Final Review of the 2010 – 2012 ALABC Research Program

Executive summary

The seventh research program of the ALABC (2010 – 2012) continued the successful history of the Consortium in promoting new, improved, lead-acid batteries for modern applications. Like previous programs, the most recent program encompassed fundamental electrochemical research and development of new technologies and advanced battery types based on these technologies. In addition, it demonstrated the exceptional performance of advanced lead-acid batteries, (especially lead-carbon ones, denoted as LC batteries) in applications where regular batteries would not survive e.g. in the high rate partial state of charge (HRPSoC) cycling, typical for hybrid electric vehicles. The massive marketing efforts of the ALABC highlighted the outstanding results from projects in this program. The success of LC batteries developed by Consortium members has also been confirmed in tests performed by other institutions e.g. UltraBatteries tested by the American Department of Energy (Sandia National Lab) for the storage of renewable energy.

The following summarizes what we have learned in the last three years, what we have offered our members in return for their support, and what new market positions exist for lead-acid batteries:

1) Lead-acid batteries continue to improve, not only during this program, but also as a result of the cumulative enhancements made during the 20 year history of the ALABC.

2) The fundamental studies supported by the ALABC revealed new possibilities for further increase in performance of advanced lead-acid batteries by novel cell design, new carbon and expander additives and the weight ratio they are added at, better electrolyte supply to the reaction sites in the plate and enhanced active mass utilization by proper grid and current collector design.

3) Today's lead-carbon batteries remain inexpensive compared to all other advanced technologies, being simultaneously sufficient for most new applications (e.g. HRPSoC cycling in hybrid electric vehicles and the storage of energy from renewable sources). LC batteries are a significant improvement over old lead-acid battery technology from 15-20 years ago.

The benefits of LC batteries are two-fold: longer service life and higher charge acceptance in HRPSoC operation. In the 2010 - 2012 program (and the continuations of the previous one), we showed that lead carbon batteries are not only able to replace any other chemistry in micro and mild hybrid electric vehicles, but also those in decentralized energy storage systems. For the first time, the ALABC demonstrated four LC batteries (Furukawa and East Penn UltraBatteries, Exide's Orbital batteries, BAE tubular plate batteries and Moura's batteries) that can serve as the foundation of new power storage solutions for both automotive and stationary storage purposes.

A new HEV concept promoted by the ALABC – the LC Super Hybrid – unites for the first time both major and previously conflicting, features consumers desire in a vehicle: very low CO_2 emissions and the power of a full-sized car with no more cost than a normal one.

This new concept, which was supported in 2012 by a 50% supplement provided by the ALABC members, opens a variety of market opportunities such as

a) utilizing LC batteries as the power source of choice not only for micro hybrids, but also for a new class of super hybrid vehicles with low voltage (12V, 48V) electric systems, down-sized and boosted engines which can match or better the performance of full hybrids and for which production could be initiated quickly; and

b) launching the concept of LC battery-based four-seat city vehicles with mileage of 100 mpg and more.

The enhanced charge acceptance ability offers a variety of new applications for LC batteries in utility and emergency storage systems, frequency control, renewable energy, etc.

In order to consolidate the achieved success and to create new options for lead-acid batteries in the energy storage and distribution markets, the new 2013-2015 research program of the ALABC envisions further steps like:

a) fundamental studies of the elementary processes of lead and lead sulfate dissolution, precipitation and crystal growth in the presence of carbon and adsorbed organic molecules,
b) development of applied battery models capable to simulate, predict and control the processes taking place in advanced lead-acid batteries when used in various applications
c) battery technology and design development aiming at boosting the service life and the dynamic charge acceptance at HRPSoC cycling while at high state of charge or at deep discharge cycling along with high rate charge; at providing rapid and complete recovery after long stay at open circuit in discharged state; and at designing of fast, safe for the battery and highly energy efficient recharge techniques,
d) demonstrating the benefits of the lead-carbon technology in new applications where the competition by alternative electrochemical systems is a serious challenge for lead-acid batteries like hybrid electric vehicles, photovoltaic systems, energy storage and distribution systems, portal cranes, hybrid electric boats, electric bikes, systems operating at low or elevated temperatures.

The results of these studies will provide the advanced lead-acid batteries with better capabilities for keeping and expanding their leading market positions in many countries during the coming decade and further.

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