Use of EWP Hybrid CDI Technology
for the use for Quick Charge Battery or for use with Hydrogen Generation for Fuel Cells.

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Overview

Aqua EWP. has for the last 12 years using a version of the energy storage device (ESD) (patents pending) using Capacitive Deionization that is presently used in water purification. In this application the charge required to purify is proportional to the amount of mass deposited on the surface of the electrodes (reference www.AquaEWP.com). The charge is not recovered. Aqua EWP has made 1000's of cells for water purification for use all over the world.

Most, if not all ESD's today uses chemical reactions with metal based electrodes and organic electrolytes that are hazardous to the environment, have long charge times and are expensive. Most chargeable batteries are Nickel metal Hydride or Lithium ion and must use organic compositions for the electrolyte. Water to these technologies degrades the electrodes. Characteristically the present technology has long charge and discharge times.

Based on the intellectual property associated with the EWP (Electronic Water Purifier) an ESD'sacitor called the BatCap™ (continuation patent pending) has been developed that is fairly inexpensive compared to current technology available. The electrodes are made of activated carbon and carbon nanotubes in a housing with an integral thin film polymeric coating. The electrolyte is a water soluble organic with an extraordinary common mineral that is non hazardous to the environment. The method of construction has very little free electrolyte. The bulk of the electrolyte is between the electrode layers. The product, for now is called EWP BatCap™.

The experimental data shows that the BatCap™ could have 3X the power when measured as Kwatts of power delivered per minute of load or Kg of weight, than any rechargeable battery technology on the market today. The cost of the BatCap™ today, is $1/10^{th}$ that of other ESD's .

Depending on the discharge and recharge load, the BatCap™ can charge and discharge as much power—at close to 100% efficiency (power in to charge vs. power out to discharge). It appears that this technology could be well suited to any rechargeable battery that has a generator (fired by gas, propane, hydrogen etc..) hybrid recharger.

Applicable markets could be HEV (hybrid electric vehicles), regenerative braking systems, lift applications, telecommunications, military (HEV or weapons systems), marine (recreational or large vessels), oil and gas drilling, industrial, utility and UPS backup power supplies, to name a few.

Technical Discussion

The BatCap™ will challenge traditional rechargeable batters such as lithium based or Nickel based chemistries. Many of the tier 1 automotive companies are now experimenting with ESD'ss for the recovery of kinetic energy from braking, but have not been succesful

The ESD's has come a long way from its original invention in 1745, but is limited by its fast charge and discharge characteristic. It is a poor battery because present ESD's can't hold charge very long—so their discharge times are short (30 seconds) compared to recharge times (1 to 2 minutes). The ESD's made by others, while claimed to be environmentally safe, but still uses hazardous electrolyte salts and fluids. A 2,500 farad capacitor is considered an ESD's. Aqua EWP has made ESD's no smaller than 33,000 farads and as large as 66,000 farads in a water purification configuration. We should probably call our capacitors Mega Caps, except that this technology doesn't have the fast discharge characteristic.

While many manufacturers are further out on the experimental edge of capacitors such as Lithium Gel based capacitors, there appear to be three major players, Mawell, Ness and Panasonic, Samsung.

Lithium Ion batteries deliver more energy faster and for longer periods of time than ESD's, but only 1/3 delivery rate of the BatCap™. While the Lithium Ion battery discharges for 3 hours, they take 3 hours to recharge. The BatCap™ discharges for four minutes (depending on discharge load) and recharges in 30 seconds. Because the cost is so much less, a duplex system can be designed charging one bank of BatCap™'s while the other bank is being discharged under load. The Lithium Ion batteries have explosion probability, environmental disposal hazards, short life and high expense.

The BatCap™ can discharge fast (or slow)—so it can deliver power fast for peak demand, such as a vehicle accelerating or delivering power to a backup system prior to the time delay of a generator reaching its peak average power delivery rating.

