Article

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A Little Bit About Batteries

Our stimulators are powered by 9V batteries and which one you choose can make a difference to the performance of your device. This article hopes to help explain the differences between battery types and help you choose the best option for your needs.

Batteries produce electricity from a chemical reaction. The type of chemistry used affects the output of the battery. Some of these reactions can only happen in one direction (disposable batteries) and others can be reversed (rechargeable batteries).

Primary (Disposable) Batteries

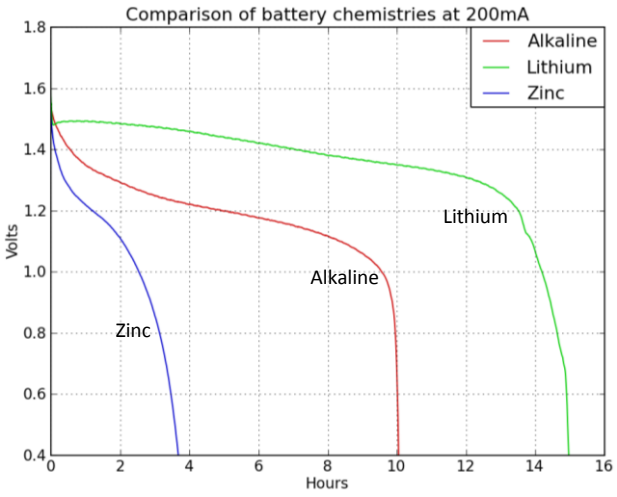
There are several types of primary battery chemistry, the most commonly available ones are zinc carbon, alkaline and lithium. These various types have characteristics and may be better suited to different applications, as such some may not be ideal for powering a stimulator

Zinc Carbon batteries are a very old design, and are often fairly cheap. They are better suited for low power drain applications such as clocks or remotes. Zinc carbon batteries will also tend to have the shortest shelf life.

Alkaline batteries are better for power hungry devices. They have a reasonable capacity (amount of stored power) and are able to cope with supplying higher currents than zinc carbon. They also tend to have a longer shelf life. Alkaline batteries tend to be a bit more expensive than zinc carbon.

Lithium primary batteries are lighter and have a good capacity, but are relatively expensive. In general, lithium primary batteries will last longer than alkaline batteries, but the additional cost may not match the additional life.

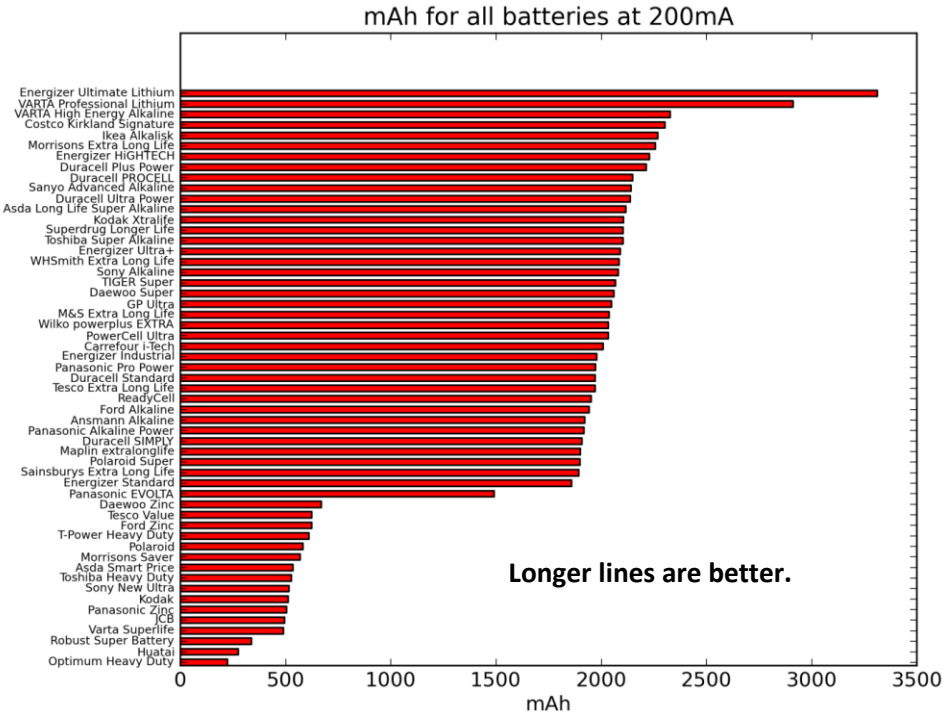
The graph below shows a comparison of the performance of the different types of battery chemistries. This is based on 1.5V AA batteries, but the results would be similar for 9V batteries.



