Battery Types: Flooded versus AGM and Gel

On the kinds of batteries:

The most common kind of battery in use today is the lead acid battery. Using an electrolyte consisting of sulphuric acid, these cells can store impressive amounts of electrical energy in a relatively small space. This energy is stored in chemical form within lead grids mounted inside the battery. The reliance on lead grids and paste explains the great heft of lead-acid batteries.

The battery universe is further divided along the lines of battery construction. Currently, there are three common lead-acid battery technologies: Flooded, Gel, and AGM.

• ***Flooded or Wet Cells*** are the most common lead-acid battery-type in use today. They offer the most size and design options and are built for many different uses. In the marine business, they usually are not sealed so the user can replenish any electrolyte the battery vented while charging the battery. Typically, the cells can be access via small ~1/2" holes in the top casing of the battery.

> The plastic container used for flooded cells will have one or more cells molded into it. Each cell will feature a grid of lead plates along with an electrolyte based on sulphuric acid. Since the grid is not supported except at the edges, flooded lead-acid batteries are mechanically the weakest batteries.
>
> Since the container is not sealed, great care has to be taken to ensure that the electrolyte does not come into contact with you (burns!) or seawater (chlorine gas!). The water needs of flooded cells can be reduced via the use of Hydrocaps, which facilitate the recombination of Oxygen and Hydrogen during the charging process.

• ***Gel Cells*** use a thickening agent like fumed silica to immobilize the electrolyte. Thus, if the battery container cracks or is breached, the cell will continue to function. Furthermore, the thickening agent prevents stratification by preventing the movement of electrolyte.

> As Gel cells are sealed and cannot be re-filled with electrolyte, controlling the rate of charge is very important or the battery will be ruined in short order. Furthermore, gel cells use slightly lower charging voltages than flooded cells and thus the set-points for charging equipment have to be adjusted.

• ***Absorbed Glass Mat (AGM)*** batteries are the latest step in the evolution of lead-acid batteries. Instead of using a gel, an AGM uses a fiberglass like separator to hold the electrolyte in place. The physical bond between the separator fibers, the lead plates, and the container make AGMs spill-proof and the most vibration and impact resistant lead-acid batteries available today. Even better, AGMs use almost the same voltage set-points as flooded cells and thus can be used as drop-in replacements for flooded cells.

> Basically, an AGM can do anything a Gel-cell can, only better. However, since they are also sealed, charging has to be controlled carefully or they too can be ruined in short order.

Gel and Absorbed Glass Mat batteries are relative newcomers but are rapidly gaining acceptance. There are some very compelling reasons to use VRLAs:

• Gel and Absorbed Glass Mat (AGM) batteries can dispense charge at a higher rate than flooded cells due to their lower Peukerts exponent. Deep-cycle Flooded Cells cannot deliver more than 25% of their rated amp-hour capacity in amps without plummeting Available Capacity.

- Deep-Cycle Flooded cell battery manufacturers recommend a 4 to 1 ratio between battery bank size and the largest load encountered.
- AGM and Gel cell manufacturers recommend a ratio of at least 3 to 1, a significant difference for loads.

● Virtually no gassing under normal operating conditions: Unlike flooded cells, gel cells and AGMs are hermetically sealed and operate under pressure to recombine the oxygen and hydrogen produced during the charge process back into water. You find VRLAs in the bilges of high end yachts such as Hinckley, Hans Christian, Island Packet, etc..

● For every additional 15 degrees of heat over 77 deg F, lead acid battery life (regardless of type) is cut in half (batteries self-destruct with time, you can only slow that process).

● VRLAs can operate in any orientation (although you may lose some capacity that way) and even if a container is broken, a VRLA will not leak.

● Gel cells and AGMs require no maintenance once the charging system has been properly set up. No equalization charges (usually), no electrolyte to replenish, no specific gravity checks, no additional safety gear to protect yourself. If you want to be anal retentive about VRLAs you can load test them. However, proper charge control and protection is much more important with VRLAs because once fried it is impossible to revive them.

● The higher charge efficiency of AGMs allows you to recharge with less energy: Flooded cells convert 15-20% of the electrical energy into heat instead of potential power. Gel-cells lose 10-16% but AGMs as little as 4%. The higher charge efficiency of AGMs can contribute to significant savings when it comes to the use of expensive renewable energy sources (wind generators, solar panels, etc.) as your charging system can be 15% smaller (or just charge faster).

● While flooded cells lose up to 1% per day due to self-discharge, VRLAs lose 1-3% *per month*.

● High vibration resistance: The construction of AGMs allows them to be used in environments where other batteries would literally fall to pieces. This is another reason why AGMs see broad use in the aviation and the RV industry.