New Lead-acid Batteries for EVs with Organic Polymer Activators

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Abstract

Based on our organic polymer studies for negative electrode of Lead-Acid Batteries, we have found that the organic polymer not only remove the salfation but also produce fine metallic lead acid powder in the negative electrode. These fine metallic lead is far more active than regular Lead which is produced from PbOx in the paste of the regular material. The new fine lead active material has far longer cycle life and the high current capability is very suitable for EVs.

Keywords

lead-acid battery, organic polymer, sulfation

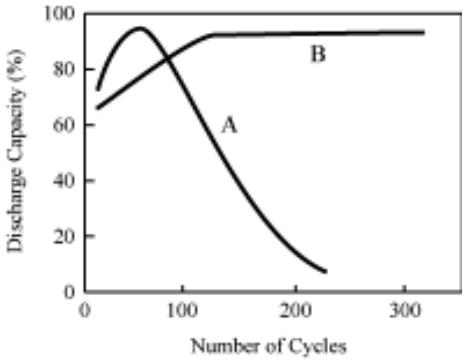
1. INTRODUCTION

We have been studying organic battery activators for lead-acid batteries. A carbonpolyvinyl alcohol composite was for found an excelent activator. [Kozawa, 1999] Later the working mechanism was studied in details and practical tests were performed. [Sugawara et al., 2003, Nishina et al., 2003]

2. MAIN RESULTS

Based on our organic polymer studies of the negative electrode of lead-acid batteries, we have hound that an organic polymer not only removes the sulfation, but also produces a fine metallic lead-acid powder in the negative electrode. These fine metal lead particles are far more active than the regular lead that is produced from PbOx in the paste of the regular material.

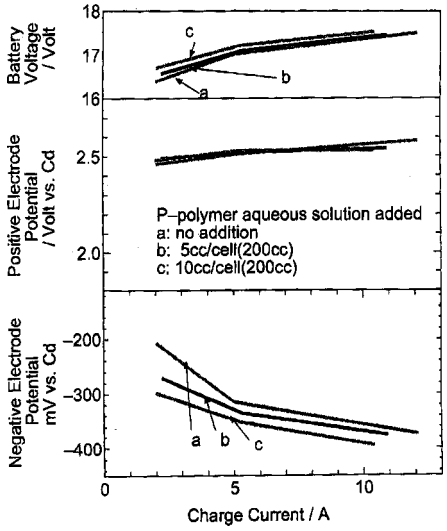
The new fine lead active material has a much longer cycle life and its higher current capability is quite suitable for EVs. A Typical result in Figure 1 shows the polymer effect to the battery capacity. Figure 2 shows that the polymer influence to the negative electrode based on the signal electrode potential measurements vs. Cd electrode.



A: No polymer addition
B: Organic polymer added (0.1% by wt.)

(Actual experiment was done using 4AH, 6 volt battery, by discharging at 2 amperes to 1.0V for a 2 volt cell.)

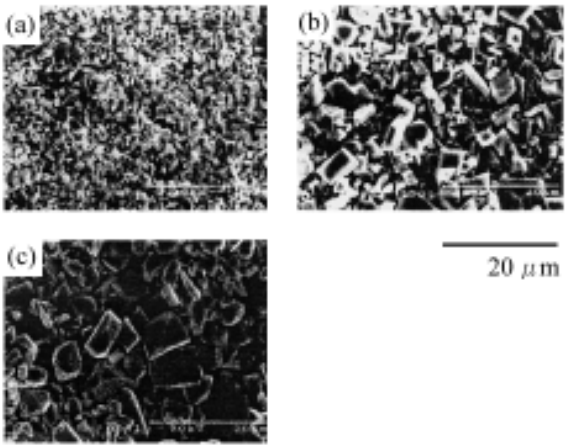
Fig. 1 Effect of polymer addition to the electrolyte of lead-acid battery



The change of the electrode voltages were measured at 2, 5, and 10 ampere charge currents.

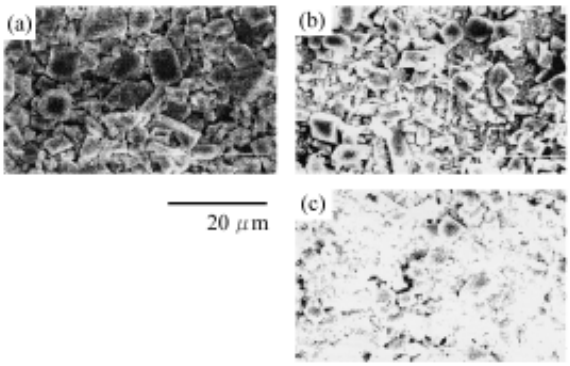
Fig. 2 Effect of addition of various amount of polymer solution to new 40 B-type car battery

The beneficial effects of the organic polymer are the production of a fine active metallic lead material (Figure 3 and Figure 4) and the prevention of sulfation or recovery from sulfation because the hydrogen evolution overvoltage increased.



Discharge currents: (a)1.0 mA, (b)0.1 mA, (c)0.01 mA in 0.25 M H_2SO_4 at 25C

Fig. 3 Lead sulfate crystals produced on a pure lead electrode



Electrode surface discharged at 0.05 mA/cm^2 in (a)0.5 M H_2SO_4, (b)0.5 M H_2SO_4 + polyvinyl alcohol with ultra fine carbon and (c)0.5 M

Fig. 4 Scanning electron microscope of the $Pb/PbSO_4$ electrode surface

The conversion of the inactive large lead particles into a new active material occurs while operating the battery. This is important for EV batteries which require a high power capability and a high energy density (large AH capacity).

References

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