Source: www.batteryshowdown.com

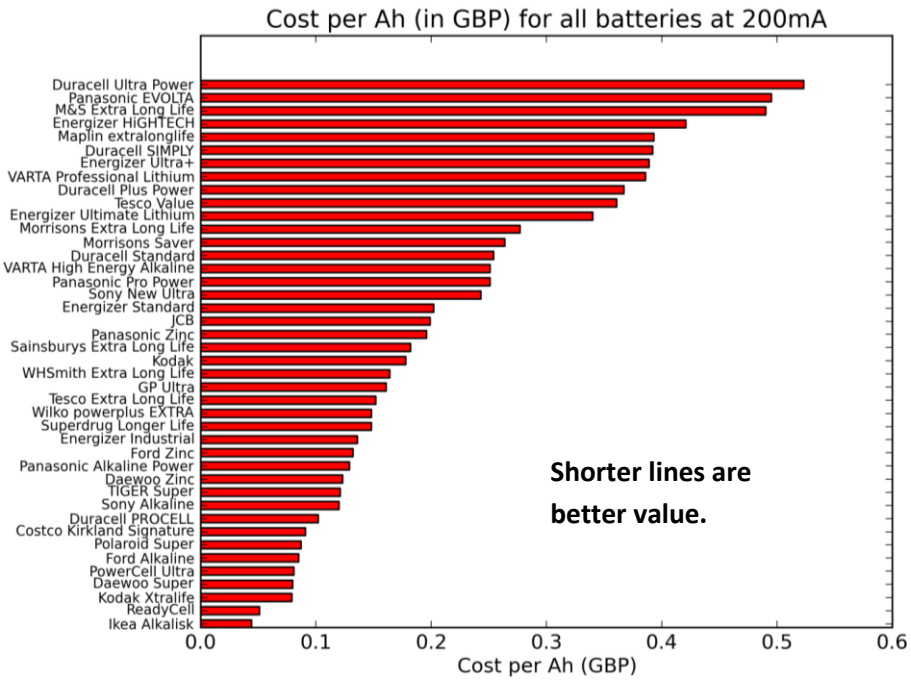
Tests carried out on AA batteries on the website www.batteryshowdown.com show the performance differences of a number of brands of batteries. Although the values on the graphs would not be the same for 9V batteries, the relative performance should be comparable.

The graph below shows the capacity of the battery when under moderate loading. The longer the line, the better (more capacity) the battery, and the longer it will last. This shows the difference in performance between zinc batteries, alkaline batteries and single use lithium batteries.



Source: www.batteryshowdown.com

Somewhat more interestingly they then factored in the cost of the battery to show how much power you get for your money. In this case the shorter the line, the better value for money. This highlights that cheaper 'value' batteries are not necessarily the best value for money for powering a stimulator.



Source: www.batteryshowdown.com

Rechargeable Batteries

There are a number of different types of rechargeable batteries available, with the most common being Nickel Cadmium (NiCd), Nickel Metal Hydride (NiMH), and Lithium Polymer (LiPo).

Nickel Cadmium batteries are less common now as the use of the heavy metal Cadmium is restricted. A PP3 battery of this type typically has a charged voltage of 8.4V so delivers a lower voltage than disposable batteries, which may affect performance.

