F.V.E.A.A. NEWSLETTER

September 1992

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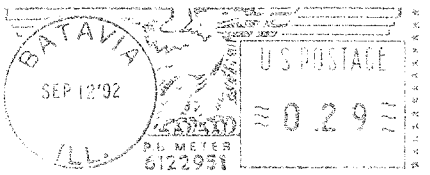
NEXT MEETING

September 18th @ 7:30
College of Dupage
Student Resource Center
Room 1046
Use Lambert Rd. Entrance, Lot 7 at the Southeast corner of 22nd & Lambert
Nonmembers are always welcome!

MEMBERSHIP INFORMATION

Membership to the Fox Valley Electric Auto Association is open to the public. Anyone interested in electric vehicles or electric transporation are encouraged to join. The cost to join is $15 per year from November to November. If joining in the middle of the year the cost is $1.25 for every month remaining til November of that year. The cost for new members joining this month is $2.50.

Fox Valley Electric Auto Association
336 McKee Street
Batavia, IL 60510



First Class

ADDRESS
CORRECTION
REQUESTED

John Emde
6542 Fairmount Avenue
Downers Grove , IL 60516
USA

PREZSEZ

In the minutes you will notice that I agreed to included information on electrathon vehicles so that we could have further discussion on the possibility of putting on such an event. I also promised to include information on the Zinc/Bromine battery technology, However, I did not have enough room for both. I chose to include the battery information because of the upcoming visit by Phillip Eidler. I hope that everyone will make every effort to attend the October meeting. Mr. Eidler's talk will be extremely interesting. It is not that often that we get the chance to talk to a person with such in depth knowledge on a developing technology such as this.

I have spoken to him on a couple of occasions and I am very excited by the Zinc/Bromine approach. He we undoubtedly shed some light on the industry as a whole and the events that occurred in Phoenix. See the article I wrote in the June issue about the Electric 500.

I promise to dedicate the next issue of the newsletter to the electrathon class of vehicles and events.

I have also included the promotional blurb about the Solar and Electric Vehicle Symposium '92, which is coming October 9th. I will again be speaking at this event and will share any and all information I can at the October or November meeting. I also encourage anyone that can afford to attend this symposium to do so. It is without a doubt the largest and most informative event concerning the EV industry. If you are serious about conversion or development from the ground this show has enough seminars to make your motor spin. In fact, there simply is not enough time to attend every talk that a person may want to.

This year GM with display the "Impact" as well as any other alternative fueled vehicle, along with its competitors. The keynote speakers included Ed Begley Jr., Environmentalist/Actor as well as Karl-Heinz Ziwicka, Director of Environmental Engineering at BMW. John Wallace, Director of Electric Vehicle Planning and Program Office at Ford Motor company, will speak on "The Commercialization of Electric Vehicles".

Last but not least I appreciate any comments or suggestions on the newsletter, or the club organization for that matter. If anyone has an editorial comment, please send it in and I will publish it the next go around.

Douglas F. Marsh

Minutes of FVEAA Meeting

21 August, 1992

The meeting in Room 1046 at the College of DuPage was called to order by President Marsh at 7:45PM. There were 16 members and 2 guests present.

There was no official Treasurer's report. The Treasurer was on vacation. President Marsh stated we are still solvent.

President Marsh reported receipt of a Newsletter from the newly-formed Hawaii EAA. They will be added to Newsletter exchange list.

The FVEAA was invited to be listed in a Directory published by Genesis Publishing. Members declined to authorize the $ 30 listing fee.

The FVEAA has been furnished 6 copies of Steve McCrea's "Why Wait for Detroit" 2nd Edition Book. One copy will be placed in the FVEAA Library and 5 copies are available to FVEAA Members for $ 5.

President Marsh made available copies of the latest issue of "Solar Mind" Several members took copies for placement in local libraries.

A guest speaker for the October meeting from Johnson Controls in Milwaukee was announced by President Marsh. The topic will be discussion of the Zinc-Bromine battery developed by that firm. It was suggested the October Newsletter contain a description of the battery principles.

Member Clark suggested instituting an EV "Question of the Month" be included in the Newsletter. The suggestion was favorably received. Members discussed Steve's question of why the middle cell of his motorcycle-type auxiliary battery did not gas when charging and the open-circuit voltage was a low 11 volts. It was concluded the battery was defective and should be returned during the warranty period.

Member Harris suggested a possible fund-raising source involves giving leads for the remanufacturing of laser printer ink modules. Several sources were suggested at the meeting.

