The Pb Battery: A Technology Management Approach

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The Pb Battery has very simple product Architecture

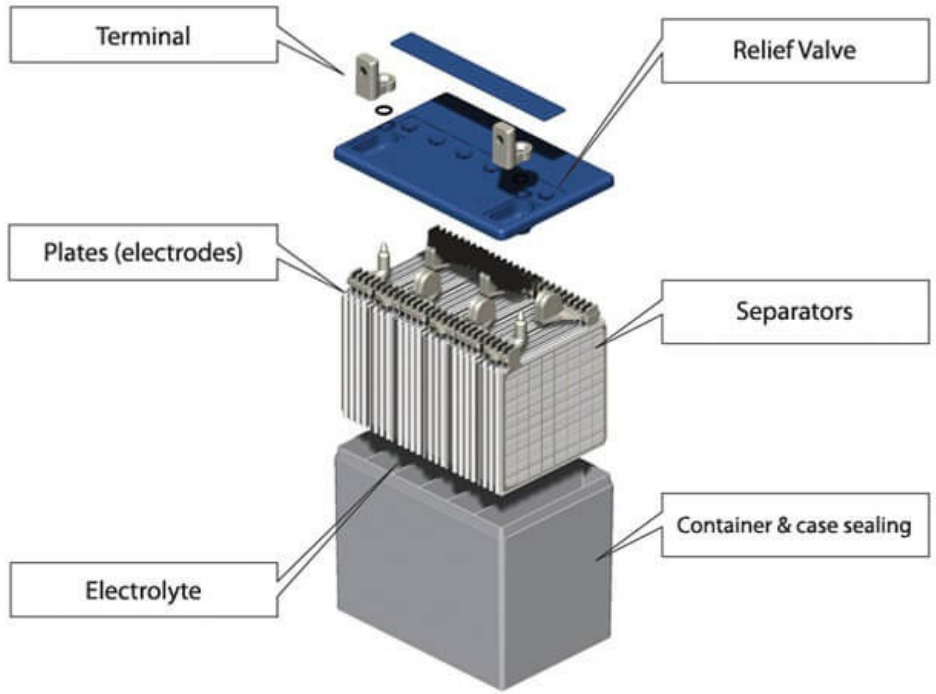
Resultants:

Materials dominate performance: control optimization for materials

Treat Pb as its wishes to be treated, optimize control algorithms

For Pb Batteries transport phenomena are key: Diffusion, Electrical Gradients

Manufacturing to very high quality levels tend to dominate performance metrics: Cycle Life, Minimum Materials for Maximum Performance



Materials dominate performance: control optimization for materials

Lead Battery Research Program (LBSRP)

- CRADA between the Argonne Natl' Lab and 16 manufactures and suppliers in the Pb battery industry
- Work focused on the core Physio-Chemical processes with a Pb battery
- Key Results: Reaction Pathway with a Pb battery during charge & discharge, active material utilization during cycling, the effect of design mono-polar vs bi-polar on active material utilization

Expanders Research Program: American Batteries Research Group (ABRG)

- CRADA between the Argonne Natl' Lab, University of Toledo and a 6 member industry group
- Work focused on elucidating the effect of structural group with Lignosulphonates expanders on the charge and discharge performance of Pb batteries.
- Key Results: Development of a map identifying the tradeoff in charge/discharge performance to molecular architecture

DOE – Office of Electricity

- Advanced characterization and testing of lead batteries
- Pacific Northwest National Laboratory and Argonne National Laboratory + 7 North American lead battery companies
- Co-refinement of electrode and electrolyte species during formation and cycling in real world applications.

For Pb Batteries transport phenomena are key: Diffusion, Electrical Gradients

Development of Bi-Polar Battery Architecture

Changes direction of current flow from with in the grid plane to orthogonal, levels material utilization

Remove Pb used for internal electrical connection

Commercial Start – Up's: Advanced Battery Concepts and Gridtential's Silicon/Joule

Manufacturing to very high-quality levels

- Lead Acid Advance Manufacturing Program (LAAMP's)
  - Applying knowledge gained in the effect of morphology and microstructure of the active material into the production of Pb batteries
  - Reduction in battery electrochemical formation time and energy requirements
  - Demonstration of improved materials production in prototype batteries
  - Program in consideration by industry partners

What the Office of Electricity is saying about Pb

Imre Gyuk at the DOE Electricity Advisory Committee October 26, 2022

“We are also working with lead and lead is a little bit surprising because lead is a well-established technology. It also happens to be the most common battery anywhere in all countries.

“Lead-acid batteries are fairly simple, they're well understood. You can tinker with them, you can play with them if you like, and they're everywhere. They also have an extremely efficient circular reuse system. 97% or so of a battery can be reused.

“However, they are not nearly as good as they should be. In fact, more than 50% of the lead in the lead-acid battery is not really fully utilized.

“So, because we need new battery materials, we have taken up a new look at lead-acid batteries and we are working at making it more efficient and effective, and Argonne and PNNL are involved in this.”