Understanding primary battery technology
by Malcolm Southern, Just Batteries

As many engineers will know, the battery industry has not yet achieved the perfect battery or rather cell technology. In almost every choice there is always a compromise to be made when selecting the chemistry which best suits a specific application.

I receive a number of calls on a daily basis by design engineers who are selecting a technology for their product and more often than not a very important factor gets overlooked. In this article I hope to provide some basic fundamentals to keep in mind when considering a Lithium-thionyl chloride cell or battery for a specific application.

It is my experience that generally speaking a higher capacity cell is most commonly sought after. Herein lies a common mistake that is made when briefly studying a potential products specification sheet. This mistake occurs when the current delivery ability of the cell is overlooked often as a result of the excitement involved when finding a potential solution. To gain a better insight into this I would like to explain some basic principles about Lithium-thionyl chloride technology.

Effectively there are two basic methods employed by the manufacturers, who produce this technology. Each method offers both advantages and disadvantages. The two methods employed are referred to as the 'bobbin cell' and the 'spiral wound cell'. The following illustration is primarily focused on the D size cell, but the principles apply to most of the sizes within the Li-SOCl2 range.

The bobbin cell allows for a higher capacity. Typically what we see here is a capacity ranging from 17 Ah to 19 Ah at a nominal voltage of 3.6 V. The spiral wound cell has a much lower capacity which are generally between 13 Ah to 14.5 Ah depending on the brand in question. So what is the difference then? Well, it all has to do with the current requirements of a particular circuit. The spiral wound cell has a much larger electrode surface area which enables a far greater current to be drawn from the cell, typically a spiral wound D cell can deliver a continuous current of about 1800 mA and a pulse current of about 4000 mA, these currents vary depending on the brand of cell used.

A factor that must be kept in mind is the effect on the cell of what is referred to as "passivation". On a recent visit to SAFT's Poitiers production facility in France I was fortunate enough to have an in depth discussion with SAFT's senior applications engineer Michel Guegan, regarding this very matter. In brief, passivation can be described a love-hate relationship at best. On the one hand it is passivation that allows for the excellent shelf life of Li-SOCl2 cells. It is an essential reaction that must occur in the production process, which effectively takes the cell out of short circuit when the electrolyte is added to the cell in the production process. Passivation can thus be described as a "protective layer" that forms on the lithium metal layer contained inside the cell. This layer basically inhibits the electrolyte from making contact with the lithium material contained within the cell. It is important to remember that passivation is reversible, please contact me directly to discuss these methods. The effects of passivation are evident when one attempts to draw current from the cell. By placing a load on the cell the passivation layer on the lithium metal is broken down but during this process there is a drop in the cell voltage and depending on the level of passivation this drop can result in the cell voltage dropping to below 2.0 V in extreme cases but gradually recovers.

The end result is that the cell cannot deliver the current or the voltage that a circuit may require and hence this could result in a situation, which could have been avoided all together. There are a number of remedies that can be applied to deal with this factor, which I would gladly discuss.

We should also understand factors that affect Li-SOCl2 cells as far as self-discharge is concerned as well as passivation. Generally speaking excessive temperatures will affect both the rate and depth of passivation as well as the rate of self-discharge. Self-discharge is often overlooked when a particular brand of cell is considered. We typically see a number of brands that offer 19 Ah rated-capacity cells when the better quality brands only offer a 17 Ah equivalent. The difference here is that the better quality cell generally has a much better self-discharge rate in comparison, so one could find that they end up with much less capacity when the cell is put to work in the field do to the rate of self-discharge.

In summary, always know your circuit's current requirements and make sure that you select the appropriate cell that can deliver the required levels of current.

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