There was a discussion of FVEAA initiation of a 1993 Electrathon event in the Chicago area. We could try to obtain a corporate sponsorship. President Marsh agreed to include the general vehicle rules in the next Newsletter and discuss this matter further at a future meeting.

The evening technical discussion was led by member Dick Marsh who presented a tutorial on use of shaft position encoders involving LED-Phototransistor assemblies to provide input data for a power controller. Member Marsh intends to construct an educational demonstration of the system. Member Shafer agreed to make available a small 28-volt Bendix motor he has for this effort.

The meeting was adjourned at 10:45, just ahead of building closing.

Submitted by
William H Shafer
Secretary

October 16th Guest Speaker: Zinc/Bromine Technology Program Manager, Phillip Eidler of Johnson Controls

The Zinc/Bromide battery technology that created such a large stir at the Solar Electric 500 at Phoenix in May will be discussed in detail at the October 16th FVEAA meeting. Phillip Eidler, the Project Manager, will visit us from Milwaukee, the home of Johnson Controls to discuss the pros and cons of this exciting technology.

The Zinc/Bromide battery was demonstrated in a GEO Metro electric vehicle created by James Worder and Solectria. The vehicle was averaging 86 MPH for over 90 laps when a leak developed in the battery cause bromine solution to spill on to the track and the inside of the car. The extreme temperature of the day caused the solution to flash into a gas causing an unnecessary panic with spectators and officials. James Worden, who was the driver was temporarily incapacitated and was taken to a Phoenix hospital for examination. He was released the next day with no long term effects. Refer to the June issue of the FVEAA newsletter for more information on the events that occurred at Phoenix.

The Zinc/Bromine battery is an emerging technology which offers an energy density of 75 to 85 watt-hours per kilogram, two to two-and-a-half times higher than that of present lead/acid batteries. The power characteristics of the battery can be modified for the selected applications by merely changing electrolytes. Therefore, the zinc/bromine battery has capabilities which make it potentially useful both as electric vehicle and load management battery technologies.

September 18th Topic:

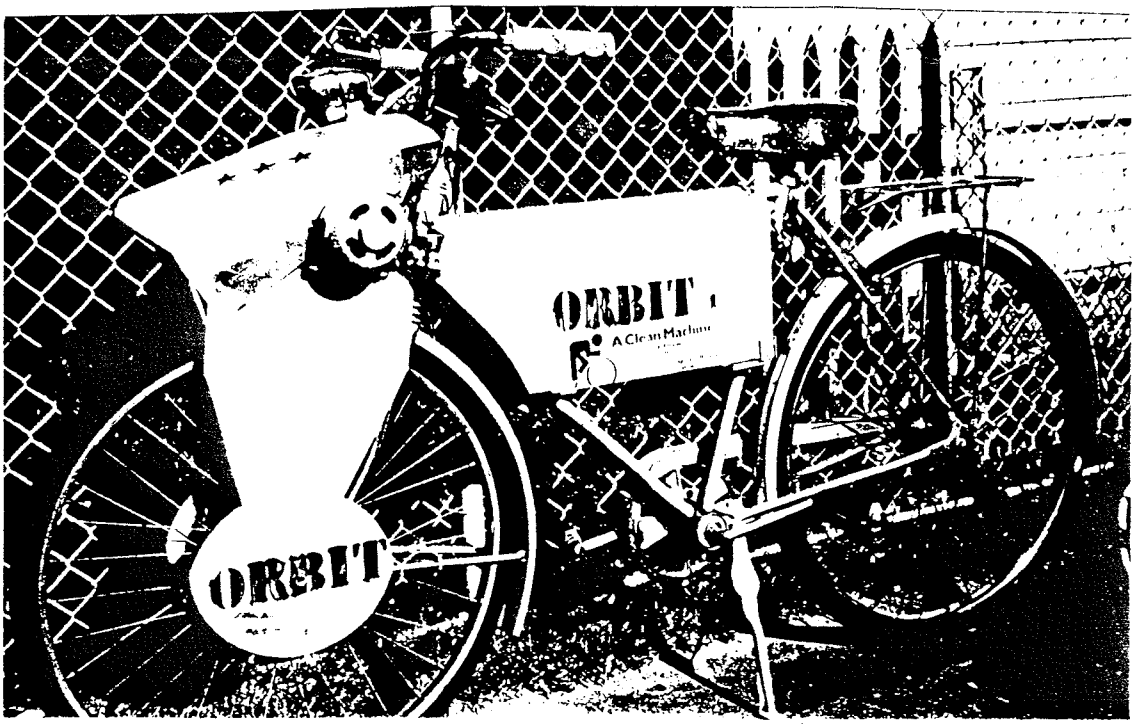
Member Carl Chapman will present slides and experiences of his trip with the ENER-RUN II crew as they drove from Washington D.C. to Los Angeles, driving alternative fueled vehicles.

