Supercapacitors improving faster than batteries

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Why supercapacitors replace batteries today

So far, supercapacitors have replaced batteries in such applications as backup for electrics and electronics, from CMOS circuits to wind turbine blade control, opening bus doors in an emergency and making brakes work when regenerative braking fails. Despite much higher price, they were used because of reliability and long life. However, later applications reflect the bias of the market for both lithium-ion batteries and supercapacitors towards larger sizes as electrical engineering becomes the biggest sector for both. Think hybrid and pure electric vehicles, land, water and air, grid storage and renewable energy. Supercapacitors enable reuse of the dropping and turning energy of material handling equipment from cranes to forklifts and soon we shall add frequent stop start of elevators. Lithium-ion batteries are simply not up to the job here, with the rapid charge and discharge. Recapturing the linear energy of trains and trams is still sometimes done using lithium-ion batteries but supercapacitors are now the preferred option because of performance, reliability and life. For some time, small supercapacitors have been used in aircraft, including the Airbus 380, without incident.

Examples

Let us consider some specific recent examples of supercapacitors being used instead of lithium-ion batteries. All fuel cell vehicles need a large storage device to manage start-up and frequent load variation because fuel cells are really only a rather expensive range extender: they do not replace the engine. The Riversimple car uses a supercapacitor for this instead of the lithium-ion battery used by almost everyone else. It is because it performs better and is hassle free - it has much longer life and better reliability. However, the fuel cell vehicle makers are looking at the half-way house that is now commonplace with pure electric vehicles where use of a supercapacitor across the lithium-ion battery extends its short life somewhat and improves performance. Indeed, the MAN urban hybrid bus, like the majority, and the Sinautec pure electric bus dispense with lithium-ion batteries altogether by using supercapacitors. Here the primary driver of the decision is usually cost-over-life. Time and time again we now hear that the high upfront cost of supercapacitors is rarely of concern beyond the private car as long as cost-over-life is much improved because that is what concerns the companies and governments operating them. they also value less hassle.

Troublesome life of rechargeable batteries

Electrification of public transport reflects concern about causing local noise and air pollution and seeking a green image. Indeed, these are now very strong drivers of the purchase of hybrid and pure electric aircraft, boats, industrial and commercial vehicles, whether they use lithium-ion batteries or supercapacitors or both. Nonetheless, let us pause a moment on that statement. The supercapacitors last for the life of the vehicle but the lithium-ion batteries do not. The cost of replacing the lithium-ion batteries is so huge, at over $10,000 even in a pure electric car, that it is likely that the vehicle will often be destroyed after the four to eight year life of that battery and a new vehicle will be bought prematurely rather than the old vehicle be fitted with a very expensive new battery. It is the opposite of green. Increasingly, such a situation, triggered by the short life of expensive lithium-ion batteries, will be questioned by industrial and commercial vehicle operators. Indeed, Renault pointed out at the EVVC meeting in Brussels this week that the poor resale value of pure electric cars and lack of any official resale price is inhibiting growth in sales. That is closely related to the lithium-ion battery problem.

Lithium-ion batteries have been replaced by supercapacitors in power tools in space stations and some on earth because the frequent but much faster charging needed is tolerable in the interests of reliability and life. The same happened with the new Toyota Formula One hybrid racing car because of reliability and performance.

So where are we now?

Supercapacitors are taking a tiny market share from lithium-ion ion batteries, partly by being placed across them so less battery is needed and that battery lasts longer as in the Bolloré Bluecar, the Mazda pure electric sports car and many pure electric buses in China. Dismissed as insignificant by lithium-ion battery manufacturers, that trend is accelerating and we actually have a disruptive technology here. The reasons for using large supercapacitors and their variants continue to be mainly reliability, performance and life but nowadays cost-over-life is increasingly cited as the primary source of payback.

What next?

The important sea change in 2013 is designers increasingly noticing that supercapacitors are safer than large lithium-ion batteries with a smaller percentage of fires and toxicity and failures to work in life-threatening situations and the gap is widening. Attention is turning to alternatives. There are many reasons for this. As a US Senate committee put it, a rechargeable battery is like a living thing with very complex, poorly understood chemistry, considerable unpredictability and swelling and shrinking during use can assist in self-destruction. Often it cannot be fully discharged for safety in a vehicle accident or for safe shipment for example and life is relatively unpredictable. By contrast, supercapacitors are electrostatic devices that do not change shape during use. While it is wide of the mark to say they last forever, because anything containing a liquid has a finite life, it is true that supercapacitors are often guaranteed for up to ten years and they typically last for twenty years or more. They can be fully discharged for safety and they are more easily made to consistent quality standards.

Supercapacitors continue to be improved faster than lithium-ion batteries where toxic flammable electrolytes largely remain and are the fuel of the fires. By contrast, IDTechEx Research analysis shows that toxic, flammable acetonitrile was in the past used by almost all supercapacitor manufacturers but now only 51% use it exclusively, a figure dropping every year.Non-flammable aqueous electrolytes are used by most of the new entrants, so we shall soon have most suppliers offering non-flammable supercapacitor electrolyte. Lithium-ion battery proponents can only look on in envy at this.

Source : IDTechEx