



## A Technological Breakthrough in Battery Bonding & Thermal Management: Introducing A New Lightweight AND Thermally Conductive Adhesive Filler

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Adhesives are commonly used to bond battery cells together. Thermally conductive materials are being widely used to fill spaces between battery cells and to bond battery casings to heat sinks. Typically, these products are heavily filled, to provide a higher level of thermal conductivity compared to regular adhesives, but these fillers increase the specific gravity (or density) of the adhesive and can make batteries very heavy. Heavy batteries are more difficult to handle, so in the interests of user comfort, rechargeable battery packs for items such as power tools and vacuum cleaners, need to be as light as possible. In electric vehicles, a heavy battery will reduce the vehicle's overall performance, speed, acceleration, charging range and fuel economy.



### What is thermal conductivity and why is it important for battery adhesives?

Thermal conductivity is normally measured in Watts per metre Kelvin (W/m.K) – a measurement of the transfer of heat across a material. Something that doesn't transfer heat is thermally insulating. A regular adhesive would not have particularly good thermal conductivity – typically around 0.3 W/m.K. Good thermal conductivity is measured at around 1 W/m.K. It is possible to increase the thermal conductivity of adhesives by adding fillers, but they start to become thick and pasty, making them difficult to handle or they can become very expensive with the addition of silver. A further challenge in battery applications is that some fillers which may be desirable for their thermal conductivity properties, are also electrically conductive (e.g. silver and copper), which could result in short circuits and electric shocks for anyone coming into contact with the battery!

The pressure is on for manufacturers to develop batteries which charge more quickly. Nobody wants to wait at a motorway service station for hours while their vehicle charges up. An additional challenge for battery

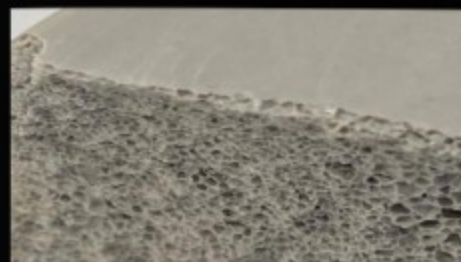
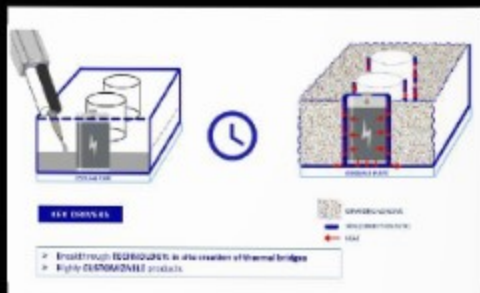
manufacturers is that the batteries produce heat and hot spots while they are charging, and the faster they charge, the hotter they get. The heat needs to be driven away from battery cells to the heat sinks, quickly and efficiently and this can be done by filling the space between the battery cells with a thermally conductive adhesive.

### Introducing... Lightweight AND Thermally Conductive Adhesive Filler



Permabond's new patent-pending technology is a two-component adhesive which when mixed, forms a foam structure which fills all the battery pack's free space. As it expands in a closed container, the compression creates a highly conductive skin that efficiently transfers heat to the cooling plate. The dual structure of the lightweight foam and hard skin in contact with the battery cells, housing and heat sink, creates a thermal bridge to conduct and dissipate heat. The low density foam weighs 0.7g/cm<sup>3</sup> and offers thermal conductivity of 0.8 W/m.K. The skin is highly conductive at 2.6 W/m.K.

The additional benefit of this product is that the foam is a lot easier to dismantle than a solid-filled system, helping to reduce recycling costs and improve recycling processes.



### Benefits

- Full cure at room temperature
- Thermal conductivity of 2.6 W/m.K (via the skin)
- Low density 0.7g/cm<sup>3</sup>
- Fire retardant
- Fills space around battery cells – supports and holds battery in place
- Excellent impact and vibration resistance
- Can resist thermal shock and differential expansion and contraction stresses
- Can be machined/removed for recycling purposes
- Economic and cost-effective (as less adhesive is needed due to the foaming increasing the volume)
- Can be modified to suit specific requirements
- Small lab batches up to full scale tonnage production available
- Easy to fill or pump into battery casing

### Customisable Technology

The patent-pending technology can be tailored to meet individual needs, depending on the requirements of the battery manufacturer. It may be that the flow requirements, cure speed or other properties need to be customised, to help optimise battery performance and production line processing requirements. Other properties can also be included such as fire retardancy and of course electrical insulation.

*"We have a custom product development service which teams our expert chemists and helpful engineers with the product designers, allowing them to come up with a high-performance adhesive matching any specific requirements."*

Rebecca Wilmott

Product Manager Permabond