Nickel Metal Hydride is an improvement over NiCd, using safer chemicals and having a higher energy density (more power for the same size/weight). It also produces the same voltage as a NiCd battery, so may also not perform as well as a primary battery. NiMH batteries can take a long time to recharge properly, and can lose their charge over the period of a few weeks.

Nickel based rechargeable batteries typically have a smaller capacity than primary (disposable) batteries, typically 2-5 times less. This coupled with the reduced voltage will mean that they have to be changed in the stimulator more often.

Lithium Ion (Li-ion) and more recently Lithium Polymer (LiPo) rechargeable batteries have been around for many years in phones, laptops and other portable devices. However, these have typically been in custom sizes and shapes and not available to the consumer in standard sizes. Recently Lithium Polymer batteries have become available in a PP3 (9V) package. The voltage produced is slightly lower than that of a disposable battery, but weighs less with a similar capacity. This means that a single charge will last about the same length of time as a disposable battery. LiPo rechargeable batteries require a special charger, and trying to charge them with a traditional charger can cause damage. Currently the cost of PP3 LiPo batteries and chargers is quite high.

Conclusions

The choice of battery to use in your stimulator is a matter of individual preference based on cost, weight or inconvenience of changing or charging the batteries. Often the choice may be based on cost, but as can be seen from the graphs above, buying the cheapest battery may not be the best value for money.

If you wish to use disposable batteries, we would recommend that you avoid zinc based batteries, as these will not perform well in your stimulator. Try to check that your battery says that it is alkaline on the packet, not all do and if it is really cheap it may well be zinc. Disposable lithium batteries should work well in your stimulator and give you a longer battery life, but the benefit you gain may not be worth the additional cost. Another factor is the shelf life of the battery. Over time the battery will lose some of its capacity even when not being used. A good alkaline battery should have several years before the use by date. Be careful of cheap batteries bought online, they may be cheap because they are coming to the end of their shelf life and will have reduced capacity. Always check for at least a couple of years left on the expiry date.

Rechargeable batteries are a good option for those wishing to save some money, as although there is a higher initial outlay this may only be the cost of a few months supply of batteries. Many of our FES users use NiMH rechargeable batteries in their stimulators, but be aware that they will not last you as long as a disposable so you will be changing them more often. Additionally because of the slightly different voltage and capacity you might not get as much notification before the battery runs out (perhaps a few hours rather than a couple of days). Some users like to keep a spare battery at hand ‘just in case’. Typically a NiMH charger and two batteries will cost around £20. Compared to using £2 alkaline batteries this cost could be

recouped after approximately 10 - 12 months. You could normally expect to be able to charge a NiMH battery about 200 times without seeing any significant drop in performance. This would probably mean a usable life of about 3 years.

If you want the benefits of rechargeable with a longer time between changing batteries then you might want to consider Lithium rechargeables. There is an increased initial cost so it will take longer to make it pay for itself, but will have the convenience of changing less often. A LiPo recharger and two batteries may cost about £85 so could take about 2 - 4 years to recoup the cost compared to using alkaline batteries. However the LiPo would last longer in the stimulator and should be able to be charged around 500 times without seeing a significant drop in performance. This means that the overall life of the battery will be much longer than that of a NiMH rechargeable battery. LiPo batteries are also lighter than alkaline batteries so can reduce the stimulator weight.

Although NiMH batteries look to be less expensive, this must be balanced with the requirement to change the battery in the stimulator more frequently and the reduced warning period given when the battery level is low. Once again it may be a matter of personal preference as to which option better suits you depending on how often you need to open your stimulator to change the battery, or the need to remember to charge your batteries or carry a spare compared to the cost of running your stimulator.

Odstock Medical supplies stimulators with Duracell PROCELL batteries and also has these available for sale. These demonstrate a fairly good capacity at a reasonable cost. We are also able to supply Lithium Polymer batteries and chargers. These are supplied as standard with the ODFS® Pace XL wireless footswitch system.