Current Waves

ELECTRICAL CONSULTANTS' ASSOCIATION OF INDIA BANGALORE

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NEWSLETTER

EDITOR'S NOTE

Small drops of water make an ocean, thus goes an old saw. With an installed capacity of about 1,32,000 MW in our country and with increasing supply-demand gap, even one percent saving, by eliminating *wasteful* electrical energy such as, keeping street lights ON even after the sunrise or switching ON even before sunset, etc., would amount a lot.

Other examples of *wasteful* energy consumptions in micro level are the so called ghost consumers, in residences, offices and commercial complexes, like fans without electronic regulators, using zero watt lamps, Television sets power left on stand-by mode, mosquito repellent machines left ON forgetfully throughout the day etc.

It is an established fact that considerable amount of electrical energy is consumed by the street lighting system in major cities and towns in our country. The street lighting system commonly uses 150W or 250W High Pressure Sodium Vapour (HPSV) lamps depending on the type of street. Most of the street lighting systems are switched ON/OFF manually. Sometimes the street lights are ON up to late in the morning and switched ON much earlier in the evening to suit the convenience of the operator, thereby *wasting* electrical energy. This *wasteful* electrical energy in macro level can be saved by proper planning and management of ON/OFF sequence with due consideration to the day's twilight time available for that local area.

Further in major cities like Bangalore, Chennai, Delhi, Hyderabad, Mumbai, the connected street lighting load could be as high as 50 to 60 MW. In case of India, the latitude range being 8degrees N to 34 degrees N the ON time can be taken as approximately 10 minutes after sunset and OFF time as 30-40 minutes before sunrise. This can be programmed to suit different city conditions to save *wasteful* energy.

Another sector in street lighting where *wastage* of electrical energy can be reduced is the vast campus areas of large companies where street lighting load using about 200 lamp posts in the campus will about 50kW.

It will be worthwhile, if a system with master computer control with over-riding facility to take care of local conditions, is established for ON/OFF sequencing of street lights. This system, for efficacy, should have a strict management and maintenance schedule. The same system can be adopted even for campus areas.

Of course targeting reduction of losses, between the control panel and the lamp posts, to less than 1%, and reducing the lamp voltage during non essential hours, say 0000- 0300 hours, will also reduce *wasteful* energy to some extent.

Though more power generation is the need of our country, reducing or eliminating the *wasteful* electrical energy in any form is the need of the hour. One watt saved is three watts generated! Right?

Thank you,

Engr. J.D.Krupakar

ULTRACAPACITORS CHALLENGE THE BATTERY

Reproduced by:
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(This is a reproduction of an article on Ultracpacitors authored by John M. Miller. The sole purpose of this reproduction is to bring to the fore the latest developments on the capacitors which some readers may not be aware. This article is a part of the original article without variations and I have only added 'How an ultracapacitor works', a small portion, from a different article. Happy reading!)

The capacitor has come a long way since it was invented in 1745 as a liquid-filled glass jar with a layer of foil wrapped around the outside, called the Leyden jar after the city where it was invented. Through their generations of technological improvement, capacitors have progressed from a laboratory curiosity to an important laboratory instrument and, throughout the twentieth century, a key component of electrical circuits. The basic principle underlying the capacitor's operation is that of charge storage: Positively charged particles collect on one surface and negatively charged particles on a second nearby, but electrically separate, surface. The two surfaces are called electrodes. Capacitors store electrical charges in static form for later use.

The basic principle underlying the capacitor's operation is that of charge storage: Positively charged particles collect on one surface and negatively charged particles on a second nearby, but electrically separate, surface.

Traditionally quick and powerful but energy poor, capacitors have transmuted into quick, powerful, and energy-rich storage devices whose applications are likely to be in backup power supplies and hybrid electric vehicles.

Known for storing a short-lived jolt of electricity essential to the successful operation of electrical circuits in devices and appliances ranging from PCs to microwave ovens, cell phones, and televisions, the capacitor is in the midst of a major, ongoing upgrade of its energy storage capabilities. After nearly two centuries in which batteries have been the obvious choice for storing usable amounts of energy, high-end capacitors, known as ultracapacitors, are poised to challenge them in a growing range of applications.

