



Activated Carbons *for* Supercapacitors



Jacobi
THE CARBON COMPANY

The Solution Company



IT IS A WELL-KNOWN FACT that the world's population is increasing at an accelerating rate. Carbon emissions and the continued depletion of natural resources cannot be ignored. Therefore, it is imperative that we find cleaner and more efficient sources of energy.

Energy storage has become a critical business investment for continued success, and supercapacitors are poised to play an important role. Clean and powerful, these devices are already showing their value in many exciting applications.

Supercapacitors are vital as components in consumer electronics, energy, automobiles, trams, trains, lifts, aircraft and more. Powerful, cost effective and environmentally friendly, supercapcitors are here for the long run.

Jacobi Carbons develops and produces activated carbons specially tailored to achieve and exceed specific requirements for all types of supercapacitors – whether you need extra energy, power or special tailor made carbon grades for your specific electrolyte.

In wind turbines supercapacitors help blade pitch control systems to optimize and maximize power output.



Traffic congestion and the rising cost of fossil fuels are issues pushing the world towards finding environmentally friendly alternative power sources for transportation. Supercapacitors provide an ecological solution to the problem by collecting expended energy and re-using it.



Supercapacitors require high tech and consistent quality carbon. We have found that carefully selected coconut shells are an outstanding raw material for energy storage applications.



WORKING IN CLOSE PARTNERSHIP with our customers we are dedicated to do more than simply providing the very best activated carbon on the market. We are in full control of the entire manufacturing process – everything from destoning, activation, washing and demagnetization to grinding to the optimum particle size using modern jet milling techniques.

We have committed significant investments to create purpose built Supercap™ facilities utilizing steam activated rotary kiln technology and our own proprietary washing unit. This production method provides an optimum ratio of micro and mezzo pores for all grades of custom Supercap™.

Jacobi Carbons is the world's largest producer of activated carbons from coconut shells. Their surface area has a high degree of microporosity and minimal torosity, while the low ash content guarantees excellent purity. Over the years we have mastered the complex process of manufacturing specialized activated carbons of superior quality.

Our manufacturing plants are located in France, Germany, USA, Sri Lanka, India, Vietnam and the Philippines. Inventory is stocked at our warehouses or with our distribution partners, which ensures first rate supply worldwide.

Our team of experts stand ready to provide assistance on all tailor-made solutions for our customers.

The Dedicated Company



Supercapacitors are produced in several sizes and forms to deliver power or energy density. No matter the desired application, Jacobi Carbons can custom tailor material with the right parameters.



Our own manufacturing facilities guarantee secure delivery of high quality activated carbon products on a global scale.

Dedicated, specially constructed rotary kiln technology is used solely for the manufacture of premium activated carbons for use in the production of supercapacitors.

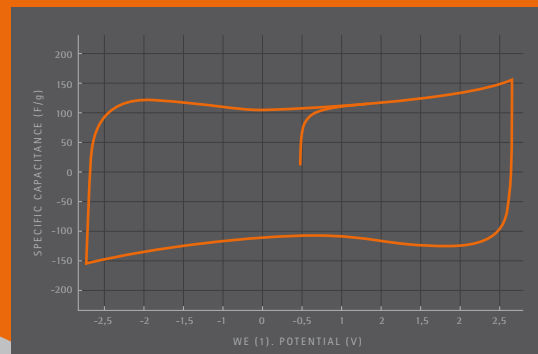




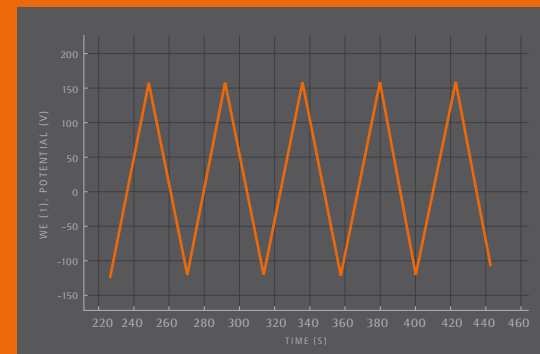
AT THE HEART of Jacobi Carbons' purpose built manufacturing facility is a kiln solely designed to produce the adsorbent carbons used in supercapacitors. It carefully regulates the properties of the activated carbon regarding Meso and Micro pore distribution ratios, BET, torosity and surface groups.

