Re: Cost per mile over 10 yr life?

Source: http://sci.tech−archive.net/Archive/sci.energy/2005−05/msg00312.html

- *From*: Tim Keating <NotForJunkEmail@xxxxxxxxxxxxxxxxxxxx>
- *Date*: Thu, 26 May 2005 09:44:18 −0400

On Thu, 26 May 2005 02:08:21 −0700, "Fritz Schlunder" <me@xxxxxxxxxxx>
wrote:

>
>"Tim Keating" <NotForJunkEmail@xxxxxxxxxxxxxxxxxxxx> wrote in message
>news:3h6a9151s6ueuflvgshkchr4hna08t2ja9@xxxxxxxxxx
>
>
>> Steel case.. two electrodes are nickel based,
>> Electrolyte is potassium hydroxide, some copper content as well.
>>
>> http://www.grs−batterien.de/english/technol/download/esslin02.pdf
>>
>> Page 4.. while NiMH is not listed..
>> NiCd is.. On average 45% of the NiCd bat weight is Fe.
>> 5% KOH and 10% H20...
>
>
>That is an interesting link, but it is unfortunate they didn't include NiMH
>on their composition table.

They're similar..

NiMH battery chemistry uses a Nickel Oxyhydroxide cathode and KOH
as an electrolyte. Similar steel case.. maybe even a little bit
heavier..

http://www.powerstream.com/BatteryFAQ.html

>I might refer you to this link here:
>
>http://www.electroenergyinc.com/products/technicalpapers/BipolarNickel.pdf
>
>They aren't talking about "AA" size NiMH cells of course, but nevertheless
>section "5" located near the end of that document has a small cost breakdown
>of their product. They would have you believe the materials cost is
>somewhere near $195/kWh.

I still wouldn't choose NiMH for a pure EV..

Both energy density, and charge efficiency are TOO LOW !!!.

>
>> >Well... If you stick a small Li−Ion battery pack in it, weight could be
>> >reduced. But then, so too will performance be reduced. The lead acid GM
>> >EV1 had a curb weight of 2922 lbs. This obviously doesn't compare

With a large portion of the weight accounted for by the Battery
pack and steel support structure.. Weight begets more weight as
related chassis components require beefing up, bigger tires, power
steering, etc.

>favorably
>> >with the Geo Metro at around 1830 lbs., or your more typical compact size
>> >cars at 2400 lbs.

^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^

>>
>> Another "Fallacy of Composition".

Again.. Comparing apples to oranges..
When gets around to designing pure EV's using lightweight Bat
tech many conventional metrics will no longer apply.

>>
>> Their are other types of Li−ion chemistries which have in excess of
>> 20x the energy storage capabilities of current laptop Li−ion tech.
>> (Lookup Li−Si, they just haven't figure out how to make the battery
>> structure handle recharge cycles, yet.)
>
>
>For the moment, if a full scale commercial production EV were being designed
>it would need to be based around standard off the shelf well proven battery
>technologies. Even if a given battery technology can deliver phenomenal
>energy density, that doesn't guarantee its suitability for EV use.
>Obviously both cost and rechargeability are incredibly important, among
>other properties.

NO, If anything, it would be foolish not to use the latest
battery designs.

There are methods of accelerated life testing.. Plus the
lightweight battery pack can located outside the passenger
compartment.. (I.E. where the gas tank used to be.. is a fairly safe
location)..

>> >Ideally for ultra rapid charge EVs, the battery pack voltage should be as
>> >high as possible. Otherwise the current required rapidly becomes

>> >unmanageable since the hook up cables would not really be easily managed

Again, NO..
You don't go redesigning the world to built a better chair..

One should select secondary components based on avail tech..
Standard Wire insulation ratings is one of them.
EV's will have the requirement to be repaired in the field..
Same goes for motor/generator windings.
Modern power mosfets are more efficient, running at higher freqs
and lower voltages. (less weight).

>by
>> >non−muscular people. Since 1200V Insulated Gate Bipolar Transistors
>(IGBTs)
>> >are readily available and offer excellent bang for the buck, I suggest a
>> >maximum in use battery pack voltage of about 1000V or somewhat less.
>Even

IGBT's are a waste of energy... you have to drive voltage and
other costs up so high just to make up for their losses. No thanks..

>>
>> Not a good idea to run near maximum voltage limits.. Inductive
>> kickback. Plus you must exceed nominal bat pack voltage by a
>> significant margin to recharge bats at any usable rate.. (braking?)
>
>
>What the power electronics look like depends upon the various design
>requirements and what kind of motor is used. Typically however, motor
>control is provided by H−bridge(s) or three half bridges for a three phase
>AC induction motor. When built from IGBTs, each device requires an
>antiparallel diode. With these diodes in place, the H−bridge is practically

Mosfet's are far more efficient and effective in this
application.. Higher switching freq == Lighter weight, smaller
inductors, smaller caps, reduced losses. It's not by accident that
most switching power supplies now run in 200Khz to 1Mhz range.
Wire sizes not an issue when there is a traction motor for each
wheel.