Three main factors determine how much electrical energy a capacitor can store: the electrode surface area; the electrode separation distance; and the properties of the insulating layer separating the electrodes. The history of capacitors has been written by numerous scientists, who have discovered the principles of capacitor operation and improved their storage capacity by increasing the electrode surface area, decreasing the electrode separation distance, and improving the insulating layer.

During the early 1980s, stacked film capacitors for use in consumer electronics, automobiles, and appliances, were developed. Called polymer multilayer capacitors, such units are simply stacks of several thousand pairs of conducting plates, each separated by an insulator. Both spiral-wound and polymer multilayer capacitors are examples of electrostatic capacitors, which are based on the original concept of two physically distinct electrodes separated by a distinct insulating layer.

Electrostatic capacitors are widely used today in virtually every electronic item, from consumer appliances and toys to electronic boards in computers and spacecraft. In most of these applications, capacitors are tiny ceramic bricks attached directly to the electronic circuit boards. The ability to store small amounts of electricity and release them quickly makes capacitors essential components, along with transistors and resistors, of most electrical circuits.

The electrolytic capacitor was developed in the 1930s. Thinking out of the box, the company's scientists and engineers introduced a new way of designing capacitors featuring three major enhancements:

- Expanded surface area: The surface of one aluminum electrode was etched with acid, leaving it roughened and pockmarked and offering more surface area on which to accumulate charge.

- Shrunken insulator thickness: After the electrode surface was etched, it was oxidized to cover it with an insulating layer of aluminum oxide that separates two layers of charges.

- A liquid (actually paste-like) electrolyte electrode: The roughened and oxidized surface of the aluminum electrode was immersed in an electrolyte, a solution whose dissolved molecules are readily ionized. The electrolyte in effect becomes an extension of the second electrode, the enclosing wall of the capacitor.

Although an electrolytic capacitor looks different from an electrostatic capacitor, it nonetheless exhibits all the characteristics of an electrostatic device: it has one conductive electrode separated from a second conductive electrode by a thin dielectric. Here, the operative word is thin. In an electrostatic capacitor, for comparison, the insulator may be a thin plate of glass or ceramic, a sheet of wax paper, or a piece of mica. As these materials are made thinner, however, they soon reach a limit - about one-tenth of a millimetre based on their inherent brittleness and limited ability to withstand a voltage.

Going Ultra:

Ultracapacitors embody another round of innovations beyond the electrolytic capacitors. The charge-separation distance in ultracapacitors also known as supercapacitors, (more technically known as electrochemical double-layer capacitors, EDLCs) has been reduced to literally the dimensions of the ions themselves within the electrolyte. Here, charges are not separated by millimetres or micrometres but by a few nanometres. In the three examples, ranging from electrostatic capacitors to electrolytic capacitors to ultracapacitors, the charge-separation distance has in each instance dropped by three orders of magnitude, from millimetres to micrometres to nanometres.

Coupling the ultrasmall separation distance with a relatively vast surface area, in ultracapacitors the ratio of available surface area to charge-separation distance has grown to an amazing 10 raised to the twelfth power. It is this ratio, in fact, that makes capacitors "ultra." The ability to hold opposite electrical charges in static equilibrium across molecular spacing is the key feature.

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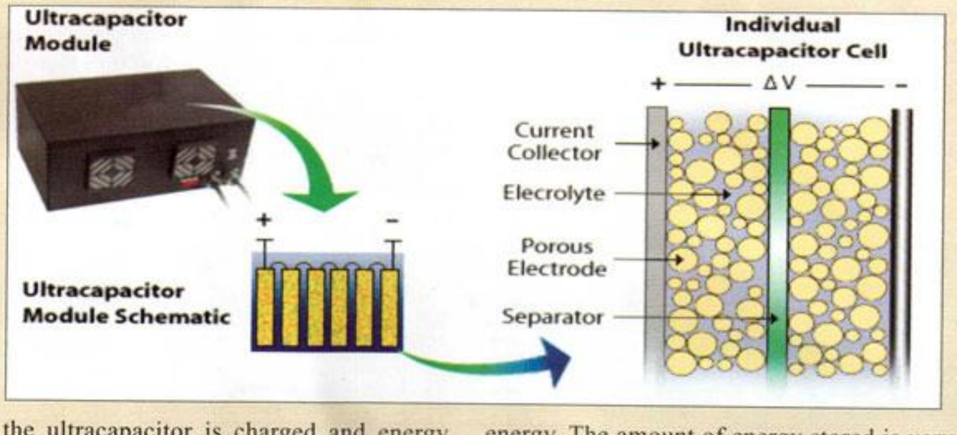
How an Ultracapacitor Works:

An ultracapacitor (ultracp) polarizes an electrolytic solution to store energy electrostatically. Though it is an electrochemical device, no chemical reactions are involved in its energy storage mechanism. This mechanism is highly reversible, and allows the ultracapacitor to be charged and discharged hundreds of thousands of times.

An ultracapacitor can be viewed as two non-reactive porous plates, or collectors, suspended within an electrolyte, with a voltage potential applied across the collectors. In an individual ultracapacitor cell, the applied potential on the positive electrode attracts the negative ions in the electrolyte, while the potential on the negative electrode attracts the positive ions. A dielectric separator between the two electrodes prevents the charge from moving between the two electrodes. The diagram shown below depicts an ultracapacitor, its modules, and an ultracapacitor cell.



Once the ultracapacitor is charged and energy stored, a load (the vehicle's motor) can use this energy. The amount of energy stored is very large compared to a standard capacitor because of the enormous surface area created by the porous carbon electrodes and the small charge separation (10 angstroms) created by the dielectric separator. However, it stores a much smaller amount of energy than does a battery. Since the rates of charge and discharge are determined solely by its physical properties, the ultracapacitor can release energy much faster (with more power) than a battery that relies on slow chemical reactions.

Giving numbers to trends in capacitor performance and costs require some capacitor language: capacitance and farad. Capacitance refers to the capacitor's unique ability to store electrostatic energy (which is different from the electrochemical energy stored by the battery). A farad is the unit measure of capacitance. Today's ultracapacitors achieve capacitances ranging up to 2700 farads, while the whole family of capacitors offers capacitances ranging down to microfarads, nanofarads and even picofarads.

Applications of ultracapacitors:

Ultracapacitors are now finding their way into automotive and utility applications as energy storage components. Utilities have interest in ultracapacitors as replacements for battery banks that are being used to buffer short-term outages on the power grid. There are also applications of ultracapacitors in uninterruptible power sources located on the premises of critical-load utility customers such as hospitals, banking centers, airport control towers, and cell phone towers. The ultracapacitor bank would supply a continuous flow of power to such customers during the critical seconds between a utility outage and bringing a standby diesel-engine-driven generator on line.

Ultracapacitors can be primary energy devices for power assist during acceleration and hill climbing, as well as for recovery of braking energy. Using in conjunction with a battery, combines the power performance of the former with the greater energy storage capability of the latter.

Perhaps the most pervasive application of ultracapacitors as power components is beginning to show up in fuel cell-powered automobiles, a few of which are being manufactured by Honda Motor Company, Toyota, General Motors, and others for lease to cities in the United States and elsewhere. The performance profiles of ultracapacitors and fuel cells are highly complementary, especially for powering vehicles driving in stop-and-go traffic. Fuel cells provide the sustained energy as it is needed, but they fall short in delivering the burst energy needed for starting and accelerating. Ultracapacitors excel at providing exactly those short bursts of energy and also at receiving and storing energy bursts produced by regenerative braking.

Many applications can benefit from ultracapacitors, whether they require short power pulses or low-power support of critical memory systems. Ultracapacitors can be primary energy devices for power assist during acceleration and hill climbing, as well as for recovery of braking energy. Using in conjunction with a battery, combines the power performance of the former with the greater energy storage capability of the latter. It can extend the life of a battery, save on replacement and maintenance costs, and enable a battery to be downsized. At the same time, it can increase available energy by providing high peak power whenever necessary. However, the combination of ultracapacitors and batteries requires additional DC/DC power electronics, which would increase the cost of the vehicle.

The use of ultracapacitors for regenerative braking can greatly improve fuel efficiency under stop-and-go urban driving conditions. Only ultracapacitors can capture and store large amounts of electrical energy (generated by braking) and release it quickly for reacceleration.