For Sale: Electric Bicycle

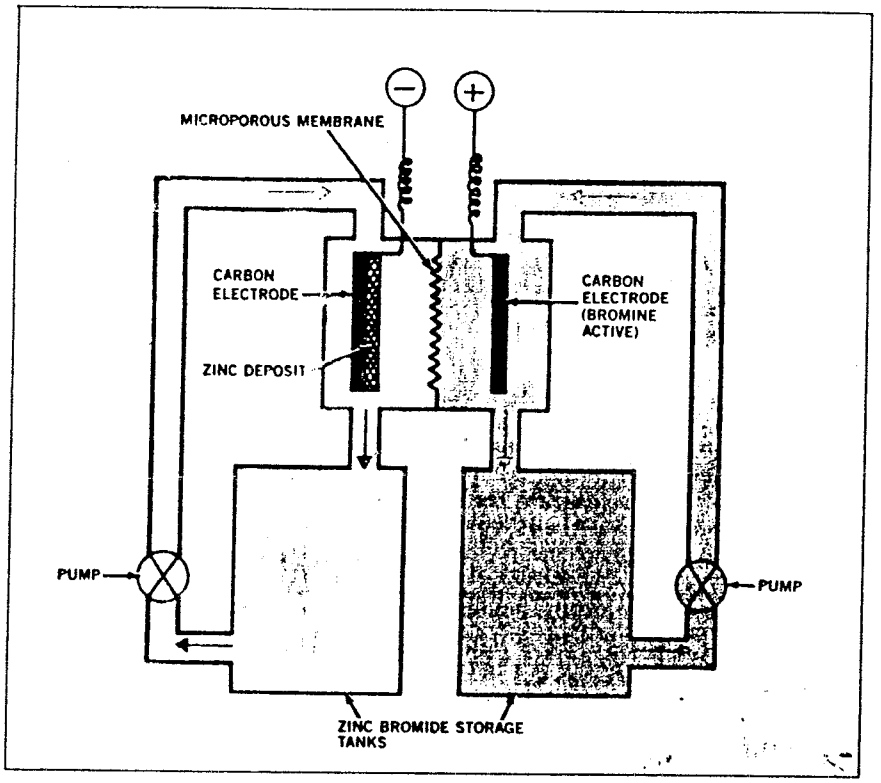
Custom built electric powered bicycle. 12 volt system. $700.00 invested. Want $500.00. New battery included.

Contact Richard Ness

(312) 889-7757



High-energy battery



PERTH, AUSTRALIA

"It doesn't look a bit like a battery," says Professor Ian Ritchie, showing me two gallon-size cylindrical tanks topped by an upended box in his laboratory. This strange rig is a new type of high-energy zinc-bromine battery being researched here at Murdoch University in Western Australia, and sponsored by Exxon Research and Engineering Co. and Energy Research Corp.

"It's a breakthrough in electrochemistry," claims Ritchie. "For a given output, this battery has twice the energy density of the usual lead-acid type, is far lighter, and uses cheap abundant materials. Most important, it has a virtually unlimited charge-discharge cycle life, so a battery could last almost indefinitely." Researchers hope the battery will evolve into tennis-court-size systems. These could save millions of dollars in power-station construction by storing energy from present plants during off-peak hours. The batteries could also store energy from wind and solar plants.

In conventional lead-acid batteries, Ritchie explains, energy is stored in the electrode plates. Chemical reactions slowly degrade the metallic plates until they fail, and the entire battery is usually junked. But with the zinc-bromine battery, energy is stored in the electrolyte fluid, which, like water in lead-acid batteries, carries electric current between the plates.

Both plates in Ritchie's experimental battery are carbon and serve as a source of electrons. The plates are chemically inert and won't fail because of deterioration. A cell (see diagram) is split into two sections by a plastic membrane. A zinc bromide solution is pumped into both sections from separate storage tanks.

During charging, zinc ions are drawn from one solution and deposited on the negative plate as zinc metal. On the positive side, bromide ions are converted to bromine. One solution is deficient in zinc ions, and the other is deficient in bromide ions but rich in bromine. The porous separator membrane permits current flow between the plates.

The electrochemical process is reversed as current is drawn from a battery. Each square foot of 1.8-volt cell area delivers some 30 amperes. Fresh solution is pumped continuously from the supply tanks, whose size determines the energy capacity of a battery system.—*David Scott*

New Life for Sulphated Lead-Acid Cells?

