Sulfation

A battery basically consists of PbO_2, lead dioxide on the positive plate and Pb, sponge lead on the negative plate, as well as H_2SO_4 sulphuric acid; when the battery is charged, oxygen bonds with H_2 and forms H_2O, and SO_4 sulfate goes to both plates and forms $PbSO_4$, lead sulfate. Chemically, both plates are identical and the potential difference is 0. The electrolyte is water.

Sulfate crystals formed as the battery self-discharges have a tendency to be larger than the crystals formed by normal discharge. These larger particles have a tendency to envelope the particles in the active material and isolate them from one another and from the grid.
This will also occur when a battery is stored uncharged, a process during which the crystals will grow, known as "Oswald Ripening", whereby small lead sulfate crystals dissolve and form larger insulating sulfate crystals.

Large insulating sulfate crystals result in increased cell impedance, which in turn affects the normal charging process. Another aspect of total self-discharge, i.e. when practically all sulfate ions in the electrolyte have reacted with the active material on the plates, is that the sulfate will have a tendency to dissolve in the strongly diluted electrolyte and be absorbed by the fibreglass separator. If one tries to charge a battery in this state, there is a risk that lead compounds (dendrites) will build up between the plates and cause short circuits.

When sulfation becomes clearly visible.

The time it takes for a lead battery to become "sulfated" varies according to type of battery.
When a cell reaches 1.98Vpc (11.88), it can no longer deliver energy. At this level, moderately large crystals develop. If the self-discharging continues, the build-up of large sulfate crystals accelerates. When voltage reaches 1.81Vpc (10.86), sulfation becomes dominant and the cell's ability to take a charge becomes marginal. Most cells will take a charge, but it must be expected that some will be destroyed. A 12-volt battery that has self-discharged to a level of 10.81 or lower has to be considered permanently damaged.

Charging a battery in this condition.

In a battery that has been so thoroughly discharged, the large sulfate crystals will insulate the lead grid from the active material and cause high interior resistance. Batteries in this condition cannot normally be charged using an ordinary CV charger.

HD 1224 High Frequency Battery Desulfator will ensure that the battery's cells are sulfation-free at all times, so that charging from the vehicle's generator or external 230V "switch mode" charger will be optimal, and the above-mentioned problem will be non-existent. Each individual cell will be 100 percent active and free of inner resistance so that charging current will result in optimal cell values and thereby significantly increase the up-time and lifetime of acid/lead batteries.

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