When ultracapacitors can store as much energy as batteries while avoiding much of the environmental threat posed by the metals (such as lead, nickel, cadmium, and mercury) required to run the battery's electrochemical process, a new era of energy for transportation will begin. Costs, of course, will need to come down, and the devices will need to be proven functional and highly reliable in daily use.

As each of these obstacles is met and overcome, the new ultracapacitors coupled with fuel cells will be a major factor in the shift toward automotive systems that are environmentally friendly and fuel efficient. Beyond automobiles, as well, the new technology seems likely to infiltrate the nooks and crannies occupied by today's batteries, ranging from flashlights to cell phones and laptop computers. In the twenty-first century, the ultracapacitor may finally get the respect that until now has been claimed by its younger brother, the battery.

Current Research:

Scientists are busy on the frontiers of research, pushing up the capacitance rating and pushing down the costs. In October 2003, JEOL Ltd. in Tokyo announced an improvment it referred to as a nanogate or nano-carbon capacitor. This new component has an energy density of 50--75 watt-hours per kilogram, more than 10 times that of existing ultracapacitors. The device features two carbon electrodes formed of a new, patented material whose uniqueness lies in its high porosity and accessibility for storing ions. The company's goal was to start shipping samples of nanogate capacitors by the end of 2004.

Even further out on the experimental edge, researchers are exploring the possibility of using carbon nanotubes for electrodes. The importance of carbon nanotubes lies in their uniform nanoscopic pores (about 0.8 nanometres in diameter), which could in theory store much more charge than the nanogate capacitors if the nanotubes could be properly assembled into macroscale units.

Manufacturers:

The leading manufacturers of ultracapacitors today are Maxwell Technologies in the United States, NESS Capacitor Company in South Korea, Okamura Laboratory in Japan, and EPCOS in Europe. These companies manufacture carbon-carbon, or symmetric, ultracapacitors. That is, both electrodes have identical construction. There are some differences in the organic salts and solvents used, and this is where manufacturing becomes proprietary.

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ACKNOWLEDGEMENT:

John M. Miller, owner of J-N-J Miller Design Services, in Cedar, Michigan, U.S., holds 44 patents on various aspects of automotive power and propulsion systems. He chairs the KiloFarad International Education and Outreach working group devoted to promoting technology. He retired from Ford Motor Company's Scientific Research Laboratories.

Engr. J. D. Krupakar is a B.E.(Elec.) degree holder from, B. M. S. College of Engineering, Bangalore, (1969) and M.Tech. (Elec.) from Indian Institute of Technology, Madras, (1971). He worked as Assistant Development Engineer in M/s. Jyoti Ltd. Baroda, from 1971 to 73 in their Power Electronics and Control Division of Research and Development Centre and developed static voltage regulators for their alternators. He also worked as Senior Assistant Engineer in Electrical Department of M/s. Tata Consulting Engineers from 1973 to 82. He worked on Thermal Power Station Simulator project, 2.3M Optical Telescope project of Indian Institute of Astrophysics, Bangalore and also at construction site of Obra Thermal Power Station, unit No. 12 & 13 of Uttar Pradesh State Electricity Board. Since 1982 he is an independent electrical engineering consultant in Bangalore under the name Don Electrical Consultants.

Mr. Krupakar was the founder Secretary of ELCA and held posts of President, Vice President and Treasurer at various times. He is currently the Treasurer of ELCA and the Editor of 'Current Waves'.

Are you a TQP?

TQP, Total Quality People, are with character, integrity, sound values, good manners, positive habits and the right attitudes. They have a combination of character and charisma and do every thing to improve the situation. They develop ABP (Automatic Behavior Pattern) of all these qualities to become TQP. A man's important aspects of personality are habits, life style, attitude and approach to problems. Habit is an acquired pattern of action and is important because it can make or mar the future. For example a productive habit like being courteous gives an impression of your personality, value and priorities. The habits should become an ABP. To show how habit of being courteous can change the future, consider this true but embellished story of a young man who had the habit of being courteous and how it changed his future.