Richard Perez

Over the years I have tried many chemical treatments supposed to rid a cell of sulphation. None of them made any perceptible difference. A strange and devious set of circumstances has led us to the successful chemical removal of sulphation from six lead acid cells. Not only are the circumstances odd, but the chemical used, EDTA, is benign– in fact, it is used as a human food preservative.

The Patients

The sulphated Trojan L-16W lead-acid batteries numbered four and were the victims of a messy divorce. The pack was less than two years old when its owners had a parting of the ways. The husband took off for parts unknown. The wife left the house vowing never to return. And she left ALL the lights on when she departed. This system was sourced only by an engine/generator, with no PVs to help out. After several days the batteries were totally discharged. The batteries then sat discharged, with the lights switched on, for the next three months.

The ailing pack was transported to Electron Connection for disposal as part of the whole divorce rigamarole. Upon inspecting the cells through the filler holes, we say vast amounts of white moss covering all the plate assemblies. Or at least we assumed there were plates in there somewhere because all we could see was an even blanket of moldy looking lead sulfate. Seven of the twelve cells were very low in water. Our job was to assess what these batteries were worth. In order to do this we attempted to recharge them and see how they held the charge. Open circuit voltage of the cells averaged 0.7 Volts.

We placed the batteries on a four panel Kyocera J48 PV array (~12 Amps) and the voltage immediately shot to 15 Volts where the r[illegible]tor cut in. The amount of current accepted by the four L-16Ws was 0.4 Amps. We left the L-16Ws on the array for five days, but they never did accept a charge. We then tried discharging the batteries. They (all four 125 pound batteries) ran a 28 Watt car tail light for about three minutes. This gave us an electrical capacity of about 0.05 Ampere-hours per cell that originally had a capacity of 350 Ampere-hours. A classic case of sulphation ruining virtually new, high quality batteries. We pronounced the cells toxic waste and told the principals involved that the batteries were worthless. In fact, worse than worthless because someone h[illegible]d to responsibly dispose of them. The original owners promptly disappeared and left us holding the batteries. They sat, forlorn and unloved, in the battery area, side by side with new cells destined for caring homes.

In another reality...

My friend, George Patterson; a battery techie second to none, ran into an article in an obscure British antique motorcar publication that described using a chemical called EDTA to remove sulphation from old lead-acid batteries. I related to him the story of the orphaned L-16Ws and, to make a very long story short, we decided to give it a try on these virtually new, but severely sulphated batteries.

EDTA, what is it?

It is an organic acid, a chemical cousin of vinegar. EDTA stands for the entire name of the compound which is, "ETHYLENEDIAMINE TETRAACETIC" Acid. EDTA is used for many chemical jobs, but perhaps the most amazing is as a food preservative. I noticed it on the list of ingredients of a can of Slice® orange pop I drank. In chemical techie terms, EDTA is a "chelating agent". That means it likes to bond to metallic ions (like lead sulfate). While EDTA is not the sort of stuff you want to eat by the teaspoon (the label carries warnings about getting it in the eyes or nose), it is a relatively innocuous chemical with which to attack the sulphated nastiness of those L-16Ws. I admit to being skeptical. I thought we were wasting our time. How could something contained in orange pop help these severely sick cells?

The Operation

George Patterson located and purchased 500 grams of EDTA from a local chem lab that specializes in the chemical testing of wine. The cost was low, under $15 for the EDTA and another ten bucks for rush shipping. George then did an essential duty in this entire process. He came up to HP Central in Hornbrook and got me off my butt to actually perform this experiment. George could have shipped me the EDTA, but he knew my faith in this project was so low that I'd get it done some time next century.

We decided to operate on two of the L-16Ws and leave the other two untreated as controls for the experiment. We had only sketchy information from the British motorcar pub. It described a teaspoon in every cell (hold the milk and sugar) and let sit for several hours. It neglected to mention the size of the cell, but George and I assumed that an antique motorcar would have a fairly small battery- about 70 Amp-hrs. So we upscaled the amount of EDTA to 2 Tablespoons to match the larger (350 Ampere-hour) L-16W cells. What follows is a step by step description of what we did:

PLEASE NOTE: These operations involve handling sulfuric acid electrolyte. We used acid resistant Norex lab coats, rubber boots, rubber gloves, and safety glasses. If you try these operations without this safety gear, then you are risking injury. Play it safe.

