Hello and welcome to the Zeus Power Podcast! Today we talk to Peter Foret, chief engineer at Zeus Battery Products. Peter will give us his history and initial interests in battery technologies and electronics, as well as the differences between SLA (Sealed Lead Acid) Batteries and LFP (Lithium Iron Phosphate) Batteries and the advantages and disadvantages for each chemistry.

Peter will also be sharing some technical differences between energy efficiency, density and capacity and giving his insights into the technology behind battery chemistry development and the future of battery technology.

Thank you Peter, for joining us on the Zeus Power Podcast! Can you give us some history on your expertise in and experience with batteries?

Hello this is Peter Foret. I'm a chief engineer with Zeus Battery Products located in Bloomingdale, IL

Can you give us some history on your expertise in and experience with batteries?

I had learned in physics class about an electrical coil and how fast changes in its electrical field lead to counter-reaction generating a high voltage while using relatively low voltage DC source (a battery). Learning about this, I had build a portable "shock box" using 4.5V Zinc Carbon flashlight battery, a tuning coil that I had removed form an old radio receiver, and a variable resistor that I had taken from a slot car speed controller. This electric shock generator was being used in the unofficial school competition to show who can brave the longest while holding on the device output leads while another person was using the variable resistor to generate a high voltage that caused twitching and twisting of the person's arms. Later in my life, while being part of the Standard Oil (now BP / Amoco)I have become part of a team working on a development of Lithium-Ion Sulfur rechargeable cell. My involvement in the R&D project was in creating test fixtures, chargers and active loads to support the lithium ion cell development. Interestingly enough, the cell factor selected then was so called sub C. Lithium sulfur (LiS) batteries. Given very light weight and theoretical height capacities are promising alternatives to conventional lithium ion batteries for large scale energy storage systems and electric (indecipherable). LiS (Lithium Sulfur batteries) currently suffer from poor longevity. This chemistry is still being under development with mixed results.

Could you define SLA or Sealed Lead Acid battery technology and its advantages and disadvantages?

SLA batteries are available in all shapes and sizes and they do not require any maintenance throughout their useful life.

SLAs are best in terms of reliability and working capabilities.

These batteries withstand slow overcharging long term inactivity and offer best value for power and energy per KWH. They offer one of the longest lives in standby or low DoD (Depth of Discharge) applications.

About 97% of lead can be recycled and reused in new batteries together with their plastic case and acid that can all too be recycled..

SLA batteries offer some of the lowest self discharge rates among rechargeable batteries.

They offer good performance at extreme temperatures.

Here are some disadvantages of SLA batteries. They are heavy with low specific energy and poor weight to energy ratio.
They take long time to fully charge, up to 16 hours from fully discharged state.

SLA batteries must be stored in charged condition in order to prevent sulfation and thus capacity degradation. They have limited cycle life that heavily depends on the rate of discharge. Repeated deep cycling significantly reduces the battery life.

Lastly, they are not environmentally friendly due to the lead and acid content.

Could you define LFP or Lithium Iron Phosphate battery technology and the advantages and disadvantages to that chemistry?

LFP (Lithium Iron Phosphate – $LiFePO_4$) is the safest lithium battery. They are offered as a drop in for SLAs and have very long life. LFP cells are of a solid construction. Unlike SLA batteries there are no fragile/brittle plates that can be prone to failure over time as a result of vibrations. LFP cells do not contain any toxic heavy metals such as lead, cadmium, or any corrosive acids or alkalis thus making them the most environmentally friendly battery chemistry available.

LFP batteries can be safely and rapidly recharged. While fully discharged, the power cell based LFP battery can be 85% charged in about 15 minutes.

They offer high discharge rate capability, up to 10C continuous, 20C+ pulse discharge.

LFP batteries have a very constant or flat discharge voltage similar to Nickel-based chemistries. Voltage stays close to 3.2V during discharge until the battery is exhausted. This allows the battery to deliver virtually full power until it is discharged. This can greatly simplify voltage regulation in electrical circuits. LFP batteries do not suffer from “thermal runaway” like other chemistries do and can be operated in any orientation. They are maintenance free for the life of the battery. They can be used safely in high ambient temperatures of up to 75 deg C without much degradation in performance.

Unlike other rechargeable batteries, LFP batteries can be left in a partially discharged state for extended periods without causing permanent damage. They offer very safe technology and will not catch fire or explode while charging or discharging.

They offer over 3000 discharge cycle lifes compared to typically around 500 cycles for lead acid battery in the same application thus providing good return on initial

investment. LFP battery lasts up to 6-7x longer than lead acid battery and about 3X longer than regular lithium ion or lithium polymer battery.

Due to the similar voltage, in most instances LFP battery can directly replace lead acid battery. Because of the nominal 3.2V voltage, four LFP cells can be placed in series for a nominal voltage of 12.8V. This comes close to the nominal voltage of six-cell lead-acid batteries, which would be a 12V battery. Along with the good safety characteristics of LFP batteries, this makes LFP a good replacement for any lead-acid batteries. LFP batteries have higher current and peak-power ratings than LiIon or LiPo. LFP cells experience a slow rate of capacity loss, greater calendar than Lithium Ion or LiPO (Lithium Polymer) battery.

What's the difference between energy efficiency, density, and capacity?

How do these qualities define an optimal energy source, and which battery can provide that?

If volume and weight are critical, Lithium Polymer and / or LiIon based battery are typically the best choices. If power density and Cycle Life are leading factors, LFP may be the best choice. For standby storage and deep discharge cycling application where initial cost is critical, an SLA (AGM) battery is the best choice. Zeus can help selecting the best chemistry based on the customer application requirements and their use case.

Thank you Peter, for joining us today and giving us a fascinating look into the world of battery chemistries and what the frontier of battery technology looks like. And thank you listeners, for joining us today. Subscribe to get notifications as soon as the next episode is released. Please visit zeusbatteryproducts.com for more information on how to Power Your World! Please join us on the next episode of the Zeus Power Podcast!