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Elkem Silicones

BLUESIL™

Novel foamed-in-place sealing solutions by Elkem Silicones enable long-lasting protection for power batteries

Delivering your potential

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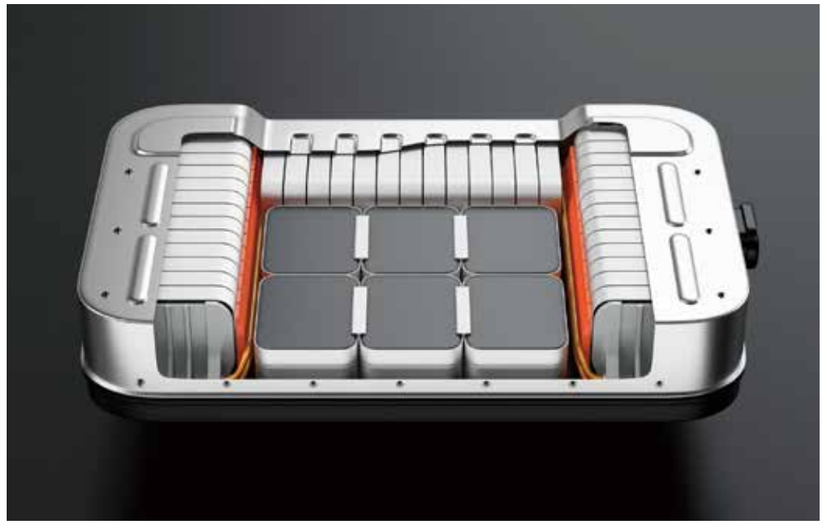
BLUESIL™ RT Foam 3244 is transforming the way battery packs are traditionally sealed by launching a new form of automatic in-line dispensing technology that offers markedly improved assembly efficiency and overall cost-effectiveness.

With many countries and regions around the world vowing to become carbon neutral, Elkem has set a goal in its climate roadmap released in 2021 to reduce total fossil CO_2 emissions by 28% by 2031. Since the automotive industry is a major source of carbon emissions, there can be no doubt that the transition to new energy will be instrumental in achieving carbon neutrality worldwide. This is why the hybrid and electric vehicle (H&EV) market is growing exponentially. In 2020, global electric vehicle (EV) sales exceeded three million units for the first time ever. In the Stated Policies Scenario, the global EV stock expands to almost 145 million vehicles by 2030, an annual average growth rate of nearly 30%.*

* Source: IEA Global EV Outlook 2021 report.



Sealing performance – key to long-lasting protection for battery packs

There are many indications that EVs are set to become the future of the automotive industry. Consumers, however, remain skeptical about the safety, capacity and service life of car batteries. These are decisive factors in whether H&EVs can eventually replace fuel cars and dominate the industry.

The sealing of the battery pack, the core component of H&EVs, is crucial to the safety and operating stability of the battery system and directly impacts the safety of the whole vehicle. The output voltage of the battery pack in EVs can be as high as 300V or more. A well-sealed battery housing can eliminate the risk of water-induced short-circuiting and spontaneous combustion caused by dust ingress. When properly sealed, the battery pack will not suffer from damaged parts and decreased electric capacity resulting from the leakage of liquid from the safety valve or junction. Therefore, H&EV OEMs and battery manufacturers need to make a rigorous selection of sealing materials for battery packs to meet regulations and consumer requirements for safety and performance.

Comparison of different sealing materials

Sealing materials can generally be divided into three groups: epoxy resins, silicones and polyurethanes. So, what are the differences between these material categories? The following table summarizes the basic characteristics of silicone materials and compares them with those of epoxy resins and polyurethane sealants.

A comparative table of materials: silicones vs. epoxy & polyurethanes

	Silicones	Epoxy Resins	Polyurethanes	
Temperature Range	-50 to 200 ℃	-50 to 150 ℃	-30 to 120 ℃	Temperature range and elasticity
Elasticity	Elastomer – Gel	Rigid resin	Rigid resin - Elastomer	
Modulus	Low	High	High	
Mechanical Strength	Medium	Strong	Strong	Strength, adhesion and resistance features
Adhesion Strength	Medium - High	High	Medium	
UV Resistance	Excellent	Poor	Poor	
Ionic Impurities	Minimal	Medium	Medium	
Combustion	Self-extinguishing	Non-self extinguishing	Non-self extinguishing	Combustion and diaelectric behavior
Dielectric Stability	High	Medium	Low	
Coeff. Thermal Exp.	High	Low	Medium	

As can be seen, **compared to epoxy and polyurethane based sealing materials, silicones are thermally stable and can maintain proper adhesion (bond strength) to the substrate over a wider temperature range. This ensures superior sealing results and excellent stability under extreme weather conditions.** In addition, silicone sealants provide better performance in elasticity, ionic contamination, flame retardancy, dielectric stability and UV resistance than epoxy and polyurethane materials.