1 We drained the old electrolyte from all six of the cells. Now this reads easier than it does. An L-16W battery weighs 125 pounds and contains 9 quarts of sulfuric acid in its three cells. Be careful not to drop the battery or spill the acid electrolyte. Reserve the old electrolyte in secure containers and dispose of it properly through your local battery shop.

2 We rinsed all the cells with water and drained them.

3 We added 2 Tablespoons of EDTA to each cell and refilled each cell with hot (~120°F.) tap water.

4 We left the cells to merrily bubble (the EDTA/lead sulfate reaction is exothermic- it gives off heat) for about two hours.

5 We then drained the cells and repeated steps 2, 3, and 4 once again. We could see the sulphation disappearing, but one treatment had not got it all. Actually, two treatments didn't either because there was still some sulphation there after the second go round.

6 We rinsed each cell with distilled water and drained it.

7 We refilled each cell with new (sulphuric acid in solution with distilled water- specific gravity 1.260) lead-acid electrolyte.

The Operation was a success?

After spending all day lifting and draining L-16Ws, George and I were sore and ready for a few beers. This technique is not recommended to the frail. If I were to do it again, I would build a cradle to hold and invert these heavy batteries. Doing it by hand is tiresome, risky, and invites injury.

Neither of us was convinced that we had accomplished much beside some heavy sweating dressed in kinky moon suits. We left the L-16Ws, disconnected and unused, in the basement battery area. Every time I passed by, I would wire the pack of two rejuvenated batteries into the PV array for some quickie recharging. I had no time to run any sustained recharging or testing at that point because we had another issue of Home Power going to press.

It was not until six weeks later that Scott Hening, our summer intern, hooked up the EDTA treated L-16Ws into a working system. This system is sourced by two ancient, anemic SolaVolt PV modules. The system is simple: the PVs and the two L-16Ws. This system provides power for lighting in Bob-O's spare trailer which houses dignitaries and heads of state visiting HP Central. Here the EDTA treated batteries received about 3 to 4 amps as long as the sun was shining. Since this system is seldom used, the batteries received a constant daily overcharge for about eight weeks. Bob-O kept on top of the cells' water levels and refilled them as needed with distilled water.

Since the trailer was seldom used, and no one staying there complained of dead batteries, we just left the L-16Ws alone. Since the system had no instrumentation, it was hard to tell how much improvement the EDTA treatment did.

Enter a pressing need

Then all of a sudden (in the space of six days) one of the L-16Ws in the main Home Power system (4@ L-16W) at Agate Flat developed a shorted cell. As distressing as it was to lose an eleven year old L-16W battery, it was fascinating to watch and record the death of one of its cells. The shorted cell dramatically unbalanced the remaining three L-16Ws in the pack. I had to do something quick. I disconnected the series string of two L-16Ws with the bad cell. Putting a new L-16W in this eleven year old pack was out of the question. I started thinking used battery and imagined the EDTA treated L-16Ws. Next day, I removed one of the EDTA treated L-16Ws from Bob-O's trailer and inserted it the main Home Power battery. I had trouble choosing the best of the two EDTA treated batteries. I went for the one that had the least voltage variation between cells.

EDTA treated L-16W performance

I had no idea what to expect. The last time I tested the sulphated L-16W it wasn't able to power up a car tail light. I inserted it into the main pack as follows in the illustration below. I gave each cell a number and recorded data on the performance of the battery on a cell by cell basis. The L-16W battery containing cells 1, 2, and 3 is the EDTA treated battery. The remaining L-16Ws (cells 4 through 12) are the original, untreated, eleven year old batteries.

What happened?