One cold, rainy night, while working at the front desk of a reputed hotel, a young man named George saw a well dressed couple entering the hotel with a worried expression. They were desperate for accommodation and all the other hotels were full. He felt very sorry for the couple because he also could not give them room as all the rooms were occupied. When they were about to leave, George went to them and asked if they would consider occupying his room because he would be working at the desk all through the night. After spending a peaceful night in George's room, the couple thanked him before leaving next morning. The gentleman gave a generous tip to him and said that he is the kind of person who should be the boss of the best hotel in the country. He also said something as wonderful as, "May be someday I will build one for you.

George just took it only as compliment and forgot about it. But he was shocked beyond measure when he received a letter from that gentleman after two years requesting him to pay a visit to his place. Tickets to New York for a round trip was also enclosed with the letter. When George visited New York, the gentleman took him to a posh avenue and pointing at a towering mansion there, he said, "This is the hotel I have built for you to manage!". When George laughed it off as a joke, the gentleman with all seriousness said, "I call this hotel 'Waldorf Astoria', after our family name. And you are the first manager of the hotel" The gentleman's name was William Waldorf Astor, the heir to one of the largest fortunes in American history and the young clerk George C. Boldt became the first manager of the grandest hotel of its time. It is still one of the leading hotels in the world.

The young man George made a productive habit of being courteous and caring to others with his automatic behavior pattern due to which he helped an elderly couple in distress which in turn decided his future. Habits are connected with our destiny.

*****

MOVING ?

IN CASE YOU ARE PLANNING TO MOVE PLEASE SEND US YOUR NEW ADDRESS AS SOON AS YOU MOVE TO THE NEW LOCATION, SO THAT OUR 'CURRENT WAVES' FOLLOWS YOU.

PLEASE INTIMATE THE EDITOR

THANK YOU !

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POTPOURRI PAGE

An eagle was sitting on a tree resting, doing nothing. A small rabbit saw the eagle and asked him, "Can I also sit like you and do nothing?"

The eagle answered: "Sure, why not."

So, the rabbit sat on the ground below the eagle and rested. All of a sudden, a fox appeared, jumped on the rabbit and ate it.

<u>Moral of the story:</u>
To be sitting and doing nothing, you must be sitting very, very high up.

*

A lawyer is a person who writes a 10000 word document and calls it a "brief".

*

A man goes to his doctor for a complete checkup. He hasn't been feeling well and wants to find out if he is ill. After the checkup the doctor comes out with the results of the examination.

"I am afraid I have some bad news. You are dying and you don't have much time", the doctor says.

"Oh no, that is terrible. How long have I got?" the man asks.

"10....." says the doctor.

"10? 10 what? Months? Weeks? What?!" he asks desperately.

"9.....8.....7.....6....."

*

A math professor to his students, "The problems for the exam will be similar to those discussed in the class. Of course, the numbers will be different. But, not all of them. Pi will still be 3.14159".

*

A surgeon, a civil engineer and a consultant were arguing about what was the oldest profession in the world.

The surgeon remarked, "Well, in the Bible, it says that God created Eve from a rib taken out of Adam. This clearly required surgery and so I can rightly claim that mine is the oldest profession in the world."

The civil engineer interrupted and said, "But even earlier in the book of Genesis, it states that God created the order of the heavens and the earth from out of the chaos. This was the first and certainly the most spectacular application of civil engineering. Therefore, fair doctor, you are wrong. Mine is the oldest profession in the world."

The consultant leaned back in his chair, smiled, and then said confidently, "Ah, but who do you think created the chaos?"

*

A couple came upon a wishing well. The husband leaned over, made a wish and threw in a coin. The wife decided to make a wish, too. But she leaned over too much, fell into the well, and drowned. The husband was stunned for a while but then smiled "It really works!"

*

A man placed some flowers on the grave of his dearly parted mother and started back towards his car when his attention was diverted to another man kneeling at a grave. The man seemed to be praying with profound intensity and kept repeating, "Why did you have to die? Why did you have to die?"

The first man approached him and said, "Sir, I don't wish to interfere with your private grief, but this demonstration of pain in is more than I've ever seen before. For whom do you mourn so deeply? A child? A parent?"

The mourner took a moment to collect himself, then replied "My wife's first husband."

*

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