>That said, you still shouldn't run a 1200V rated IGBT at 1200V for
>reliability reasons.

snip.... IGBT's are a waste energy in this application.

> So in theory, for an H−bridge constructed of 1200V
>devices, during ultra rapid charge the maximum voltage could reach 2400V

Only in theory.. their are many related connected components
which you will need to deal with, and you still have to get your

1000v bat pack up to 1200v to accept the regenerative braking energy.

>without causing harm provided that all switches are fully off during
>recharge. A clever engineer might be able to take advantage of this
>property depending upon topologies used and other design constraints.

You keep on focusing on the wrong issues,
using the wrong tech,

Probably because of your past experiences
when you had limited options, avail tech,
and your goal was very narrowly defined..

I'm thinking about solving the whole enchilada using tech that
complements other components of our nation's future energy
infrastructure.

'
>> Long strings of batteries decreases reliability..
>
>
>This is true, but on the other hand, no matter how you arrange the cells
>performance suffers if one cell in a pack should fail. Something to
>consider though. NiMH batteries produce hydrogen gas if they are reverse
>charged for too long. If a singe cell in any series arranged pack has much
>lower capacity than the other cells, it will be reverse charged by the other
>cells. For sealed cells, this might activate the vents and hydrogen gas may
>leak out. This is unfortunate, but there isn't that much you can do about
>it since clearly an electric vehicle operating at 1.2V is not practical.
>
>Li−Ion has its own safety quirks however, since under certain conditions
>they can produce lithium metal. Given the reactivity of lithium metal, they
>can conceivably violently rupture (ie: explode).

Depends on the battery chemistry.... The two most popular types are
LiMnO2 and LiCoO2.. LiMnO2 is doesn't have a damaged battery
run−away problem, but it has a lower energy density. Damage battery
issue can be solved by locating bat pack outside passenger compartment
in between rear wheels. Advantage of Li is the higher voltageper cell
(3.6 to 4.2v) which in turn reduces the number of cells and
connections between them.

A dozen flame resistant battery spacers (in bat compartment, volume
not is an issue), can significantly reduce the run−away effect.. A
30kWh bat back going up in flames. releases less thermal energy than a
gallon of gas.

>
>Of course, to put things in perspective a gasoline tank always contains
>volatile and highly reactive hydrocarbon liquids and vapors, so in that
>sense it is always a fire/explosion hazard. In either case safety is

>adequate.
>
>As for reliability of battery packs... It seems to me the best way to
>improve reliability is to insure good quality control on the individual
>cells. Since a battery pack is in many ways as weak as its weakest element,
>it makes great sense to make sure there are no weak elements.
>
>
>> >No electrical contact is made but they are magnetically coupled when
>together.
>>
>> Not practical.. too much loss..
>
>
>Umm... What are your credentials? I have a bachelor's degree in electrical
>engineering. My particular area of expertise is in power electronics. I

First part you've chosen the wrong technology IGBT for you motor
control.. Higher PWM freqs == lighter weight Mosfet.

>say inductive coupling is practical. The engineers at GM who made the EV1
>clearly thought inductive coupling was practical. The GM EV1 used inductive
>coupling through the little paddle you plug into the hood. Presumably the
>car could be charged through this small device at a rate up to 50kW.
>
>Inductive coupling was chosen in large part due to considerations of safety.

That was before optics and associated electronics became fairly cheap.

In the end.. a hardwired design serves many purposes which I've
already gone over.. Off hours load generation, accurate billing,
far greater energy transmission, higher efficiency, reduced
electronics/weight in EV, etc..

You're still thinking with a one track mind. Which less than
optimal when you're trying to come up with a whole new transportation
infrastructure for the nation. EV's are just one part of the
equation.

>An ideal electric car should be able to be charged outdoors as well as
>indoors. Water and electricity don't mix so well, so I can definitely
>appreciate their design decision. GM advertised that the EV1 could be

Nothing in a plug in design precludes such usage.

>safely charged even if the whole bottom of the car, you, and the paddle
>itself was submerged under water. That isn't a realistic combination, but
>the claim was probably true.

If the power coupling ins't energized until a self test and
bi−direction comms is established, Fibre optic comm channel is

embedded into power cable. I don't see a problem.

>
>On the other hand there were a few incidences of a capacitor failing and
>causing the paddle to get stuck in the car. The recommended procedure was
>to shut off power, cut the cable between charger and paddle, and drive to
>the nearest dealer for service.

Both sides would have the ability to cut energy flow. You would
need to establish an alternative comm channel to perform that
function.. It would be subject to hacking. Reverse energy flow
capability difficult.. lossy..lot's of extra weight and electronics
being carried around in EV.

>> Another nice feature would be a EV with a PV roof.
>> An EV that self charges would be great.
>> Nt much extra range 25 miles a day worth of energy.. But it's
>> transportation that's free of infrastructure. (A very handy feature
>> after a widescale disaster).
>
>
>A photvoltaic solar panel on the roof of a full size EV is almost worthless.
>The hood is subject to bombardment by road debris, and given the price of PV
>cells, it would be a real shame for it to get broken. Therefore, only the

Pure EV's probably won't have hoods as we know it..
Just passenger and luggage compartments.