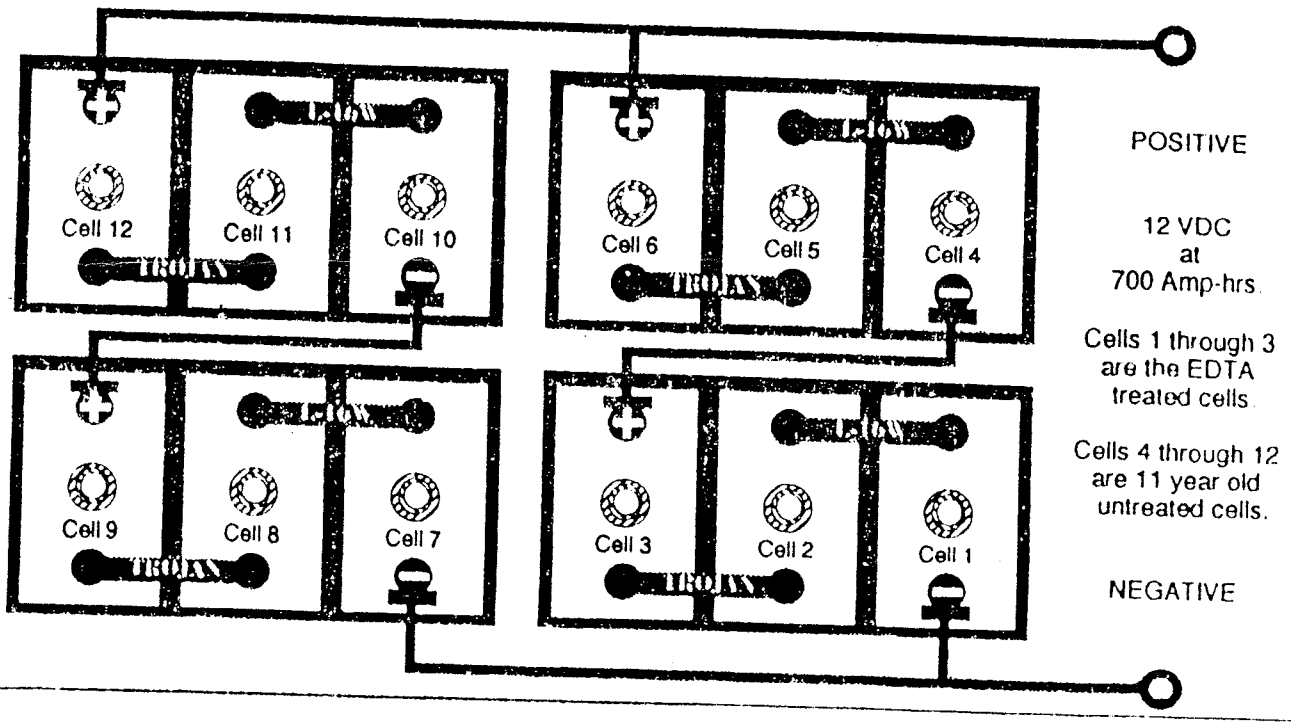
I'll cut to the chase here. The L-16W treated with EDTA had regained enough of its electrical capacity to function as an equal element with the battery. It works! What follows below is data from all cells making up this battery under a variety of conditions. Detailed in the tables on page 25 are a variety of data, here's a score card to help tell the players:

Battery Data

1. the date. 2. the battery Ampere-hour Meter reading which indicates the pack's State of Charge (minus indicates discharge amp-hrs.). 3. the discharge or charge rate in Amperes (minus indicates discharge).

Individual Cell Data

4. the voltage of each cell. 5. the absolute cell voltage deviation from the average cell voltage. 6. the average battery (that's three cells in a case) voltage deviation. Note EDTA treated cells' data (Cells #1, #2, & #3) are printed in bold type.



Cell Data

7. average cell voltage. 8. cell voltage standard deviation (computed via standard statistical method). 9. maximum cell voltage difference.

What the data means

What we are looking for are differences in voltage between cells. Which is why the average cell voltage and deviations from average cell voltage are computed. A maximum cell voltage difference greater than 0.05 VDC, under light discharge (<C/40) means the cells are unbalanced. This measured by subtracting the voltage of the highest cell from the voltage of the lowest cell.

Note that on all four test discharge runs (10/21/90, 11/2/90, 11/7/90, and 11/19/90) all the cells making up the pack show about the same voltage. In fact, some of the EDTA treated cells are showing higher voltages than some of the non-treated cells.

Bottom line is that the EDTA treated cells are functioning in as a series parallel element in a battery pack. Before treatment these very same cells couldn't store enough power to operate a small light blub for five minutes.

To date I have discharged the test battery to the depth of 214 Ampere-hours (indicated by the Cruising Equip. Amp-hr. meter) from the test battery. The EDTA treated cells are continuing to function within the pack with less than 0.02 VDC difference from untreated cells.

Date:	10/21/90
Amp-hrs.	-61
Amperes	-6.4

Cell #	Cell Voltage	Absolute Cell V. Deviation	Average Battery V. Deviation
1	**2.051**	**0.00058**	**0.00586**
2	**2.048**	**0.00358**	
3	**2.065**	**0.01342**	
4	2.051	0.00058	0.00325
5	2.051	0.00058	
6	2.043	0.00858	
7	2.051	0.00058	0.00125
8	2.050	0.00158	
9	2.050	0.00158	
10	2.058	0.00642	0.00714
11	2.058	0.00642	
12	2.043	0.00858	

Average Cell Voltage	2.052
Cell Voltage Standard Deviation	0.006244
Max. Cell Voltage Difference	0.022

