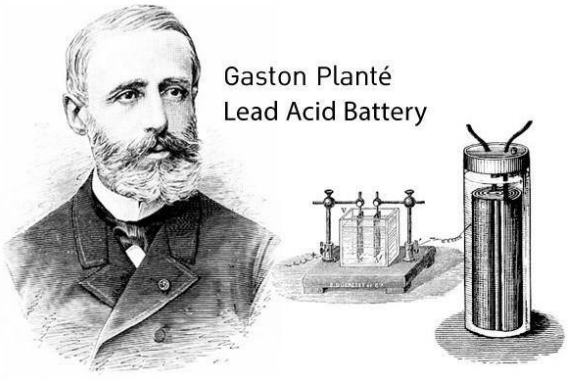
CHALLENGE BATTERIES WA

Technical Update

The Lead Acid Battery

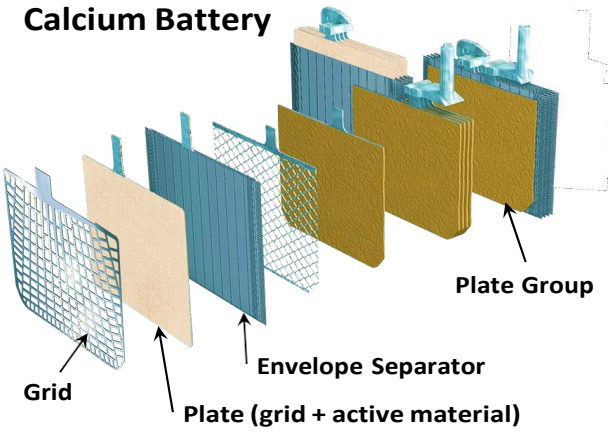
The humble flooded lead acid battery has been in use for well over 100 years. Lead acid chemistry provides a safe, reliable and cost-effective energy storage device for all types of applications. Lead acid batteries are also over 96% recyclable! This update will discuss the main types of lead acid batteries in use today



The lead acid battery has undergone several changes since it was first invented by Gaston Planté in 1859. The first major change was made in the late 1800's when antimony was added to the lead grids to improve plate rigidity. The downside of this was an increase in water consumption and gassing.

In the 1930's it was discovered that adding calcium to a lead-antimony grid improved grid strength and durability, however this technology didn't find its way into mainstream automotive batteries until much later in the century. The addition of calcium also reduced both water consumption and self-discharge rate. Eventually this lead-calcium alloy was used for the negative grids in automotive applications and were known as **Low Maintenance** batteries - we now retrospectively refer to these as ***hybrid batteries*** (a hybrid of lead-calcium negative grids and lead-antimony positive grids).

Calcium Battery

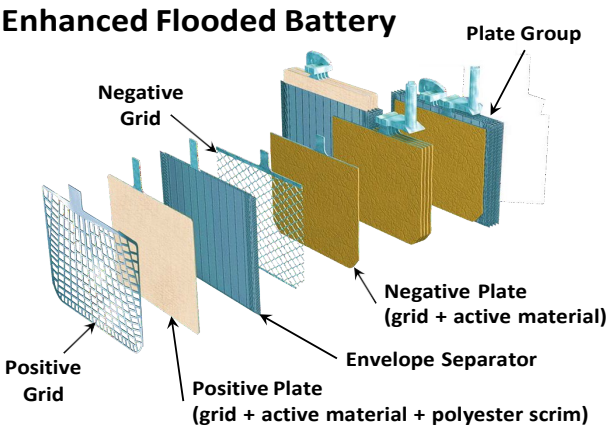


Adding calcium to both the positive and negative grids reduced water consumption even further, and the ***Maintenance Free*** battery we know today was born. This battery design is also known as Calcium-Calcium, Calcium Silver and Sealed Maintenance Free (SMF). By the 1990's most vehicle manufacturers were installing calcium batteries in their vehicles.

It is interesting to note that there are many other alloying elements in a lead-calcium grid including Tin, Silver, Antimony, Barium, Aluminium, Thallium and Selenium – each element contributing to battery performance or durability in some way. As an example, calcium improves a number of characteristics as discussed above

however calcium is a poor conductor. Adding silver (an excellent conductor) compensates for the calcium by restoring the loss in conductivity.

