Eight Year's Summary of ITE's Organic Activator Tests for New and Used Lead-acid Batteries

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Abstract

Since 1996, we have been working various activators for lead-acid batteries. Originally the organic polymer activators with or without carbon black were developed to regenerate or recover the deteriorated lead-acid batteries from its sulfation. Recently we discovered that the organic activators can be used to improve the performance of the new top class Japanese batteries, and regular and new batteries made in China, Korea etc. This paper summarised our 8 year test results for ITE activators for various new and used lead-acid batteries.

Keywords

organic polymer, sulfation, organic activator, used lead-acid batteries, charge-discharge

1. TEST RESULTS NEW BATTERIES MADE IN JAPAN, AND KOREA

Table 1 shows the new batteries tested for 90 ampere discharges. The charge was done at 2 ampere charger to the end voltage of 16.5 volt. During the charge the battery voltage increased gradually to 16.5 volt and the current was initially 2.0 amperes and decreased to about 0.5 amperes after a 20 hour charge. The discharge was done through constant resistor of 0.1225 Ohm in water at room temperature.

Table 1 New batteries tested at 90 ampere discharge

		10 hr	5 hr	Status
1	40 B (2 year, 40,000 km guarantee) made in Japan	40 Ah	28 Ah	new
2	40 B (one year, 20,000 km guarantee) made in Japan	40 Ah	28 Ah	one year old *
3	44 B made in Korea (sealed battery)	–	–	unused

* The battery was purchased and left for one year without use.

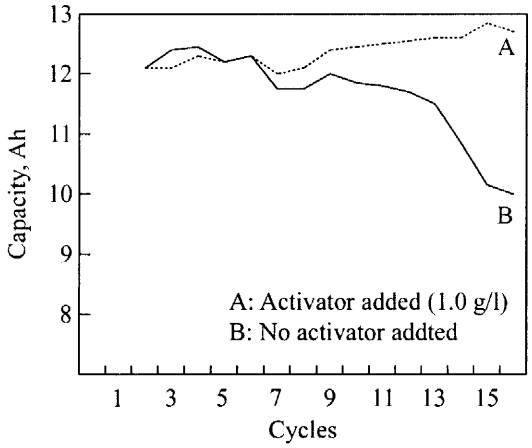
All these batteries are hybrid type. Using ca-alloy for the grid of negative electrode and Sb-alloy for positive grid.

Figure 1, 2, and 3 show the results for the three batteries. The capacity of the first cycle varies considerably because of the battery condition. After the 2nd cycle, the battery discharge is started for full charge status. The Japanese top quality battery (Figure 1, 2 year guarantee) maintained the discharge capacity high (about 12 Ahs) regardless of the activator addition of up to 10 cycles. After 10 cycles, the battery with organic activator (1.0 g/l) increased slowly, but the battery without organic activator decreased rapidly.

For the inexpensive regular battery (1 year guarantee, Figure 2) shows a rapid capacity decrease for the no activator battery as seen in curve B. With activator (curve A), the capacity increased slightly up to 6 cycles, then it decreased slowly.

For the battery made in Korea (Figure 3), we can see much clear beneficial effect of our organic activator even though the test is only 7 cycles.

These results indicate that our organic activator provides



Charge: 2 Amp. charger for 2.0 hours (end of charge was 0.6 Amp. and the voltage was 16.5 volt.)

Discharge: constant resistant discharge through 0.1225 Ohm. Initial current was 90 Amp. and the current was 70 A at the end voltage of 9 Volt.)

Fig. 1 Car battery (40 Ah, 40 B type, 28 Ah at 5 HR) test with and without activator (organic polymer)

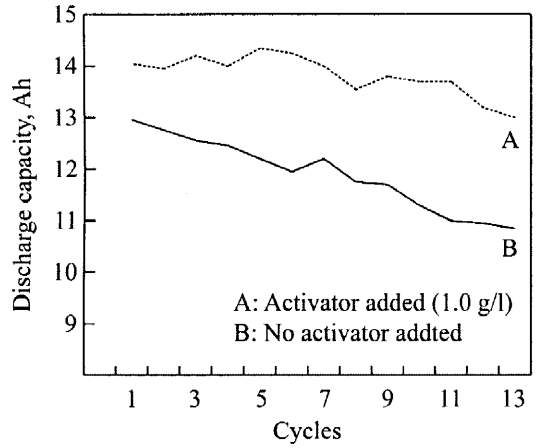


Fig. 2 Car battery cycles (40 B, one year old) tested for activator in the same condition as Figure 3B

