Test Program for Low-lead Long-life Batteries Developed with ITE Activator for Trucks, Buses, Taxies, and Regular Cars

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Abstract
The ITE Research Group in Japan has developed low-lead long-life batteries using an organic polymer activator "Super-K". Some preliminary test results of the low-lead batteries have been made for 3,000 batteries in Japan and Middle East countries. The results were excellent. Therefore, we decided to perform large scale tests for 100 to 500 trucks, busses, taxies and regular cars in various parts of the world for low-lead batteries with 25-50% reduction of electrode plates.

Keywords
organic polymer activator, SLI batteries, PbSO₄, low-lead battery

1. INTRODUCTION
Recently, lead price has increased rapidly from $500 per ton in early 2004 to $3,000 per ton at the end of 2006. The increase occurred 6 times in four years and the price seems to be staying high at around $3,500 per ton. Since the lead cost of the lead acid battery is about 70% for SLI (Starting, Lighting, Ignition) batteries for engine starting, all manufacturers in the world have now begun a big effort to reduce the amount of lead in use as much as possible. The lead reduction includes reduction of the plate size and the number of plates, and also the thickness of the electrode plates. These approaches are known to reduce the service life.

ITE Research group have been working on a new activator for lead acid batteries since 1955. Our activator is an organic polymer to be added to the acid electrolyte in order to extend the battery life, or reactivate the deteriorated batteries. [Kozawa, 1997; Kozawa, et al, 1997] The beneficial action of the activator is to remove sulfation from the negative electrode (convert the large crystalline PbSO₄ to amorphous active PbSO₄).

Since our activator has an excellent ability to convert the deteriorated electrode material in the negative electrode to active material, if we add it to a new battery, no deterioration takes place. Because of the gradual deterioration, a new battery uses a large excess material initially. Figure 2 shows how much active material is

![Graph of closed circuit voltage (CCV) after 5 second discharge at 75A, 150A, or 300A of new 40Ah and 55Ah lead-acid batteries](image)

Fig. 2 Closed circuit voltage (CCV) after 5 second discharge at 75A, 150A, or 300A of new 40Ah and 55Ah lead-acid batteries

Fig. 1 Increase of lead prices
needed for engine starting. For the cars which use a 40
to 50Ah battery, 150A is enough to start the engine, since
recent cars do not need a very high current. Usually,
150A 5 seconds is sufficient. As seen in Figure 2, an
80% discharged battery (remaining active material is
only 20%) can deliver 150A at 9.0 to 10.0V. This indi-
cates the initial high capacity is mainly reserve capacity
counting gradual sulfation or occasional excessive use
of current for air conditioning and lighting.
In order to evaluate how much initial capacity is appro-
priate, we checked the capacity of replaced (deteriorated)
battery. As shown in Figure 3, most batteries were 20% or
less for the remaining capacity. The excess capacity
is required for air conditioning and lighting etc. This
point is discussed in a separate paper. Based on the fact
that most battery replacement takes place when the ca-
pacity is below 25% of the original battery capacity,
therefore, if we have good activators which prevent the
deterioration and the initial activity is kept unchanged,
50% of the current new battery capacity should be
enough for SLI batteries. For this reason, we plan to
test 25%, 35%, 45%, or 55% reductions of the electro-
drome from the new battery for practical car, truck or
taxi operation.

![Graph showing closed circuit voltage (CCV) of used batteries from a taxi company](image)

**Fig. 3** Closed circuit voltage (CCV) of used batteries from a taxi company

### 2. ITE'S LOW-LEAD BATTERY TESTED

ITE Research Group produced some low-lead batteries
in China as shown in Table 1 and 2. The lead plate
reduction was 20-25% for these batteries. These batter-
ies are dry charged batteries containing an ITE powder
activator. Users or battery sales shops add acid electrolyte (s.g. 1.28) to the indicated level.
The powder polymer dissolves into the acid electrolyte.
These batteries are used for cars, trucks, taxies etc. We
did not have too many claims or returned batteries. In
Japan, the guarantee is 2 years for new batteries. We
received only 15 returns in 2 years from the distributors
for 2,500 sold batteries.

