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When Fire Meets Plastic

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Kautex is well-known within the automotive industry as a Top 100 supplier of hybrid and conventional fuel systems. Translating that knowledge to battery systems has been a unique challenge that the global R&D team has readily embraced. In fact, you could say the challenge "lit a fire" under them to find solutions to this unanswered question: "Can plastic really meet the fire test requirements for a battery housing?"

While Kautex is well-versed in the fire test requirements for plastic fuel tanks, the testing for a battery system was an entirely new challenge, in part, because of how the fire reacts within a fuel tank versus a battery housing.

"To understand how to pass an external fire test for a battery system, we first had to understand the different chemical reactions that occur in a battery system versus a fuel tank," said Felix Haas, director, Pentatonic product development. "With automotive fuel tanks, an external fire produces enough heat to evaporate the fuel in the tank, drawing energy away from the tank walls and allowing it to remain intact."

A battery system is much different.

"In a battery housing, the reaction is almost the opposite," Haas continued. "Without proper protection, the thermoplastic just melts, direct exposing the battery cells."

One solution - a fire-retardant spray coating which protected the Pentatonic battery housing structure when exposed to an external fire. The coating created a layer of insulation between the fire and the walls of the battery system. The team performed numerous fire tests in varying conditions, and Pentatonic's material construction held up against external fires as hot as 850°C.

Not only did Pentatonic pass the required fire tests, but the system proved to be a built-in insulator for the battery cells – because of the superior insulating properties of thermoplastics composites versus metal. While a metal housing can hold its structure at up to 900 ˚C for three minutes, the heat is transferred to the battery cells which can subsequently reach temperatures of 300-400˚C, almost guaranteeing internal thermal propagation. As a countermeasure, today's metals housings include insulating material or an "air gap" which serves as an insulator. While both are effective at insulating the battery cells, both solutions drive increased packaging and, in the case of an in insulating foam, additional material and cost.

By contrast, Kautex's Pentatonic battery system successfully passed numerous external fire tests with wall temperatures of the battery housing reaching only 200˚C while the battery cells maintained a steady 100˚C – well within their required range. The system consistently proved that Kautex was able to meet the global external fire test requirements, ensuring passengers would have enough time to evacuate safely.

The video below shows one of several successful external fire tests. In this test case, the pack was positioned 1.5M above the rig. Gasoline was ignited in a bowl underneath the test pack so that the pack was subjected to the flames for 70 seconds. A disk was then used for shielding and left there for an additional 60 seconds. After the flames were extinguished, the system was observed for three hours for further monitoring.

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