Winter Battery Maintenance

Out of sight, out of mind. In the spring most of us are anxious to get down to the boat and start working on her, but most of us feel less motivated in the fall, and often our boats get put to bed for winter quickly as the weather deteriorates. All too often, batteries are amongst the casualties of this rush, and freezing temperatures and inactivity over the winter can quickly take their toll. Given the cost of a quality marine battery (and yes, there is an appreciable difference between these and their bargain "cousins"), it is definitely worth taking the proper steps to lengthen their useful life and ensure a good power supply for our vessel come the spring and summer. This month's "Boat Talk" addresses this question for the more common battery types in marine use, namely wet cell and AGM lead-acid batteries.

As a preface to this article, please note that ***whenever working on or around batteries, proper personal protection gear should be worn, including safety glasses, protective clothing and chemical resistant gloves, and of course no source of open spark or flame should be present.***

A bit of background information first. All lead-acid batteries (wet-cell, AGM, Gel) are chemically similar, with the lead (Pb) on the negative plates reacting with the sulfate ion ($H_2SO_4^{2-}$) from the sulfuric acid (H_2SO_4) in the electrolyte (solution of the sulfuric acid and water); and the lead oxide (PbO_2) on the positive plates reacting with the hydrogen ion (H^+) from the acid. As a result of this reaction, electrons are released, providing the electric current, both the positive and negative plates are coated with lead sulfate ($PbSO_4$), and the concentration of sulfuric acid in the electrolyte decreases, ultimately becoming nearly pure water (theoretically) when fully discharged.

From the perspective of winter storage, there are two main consequences of this:

1) The temperature at which the electrolyte will freeze increases as the concentration of sulfuric decreases, i.e. as the battery discharges. The electrolyte in a fully charged battery (approximately 12.6V-12.8V for a 12V battery) will freeze somewhere around -50C to -70C, whereas a fully discharged battery will freeze at near 0C (the freezing point of pure water). The freezing temperature drops off very quickly with diminishing state of charge – a battery at 12.0V will freeze somewhere around -10 to -15C for example, clearly not sufficient for those of us in the north. Freezing of the battery can cause fatal damage to the battery.
2) The sulfate on the plates tends to crystalize over time if the battery is left in any state of discharge, becoming permanently fixed to the plates. This crystallized sulfate acts as an electrical insulator, decreasing the output of the battery.

Removing the batteries from the boat and storage in a cool (not freezing), dry place is ideal. However, this may not be practical for many reasons, especially for larger

batteries (such as Group 31 batteries or 4D/8D batteries) where the size and weight presents real risks in moving them around. Fortunately, if properly prepared, the batteries can safely remain on the vessel for the winter. However, to do so safely, it is essential that the batteries be fully charged prior to winter in order to prevent freezing, and to minimize sulfation. On sailboats, especially those used for frequent anchoring out, the short charging cycles associated with infrequent, short periods of engine/alternator mean that the batteries are rarely returned to full charge. This situation predisposes the battery to be more susceptible to sulfation. Particular care should accordingly be taken in these cases to ensure that the batteries are well and truly charged. Leaving them to charge with a proper marine battery charger with the appropriate charge profile for your type of battery for a minimum of 24 hours is a good way to ensure that they are fully charged. After letting the battery rest for 4 hours post-charge with no load, the open circuit voltage across the terminals should read 12.6 to 12.8V. For wet-cells, it is also important to confirm the level of the electrolyte, and re-fill it to the fill line with distilled water before storage so that the plates do not dry out.

Once charged, the negative battery cables should be disconnected from the batteries to preclude discharge by any parasitic loads in the electrical system. Even disconnected, lead-acid batteries will discharge over time due to internal chemical reactions, at a rate of approximately 5% per month at 20C for wet-cell batteries (somewhat less for AGM). This decreases with decreasing temperature (to about 1% per month at 0C), so the battery stored on the boat for the winter will discharge less quickly. To minimize damage due to discharge, batteries stored indoors should be recharged monthly, while those on the boat should be recharged perhaps once or twice during the off-season. In both cases, it is important to use a charger rated and set for the specific battery chemistry that you have (wet-cell, AGM, Gel). It is important to note however that one should never attempt to charge a frozen battery, so it is important to verify the condition of the battery before applying the charger.

While at the business of charging and checking electrolyte levels, it is a really good idea to clean the batteries themselves, as well as the posts and ring terminals. A wipe down of the battery case with a mixture of baking soda and water will neutralize any acid residue. Check for any cracks or deformation while doing this, and replace as necessary. Note that one bad battery in a parallel bank will quickly bring down the other batteries in the bank as well, so proactive replacement is definitely in your best interest! Cleaning all battery and cable terminals with a soft brush, removing any corrosion, and applying a light coating of dielectric grease is a great way to ensure a good electrical connection is as low resistance as possible. Even moderately contaminated contacts can significantly increase the connection resistance causing increased heating (risk of fire) and poor electrical performance (increased consumption).

Similarly, check all crimped connections to ensure that there are no broken strands or sharp bends in the cables, and that the ring terminals are correctly sized for the battery post. Replace any connections that are suspect or incorrectly sized with new crimped connections, and cover the terminal with a fitted rubber boot. Do not use soldered connections as these are prone to fatigue failure from the vibrations inherent to marine use. Finally, ensure that there are no more than four cables attached to any terminal stud, and that they are installed in order of cable size with the largest cable closest to the battery. The terminals should be secured with a plain nut and lock washer (not wing nuts!) and the nut tightened to the torque specified by the battery manufacturer. Too tight and you risk damage to the battery, and too loose will not provide an adequate connection. Washers should only be installed directly under the nut/lockwasher.

With the above steps, you can ensure that your batteries life will be extended, and that the risk of overheating at the battery connections is minimized, resulting in increased safety, increased efficiency and lower operating costs.