Solar Publication

A regular and saveable module to build knowledge of solar power, build on Zimbabwe's experiences and build the Zimbabwean Solar Industry

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Batteries, Maintenance

The usual rule of thumb, with solar systems, is 80 percent of the cost is batteries. And they are the only part that will 'wear out'. But, I am aware of one system, a "high quality"system, which cost $18 000, of which $5000 is battery. That is, 28 percent.

And these batteries will last ten years with proper maintenance. A household system that (aside from the stove) replaces ZESA input.

However, maintenance, **and intelligent maintenance**, is required.

Of the two large types of batteries, Lead Acid and Metal Ion types (most commonly Lithium Ion, or LIon), only lead acid batteries require maintenance, and of those lead acid ones, not all need or can be maintained.

Maintenance free – These are best, if not vital for many people. Those who are unable to add water, (a remote location, work all day, age, disability, and many good reasons).

Maintenance batteries – Generally flooded (there is liquid over the panels in the cells), and wet (not gel or AGM).

These will give you a longer life span, provided they are maintained. And maintenance requires a bit of work and a LOT of attention. They are not the best for everyone.

First, your energy audit. You must ensure there are enough panels to supply your house (office, farm, factory) needs during the day PLUS charge batteries to 100 percent, including times of 'inclement weather' (which can last 2 to 3 weeks).

DoD (Depth of Discharge) is the opposite of SoC (State of Charge)

To maintain, you need to:

- Ensure liquid levels are always maintained.

- Equalize batteries at least every three months, and go to float at least once a week.

"Float" means a state where the batteries are fully charged, but being used. While the sun is on the panels and charge is being delivered, appliances are turning on and off and 'spiking' - drawing some power for some moments.

Within a string of batteries (you may have four 12V batteries, wired as if they were two 24V batteries) each battery will develop specific attributes, and cells within each battery will develop specific attributes.

So when you discharge (use, put a load on it) a cell, battery or string of batteries, power will be taken from them until the weakest portion attains it lowest level, and the whole thing will stop producing power. When you charge a cell, battery or string, power will be put in until the strongest portion attains it's highest level, and then charging will stop.

Weakest cell on discharge, strongest one on charge.

Technical assistance has been sought and is acknowledged!
Technical inputs received with pleasure

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Cells will become unbalanced, and this is the effect of unbalanced cells.

In addition, the high current used for equalization, will de-sulphate the battery.

Sulphation

During use, sulphate crystals are formed. If left discharged, they grow, harden and layer to make reconversion

- **of metal sulphate back to raw metal plates**
- **of metal bonding back on to the metal plates**

difficult to impossible.

Equalization is a very high power charge, for about one hour. See your battery specifications for the details, and you will add a fair bit of (distilled) water during the process. If you cannot add water (as you cannot in most maintenance free batteries) it is best not to equalize! Over equalization may aggressively eat the plates. You should only equalize a fully charged battery.

Levels of charging.

There are three basic charge rates.

- Bulk
- Absorbing
- Float

Bulk means the battery is pumped full, with high volts, and high amps. E.g.. a 48V system up to 57.4V on bulk charge, up to 40 amps.

Absorption, it will remain at 57.4V, but current drops to 5.5 amps

Float the battery is full, with a little trickle in as it is being used. 54V, 0.2A

(**See your battery spec. sheet**).

Most common lead-acid batteries

1/ Lead antimony and lead calcium.

2/ Wet/flooded or starved (gel or AGM) VLRA.

3/ Flat plate auto (flooded). Thin plates, large surface area. Good for short term high discharge (starting motor!). Not good for long, high discharge.

4/ Flat plate semi-tractor (flooded). Thicker plates, better separators. Light duty cycling.

5/ Tractor or deep-cycle battery. Thick plate or tubular-plate. Discharge 60 to 80 percent daily. Fully recharged nightly (think forklift trucks). Needs charge at high voltage (for sulphate prevention).

Shedding

(On discharge and recharge).

Material falls off the plates and sinks to the bottom of the cell. Down there, it may form a pyramid, reach the bottom of the plates and short circuit the cell / battery.

6/ Sealed (VLRA) gels. Electrolite is immobile gel.

7/ Sealed (VLRA) AGM. Ions move more easily than in gel, therefore better for short term high current use than gel.

8/ Sealed (VLRA) spiral cell. Plates are spiraled together. Very high discharge, very high recharge currents without overheating.

Starved means the electrolyte is not liquid (a gel or absorbed in a mat)

AGM = Absorbed Glass Mat.

VLRA = Valve Regulated Lead Acid. (so no cap to add water).

Battery capacity

Two factors will diminish your battery's capacity.

- Rate of discharge.

A faster discharge will give less Ah. e.g.

- 200Ah battery will give 200Ah for 20 hours at 10A.
- 200Ah battery, will give 200Ah for 30 min at 200A

Therefore, the more rapidly discharged (used, loaded…) the less capacity the battery will have.

- Temp

20C (for most to all batteries) is the optimum temperature. Cold is worse for lead-acid, but if you live in the Zambezi Valley, your battery life will be less.

Lithium Ion are not as susceptible to high temperatures, as wet cells, but are not good at low temperatures.

Premature aging

All batteries age, however premature aging can be avoided as it is caused by;

- Battery being discharged too deeply.
- Charging too rapidly, or not fully charging.
- Undercharging
- Over charging.
- Temperature