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What's The Difference Between Industrial And Consumer Ultracapacitor Applications?

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Most people are familiar with how batteries work. A chemical reaction converts stored chemical energy into electrical energy, which flows out of terminals to power an application. Ultracapacitors, also called supercapacitors, store energy in an electric field by putting an electric charge on plates that are separated by an insulator.

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Though ultracapacitors have only a fraction of the storage ability of batteries, their energy storage mechanism allows them to charge and discharge energy much faster than their battery counterparts. Unlike batteries, ultracapacitors can operate reliably in extreme temperatures from –40°C to 65°C and resist disturbances such as shock and vibration. Additionally, ultracapacitors can function at full capacity for 1 million or more charge-discharge cycles in most applications.

As modern technology progresses, our energy demands are growing equally sophisticated. Ultracapacitors provide a safe, clean, and cost-effective alternative energy solution for a wide range of applications. By supplementing or replacing batteries with ultracapacitors, businesses in many industries can capture a return on investment and achieve sustainability objectives.

Ultracapacitors in industrial applications function differently from ultracapacitors in consumer electronics, but deliver similar end benefits. The scale and operation of ultracapacitors in both markets are independent in numerous ways, but ultimately they converge in terms of the energy savings and financial benefits they offer users.

Industrial Applications

In large warehouse operations, heavy equipment regularly faces limitations due to battery failure. When a battery's ability to provide energy falls below the power requirement of the equipment, operators must swap it mid-shift. This maintenance is costly and time-consuming, as the equipment cannot function properly until the battery has been changed.

Ultracapacitors supplement batteries in heavy equipment by easing stress on battery packs. They absorb energy during equipment movement and rapidly deliver that energy on demand to supplement the main power system. Two important functions of ultracapacitors in industrial and manufacturing applications are regenerative power and peak assist:

• Regenerative power: Ultracapacitors absorb and store energy during movement, then apply that energy when the machine requires a sudden burst of power. High-strain activities such as lifting and hoisting increase fuel consumption and emissions production in heavy duty equipment. With an ultracapacitor-based system, forklifts, cranes, mining shovels, and other industrial-scale equipment can capture and reuse regenerative energy, reducing fuel use and its accompanying emissions.

• Peak assist: Because they deliver a surge of power on demand according to the needs of the equipment, ultracapacitors can handle peak power demands, reducing stress on the primary energy source. For example, a forklift powered by a fuel cell can use ultracapacitors to generate enough power for heavy lifting tasks. Industrial equipment that uses diesel power can implement ultracapacitors to handle peak power demands, reducing fuel consumption and engine size.

Ultracapacitors' regenerative power and peak assist capabilities provide multiple environmental and financial benefits to users in industrial applications. They supplement the machinery's existing electrical system, extending equipment life and lengthening intervals between battery replacements. This reduces downtime and costs due to maintenance. The regenerative energy that ultracapacitors store from equipment movements for later use can be seen as recycled energy since it is stored and then reused to assist power demands, reducing fuel consumption and its associated emissions.

The cost of ultracapacitor modules in industrial applications is duly compensated by the enhanced durability, consistency, and productivity they offer as an addition to existing battery-powered systems. Caterpillar Inc. uses Maxwell's ultracapacitors in the industry's largest-ever hydraulic mining shovel *(see the figure)*. Its high-efficiency energy management system includes 98 125-V ultracapacitor modules to capture energy during shovel movements and quickly deliver the energy to assist the central power system. The ultracapacitor-based power system lowers fuel costs and provides energy recuperation and power delivery assistance to the shovel.

Consumer Electronics Applications

As advances in consumer electronics technology perpetuate the demand for increasingly portable, intelligent, and sustainable devices, many companies are recognizing the advantages of ultracapacitors. There are many differing operational factors to consider when incorporating ultracapacitors into consumer electronics compared to industrial applications, but both systems are based on the ability of ultracapacitors to deliver bursts of power rapidly and effectively.

Unlike industrial-scale ultracapacitors that absorb energy through movement, ultracapacitors in consumer electronics are charged from a primary power supply to then provide backup energy and handle peak demands of devices such as cameras, cell phones, and GPS systems. For example, the amount of energy it takes for advanced cameras to take a picture and transfer the image to a memory card or across wireless systems strains common batteries, draining their life and requiring frequent charging. Ultracapacitors can supplement or replace batteries altogether in consumer electronics applications. Ideally, since ultracapacitors have high power density and batteries have high energy density, the two technologies can be combined to maximize the energy storage and power delivery benefits of both.

Ultracapacitors in consumer electronics are considerably smaller than those used in industrial applications. Think of cells smaller than two AAA batteries compared to a module that weighs 133 pounds.

One major reason electronics companies are turning to ultracapacitors as an energy storage solution for consumer electronics is the increasing demand for smaller and lighter systems. Devices continue to require the same levels of power, but in smaller packages.

Ultracapacitors offer sustainable, sufficient power to small gadgets without sacrificing performance and reliability. Ultracapacitor-powered devices only take several minutes to charge before they can power an electronic device. They also greatly reduce the hazards of appliance disposal, since the toxic chemicals in batteries are harmful to users and the environment. The long lifespan of ultracapacitors extends the lifespan of electronics without losing storage space with age.

The dependable energy longevity of ultracapacitors saves consumers money and reduces overall waste. That's why Celadon Inc. developed remote controls using ultracapacitors instead of batteries. The remotes are used with set-top boxes used by mobile and broadband providers such as Orange. The remote control can charge in about five minutes and run for hours, or even days, depending on the frequency of use. Since ultracapacitors have such a long life, they can typically outlive the product they are used in, offering cost savings and power reliability versus an alternative such as batteries.

As power demands evolve with progressing technology and sustainability standards, ultracapacitors are reaching an increasingly diverse spectrum of applications. Since they are implemented in such a wide range of industries, ultracapacitors provide returns on investment to end users in different ways depending on the application. Their flexibility as a power source creates ample opportunity for technology improvement and innovation, and they supply many markets with necessary energy solutions as the demand for more efficient and sustainable power sources continues to grow.

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