ITE Research Group recommended the low-lead bat-
tery users to add activator once a year or once every two
years when they add water. Usually, vehicle examina-
tion is required every year for trucks and taxies, every
two year for passenger cars. We recommend the use of
our activator regularly and charge when needed in order
to use the battery for 10 years. Our battery test for 200
trucks has been carried out for 8 years with Sanwa Truck-
ing Company in Tokyo. All the batteries worked for
more than 8 years. The results are shown in Figure 4.
This company did not add our activator from 1997 to
2000, and the average battery change was 60 trucks per
year. 1998 was unusually small (only 39) for the battery
change. Since the company purchased a large number
of new trucks, the company started to add our activator
to their truck batteries in 2001 and the total addition for
200 trucks was completed at the end of 2002. From the
year 2003, battery change was zero. Since some of the
batteries for the initial year 2001 were already 3 years
old, the oldest battery in 2007 is 8 years. Therefore, we
conclude that the battery life exceeds 8 years if our acti-

![Bar graph showing battery changes per year among 200 trucks](image)

**Fig. 4** Battery changes per year among 200 trucks

### 3. LARGE SCALE TESTS PLANNED

Based on excellent results for 25% electrode reduction
for 3,000 batteries made in China, we have now decided
on various tests in various countries (high temperature
area and low temperature area) for various degree of
electrode reduction as shown in Table 3. The test com-
mittee is headed by Prof. Shigeyuki Minami and the office
manager is Mr. Hajimu Ikeda (Table 4).
Table 1 Batteries (about 2000) from China and shipped to Japan

<table>
<thead>
<tr>
<th>Battery size</th>
<th>JIS No.</th>
<th>JIS Capacity (20hr)</th>
<th>GTP Capacity (20hr)</th>
<th>Lead reduction (%)</th>
<th>No. of electrode (Pos./Neg.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B19</td>
<td>40B19</td>
<td>35</td>
<td>28</td>
<td>20.0</td>
<td>24/30</td>
</tr>
<tr>
<td></td>
<td>42B19</td>
<td>37</td>
<td>28</td>
<td>24.3</td>
<td>24/30</td>
</tr>
<tr>
<td>B24</td>
<td>50B24</td>
<td>45</td>
<td>28</td>
<td>37.8</td>
<td>24/30</td>
</tr>
<tr>
<td></td>
<td>55B24</td>
<td>45</td>
<td>28</td>
<td>37.8</td>
<td>24/30</td>
</tr>
<tr>
<td>D23</td>
<td>55D23</td>
<td>60</td>
<td>44</td>
<td>26.7</td>
<td>24/30</td>
</tr>
<tr>
<td></td>
<td>65D23</td>
<td>65</td>
<td>44</td>
<td>32.3</td>
<td>24/30</td>
</tr>
<tr>
<td></td>
<td>75D23</td>
<td>65</td>
<td>48</td>
<td>26.2</td>
<td>24/30</td>
</tr>
<tr>
<td>D26</td>
<td>80D26</td>
<td>69</td>
<td>55</td>
<td>20.3</td>
<td>30/36</td>
</tr>
<tr>
<td></td>
<td>90D26</td>
<td>69</td>
<td>60</td>
<td>13.0</td>
<td>30/36</td>
</tr>
<tr>
<td>D31</td>
<td>95D31</td>
<td>80</td>
<td>66</td>
<td>17.5</td>
<td>36/42</td>
</tr>
<tr>
<td></td>
<td>115D31</td>
<td>90</td>
<td>77</td>
<td>14.4</td>
<td>42/48</td>
</tr>
<tr>
<td>E41</td>
<td>105E41</td>
<td>104</td>
<td>88</td>
<td>15.4</td>
<td>48/54</td>
</tr>
<tr>
<td></td>
<td>115E41</td>
<td>110</td>
<td>88</td>
<td>20.0</td>
<td>48/54</td>
</tr>
<tr>
<td></td>
<td>130E41</td>
<td>115</td>
<td>88</td>
<td>23.5</td>
<td>48/54</td>
</tr>
<tr>
<td>F51</td>
<td>130F51</td>
<td>120</td>
<td>88</td>
<td>26.7</td>
<td>48/54</td>
</tr>
<tr>
<td></td>
<td>145F51</td>
<td>140</td>
<td>99</td>
<td>29.3</td>
<td>54/60</td>
</tr>
<tr>
<td></td>
<td>170F51</td>
<td>150</td>
<td>110</td>
<td>26.7</td>
<td>60/66</td>
</tr>
<tr>
<td>G51</td>
<td>155G51</td>
<td>150</td>
<td>122</td>
<td>18.7</td>
<td>66/72</td>
</tr>
<tr>
<td></td>
<td>195G51</td>
<td>175</td>
<td>132</td>
<td>24.6</td>
<td>72/78</td>
</tr>
<tr>
<td>H52</td>
<td>210H52</td>
<td>200</td>
<td>143</td>
<td>28.5</td>
<td>78/84</td>
</tr>
<tr>
<td></td>
<td>245H52</td>
<td>220</td>
<td>154</td>
<td>30.0</td>
<td>84/90</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td></td>
<td></td>
<td>24.5</td>
<td></td>
</tr>
</tbody>
</table>

