TO ANSWER THE URGENT NEEDS FOR SECONDARY BATTERIES

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In Japan, development trials of secondary batteries were carried out from 1971 to 1977 as part of the National Electric Vehicle Project [1], and these have continued from 1980 in the present National Advanced Battery Electric Power Storage System Project. In both projects, field tests of batteries in vehicular and utility load-levelling applications have been supported by laboratory tests conducted in the author's Institute. As a result of this latter work on both advanced and conventional batteries, the author has formed the following opinion on the present status of such systems.

In the past two decades there has been considerable world-wide research and development of many types of advanced batteries. Owing to the large commitment of research funds and manpower in this area, remarkable progress has been made. Nevertheless, the traditional lead/acid and nickel/cadmium systems still dominate the market. Each of the advanced battery systems combines the attractive feature of high specific energy with serious problems of, for example, high production cost, short service life, high maintenance, etc. Commercialization of these advanced batteries is still a long way off, despite the growing social needs for better batteries in the field of electric vehicles, utility load-levelling, and electric power storage for intermittent power generators (*e.g.*, solar cells, windmills, etc.). To fulfil these needs, the development of advanced batteries must be continued. In addition, improvements must be sought in the performance of the lead/acid battery and its supporting system (*e.g.*, battery-state indicator, rapid charging system, lead recycling system, etc.).

The following subjects should be given urgent attention in lead/acid battery development work.

(a) Hermetically sealed system

Recently, sealed lead/acid batteries which can sustain shallow charge and discharge have been developed for automotive (SLI) applications. The market would be expanded considerably if an hermetically sealed lead/acid battery able to supply high-rate deep-discharge could be achieved at reasonable cost.

(b) State-of-charge monitor

Though several types of battery monitor have been proposed, their reliability is inadequate for practical use. Monitors of high reliability would minimize battery maintenance requirements.

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(c) State-of-life indicator

At present, it is difficult to determine the state of the life of lead/acid batteries, and there appears to be little existing research in this area. If such an indicator could be developed, management of batteries would be markedly simplified. One of the present commercial microprocessors, which are compact and have a large memory and low cost, could act as the basis of such an instrument. The microprocessor could be used to record battery history, *e.g.*, total discharged A h, total charged A h, number of completed cycles, mean ambient temperature, mean discharged power level, electrolyte specific gravity, vibrational damage, etc. With development of a suitable program, the microprocessor could estimate battery life from computation of the recorded operational data.

(d) Rapid charging system

Much effort has been devoted to achieving rapid recharging of lead/acid batteries in order to increase battery availability. However, existing rapid charging methods suffer from two major problems. One is their high cost, and the other is excessive temperature rise in batteries during hot weather. Development of a low-cost, rapid charger with a battery cooling device is awaited.

(e) Temperature control

The life of lead/acid batteries is strongly dependent on the ambient temperature, as shown by the data presented in Fig. 1 [2]. Therefore, battery life would be increased under careful temperature control. For this purpose, a temperature control device, of low cost and simple operation, has to be developed.

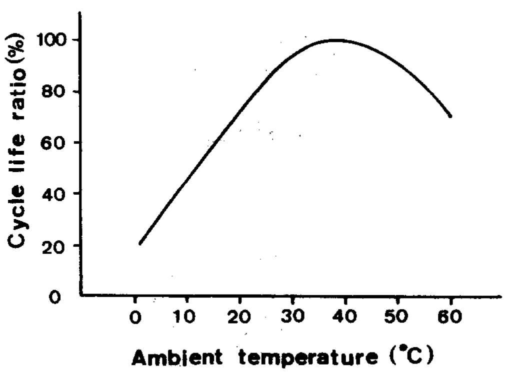

Fig. 1. Typical influence of ambient temperature on cycle life of lead/acid batteries.

(f) Accelerated life tests

Batteries with long lives will, of necessity, take long periods to test under normal operating conditions. Therefore, the development of appropriate accelerated life tests is required. If evaluation time is shortened, the data obtained from such tests will assist any advanced studies aimed at improving battery performance. As stated in (c) above, battery life is influenced by several factors. Thus, whereas it is a simple matter to shorten the life of a battery, it is difficult to achieve a meaningful correlation to normal life, since the life-limiting factors will depend on the conditions used in the accelerated tests. Because of this difficulty, further efforts are required in this area.

(g) Lead recycling system

Lead/acid batteries can be recycled easily since both electrodes are made from lead which can be melted at low temperature. Nevertheless, only 60 - 70% of used lead/acid batteries are recovered in Japan. Improvement in metal recovery may reduce the price of lead and, hence, the cost of batteries. An efficient recycling facility has to be developed for lead/acid batteries.

The above opinions may be shortsighted, but it is the belief of the author that the lead/acid system has further considerable scope for improvement and can fulfil the urgent needs for convenient electrical energy storage in various applications.

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References

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2 Japan Electric Vehicle Association, *Research on Countermeasures for Batteries in Cold Seasons*, April, 1981, p. 14.