Ultracapacitors Make Battery Modules Greener

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In order to see how ultracapacitors make battery modules greener, one needs to have a basic description of the devices. Batteries rely on a chemical reaction to dissipate stored energy. There is no chemical reaction in ultracapacitors, as they store energy in an electrostatic field. This lack of chemical change is the reason that ultracapacitors will last hundreds of thousands of cycles, versus the hundreds to low thousands for various batteries.

Ultracapacitors have high charge-to-discharge efficiencies, better than 90 percent compared to lead-acid batteries, which are approximately 80 percent efficient. Ultracapacitors can begin to accept a charge from zero volts, while batteries require the input to reach a certain voltage before accepting a charge. Ultracapacitors can be discharged to zero volts, whereas experts recommend that most batteries not be used below 80 percent state of charge.

In many applications, ultracapacitors will not replace batteries. But since ultracaps have a much lower internal resistance and much faster charge rate, they make battery-powered systems run much more efficiently. Ultracapacitors make batteries last longer because they do the brunt of the work when the load is initially switched on, and allow the battery to pick up load gradually, preventing high-current draws. By gradually taking on a load, batteries are insulated from high-current drains that cause thermal, chemical, and mechanical stresses. By reducing current spikes, the internal temperature of batteries is decreased substantially, extending the life of the batteries by as much a 400 percent, depending on the application. Additionally, there are times when a battery simply cannot deliver the current needed for an application.

Ultracapacitors allow design engineers to separate energy and power needs. In most applications, there is a continuous power demand that is handled by a primary energy source. At times, there are peak power demands. Engineers can either size the batteries to handle peak demands, or use ultracapacitors to bridge the demand, which has the added benefit of being able to downsize the primary energy source.

In hybrid vehicles, when a vehicle accelerates, there is a huge demand for power in the form of amps (current). Putting ultracapacitors in parallel with batteries, along with control electronics, allows ultracapacitors to provide high current, which will increase the life cycle of the battery. Because there is no chemical reaction, ultracapacitors can handle hundreds of thousands of charge/discharge cycles without degrading. The batteries become strictly an energy source, rather than the energy and power source. The hybridized energy storage system then works together, forming an energy-dense, high-power solution, with long life and increased reliability. This combination can also decrease the warranty and replacement cost of the batteries, making the system economically feasible.

Combinations of ultracapacitors and batteries in energy storage systems can reduce the size, weight, and the number of batteries in a system. Such hybridized systems are more efficient and use less (often expensive) materials. They can also extend the cycle life of the battery component, which makes the whole system greener.

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