Table 2 Batteries (about 1500) from China and used in Middle East countries

<table>
<thead>
<tr>
<th>Battery size</th>
<th>JIS No.</th>
<th>JIS Capacity (20hr)</th>
<th>GTP Capacity (20hr)</th>
<th>Lead reduction (%)</th>
<th>No. of electrode (Pos./Neg.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B20</td>
<td>NS40L</td>
<td>32</td>
<td>28</td>
<td>12.5</td>
<td>24/30</td>
</tr>
<tr>
<td>D26</td>
<td>N50</td>
<td>50</td>
<td>39</td>
<td>22.0</td>
<td>24/24</td>
</tr>
<tr>
<td>D31</td>
<td>N70</td>
<td>70</td>
<td>50</td>
<td>28.6</td>
<td>30/30</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td></td>
<td></td>
<td>21.0</td>
<td></td>
</tr>
</tbody>
</table>

4. BATTERIES TO BE TESTED
ITE Research Group supply batteries made in China at a reduced price and 5 year activator to test the battery life (we hope a 10 year life is realized by this test) for the truck, bus and taxi companies having more than 100 vehicles. In case of battery trouble, the service station can change, since we supply new extra batteries for reserve use.
Table 3  Test conditions

<table>
<thead>
<tr>
<th>Electrode reduction</th>
<th>25%, 35%, 45% and 55%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cold temperature area</td>
<td>Tropical area</td>
</tr>
<tr>
<td>Water addition</td>
<td>How many times required</td>
</tr>
<tr>
<td>Activator addition (once a year, once every two year)</td>
<td>Using special activator supply bag (having one or two small holes in the activator bag.) (Figure 5)</td>
</tr>
<tr>
<td>Extra charge</td>
<td>How many times a year</td>
</tr>
</tbody>
</table>

Amount of activator powder (0.5, 1.0-2.0g)

![Small activator bag](image)

- Hole (2 to 3mm diameters)

Fig. 5 Small activator bag

Table 4  World-wide test committee for low lead SLI batteries

<table>
<thead>
<tr>
<th>Chairman</th>
<th>Prof. S. Minami</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office Manager</td>
<td>Mr. H. Ikeda</td>
</tr>
<tr>
<td>Advisors</td>
<td>Dr. A. Kozawa</td>
</tr>
<tr>
<td></td>
<td>Prof. C. C. Chan</td>
</tr>
<tr>
<td></td>
<td>Prof. Y. Li</td>
</tr>
<tr>
<td>Offices</td>
<td>Japan: Osaka ITE Office</td>
</tr>
<tr>
<td></td>
<td>Hong Kong: Mr H. Wada</td>
</tr>
<tr>
<td></td>
<td>U.S.A.: Mr J. C. Nardi</td>
</tr>
</tbody>
</table>

All the taxi, truck or bus companies have a service station, so we contact the office for their need of activator, charger or extra batteries. The nature of test batteries with reduced electrode will be informed to the service station.

5. ADDITIONAL TEST FOR ACTIVATOR

For currently working batteries, we would like to test our activators. We supply free activator for this test for a one year period. From the 2nd year the company has to purchase the activator at a 50% discount price. Mr. Ikeda is responsible for this activator test program.

6. CONCLUSION

Our goal is to use batteries from which 50% electrode reduction is made. If all the cars, trucks, buses, and taxies use 50% less lead-batteries, the annual contribution of our technologies is $7.5 billion per year for the environment due to lead reduction. We hope we will receive many proposals for participating in this low-lead battery test program from various parts of the world. Please note that this lead electrode reduction is possible only for SLI batteries. Deep cycle batteries can not reduce the electrode material.

References


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