RECHARBLE BATTERIES

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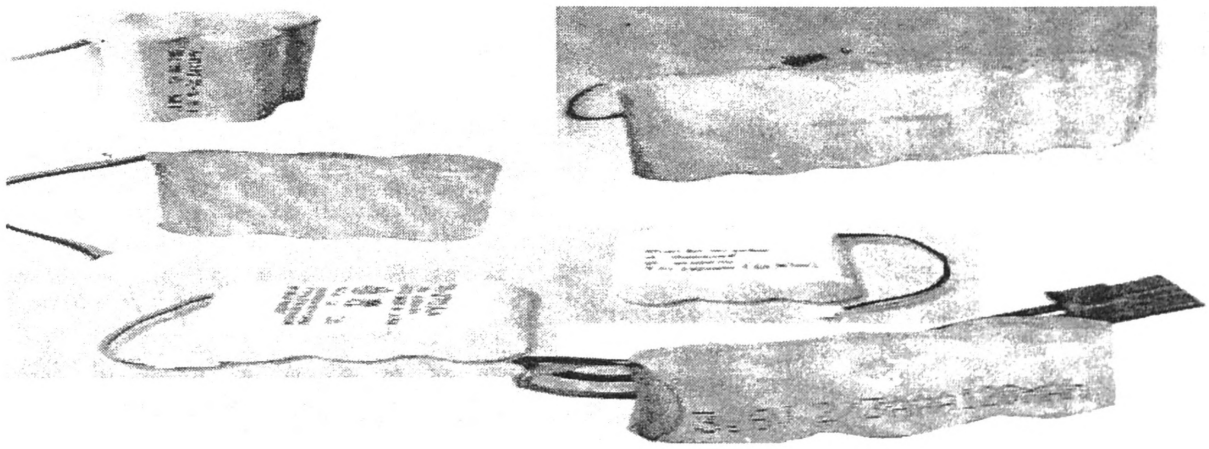
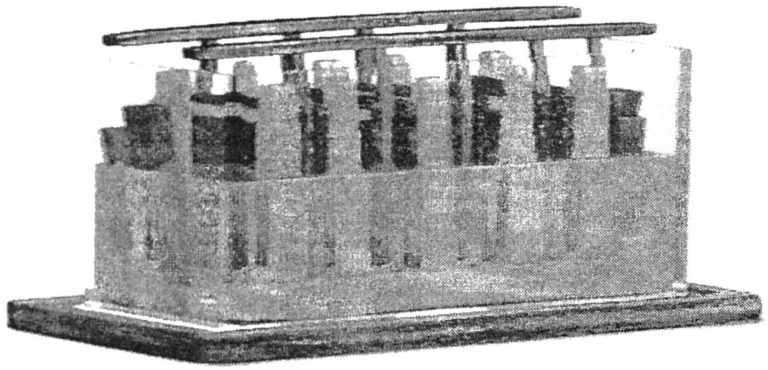
A **rechargeable battery** (also known as a **storage battery** or **secondary cell**) is technically a group of one or more *secondary cells*,(such as a laptop battery containing six individual cells). However, they are often used to refer to a single cell, such as a NiMH AA battery. These batteries can be restored to full or partial charge by the application of electrical energy, such as through a battery charger. In other words, rechargeable batteries are batteries in which the electrochemical reaction that releases energy can be electrically reversible. Rechargeable batteries come in many different sizes using different chemicals. Commonly used secondary cell ("rechargeable battery") chemistries are lead acid, nickel cadmium (NiCd), nickel metal hydride (NiMH), lithium ion (Li-ion), and lithium ion polymer (Li-ion polymer).

Rechargeable batteries can offer economic and environmental benefits compared to disposable batteries. Some rechargeable battery types are available in the same sizes as disposable types (eg. AA, AAA, CR123A). While the rechargeable cells have a higher initial cost, rechargeable batteries can be recharged many times. Proper selection of a rechargeable battery system can reduce toxic materials sent to landfills compared to an equivalent series of disposable batteries. For example, battery manufacturers of NiMH rechargeable batteries claim a service life of 100-1000 charge cycles for their batteries.



History of rechargeable batteries



Planté Battery (circa 1859)

With the rise in portable devices such as laptops, cell_phones, MP3_players and cordless power tools, the need for rechargeable batteries has grown substantially in recent years. The concept of the rechargeable battery has been around since 1859, when French physicist Gaston Plante invented the **lead acid cell**, which would later become the world's first rechargeable battery. That same chemistry is still used in today's car battery.

