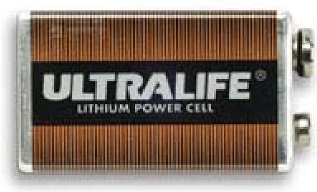
ULTRALiFE®
BATTERY & ENERGY PRODUCTS

Large Format Lithium System Design Considerations

Newark, New York | 315-332-7100 | Fax: 315-331-7800

Ultralife Brand

The Ultralife Lithium 9V battery was launched in 1991 as the world's longest lasting Lithium 9V battery.



Lithium Rechargeable

Lithium has the highest energy available in the periodic table, which makes it a natural choice for batteries and portable power applications. Lithium, in its base form, is metal and is not stable in most environments. This has Lead to many developments in mixed metal oxides to obtain safe Lithium based rechargeable battery power. Commercially known as Lithium-ion batteries, these metal oxides have changed the way the world works, making portable electronics a true possibility. In the 1990's and 2000's, the primary mixed metal oxides were Lithium Cobalt ($LiCoO_2$) and Lithium Manganese ($Li_{(1+x)}Mn_{(2-x)}O_4$) based.

Both provide exceptional energy density for consumer electronics, with the Manganese less expensive than the Cobalt versions, with similar cycle life of typically less than 500 full use cycles to 80% of original capacity.

Technology Advances

Several new and exciting Lithium ion materials started to appear in the 2000's and continue to evolve today. One of the materials is Lithium Iron Phosphate ($LiFePO_4$), which has a lower voltage and lower energy density than earlier technologies. Why is less energy density attractive?

The biggest advantages are in terms of cost and long term life capability. The cost of the base material, Iron, is lower and plentiful. The base material is very stable and the lower voltage allows for better long-term life versus the current Cobalt and Manganese versions.

Current Phosphate Lithium Ion versions perform well over a variety of temperatures, have cycle life that can easily reach 3000 cycles to 80% original capacity, and with proper battery management between 5000 and 10000 cycles.

Replace Lead Acid?

Phosphate versions of Lithium ion technology have started the discussion - when does it become possible to replace Lead acid batteries in terms of cost and performance?

The answer is complicated, but these newer technologies have made the discussion possible.

Currently, Phosphate versions of batteries that could replace similar performing

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Lead acid batteries are in a 3-6X cost range per available kilowatt hour (KWh) of available use. Several factors need to be considered when comparing the two technologies.

Depth of Discharge

Lead acid batteries are rated typically for full use of the battery, but in real world scenarios, use is restricted to 50-80% of the available energy to obtain a reasonable service life. Repeated full discharge cycles on Lead acid batteries typically reduce cycle life expectations dramatically.

An advantage of Lithium Phosphate is the Lithium ion battery can be repeatedly cycled to 100% depth of discharge, if required, with little loss of performance. This results in a system size in KWh of 80 to 50% of a comparable Lead acid system.

Maintenance

Lead Acid battery installations often require large amounts of maintenance from periodic re-watering of the cells, to cleaning of battery terminals.

Lithium Phosphate requires little to no maintenance over the expected installed life. With enhanced battery management systems, it is possible for the batteries to self-test, self-manage and request support as required, eliminating the need for typical preventative maintenance schedules and associated costs. Remote locations and difficult egress areas can benefit dramatically from the reduced maintenance by requiring less trips and man hours per system life.

The above considerations are important variables in the return on investment (ROI) model for calculating comparative cost between the two chemistries.

Space Requirement

In evaluating the two technologies, space could be a concern, with the cost of square footage and the associated overhead per square foot increasing. A reduced battery footprint could be a valuable trade off over the system life. Typically, a Lithium ion battery system will reduce the overall space requirement devoted to energy storage when compared to Lead acid by at least half. In applications where existing storage is barely adequate, it may be possible to swap out the existing Lead acid storage systems with Lithium systems, increasing system backup time by 2-3 times.

Weight Reduction

Lithium Ion batteries have much higher energy density per unit of weight. Where as a Lead acid battery contains 25Wh/Kg of energy, Lithium ion systems range from 90 to 150Wh/Kg, an increase of 4-6 times the energy per equal unit of weight.

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This can drastically effect the structural considerations of energy storage facilities, reducing costly load bearing walls and floors.

Charge Savings

One of the large hidden benefits of Lithium based systems are the exceptional charge efficiencies. Lithium ion batteries charge at greater than 99% efficiency. Lead acid charge efficiencies are typically in the 70% range, meaning that with every charge cycle of the system life 30% charge energy is wasted!

The second charge advantage Lithium systems have over Lead acid systems is the ability to charge successfully at high charge rates with little heat generation and no out gassing. This reduction in HVAC requirements of the facility should be carefully considered in any ROI model.

Replacement

The recurring replacement of Lead acid batteries has an associated cost that must be considered when choosing energy storage solutions. Depending upon the usage and application, this replacement can range from yearly to every 5 years. The more frequently the batteries are replaced, the higher the cost of ownership.

Installation Requirements

Many municipalities are evaluating their current building codes in the use of battery storage. The typical requirements for Lead acid battery installations may not be applicable to some of the new Lithium battery requirements and vice versa. Please refer to local code enforcement offices for details in you area.

Renewable Challenges

There are a host of problems facing the renewable energy market, with one of the largest being energy storage. Creating large quantities of renewable power is not necessarily the most economical equation, and if the power created is not capable of being fully utilized, the equation gets worse.

The desire to utilize renewable power is not typically as easy as one thinks. The grid is a very quick supply and demand customer, where large amounts of power need to be flexed as required to prevent catastrophic failures. Displaced renewable energy generation sources are difficult to control, and the need to buffer and store power becomes a real challenge.

Lithium ion technology can assist in making the renewable equation work. Lithium ion batteries are highly efficient during charge and discharge, allowing for more renewable energy to be successfully stored and utilized. The high cycle life makes the return on investment, over

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competing technologies such as Lead acid, look very favorable in applications expected to use the battery for over 3000 cycles over the system life.

Our Experts Can Help

At Ultralife, we have developed comprehensive return on investment models, which we can use to aid in your decision process. Our experts can help answer your questions you may have. The evaluation process is complex with many variables. Lithium systems can have a favorable performance and payback, but are not for every application… yet.

About Ultralife

Ultralife Corporation (NASDAQ: ULBI) Batteries and Energy Products group manufactures and assembles rechargeable and non rechargeable cells and battery packs, chargers, and energy storage systems. For additional information please visit www.ultralifecorp.com.

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