Our washing facilities can reduce ash content of our Supercap carbons to levels unprecedented in the industry. We are also on the front line when it comes to grinding, demagnetizing and drying technologies. Our state of the art equipment and know-how ensures the highest and most consistent quality carbons for our customers' applications.

Buses, trains and heavy transportation vehicles all benefit from using supercapacitors in generative breaking or as a power source in electrically powered vehicles. By storing and releasing power collected from regenerative braking systems, power consumption is kept to a minimum.



Cyclic Voltammetry (CV) is a widely used technique in electrochemistry, as it yields basic information of the supercapacitor's performance, including the voltage window, capacitance and cycle life. In the presence of pseudo capacitance, total capacitance of the device depends on the applied voltage. If the voltammograms show peaks/ bumps at the corresponding potentials this indicates redox reactions. ESR is shown as slow rise in the current with voltage and rounds the two corners of the rectangle at the beginning of the charge and discharge cycle.



The generation of Constant Current Charge Discharge Curves (CCD) curves is the standard technique used to test the performance and cycle life of supercapacitors. A repetitive loop of charging and discharging is called a cycle. Asymmetric charge discharge curves indicate that there is a process, which contributes to capacitance that is not reversible. It occurs either during charging or discharging, giving different slopes. Presence of redox reactions also result in potential plateaus in the charge discharge curve. Presence of an equivalent series resistance (ESR) leads to a voltage drop (IR-drop) at each half-cycle. Generally, IR drop depends on the ESR of the device and the charge-discharge current density. The lower the ESR, the higher the power output and lower heat generation improves safety.

The High Tech Company



Renewable energy sources provide uneven power output. Supercapacitors smooth the power supply resulting in a consistent energy supply to the grid.

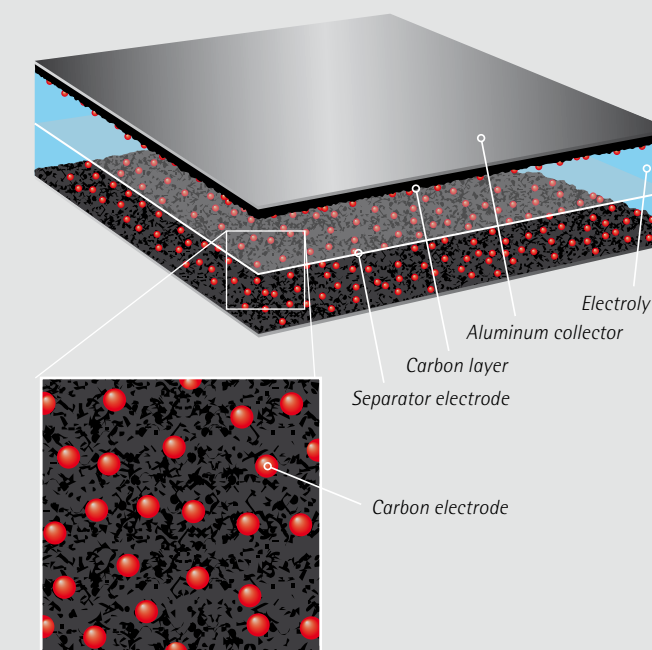


During a 24 hours race at Le Mans, a Toyota TS030 hybrid using EDLC was the second fastest car, reusing breaking power to aid acceleration, only 1.055 second slower than an Audi r18.



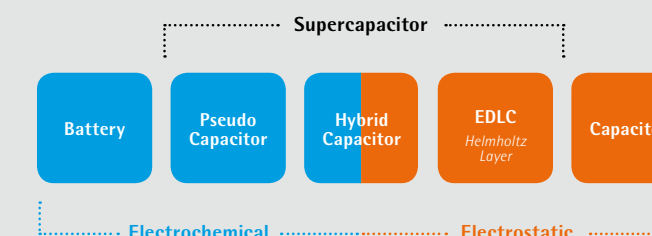
In the event of power failure on board an aircraft, supercapacitors provide power to open the emergency doors to facilitate evacuation of passengers and crew.

