

Lithium cell technology provides a clean, efficient alternative to Lead Acid in medium to large energy storage applications.

Lithium chemistry cells are regarded by some as being close to the 'ideal' cell chemistry due, primarily, to lithium possessing the highest negative electrochemical potential of all metals. However, this makes lithium one of the most reactive metals in its elementary form and as such there are a number of safety concerns associated with its use. Lithium ion secondary cells were invented in the 1970's but did not attain significant market share until the mid 1990's as the rapid expansion of power hungry handheld appliances drove the demand for higher energy cells. This mass consumer market has pushed the cost of lithium cell manufacture down to levels that now open up established markets, once the preserve of NiCd, NiMH and lead acid.

Due almost entirely to their low cost, lead acid cells dominate the secondary battery market. However, as indicated, the reduction in the manufacturing costs of lithium has the potential to displace lead acid from some key markets such as standby power and automotive. In addition, advances in lithium battery management systems are providing a level of functionality that cannot be achieved when using lead acid batteries. These features, coupled with the falling cost of lithium, makes for a very compelling case in favour of the displacement of lead acid batteries by lithium. Particularly when the environmental concerns surrounding the use and disposal of lead are also considered.

The Lithium Advantage

	Lithium	Lead
Environmental Impact	Moderate	High
Availability	X20	X1
Energy Density	>200Wh/kg	50Whr/kg
Volumetric Density	340Whr/ltr	100Whr/ltr
Coulombic Efficiency	Near 100%	70%
Self Discharge	10 Year	2 Year
Charge Rate	>2C	C/5 Typ

When compared to lead acid, lithium chemistry has four times the energy density, three times the volumetric density, near 100% Coulombic efficiency, low self discharge and faster charge times. What's the catch?

Lithium Challenges

	Lithium	Lead Acid
Reactivity	Very High	Very Low
Cost	US\$600/kWhr	US\$200/kWhr
Internal Impedance	Moderate	Low
Safety Circuitry	Required	Not Required

Lithium chemistry cells have two key barriers to wider market adoption; safety concerns and cost. The reactive nature of lithium metal has driven the need for the development of new safer lithium cell chemistries that lessens the possibility of lithium dissociation under extreme operating conditions and reduces the effects of manufacturing contamination. Lithium chemistries that make use of a solid or polymer gel based electrolyte offer enhanced safety by ensuring that contaminants have a reduced mobility and the less constrictive cell housing allows for safe rupture under extreme fault conditions. Although these newer cell chemistries are recognised as 'safer' the need remains for the use of electronic battery management systems. This requirement increases manufacturing costs, however, new features are now being incorporated into Lithium battery management systems that add value and further increase battery operating safety.

Hidden environmental costs are added through the use of lead acid batteries which have a poor coulombic efficiency, meaning a significant amount of charging energy is wasted during a charge cycle. Lead acid chemistry also requires either frequent charge top ups or a maintenance float charge which wastes significantly more energy and further adds to the carbon problem. Lithium Chemistry with its 10 year charge retention does not require float charging and almost 100% of charge power is absorbed by the lithium cell. Thus lithium batteries have a significantly lower environmental impact than lead acid.

In summary, the continual fall in lithium cell costs, increased environmental concerns and superior electrical performance mean lithium batteries are set to make significant inroads into the lead acid battery market.

Xipower Ltd
 Beta Centre,
 Stirling University Innovation Park,
 Stirling,
 Scotland, FK9 4NF.
www.xipower.com
 +44 (0)1786 470598