CARE AND MAINTENANCE OF ACCUMULATORS

SO far as the charging station is concerned, the maintenance of accumulators is largely concerned with the repair of the ravages caused by careless owners and attempts to minimise the damage.

By far the greater proportion of short-lived cells owe their condition to persistent over-discharging, and this condition is the most difficult of all to avoid. It is useless to tell the customer that he must not use the cell beyond a specified period—a time will always occur when the cell is persuaded to give a little longer discharge, or he will come in with the remark that he meant to bring it back last week but forgot.

The indicators which are fitted to most cells at the present time do much to prevent this, but it is a very conscientious user that keeps one eye on the discharge state during a week of interesting programmes.

In charging such cells there is often a temptation to under-charge, especially if the cells are connected in large batches to charge for a fixed period. This is, of course, an aggravation of the trouble, as the cell is fighting a losing battle against excessive demands and insufficient reserves.

The final end of such cells is the loosening of the active material and the formation of sulphate over the surface of the negative plate. If the trouble has gone too far it may not be worth while to remedy it, but a course of careful prolonged charging and discharging may bring back the capacity.

It is important to remember that there are two factors which show the state of the battery—the voltage and the specific gravity, and it is not sufficient to rely on the latter indication implicitly.

The variations which are stated for the specific gravity between the charged and discharged conditions presume that the cell started life with its acid at a specified density. If this condition for some reason is not observed the density figure will be permanently misleading.

There is sometimes a temptation to continue charging a cell in which the density is low, overlooking the fact that it may have been below normal in the first place, and the result will be an over-charged cell. Where a cell is obstinate in raising its density the voltage reading on charge should be noted as an additional check.

S.G. and Voltage

The specific gravity should be measured by an accurate hydrometer, and the indication of any device in the cell should not be relied on for checking purposes. A good syringe type of hydrometer must be used, and it is as well to check it with one of the precision type used in a tall jar with acid of a known density.

It is hardly necessary to point out that readings of density taken just after the addition of water to the acid in the cell are unreliable. The contents of the cell near the top are nearly pure water for some time after the addition, and it is only after prolonged charging that the liquid acquires a uniform density.

The reading of the hydrometer is appreciably altered by temperature, and as this rises towards the end of a charge, allowance should be made if great accuracy is required. The following table shows the variation in density of 1.250 acid between 15 deg. C. and 25 deg. C.

Temperature.	Density.	Temperature.	Density.
15	1.250	21	1.2543
16	1.2507	22	1.2550
17	1.2514	23	1.2557
18	1.2521	24	1.2564
19	1.2529	25	1.2572
20	1.2536		

Voltage readings taken when the cell is on open circuit are no guide to its condition. To enable a reading to be taken when the cell is discharging one of the types of "tong" voltmeters should be used, which apply a fixed resistance across the terminals of the cell, the voltmeter being connected at the same time.

During charge the voltage steadily rises until the 100 per cent. charging point is reached, which marks the duration of a charge equal in amp.-hrs. to the previous discharge. After this point the voltage rises abruptly and the cell begins to gas.

A final figure is 2.6-2.65 volts, and the value should remain constant for about an hour. When the cell is fully charged the open-circuit voltage may be higher than 2.0 if the cell is warm, 20 deg. C. giving a value of about 2.12.

The actual voltage of the cell is made up of the potentials of the positive and negative plates with respect to the solution, and if these can be found separately they give an excellent guide to the cause of poor performance.

In a normal cell the voltage at discharge is 1.8 and this is made up of 2.0 volts between the positive plate and acid and −0.2 volts between the negative and acid. To measure these separately an extra electrode is introduced into the cell and the voltage measured between this and each plate in turn.

This is usually known as the "cadmium test," from the metal used for the exploring electrode. A cadmium rod should form part of every station's equipment.

To use it, a length of cadmium (which can be bought in stick form from any chemical wholesaler) is covered with a short length of rubber tube to prevent accidental contact with the plates, the tip being left exposed. The rod is then connected to one terminal of the voltmeter and the other terminal joined in turn to the + and − plates. The voltmeter must be of the high resistance type (1,000 ohms per volt), as a heavy current passing to the cadmium spoils the test.

The cell is discharged through its normal load and the readings noted. An average figure is the one quoted above, but in the case of defective cells a considerable variation is found. If the voltage to the + plate is below 2 and the negative is also low (0.15, say), the active material on the + plate is exhausted, and this has terminated the useful working life of the cell.

If, on the other hand, the positive plate is higher than 2.0, it is probable that the negative plate is exhausted. The principal use of the test is in determining that each plate of the cell is contributing its share to the discharge.

When a cell is fully charged and normal the distribution of voltage is somewhat as under :—

Positive plate, 2.45 v.
Negative plate, 0.15 v. Total 2.6 v.

Note that in this case the negative reading is additive. To check the polarity of the readings a centre-zero voltmeter is desirable.

The table on this page may help in determining the cause of some of the more obscure faults in cells. The remedy is added in some cases, although the faults themselves suggest the cures. The general advice which may be deduced from the table is, "Don't do it!"

The suggested remedy for sulphated plates is to replace the electrolyte with water and charge at a low rate, the terminal voltage being less than 2.3. If the final density of the liquid is fairly high this is evidence that too strong acid was used initially.

If density is low throughout, acid may be cautiously added to increase the charging current. When charged, empty cell and replace with fresh standard acid for a fully charged cell.—G. PARR.

FAULTS — and — CURES

Excessive sediment, mainly from positive plate. Excessive gassing.	Overcharging, or charging at too high a rate. Note: An occasional prolonged charge does a cell good.
Light grey negatives. Low density of acid. White sediment. Buckling of plates.	Undercharging, whether too low a current or too short a time.
Rapid loss of charge. Immediate gassing on charge.	Internal short circuit. Cure by cleaning out sediment.
Yellow deposit on plates.	Impure acid or water used for mixing. Scrape off and renew acid after thoroughly rinsing plates.
Large bits of active material dislodged.	Level of acid allowed to remain below plates. Heavy short circuit.
Sulphated negatives.	If at top, acid level has been allowed to drop. Too strong acid. Standing discharged too long. Persistent undercharging.
Sulphated positives.	Impure acid. Too strong acid. Too high a temperature.