Major challenges facing battery and H&EV manufacturers

Apart from ensuring that the battery pack will not be damaged by the ingress of dust, water vapor or other contaminants, battery manufacturers and H&EV OEMs must also consider a variety of other factors, such as safety, stability, flame retardancy, thermal conductivity, vibration resistance, harmful gas generation and cost effectiveness.

Currently, battery manufacturers and H&EV OEMs mainly use silicone foam gaskets, epoxy resins or polyurethane adhesives to seal the packs. As the solutions, silicone foam gaskets need to be die-cut into specific shapes and manually laminated, resulting in low production efficiency and high production cost. Epoxy resins or polyurethane adhesives also have shortcomings, namely high mass density, insufficient flow, the emission of toxic volatile compounds and lack of ease with dismounting. In addition, the existing sealing products are unable to effectively cope with large tolerances or complex curved surfaces of the battery housing, thus potentially resulting in seal failure.

New foamed-in-place sealing solutions by Elkem Silicones

As the world's leading fully integrated silicone provider, Elkem Silicones not only helps EV manufacturers to create more reliably sealed battery packs that improve battery performance, safety and service life, but also helps customers to improve process technology and accelerate mass production and assembly automation.

In response to the pain points of the industry, Elkem Silicones created foamed-in-place sealing solutions, applying adhesive directly on battery housings via automation equipment. Taking advantage of the excellent performance of silicone, it moves away from the traditional manual lamination process to fully automated dispensing technology. This not only substantially improves production efficiency, but also ensures the consistency of sealing whilst significantly reducing total cost. The result is an easier and more standardized assembly process.

How does Elkem Silicones make in-line dispensing technology possible?

Since its establishment in 1904, Elkem Silicones, as one of the world's leading suppliers of advanced silicon-based materials, has continuously launched innovative products and services based on customer and market insights. Committed to the Chinese market, Elkem Silicones has pooled together its established global resources to provide cutting-edge technologies and products, creating an innovation ecosystem among its Chinese customers and partners.

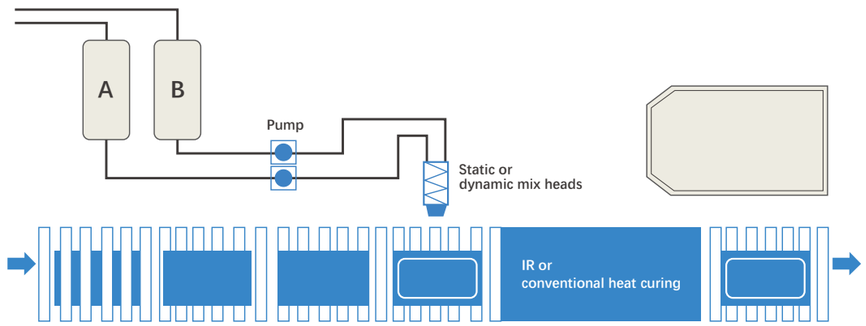
For example, a first-tier Chinese OEM has used BLUESIL™ RT Foam 3244 in its in-line dispensing application. BLUESIL™ RT Foam 3244 is a two-component RTV silicone foam that can create a solid foam after a crosslinking and foaming reaction between component A and component B flowing through a static or dynamic mixing head via a transfer pump. Mixed in a 1:1 ratio, the two components are dispensed uniformly onto the surface of the battery housing along a set path. After this, the product is transported by a conveyor to the next station for IR or heat curing, followed by a simultaneous foaming and curing reaction to a seal with appropriate shape and aspect ratio. **This foam ensures excellent sealing of the battery pack box up to IP67/68 when the upper and lower covers are closed and bolted. Compared to traditional manual lamination, the automated in-line dispensing process is much more easier and can lead to standardized operations and quality control.**

EV Battery pack cover sealing - BLUESIL™ RT Foam 3244

Dispensing process

Elkem BLUESIL™ RT Foam 3244 is applied directly to a battery prototype by means of a silicone foam dispenser. There are some important points for consideration, as follows:

- **The prototype is initially subject to post-curing, which does not affect the continuity of production**
- **Production efficiency is a function of dispensing speed (cover plate size/perimeter)**
- **Elkem primer is required to ensure effective bonding**



Performance of BLUESIL™ RT Foam 3244 seals

BLUESIL™ RT Foam 3244 is a silicone foam with a solid bubble structure. With a density of only 0.25 g/cm^3, the molded foam provides excellent compression resilience and reduces the tolerances required for the battery pack housing. Extensive experiments confirm the outstanding advantages of RT Foam 3244:

■ **Excellent sealing performance:** under repeated airtight, water-immersion, vibration, disassembly and aging tests, RT Foam 3244 vulcanized seals provide a compression set of less than 5% (at compression ratio of 50%) and a water absorption rate of less than 1%, enabling IP67/68 rating for battery packs. This means that the product can work with the battery pack box while maintaining excellent resilience and consistent sealing performance in extreme environments, such as high pressure and humidity.

Properties	RT Foam 3244
Viscosity Viscosity A（mPa.s）	19000(10S^{-1})/24000(1S^{-1})
Viscosity Viscosity B（mPa.s）	35000(10S^{-1})/160000(1S^{-1})
Working time	142 S
Curing time	Approx, 10 min
Color	Black
Density（g/cm^3）	0.25
Tensile Strength（Mpa）	0.4
Thermal resistance in peak（3days）	250 ℃
Compression set（50%）	<5%
UL 94 rating（UL94）	V0
Water absorption （24 hrs and 2cm, %）	<1%
Application & flow	

■ **Flammability：** As a UL94 V0 certified flame retardant material, RT Foam 3244 can be used at temperatures of up to 250°C.

■ **Process reliability and stability:** Elkem Silicones has optimized the dispensing process of RT Foam 3244 through extensive experiments to achieve long and continuous dispensing, ensuring high volume production and quality stability.

In collaboration with our customers and dispensing machine manufacturers, Elkem Silicones' team of experts creates foamed-in-place technology to provide customers with a complete range of solutions including materials, equipment and processes. Product performance and service quality were two of the decisive factors behind the domestic first-tier OEM selecting Elkem Silicones' products for use in harsh conditions. At present, this customer has applied BLUESIL™ RT Foam 3244 extensively in its battery housing sealing applications.

Markedly improved assembly efficiency and overall cost-effectiveness

BLUESIL™ RT Foam 3244 is transforming the traditional process by launching an automatic in-line dispensing technology for continuous production. The foamed-in-place silicone product optimizes the pack production line by eliminating the bottlenecks: peeling off release paper and manually applying adhesive strips. Battery housings can be assembled directly after foaming, impressively improving assembly efficiency and reducing the process steps.

“The Elkem Silicones foam product enables the flexible production of silicones and equipment, and meets the aspect ratio requirements of different manufacturers. It has also passed relevant third-party and in-house testing and ensures compliance with IP 68 waterproof rating. It meets the sealing requirements under high temperature accelerated aging conditions (1000 hrs at 130 ° C and 50% compression ratio), solving challenging problems such as condensation inside battery packs. In particular, RT Foam 3244 features high expansion ratio and is failure-free at a long-term compression ratio of 60%, which can save 1/3 more of the material cost than the competition. It also provides so good adhesion to substrates such as electrophoretic-coated metal sheets, SMC and PCM parts that only cohesive failure occurs inside them. This product enables high pass rate of battery packs. We are very satisfied with it.”

“Elkem Silicones not only provides us with quality products, but also innovative solutions. We can rely on Elkem to meet OEMs’ performance requirements while improving properties of our products and solving a flow problem” commented the general manager of the company.

One-sixth of NEVs in the world are protected by Elkem Silicones

Since the invention of the world's first CAF industrial one-component sealant in 1970, Elkem Silicones has been driving innovation in a wide range of industries through high-performance silicone solutions. **Since the rise of new energy vehicles, Elkem Silicones has also been innovating to provide competitive and integrated solutions for the hybrid and electric vehicle sector. Now, Elkem Silicones products are found in one-sixth of NEVs in the world.** Looking ahead, Elkem Silicones is dedicated to cooperating with you to manufacture safer, more durable and higher performance automotive batteries. This is how we are working to drive prosperity for the new energy vehicle industry.

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