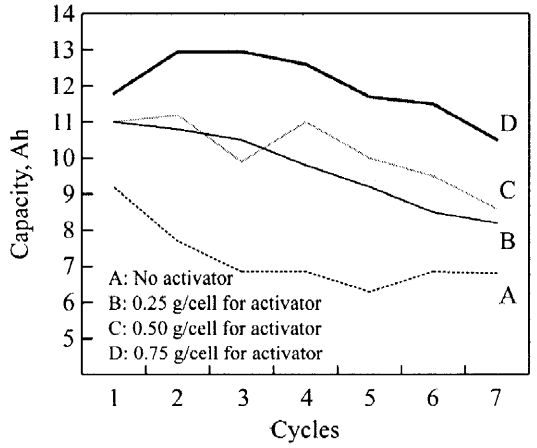


Fig. 3 Effect of organic activator for 44 B battery made in Korea

beneficial effect regardless of the quality of the test battery.

This 90 ampere constant quick test is a high rate test, about 2C rate discharge and the test will end at 8 to 10 minutes. Therefore it is very convenient to use for the examination of battery performance. In order to see full capability, we need 50 ampere and 150 ampere constant current tests in addition to this 90 ampere test. For a quick rechargeability test, we need to test using charge currents, 10A, 25A, 50A etc in addition to this 2 ampere charge.

2. TEST RESULTS FOR 60 AH CAR BATTERY MADE IN CHINA

These four batteries (A, B, C, D) shown in Figure 4 were made at a regular production line in Sea-Gull Battery factory in August, 2004. The organic activator was added to the sulphuric acid electrolyte in the amount of (A) 1.0 g/l, (B) 2.0 g/l, (C) 3.0 g/l. The batteries received repeated charge-discharge operation at 40 C before the capacity test at 240 ampere at -18 C. The discharge at 40 C was 1 hour at 15 amperes and the charge was done to 14.8 volt with current of 30 amperes or less. This charge-discharge condition at 40 C is a simulation of the car engine room. After 32 cycles which needs 72 hours, the battery was cooled to -18 C and discharged continuously at 240 amperes. Figure 4 shows the test results after 160 charge-discharge cycle at 40 C.

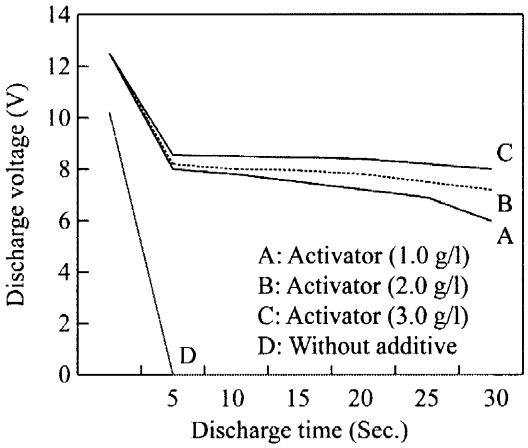


Fig. 4 240 ampere discharge test at -18C

These results indicate that by the charge-discharge operation the active material in the electrode remains active in the presence of organic activator in the acid electrolyte. This means that our organic activator is effective to remove the sulfation from the negative electrode, and also modify the size of the metallic lead in the negative plate.

3. TEST RESULTS OF 200 CYCLES FOR 4 AH BATTERY

A 4 Ah motorcycle battery, made in Thailand by a Japa-

nese company, was tested for our organic activator with carbon black. The charge-discharge conditions are shown in the caption of Figure 1.

Without the organic activator (Figure 5A), the capacity decreased rapidly after 50th cycles, but with the activator (Figure 5B) the capacity remains high even after 200 cycles.

