Energy and CO_2 Savings

Scenario 1: The Mobile PC

Mobile PC sales now outstrip sales of desktop PC's, their growth driven largely by the adoption of wireless applications. In 2005 alone, 60 million mobile PC's were produced worldwide (Source-Gartner).

The vast majority of mobile PC's are powered by lithium ion battery packs that require charging every 3 to 5 hours during operation. Stringent safety measures require the lithium ion cells used within the battery packs to be 'balanced' during charging to overcome parametric variations introduced during their manufacture from potentially interfering with their safe operation. Driven principally by cost, the most common 'balancing' method used is 'Passive' mode. This technique wastes significant amounts power during charging when compared to the alternative 'Active' mode. A comparative analysis of passive vs. active balancing shows:-

Assumptions:

- 10% cell mismatch *
- Cell voltage 3.7V *
- Charge current 3.5A *
- Charge time 3.5 hours *
- Active Cell Balancing Efficiency 80% *
- CO_2 production at 0.43kg per kWh

Wh lost per charge due to Passive Balancing during each charge cycle:

=3.7*0.35*3.5
=4.5Wh

Wh lost per charge due to Active Balancing during each charge cycle:

=(3.7*0.35)*(1/0.80 -1)*3.5
=1.13Wh

Assuming an average of four charge cycles per week the annual saving in moving from passive to active balancing is 700Wh per mobile PC.

Global energy and carbon dioxide savings based on 2005 worldwide mobile PC sales:

=60E6*0.7 kWh
=42 million kWh

Saving 42 million kWh or 18 million kg of CO_2

In summary, the adoption of active cell balancing within mobile computer battery packs offers significant global energy and carbon savings.

Scenario 2: Standby Energy Systems

Globally, the standby battery market is dominated by the lead acid cell. Around 100 million are manufactured annually for the standby market alone.

One of the main drawbacks of lead acid batteries is that in order to overcome the high self discharge current and maintain cell chemistry they require a float charge. This low level charging current has to continuously pass through the cells. Over time, the energy consumption required to provide the float charge produces significant carbon dioxide emissions. It also has the effect of reducing battery life due to mismatches in float charge requirements between individual cells within a battery. As a result cells fail prematurely due to plate corrosion or sulphation and require early replacement. This further increases the release of carbon dioxide through the manufacture of additional lead acid cells.

Lithium cells are ideally suited to replace lead acid cells in standby batteries because of their extremely low self discharge current. Standby lithium batteries do not require a float charge and potentially offer a significantly longer life than lead acid cells in this application.

Analysing the energy and CO_2 savings made by replacing lead acid with lithium cells shows:-

Assumptions:

- Existing charger efficiency 50% *
- Lithium charger efficiency 80% *
- Lithium standby annual capacity loss 20% (conservative 80% State of Charge) *
- Lead acid battery comprised of 200 series connected 2V 1,000Ahr cells *
- 1A standby float current *
- 100 million standby cells sold globally each year *
- Standby installation operates 99.9% in standby mode *
- CO2 production at 0.43kg per kWhr

Existing annual energy consumption of a single lead acid standby battery:

* Figures provided are for comparative purpose only

Calculation: standby current x nominal voltage x charger duty x no of charging days x hours per day/ efficiency = kWhr

1*400*0.999*365*24/0.5 = 7,000kWhr per battery.

Annual CO_2 released per unit:

= 0.43*7,000
= 3,010kg

Annual CO_2 produced from new & replacement sales:
= (100,000,000/200)*3,010
= 1,505 million Kg

Using lithium cells:

Annual energy consumption of a single lithium standby battery:

Calculation: lost capacity x nominal voltage/ efficiency = kWhr

It is assumed that the lithium battery will loose 20% of capacity in a single year due to self leakage. This is a very conservative figure as a lithium cell self leakage current is very low.

0.2*1,000*400 / 0.8 = 100kWhr

Annual Carbon consumption per unit:

= 0.43*100
= 43 kg

Annual CO_2 released from new sales:
= (100,000,000/200)*43
= 21.5 million Kg

Saving 3,448 million kWh or 1,483 million kg of CO_2 on annual new sales

Thus, if annually, lithium cells replaced lead acid cells in new sales of standby batteries there is the potential to make annual global reductions in CO_2 emissions of 1,483 million kg. This saving is a result of the significantly lower self leakage current of lithium cells, the higher efficiency of a lithium charging regime and the necessary sophisticated lithium cell management system that extends standby battery life as well as maintaining operational safety.

In summary, replacing lead acid with lithium based storage systems in the standby market offers significant opportunities for energy and carbon savings.

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