Lead acid battery specifications

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The lead-acid battery is a type of rechargeable battery first invented in 1859 by French physicist Gaston Plant?. It is the first type of rechargeable battery ever created. Compared to modern rechargeable batteries, lead-acid batteries have relatively low energy density. Despite this, they are able to supply high surge currents. These features, along with their low cost, make them attractive for use in motor vehicles to provide the high current required by starter motors. Lead-acid batteries suffer from relatively short cycle lifespan (usually less than 500 deep cycles) and overall lifespan (due to the double sulfation in the discharged state), as well as long charging times.

Using a gel electrolyte instead of a liquid allows the battery to be used in different positions without leaking. Gel electrolyte batteries for any position were first used in the late 1920s, and in the 1930s, portable suitcase radio sets allowed the cell to be mounted vertically or horizontally (but not inverted) due to valve design.[11] In the 1970s, the valve-regulated lead-acid (VRLA), or sealed, battery was developed, including modern absorbed glass mat (AGM) types, allowing operation in any position.

It was discovered early in 2011 that lead-acid batteries do in fact use some aspects of relativity to function, and to a lesser degree liquid metal and molten-salt batteries such as the Ca-Sb and Sn-Bi also use this effect.[12][13]

In the discharged state, both the positive and negative plates become lead(II) sulfate ($PbSO_4$), and the electrolyte loses much of its dissolved sulfuric acid and becomes primarily water.

The release of two conduction electrons gives the lead electrode a negative charge.

As electrons accumulate, they create an electric field which attracts hydrogen ions and repels sulfate ions, leading to a double-layer near the surface. The hydrogen ions screen the charged electrode from the solution, which limits further reaction, unless charge is allowed to flow out of the electrode.

taking advantage of the metallic conductivity of PbO_2.

The net energy released per mole (207 g) of Pb(s) converted to $PbSO_4$(s) is approximately 400 kJ, corresponding to the formation of 36 g of water. The sum of the molecular masses of the reactants is 642.6 g/mole, so theoretically a cell can produce two faradays of charge (192,971 coulombs) from 642.6 g of reactants, or 83.4 ampere-hours per kilogram for a 2-volt cell (or 13.9 ampere-hours per kilogram for a 12-volt battery). This comes to 167 watt-hours per kilogram of reactants, but in practice, a lead-acid cell gives only 30-40 watt-hours per kilogram of battery, due to the mass of the water and other constituent parts.

In the fully-charged state, the negative plate consists of lead, and the positive plate is lead dioxide. The electrolyte solution has a higher concentration of aqueous sulfuric acid, which stores most of the chemical energy.

Overcharging with high charging voltages generates oxygen and hydrogen gas by electrolysis of water, which bubbles out and is lost. The design of some types of lead-acid battery (eg "flooded", but not VRLA (AGM or gel)) allows the electrolyte level to be inspected and topped up with pure water to replace any that has been lost this way.

Because of freezing-point depression, the electrolyte is more likely to freeze in a cold environment when the battery has a low charge and a correspondingly low sulfuric acid concentration.

Because the electrolyte takes part in the charge-discharge reaction, this battery has one major advantage over other chemistries: it is relatively simple to determine the state of charge by merely measuring the specific gravity of the electrolyte; the specific gravity falls as the battery discharges. Some battery designs include a simple hydrometer using colored floating balls of differing density. When used in diesel-electric submarines, the specific gravity was regularly measured and written on a blackboard in the control room to indicate how much longer the boat could remain submerged.[14]