Date:	11/2/90
Amp-hrs.	-53
Amperes	-8.4

Cell #	Cell Voltage	Absolute Cell V. Deviation	Average Battery V. Deviation
1	**2.056**	**0.00083**	**0.00594**
2	**2.054**	**0.00117**	
3	**2.071**	**0.01583**	
4	2.052	0.00317	0.00583
5	2.053	0.00217	
6	2.043	0.01217	
7	2.054	0.00117	0.00117
8	2.054	0.00117	
9	2.054	0.00117	
10	2.062	0.00683	0.00728
11	2.062	0.00683	
12	2.047	0.00817	

Average Cell Voltage	2.055
Cell Voltage Standard Deviation	0.007259
Max. Cell Voltage Difference	0.028

Date:	11/7/90
Amp-hrs.	-29
Amperes	-2.5

Cell #	Cell Voltage	Absolute Cell V. Deviation	Average Battery V. Deviation
1	**2.114**	**0.00508**	**0.00903**
2	**2.110**	**0.00908**	
3	**2.132**	**0.01292**	
4	2.120	0.00092	0.00164
5	2.121	0.00192	
6	2.117	0.00208	
7	2.117	0.00208	0.00142
8	2.118	0.00108	
9	2.118	0.00108	
10	2.125	0.00592	0.00697
11	2.126	0.00692	
12	2.111	0.00808	

Average Cell Voltage	2.119
Cell Voltage Standard Deviation	0.006317
Max. Cell Voltage Difference	0.022

Date:	11/19/90
Amp-hrs.	-214
Amperes	-2.1

Cell #	Cell Voltage	Absolute Cell V. Deviation	Average Battery V. Deviation
1	**2.083**	**0.00075**	**0.00758**
2	**2.078**	**0.00425**	
3	**2.100**	**0.01775**	
4	2.082	0.00025	0.00258
5	2.082	0.00025	
6	2.075	0.00725	
7	2.092	0.00975	0.00575
8	2.077	0.00525	
9	2.080	0.00225	
10	2.087	0.00475	0.00658
11	2.083	0.00075	
12	2.068	0.01425	

Average Cell Voltage	2.082
Cell Voltage Standard Deviation	0.008203
Max. Cell Voltage Difference	0.032

An alternative to the dump and refill method

The British motorcar publication recommended just adding the EDTA to the cells and that's all. We went into the dump and rinse madness on our own. Now, EDTA is supposed to work by just adding the compound to the cell. No draining, no rising and no electrolyte replacement. We are trying this technique with the remaining two sulphated L-16Ws and will publish the data when we get it.

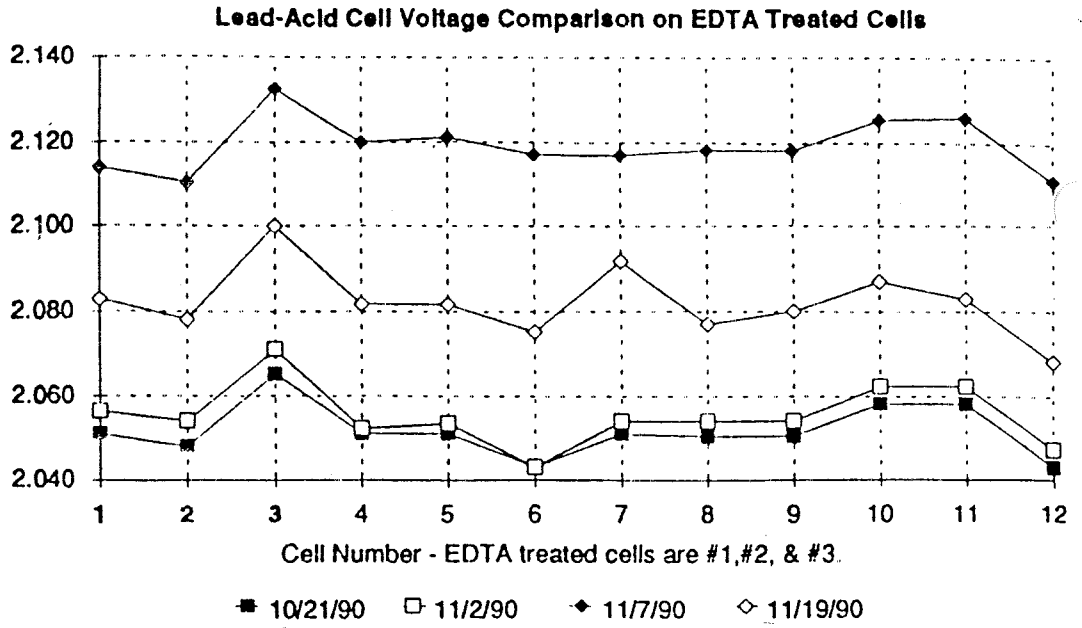
How you can help...