In order to minimize weight, the device \must deliver 5 wh/kg (watt hours per kilogram)….. have a power density of 600 w/kg…..have a useful life of 100,000 cycles….and be 90% efficient (power compared to power out) [1]. The BatCap™ in it's present form today, meets these requirements delivering 1kw/kg per minute of use, life of 1,000,000 cycles and is 98% efficient. The power density is 10 times that of Lithium Ion batteries.

Nickel Cadmium (NiCad) batteries are capable of supplying high power applications, but are far more expensive that other rechargeable batteries and have short life cycle.

Our estimate of available power, based on experimental data is that 75% of the power in the BatCap™ can be converted to useful work at an average of 2.0 VDC. There is quite a bit of optimization that can improve the useful power based on chemistry of the electrolyte, electrolyte fluid, concentration and electrode chemistry. It is highly probable that the stated performance can easily triple with some laboratory development work.

Comparison of Key Metrics

(data from various sources on the web)

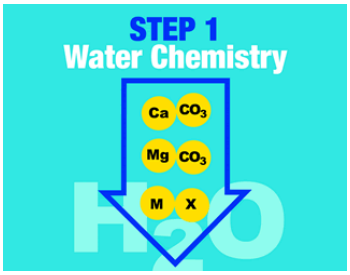
	volts of cell	Useful Voltage of cell	energy weight wh/kg	power density w/kg	recharge time hrs	discharge Time Hrs	Cost $/wh
Ultracapacitors*	2.5	2	10	2,040	1.0 min	0.5 min	
Li ion gel*	3		200				$ 800
Li Co	3.3	3	140	760 253 /hr	3 hr	3 hr	$ 2,500
BatCap™	**2.5**	**2**	**1,000**	**1,000** 2667 /hr	**1/2 min**	4 min	**$0.60**
NiCad	1.2	1	60	150 50 /hr	8 hr	3 hr	$ 600
Ni MH	1.2	1	80	1000	6 hr	3 hr	$ 250
Zn air	1.15	1	200	140			
Lead Acid	2	2	40	180	10 hr		$ 150

* Too new—still in development

The BatCap™

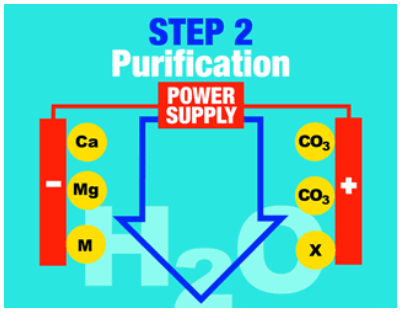
EWP Electronic Water Purifier **BatCap™**

Step 1 - Water Chemistry



There is no comparable technology on the market today and is marketed under the EWP brand name by Aqua EWP. A dissolved mineral in an electrolyte solution (water based). The dissolved mineral will be removed and the mass transferred to the electrode.

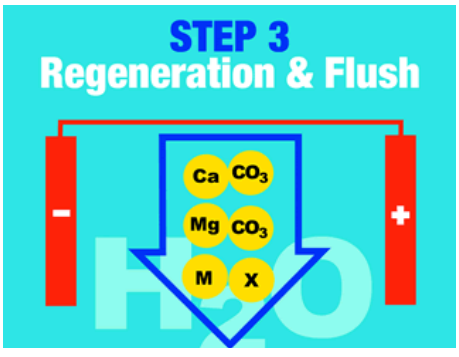
Step 2 –(charging cycle) or Generate Hydrogen 2 CC/gram carbon



Electrodes used are made from activated carbon. When these electrodes are layered using a DC power supply, the individual electrodes are charged with different polarities. The dissolved mineral in the electrolyte have polarity charges are attracted to the opposite polarity of the electrode, thus removing the dissolved minerals from the electrolyte. These dissolved minerals are absorbed electrochemically on the electrode surface creating the charge due to mass deposition.

When sufficient dissolved minerals are transferred onto the electrodes, the charge increases

Step 3 – Regeneration (discharge Cell i.e. conversion to useful work)



The minerals are released from the surface of the electrode simultaneously as discharge occurs and re-dissolves back into the electrolyte solution. This charge is then converted to useful work such as driving a DC motor.