Sulphation

Following up on the letter from Greg Clitheroe (EA March 1988) on the subject of sulphation in lead/acid accumulators, the description given by Greg is basically correct.

A fully-charged battery has a positive plate of lead dioxide and a negative plate of lead, both in finely-divided form. On discharge, the negative plate reacts with the sulphate ions of the sulphuric acid electrolyte to give lead sulphate, whilst the lead dioxide is re-

duced to lead on the positive plate and water is generated at the same time. When fully discharged, the negative plate is now finely-divided lead sulphate, the positive plate is fine lead and the electrolyte is weaker.

When we re-charge the battery, all this is reversed. We pass a current through the battery and electrolyse the water in the weakened acid, producing hydrogen at the negative plate and oxygen at the positive plate, both in a 'nascent' or very reactive form. The hydrogen reacts with the lead sulphate to produce lead on the plate and more sulphuric acid in the electrolyte. The oxygen re-generates the lead dioxide on the positive plate.

However, if the battery is left in a discharged state for some time, a new problem occurs. Lead sulphate is very slightly soluble in sulphuric acid. It will dissolve and slowly re-crystallise on the negative plate, but this time in large crystals which do not react easily with the hydrogen during the charging process. This re-crystallising is also helped by the normal day-to-day temperature fluctuations, as the lead sulphate is more soluble at higher temperatures. Another problem is the mechanical effect of the growing crystals, which tends to loosen portions of the plate material.

This change from finely-divided lead sulphate to big crystals in a partially or fully discharged battery is the process generally called 'sulphation'.

What can be done about it? Once it has occurred, it is almost irreversible. Certainly any mechanical damage cannot be repaired. A very long, very slow trickle charge may restore a little capacity but this will only put off the evil day for a short time.

Prevention is the only way. Keep the battery fully charged at all times. Even a partly discharged battery will undergo some sulphation. If the battery is to be left unused for a time, regular top-ups of charge or a very small trickle charge is necessary, because internal leakage will gradually discharge the battery, even if it is disconnected. A figure as high as 1% of charge per day has been quoted for this.

As a matter of interest, during WW2 batteries were almost unobtainable and all sorts of things were tried to restore them. I recall an article being published, in 'Radio and Hobbies' I think, which suggested replacing the sulphuric acid electrolyte with sodium solution (Glauber's Salts) and trickel charging. This resulted in sodium hydroxide being

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formed at the negative plate and reacting easily with the lead sulphate. After charging, the battery was thoroughly rinsed out and refilled with sulphuric acid at full charge strength. It worked and restored some capacity to the motor-cycle battery I tried it on, for at time, but it eventually shorted out from the mechanical damage to the plate.

I hope this may be of interest to you and your other contributors.

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Comment: Many thanks for the clarification, Frank.