This experiment seems to have worked. We would appreciate verification from anyone else who tries it. After all, if you are sitting on top of a heavily sulphated lead-acid pack, what do you have to lose? EDTA is cheap and it may restore lost electrical capacity to sulphated lead-acid cells. We would appreciate any feedback from those trying our dump and flush technique or those simply adding EDTA to the cells and just leaving it there. As a very general rule of thumb, use 1 to 2 teaspoons of EDTA per 100 Ampere-hours of lead-acid cell rated capacity. EDTA can be ordered from any chemical supplier or from any aggressive drug store.

Conclusion

EDTA seems to work. I say again SEEMS to work. This experiment was far from scientific because it lacks enough cells to get a large statistical sample. Use of EDTA may extend the useful life of sulphated lead-acid cells by chemically stripping the sulphation from the plates' surfaces.

Really, the bottom line here is that I am sitting in front of this Mac, writing this article with electricity stored in lead-acid cells that before EDTA treatment were toxic junk. Color me amazed. And as a sidelight, the long and involved set of circumstances that led us to try this experiment is as amazing as the fact that it worked. Serendipity is an ingredient in this process.



Access

Richard Perez, C/O Home Power, POB 130, Hornbrook, CA 96044 • 916-475-3179.

George Patterson, 3674 Greenhill Road, Santa Rosa, CA 95404.

Makers of the EDTA we used: Sigma Chemical Co., POB 14508, St. Louis MO 63178 • 314-771-5750. Their stock number for EDTA

Suppliers of the EDTA we used: Vinquiry, 16003 Healdsburg Ave., Healdsburg, CA 95488 • 707-433-8869.

S/EV 92

S/EV 92, the fourth annual Solar and Electric Vehicle Symposium Car and Trade Show, offers the auto industry, policy makers, utility companies, fleet owners and operators, first time and advanced EV builders, and the photovoltaic industry a forum for advancing technology, and developing the electric vehicle market. Sessions on infrastructure, planning, utility concerns, battery technologies, electric motors, mass transit, economics and legislation are designed to bring electric vehicles one step closer to being integrated into the U.S. transportation system.

Photovoltaic sessions address policy, regulatory, and technical issues. The purpose is to present a realistic picture of photovoltaic integration into the utility sector. The focus will be on applications and on the institutions, market, and regulatory actions required to facilitate development. Photovoltaics is an integral part of S/EV 92 because NESEA believes that renewable energy can contribute significantly to our energy needs, and that electric vehicles and renewable energy will lead the way to a sustainable energy and transportation system.

S/EV 92 is organized by NESEA, the Northeast Sustainable Energy Association, the largest regional energy association in the U.S.A.

TRANSPORTATION 2001

Northeast Sustainable Energy Association and Massachusetts Division of Energy Resources have joined forces to create Transportation 2001: the largest alternative energy vehicle and trade show ever held in the United States. It presents a broad overview of the latest electric, gaseous, and liquid fueled cars and components which will power our transportation system in the years to come. A special exhibit of photovoltaic technology complements the Photovoltaics component of the S/EV symposium which highlights the need for clean sources of energy for electric vehicles. Transportation 2001 will be open to the general public as well as symposium attendees. Activities for kids include miniature solar car and boat races, and workshops. Hours are 8am--7pm Friday and 8am-5pm Saturday.

TRANSPORTATION ALTERNATIVES 92

Transportation Alternatives 92 in conjunction with S/EV 92 provides a broad forum for alternative fueled vehicle technologies including liquid and gaseous fuels and electricity. Transportation Alternatives 92 will focus on compressed natural gas, liquified petroleum gas, ethanol, methanol and other liquid and gaseous alternative fuels. Transportation Alternatives 92 will address the technology as well as the application of alternative technologies including: governmental initiatives which encourage the use of these fuels and technologies; issues of infrastructure and safety; an in-depth look at economic and environmental impacts; the involvement of the educational community; demonstration projects; and the economic impacts that the development of these technologies may have on the region.

Speakers are professionals who are well versed in these fields. They include representatives from leading fuel suppliers, engine manufacturers, the auto and trucking industry, and federal and state officials.

Transportation Alternatives 92 is organized by the Massachusetts Division of Energy Resources (DOER), a division of the Massachusetts Executive Office of Economic Affairs.