Truck starting with supercapacitors

In response to anti-idle laws, truck manufacturers seek solutions that ensure sufficient stored energy is available for starting. Supercapacitors deliver the required high rates of discharge.

By Bill Campbell, Nanotecture Ltd -- EDN, January 26, 2011

An example of government response to public demand for a cleaner environment and greater fuel efficiency is the introduction of anti-idle laws in a large number of US states, initially led by California. These laws restrict the amount of time that large commercial vehicles can continue running while stationary. The primary purpose of extended idling in heavy trucks is to retain battery charge for engine starting while operating in-cab “hotel” functions such as heating, TV, and refrigeration for driver comfort.

As a result of this legislation, truck manufacturers are seeking solutions that ensure sufficient stored energy is available for starting; hence, avoiding expensive jump starts and maintenance costs in a system where full battery charge can no longer be guaranteed. Not only must there be sufficient energy but the energy must be delivered at a high rate to crank the engine, especially at low temperatures.

Supercapacitors are energy-storage devices that deliver the required high rates of discharge. They are now being considered as a preferred solution and, in this application, as a replacement for lead-acid batteries.

Advantages for truck manufacturers

Truck manufacturers have outlined a number of advantages in the deployment of supercapacitors when compared with current lead-acid batteries:

Supercapacitors are optimized for high-rate discharge (power density), so they are significantly smaller and lighter than an equivalent lead-acid battery pack, which is typically overspecified to deliver the required discharge rates. In this application, reduction of over 50% is typical on both parameters.
Supercapacitors are capable of many hundred of thousand of cycles (300,000 to 500,000 or more), whereas batteries are typically specified at less than 1,000 cycles. Field repairs and replacements, especially in remote areas, can be hundreds of times more expensive than depot servicing.
Because supercapacitors have high rates of both charge and discharge, they are suitable for multiple start-stop applications and quickly recover charge after starting, ready for re-use.
In the event of “low batteries,” supercapacitors can be charged slowly from a dead battery, then enable cranking.
Supercapacitors typically have better low-temperature performance. Temperature is typically electrolyte-dependent; however, these devices operate at −40°C as compared with −20°C to −30°C for lead acid.

Unique advantages

The case has been made for the performance advantages of employing supercapacitors rather than lead-acid batteries for truck starting following new anti-idle legislation. However, although supercapacitors have been available and evaluated, for some they have not yet made a major breakthrough in this application. Truck manufacturers have highlighted three major barriers to entry.

The most significant barrier to adoption is cost. Supercapacitor costs are typically higher than lead-acid batteries. Truck manufacturers will accept some level of premium in order to gain the advantages highlighted here, but the balance is in favor of lead acid at the moment. The Nanotecture supercapacitor device utilizes a water-based electrolyte, which enables a low-cost manufacturing process. By comparison, the current generation of capacitors use an acid-based electrolyte, which requires a costly drying process to remove moisture from the electrodes prior to insertion in the acid. Second, and most important, Nanotecture has developed a unique hybrid electrochemistry that combines an asymmetric electrode configuration with the company’s patented nanoporous material. This technological breakthrough means that the Nanotecture supercapacitors can not only deliver a high discharge rate but also store significantly more energy per unit volume than competing products. The benefit for truck manufacturers is that, at the system level, fewer supercapacitor cells are required to meet the specification. Fewer cells mean lower cost.

The third barrier to entry is safety. Much has been made recently of battery safety. As discussed previously, the Nanotecture device utilizes a water-based electrolyte, which is less hazardous than acid-based systems.

Conclusion

Supercapacitors offer significant performance and life cost advantages to truck manufactures for engine starting, which is now controlled by new anti-idle laws. This application is an emerging market, which recognizes that an alternative to batteries exists but is concerned by both cost and safety issues. A unique combination of cell chemistry and nanoporous material offers the required performance advantages and directly addresses current barriers to entry.

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