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

Hajimu Ikeda [1], Akiya Kozawa [2], Hisashi Wada [3], John C. Nardi [4], and Shigeuki Minami [5]

[1] Graduate School of Science and Engineering, Yamagata University, hajimu.ikeda@union-services.com
[2] ITE Battery Research Institute, akiya-kozawa@mwb.biglobe.ne.jp
[3] ITE Hong Kong Office, hwada@gtpi.hk
[4] ITE Ohio Head Office, editing@adelphia-net
[5] Department of Electrical Engineering, Osaka City University, minami@elec.eng.osaka-cu.ac.jp

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, buses, 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, $PbSO_4$, 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.

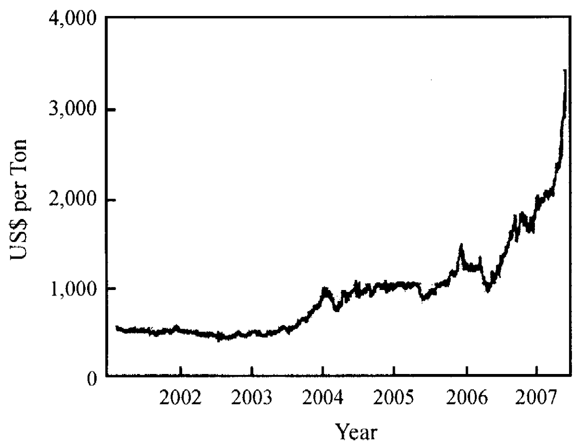

Fig. 1 Increase of lead prices

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 $PbSO_4$ to amorphous active $PbSO_4$).

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

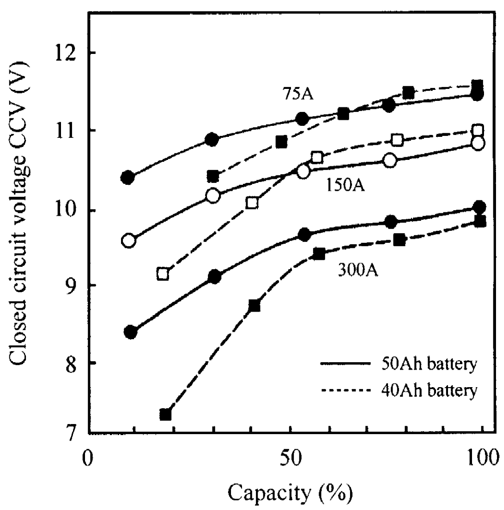

Fig. 2 Closed circuit voltage (CCV) after 5 second discharge at 75A, 150A, or 300A of new 40Ah and 55Ah lead-acid batteries

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 indicates 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 appropriate, 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 capacity 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 electrode from the new battery for practical car, truck or taxi operation.

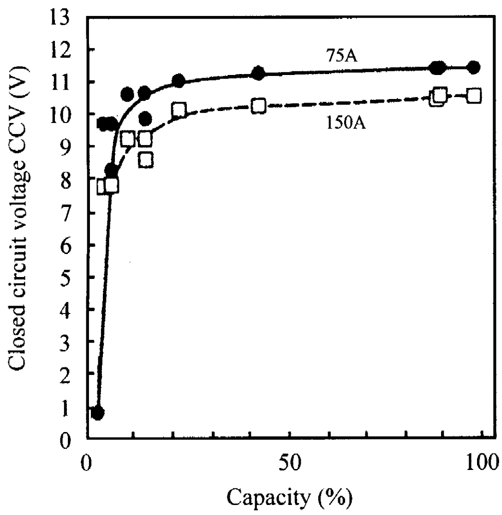

Fig. 3 Closed circuit voltage (CCV) of used batteries from a taxi company

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 batteries 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 battery users to add activator once a year or once every two years when they add water. Usually, vehicle examination 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 Trucking 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 activator is added once a year to the working truck batteries. These trucks are 2 to 10 tons, therefore, all sizes of batteries are working during these test periods.

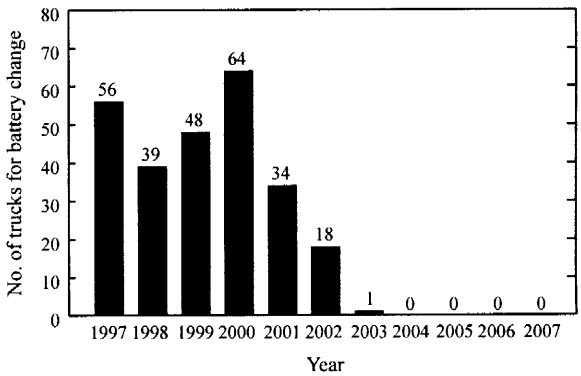

Fig. 4 Battery changes per year among 200 trucks

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 committee 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

Battery size	JIS No.	JIS Capacity (20hr)	GTP Capacity (20hr)	Lead reduction (%)	No. of electrode (Pos./Neg.)
B19	40B19	35	28	20.0	24/30
	42B19	37	28	24.3	24/30
B24	50B24	45	28	37.8	24/30
	55B24	45	28	37.8	24/30
D23	55D23	60	44	26.7	24/30
	65d23	65	44	32.3	24/30
	75D23	65	48	26.2	24/30
D26	80D26	69	55	20.3	30/36
	90D26	69	60	13.0	30/36
D31	95D31	80	66	17.5	36/42
	115D31	90	77	14.4	42/48
E41	105E41	104	88	15.4	48/54
	115E41	110	88	20.0	48/54
	130E41	115	88	23.5	48/54
F51	130F51	120	88	26.7	48/54
	145F51	140	99	29.3	54/60
	170F51	150	110	26.7	60/66
G51	155G51	150	122	18.7	66/72
	195G51	175	132	24.6	72/78
H52	210H52	200	143	28.5	78/84
	245H52	220	154	30.0	84/90
Average				24.5	

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

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

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

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

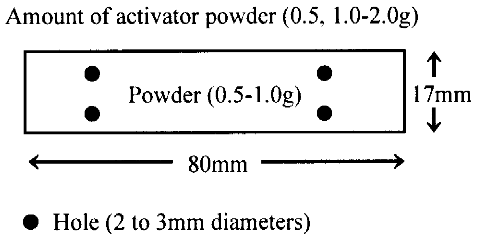

Fig. 5 Small activator bag

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

Chairman	Prof. S. Minami
Office Manager	Mr. H. Ikeda
Advisors	Dr. A. Kozawa Prof. C. C. Chan Prof. Y. Li
Offices	Japan: Osaka ITE Office Hong Kong: Mr H. Wada U.S.A.: Mr J. C. Nardi

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

Kozawa, A., U.S. Patent 6,958,623 (September 28, 1999) filed on April 7, 1997.

Kozawa, A, S. Mase, N. Suzuki, and A. Sato, Progress in Batteries and Battery Materials, *Progress in Batteries and Battery Materials*, Vol. 16, 350, 1997.

(Received March 23, 2007; accepted April 27, 2007)