>roof is a practical mounting location. This restricts you to a panel of
>perhaps one square meter or less.
>
>At the earth distance from the sun (1 AU), the sun provides 1300
>watts/square meter of radiation. On the surface of the earth, at the
>equator, at noontime, on a clear day, up to 1000W/m^2 of radiation is
>available. Solar cells are not typically better than 20% efficient.
>Typically they are much worse. Dramtically much worse. The efficiency
>drops off at high temperatures, a highly effective maximum power point

You're still thinking conventionally.. A solar panel roof would be
vented. Probably forced air.. Using a couple of watts of PV output..
Secondary benefit.. Much cooler EV's during the summer :−)

In general, I expect EV's will have more thermal/sound insulation
installed around passenger compartment, since they don't have lots
excess power to waste on A/C or Heat. The extra insulation will
also act as energy absorbing component in vehicle crashes.

>tracker is needed, the panel must be perfectly clean and pependicular to the
>sun's rays, and the solar cell packing efficiency of a panel usually reduces
>the effective efficiency.

There is US solar flux data for Horizontally mounted, flat plate
collectors located at the follwoign link..

http://rredc.nrel.gov/solar/old_data/nsrdb/redbook/atlas/

>
>So, even with the absolute best possible conditions you could not exceed
>200W of output from a roof mounted solar cell. If you assume 6 hours/day of
>strong sunshine producing 200W (which it clearly couldn't since the cell
>isn't tracking the sun when mounted on the roof), then you only get 1.2kWh
>less power electronics and battery chemistry charging inefficiencies. At
>120 Watt hours per mile, that would be ten miles or less. That is of course
>highly unrealistic/optimistic.

One meter^2 is an awfully small passenger compartment..
It will be much larger and not always flat.. PV tech may even be
incorporated into fixed windows.. (like a rear hatchback window.)

>Additionally NiMH cells have non−negligible self discharge rate. A rate of
>1% per day (more for the first few days) is not unreasonable for many cell
>designs. A solar panel therefore might not be able to provide any extra
>range, only enough to combat self discharge. Of course, you are a fan of
>Li−Ion so that won't likely be of concern for you.

Again.. NiMH is not a solution for pure EV..
way too lossy... very high self discarge rate..

>
>> Currently, people have no problem filling their cars with gas..
>> Hooking up a high performance charging connector should be no problem.
>> The EV would be programmed not to move unless the charging connector
^^^^^^^^^^^^^^^^^^^^^^^^^^^^
>> was properly disengaged. (verbal warning).
>
>
>A verbal warning would not be enough. Electrical interlocks should be built
>into the devices such that the charger is not energized until after it has
^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
Already discussed..

>been fully plugged into the vehicle. Similarly, the car should be fully

^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
You edited that part out. bidirectional comms need to established
first.. The optical communication channel is part of the connectors.

>disabled when under charge/plugged in. Additionally the charger should
>fully deenergize before the plug can be unplugged from the car. Further,
>the connector moldings should be such that they naturally reject moisture,
>and that no human can touch any metal contacts. Additionally the chargers

>should be fully covered so that they do not get wet and can still be used
>during a rain storm.

Not an issue.

>
>I happen to know a guy (not me) who one time drove off in his car while the
>gas pump nozzle was still in the car filling the tank. Apparently it ripped
>off the hose from the pump but didn't shut off the pump in the process. So
>gas went everywhere, and he didn't even know there was a problem until he
>drove 1/4 mile down the street and stopped at a stoplight. At that point a
>driver next to him got his attention and pointed to the dangling gas nozzle
>and hose hanging from his vehicle. He said he felt stoopid afterwards,
>claims it was the dumbest thing he ever did.

It's not going to happen..

The EV will sense that the weather seal on the energy port is
still open. The EV will refuse to move, and it will tell you why it
refuses to move !
.

- ***Follow−Ups***:
  - ♦ ***Re: Cost per mile over 10 yr life?***
    - ◊ *From:* Fritz Schlunder

- ***References***:
  - ♦ ***Cost per mile over 10 yr life?***
    - ◊ *From:* BobG
  - ♦ ***Re: Cost per mile over 10 yr life?***
    - ◊ *From:* Hatunen
  - ♦ ***Re: Cost per mile over 10 yr life?***
    - ◊ *From:* BobG
  - ♦ ***Re: Cost per mile over 10 yr life?***
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    - ◊ *From:* Tim Keating
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- Prev by Date: ***Re: Cost per mile over 10 yr life?***
- Next by Date: ***Re: Cost per mile over 10 yr life?***
- Previous by thread: ***Re: Cost per mile over 10 yr life?***

- Next by thread: ***Re: Cost per mile over 10 yr life?***
- Index(es):
    - ***Date***
    - ***Thread***