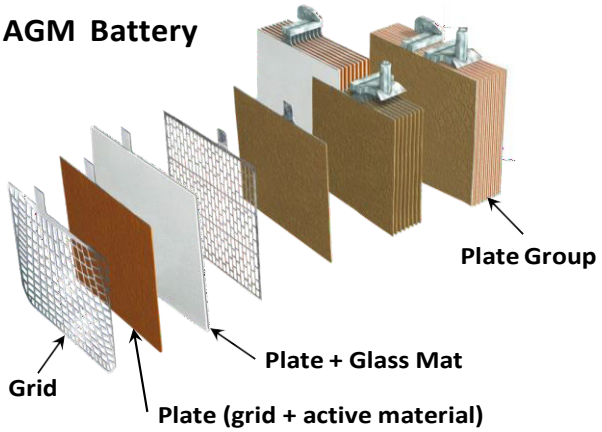
Enhanced Flooded Battery (EFB)



The EFB is an evolution of the calcium battery - think of it as an enhanced calcium battery. The different operating parameters required by Idle Stop Start (ISS) technology meant that the existing calcium starting battery could not cope in this new operating environment.

Although they look similar internally, there are a number of changes which enable an EFB to deliver approximately twice the cycle life of calcium batteries while constantly operating at a Partial State of Charge (PSoC). EFB's are designed to have very high charge acceptance so they can take advantage of fuel saving energy recuperation systems. Visually, EFB grids are slightly thicker to help with plate stability. They also have a polyester scrim surrounding the positive plate to help support the active material during the cycling experienced in an ISS vehicle.

Absorbent Glass Mat (AGM)



AGM technology was originally developed in the 1980's for military aircraft applications where it was critical for a battery to continue to deliver power while not leaking battery acid into the airframe if it was pierced by a shell. It is still a lead acid battery however the construction is quite different.

The AGM design utilises a compressible mat made from fine glass strands (which looks similar to felt) to absorb and hold the electrolyte in suspension while also separating each plate. This means that there is no spare electrolyte in an AGM battery, allowing them to be mounted in any orientation. AGM plate groups are compressed by approximately 20% when inserted into each cell – this compression retains the active material in place throughout the battery's life and contributes to this design's superior cycle life, cranking efficiency and vibration resistance.

AGM batteries are also known as VRLA (Valve Regulated Lead Acid) batteries. AGM's use a recombination reaction which requires that each cell be isolated for optimum performance. The use of a one-way valve for each cell allows any pressure build up to escape the battery without allowing any fresh air in as this would corrupt the chemical balance of the cell and reduce battery service life.

Deep Cycle

Deep Cycle batteries are very different to automotive starting batteries as they are not required to deliver the high current bursts required to start an engine. Instead they are designed to deliver their energy over longer periods of time. This difference means that there are fewer plates in each cell compared to a cranking battery (cranking power requires more plates) however the plates are noticeably thicker which keeps plates dimensionally stable while cycling.

If you used an automotive cranking battery (i.e. calcium battery) in a deep cycle application, the thinner plates would buckle or curl with the constant cycling, which would result in the active material separating from the grid causing premature battery failure.

Marine

The key characteristic, critical for all marine batteries is a high resistance to vibration. This is achieved by bracing the plate groups to each other and the battery case using hot melt glue. This additional support allows the plates to withstand the high vibration and shock loads experienced in boating applications.

There are actually two different types of Marine battery. The first is a **starting** battery designed to deliver the high CCA required by some marine engine manufacturers.

The second type of marine battery is a compromise which delivers an all-round solution capable of **starting & cycling**. This is because many marine applications use the battery to start the engine so you can motor out to a favourite fishing spot, and then also use it to provide power for lighting and other auxiliary power consumers without any charging input. After a number of hours when the esky is full of fish, the battery is then required to start the engine again so you can motor back to shore while the battery is recharged by the alternator. These marine batteries are also often used in Off Road and RV applications where both starting and cycling capability is required with a high resistance to vibration. A marine starting battery **must not** be used in a starting & cycling application as it will result in a premature battery failure.

Gel

Another type of Valve Regulated Lead Acid (VRLA) battery is the Gel Cell battery. This type of battery is essentially a flooded battery where silica has been added to the electrolyte to create a firm gel. An advantage of the gel cell battery is that it is a spillproof design (like the AGM) and does not need to be mounted upright. This battery also uses the recombination reaction like the AGM battery, hence the one-way valve on each cell.

The idea of using a gelled electrolyte dates back to the 1930's to avoid electrolyte spillage as batteries were often housed in glass jars at that stage.

Gel cell batteries are not able to deliver the high current bursts like AGM's however they are excellent for energy storage and deep cycle applications where low gassing and an extended service life is required.