THE SUPER CAPACITOR STRUCTURE



High specific surface area in balance with material density is essential for achieving high capacitance. Other important parameters are tortuosity and surface groups.

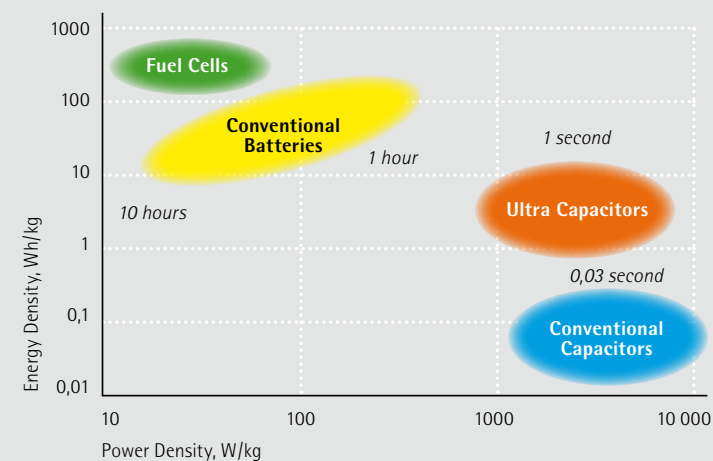
SUPER CAPACITOR CHARGE STORAGE



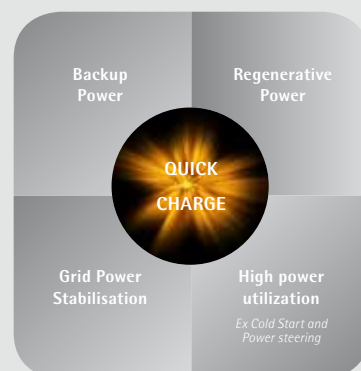
The two main principles used for charge storage in supercapacitors are electrostatic (Helmholtz Layers) and Electrochemical (Faradaically).



SUPERCAPACITORS VS. OTHER ENERGY STORAGE TECHNOLOGIES



ENERGY VS POWER DENSITY



APPLICATIONS

Supercapacitors can be used in various applications where quick charge and discharge are an essential factor.



Energy usage can be greatly reduced by using supercapacitors to streamline supply of renewable energy sources, increase efficiency by prolonging battery life and secure power supply in UPS systems.



Compact digital cameras are infamous for draining battery life. From hobbyists to professionals, everyone dreads that little flashing red light. Supercapacitors ensure that you get the maximum power and energy out of your device.

The Diverse Company

MODERN EVERYDAY LIFE is dependant on electronic equipment that relies on quick charge and recharge. Supercapacitors have a wide variety of applications and Jacobi Carbons' production base is the most diverse in the industry. We continuously develop activated carbons specially for power output as well as energy storage and usage.



Electrical disturbances like power surges, frequency variations and voltage spikes occur regularly. Supercapacitors provide short-term power to correct these faults.

Supercapacitors are used in heavy duty applications at almost any temperature. This reduces diesel consumption by adsorbing energy while lowering weight, providing cranking power in cold weather and increasing battery life as peaks in output are reduced.



Maintaining accessibility is important in today's business world. Functions requiring high energy, like ring tones and camera flashes, quickly drain batteries. This is where supercapacitors come to the rescue.



As the intensity of the sun varies solar cell parks generate uneven energy output. Supercapacitors reduce peaks and bolster low power generation smoothing energy supply to the grid.



Ensuring power and energy on demand is crucial at all levels and our expert technicians are on the leading edge of quick charge technology.



Electric cars and plug-in hybrids are the way of the future. There are already many highway capable models able to travel hundreds of miles on one charge, and they are comfortable enough to drive for more than 12 hours per day. Jacobi has the range of carbons to help supercapacitors go the distance.

