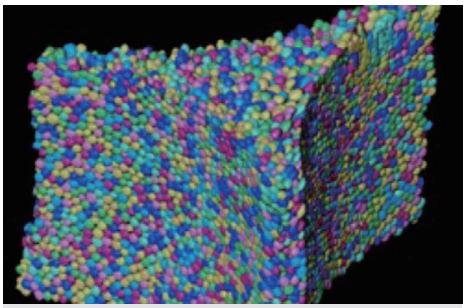
Their inherently low densities help VORATRON™ systems produce lighter weight batteries, in turn reducing vehicle weight. And, as an added safety measure, VORATRON™ potting materials are also designed to allow degassing for pressure balancing during a thermal event.

Additionally, the adhesion of the VORATRON™ systems-based materials to several substrates in the battery assembly can improve integration of the pack.

In addition to H/EVs, VORATRON™ Polyurethane Systems can offer excellent performance as lightweight, foamed potting materials for e-bike batteries.



Dow Foam Flow (DoFF) Model predicts void location (left) & is experimentally verified (right)



X-ray tomography of potting foam showing uniform cells

Table 1: Performance range of VORATRON™ Polyurethane Systems for battery pottants[1]

Key Attributes	VORATRON™EP 500 Series	VORATRON™ EP 2000 Series
Foam/Non-Foaming	Foam	Non-Foaming
Type of Dispensing	High Pressure	Static Mixer, Low Pressure
Density	0.25 – 0.6	0.85 – 1.1
Mixed Viscosity @ 25°C	<1500 mPas	<3000 mPas
FR Performance	-	UL94V0
Elongation	5 – 50%	3 – 30%
E-Modulus	50 – 500 MPa	100 – 700 MPa

[1] Typical values, not to be construed as specifications. Users should confirm results by their own tests.

The right tools for the job

Okay, that's great, but how do we do all that – and make sure everything works as planned?

In addition to decades of experience in material science, research, development and manufacturing, we've developed advanced modeling and predictive intelligence capabilities that aid and guide the materials selection and application development processes.

These predictive models support the optimization of our foam systems – ensuring the most advantageous mix of polyurethane, catalysts, surfactants and additives to achieve the desired results (Table 1).

Dow foam flow model (DoFF) enhances the ability of Dow and its innovation partners towards rapid product development while simultaneously guiding with pathways for an efficient and complete potting inside the pack.

Better together

We work closely with OEMs and tiers, using all our MobilityScience™ resources to find the best possible option for each cylindrical cell battery design. By combining decades of material science, technological and R&D experience with the vast knowledge and experience of our customers, we're able to develop innovative, efficient and sustainable solutions to mobility challenges.

Please contact your Dow representative or visit us online at **dowmobilityscience.com** to learn more about MobilityScience™ and VORATRON™ Polyurethane Systems and our full portfolio of advanced battery pack pottant and encapsulant solutions.

For more information about Dow, visit www.dow.com/about. To contact a Dow representative, visit, www.dow.com/contact.

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