



Technical Note.

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The Difference between Lead-Acid and Nickel Cadmium Batteries with respect to end-of-life and the Proper Disposal of Nickel Cadmium Batteries

One of the main problems with lead-acid batteries is that the aging process is not linear. In other words, they do not degrade in a predictable manner and it is hard to figure out when they will need replacing. On the other hand, nickel cadmium (NiCd) batteries have a more linear aging process and the end-of life is easier to predict.

The lead-acid battery is a “sacrificial” design as the lead plates are gradually consumed by the dilute sulfuric acid electrolyte (H₂SO₄) as part of the normal operation of the battery as they are reacting all of the time with the acid electrolyte. The result is an unpredictable degradation of the capacity of the cell and the sudden “fall-off” towards the end-of-life of the batteries ability to support the load. Most of the inherent failures of lead-acid batteries, particularly lead-calcium, are due to the degradation of the positive plates because of either paste shedding or corrosion.

The NiCd batteries electrolyte, which is potassium hydroxide (KOH), does not corrode the plates and consequently there is no sudden end-of-life. Normal NiCd aging involves a slow loss of capacity caused by a gradual change in the activity of the positive (nickel) plates. The most common failure is caused by internal short circuits caused by dendrites, which are thin, conductive crystals that may penetrate the separator membrane between electrodes.

Also, the NiCd design is of a more rugged, mechanical strong design, which helps the battery to withstand electrical abuse from overcharging and temperature extrusions.

Various IEEE Guides define the end of life of a lead-acid battery to be when the available capacity drops to 80% of the rated capacity. For NiCd batteries, the IEEE does not define an end-of-life point.

Disposal and Recycling of NiCd batteries.

NiCd batteries are hazardous to the environment because the cadmium in them is a heavy metal and toxic. It is important that they are disposed of properly at the end of their life. They are subject to special regulation and requirements that are very different from lead-acid batteries. Indeed, NiCd batteries cannot even be packed for disposal together with lead-acid batteries.

Most of the major US NiCd manufacturers', including Alcad, Hoppecke and Saft, have systems in place where they will "take back" spent NiCd's and recycle them properly. In most cases, the manufacturers operate a closed loop recycling system and arrange and pay for the return of the spent batteries from the end-user to a collection point from which they are sent to the recycler.

The only recycling plant in the US is INMETCO, 245 Portersville Road, Ellwood City, PA 16117. This plant operates under an EPA permit and they are authorized by the EPA to receive industrial NiCd batteries. They provide a thermal materials recovery process that the EPA has determined to be the Best Demonstrated Available Technology (BDAT). They also recycle small NiCd cells.