THE ART OF PRODUCING activated carbons for supercapacitors encompasses in-depth knowledge of the entire system. This includes binders, electrolytes, electrode build up and pure carbon properties like pore size distribution and torosity.

Our R&D department is what truly sets Jacobi Carbons apart in the industry. We work constantly to discover how certain system-parameters influence each other. Whether it concerns BET to compression, pore size distribution to electrolyte, surface groups to aging or pseudo capacitance.

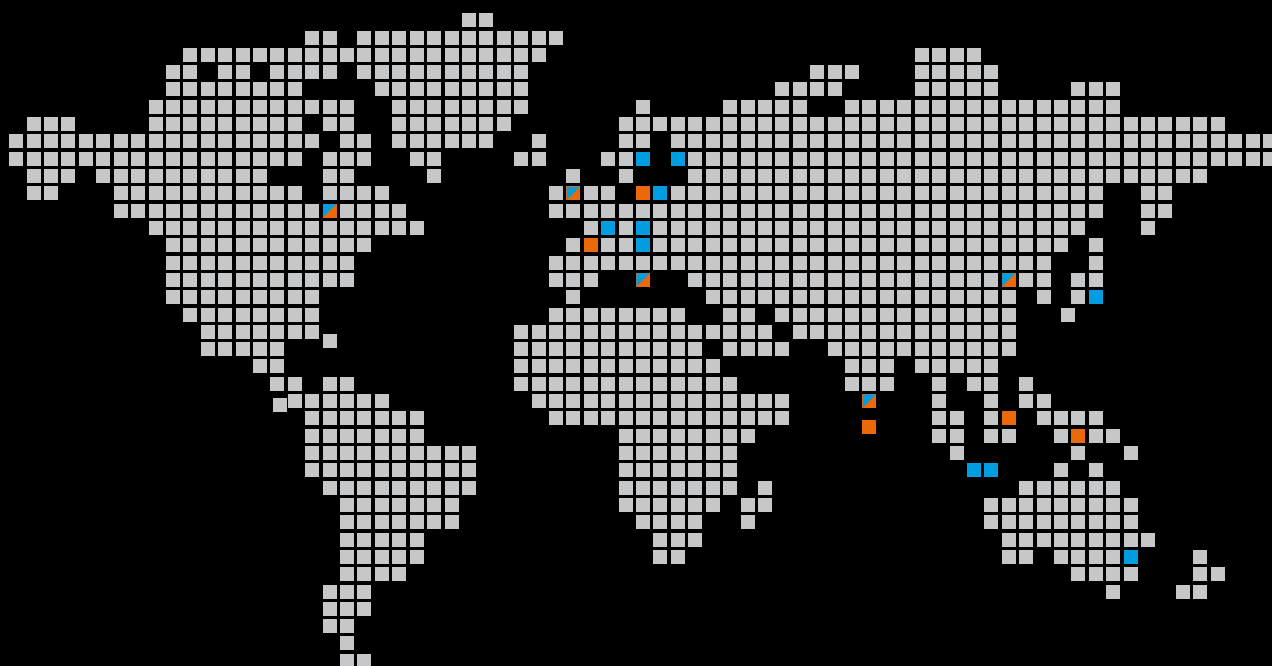
Tomorrow's demand for higher voltage and capacitance and lower ESR makes it important to always continue to improve. At Jacobi Carbons we are already working on the next generation of carbons tailored for use in supercapacitors.

The Future
Company

The Global Company



Jacobi Carbons has rapidly grown to become one of the world's largest manufacturers of activated carbon products. With manufacturing and sales operations in 19 countries we represent a truly global partner.



■ SALES OFFICES

Australia	Poland
China	Singapore
Finland	Spain
France	Sweden
Germany	Switzerland
Italy	United Kingdom
Japan	United States
Malaysia	

■ MANUFACTURING PLANTS

China	United Kingdom
France	United States
Germany	Vietnam
India	
Italy	
Sri Lanka	
The Philippines	

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