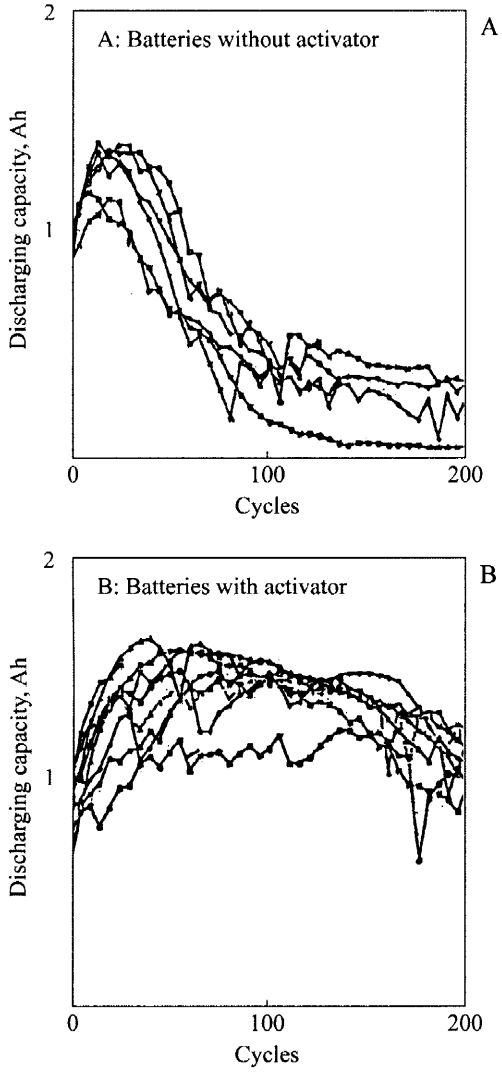
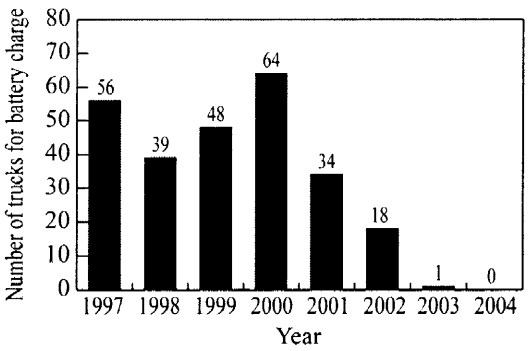


Fig. 5 Effects of activator for 4 Ah motorcycle battery

4. TEST FOR 200 TRUCKS FOR 5 YEARS

Sanwa Transportation Co., in Tokyo tested our organic activator for their 200 trucks for 5 years starting in 2000. The company's record is shown in Figure 6 for the number of battery replacement trucks among the 200 trucks. Our activator addition started in the year 2001. The activator added was initially 15 cc/cell of 5% organic activator solution. All 200 trucks completed the activator addition by the end of 2002. The batteries for the trucks are two 150 Ah batteries for each truck.

The results are very clear in Figure 6. The average battery change was between 56 and 64 trucks for the year



1998 was the year for track change due to Japanese regulation change for exhaust gas control.

Fig. 6 Battery changes per year among 200 trucks

1997 to 2000. For 1998, new trucks were introduced considerably because the exhaust gas control regulation began in Japan. The 5% activator solution was added once a year after the year 2002 when the truck examination was once a year. After completion of the activator addition at the end of 2002, the battery replacement was almost zero. When our activator addition test started, the battery's age was one year, two year, and 3 years. The oldest battery was almost 3 years, since the company's average battery life was 3 years. These results indicate that the oldest battery (3 years old) remained in active service for another 3 years. Therefore we can state that with our activator the battery life is 5 to 6 years on the average. If we use the organic activator from the beginning (new), we expect the life will be 6 to 8 years. During the test we measured the specific gravity of the battery electrolyte. The average s.g. value is shown in Table 2.

Table 2 Specific gravity of the battery electrolyte

Age	One year	Two year	Three year	Four year
Average s.g.	1.27	1.25	1.23	1.22

We can see the s.g. value decrease gradually, probably because of the sulfation in the negative electrode.

When we reassure the s.g. after activator addition, the s.g. value increased to 1.26 - 1.27 regardless of the age. This means that the 3 to 4 year old battery having s.g. of 1.23 - 1.22 increased the s.g. 1.26 - 1.27, indicating sulfation recovers while using trucks in usual business operation.

This indicates that our organic activator works without special charge.

5. BATTERY LIFE AND CHARGE CONDITION

It is well known that the charge condition has a big influence to lead-acid battery life. For a forklift, the charger usually has a special equalization charge, providing an

extra 2 to 3 hour charge for every one to two weeks. If the battery is used without full charge, $PbSO_4$ (lead sulfate) becomes crystalline material which is difficult to charge back. It is important to charge the lead-acid battery fully. Deteriorated batteries can be regenerated in its capacity by extra charge. Usually a low current charge for 2 to 5 days is very effective to remove the sulfation. We recommend the use of our organic activator from the beginning (add activator when battery is new and continue to add once a year). The organic activator is gradually oxidised at the positive electrode and lose effectiveness. Therefore we need to add once a year when water is added. If we do this type of good maintenance, the battery life will be 3 to 5 times.

6. CONCLUSION

Our ITE (International Technology Exchange Society) battery research group started to make new batteries using our organic activator in China. These batteries are expected to be better in performance and the life will be twice based on previous Chinese products.

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