The basic idea behind the rechargeable battery is simple: when electrical energy is applied to the battery, the electron flow from negative to positive that occurs during discharge is reversed and power is restored. This requires an adapter in the case of devices with built-in batteries or for standard nickel-cadmium or nickel-metal hydride batteries, the most common multi-use rechargeable batteries used today in your remote_control, flashlight or digital_camera

Usage and applications

Rechargeable batteries currently are used for applications such as automobile starters, portable consumer devices, light vehicles (such as motorized wheelchairs, golf carts, electric bicycles, and electric forklifts), tools, and uninterruptible power supplies. Emerging applications in hybrid electric vehicles and electric vehicles are driving the technology to improve cost, reduce weight, and increase lifetime.

Unlike non-rechargeable batteries (primary cells), rechargeable batteries had to be charged before use. The need to charge rechargeable batteries before use deterred potential buyers who needed to use the batteries immediately. However, new low self discharge batteries allow users to purchase rechargeable battery that already hold about 70% of the rated capacity, allowing consumers to use the batteries immediately and recharge later.

Grid energy storage applications use industrial rechargeable batteries for load leveling, where they store electric energy for use during peak load periods, and for renewable energy uses, such as storing power generated from photovoltaic arrays during the day to be used at night. By charging batteries during periods of low demand and returning energy to the grid during periods of high electrical demand, load-leveling helps eliminate the need for expensive peaking power plants and helps amortize the cost of generators over more hours of operation.

Lead-acid

Advantages:

This chemistry has been proven over more than 140 years. Batteries of all shapes and sizes, available in sealed and maintenance-free products, are mass-produced today. In their price range, lead-acid batteries provide the

greatest energy density (the amount of energy produced) per pound, have the longest life cycle and a large environmental advantage in that they are recycled at an extraordinarily high rate. (Ninety-seven percent of the lead is recycled and reused in new batteries.). No other chemistry can touch the infrastructure that exists for collecting, transporting and recycling lead-acid batteries.

Disadvantages:
Lead is heavier than other metals and can be toxic.

Aluminum-air

Advantages:
This is a mechanically rechargeable primary battery system with a capacity equal to 15-20 cycles on a lead-acid system (a cycle refers to a discharge and a charge).

Disadvantages:
Its components must be replaced frequently, water must be added and sludge must be removed. When combined with the expense of reprocessing aluminum, the system is nowhere near commercialization.

Lithium-ion

Advantages:
It has a high specific energy (the number of hours of operation for a given weight) making it a huge success for mobile applications such as phones and notebook computers.

Disadvantages:
More expensive than lead. The cost differential is not as apparent with small batteries for phones and computers, and owners of these devices may not realize that they are paying much more per stored kilowatt hour than other chemistries. However, because automotive batteries are larger, the cost becomes more significant. In addition, currently there is no established system for recycling large lithium-ion batteries.

Nickel-Cadmium

Advantages:
This chemistry is reliable, can operate in a range of temperatures, tolerates abuse well and performs well after long periods of storage.

Disadvantages:
It is three to five times more expensive than lead-acid, its materials are toxic and the recycling infrastructure for larger nickel-cadmium batteries is very limited.

Nickel-metal hydride

Advantages:
It is reliable and lightweight. In hybrid vehicles, these batteries are projected to have very long cycle life, equal to 100,000 miles.

Disadvantages:
The metals in the battery are 25 times more expensive than lead. Nickel has been identified as a carcinogen. Hybrid vehicles have not been on the road long enough to allow the batteries to prove their projected cycle life. No significant recycling capability exists.

Note: The Advanced Lead-Acid Battery Consortium has developed a lead-acid battery system that operates at the very high rates necessary for a hybrid vehicle and recently equipped a Honda Insight with this sytem. If it proves to be capable of reasonable life, the lead-acid batteries will challenge the very expensive nickel metal hydride system in hybrid vehicles today.

Nickel-zinc

Advantages:

This chemistry has good energy density, good operating temperature range and performs reasonably well after long periods of storage.

Disadvantages:

It is expensive and its life cycle, while improved during the past few years, is still merely adequate. So there has been no breakthrough in this chemistry.

Sodium-sulfur

Advantages:

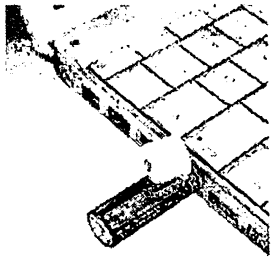
This chemistry is about as efficient as lead-acid, but has three to four times more specific energy (the number of hours of operation for a given weight).

Disadvantages:

Twenty seven years of research has yielded only one commercial application – load leveling by electric utilities in Japan

Future of rechargeable batteries

Sanyo has announced their ENELOOP batteries yesterday. These rechargeable AA and AAA Nickel Metal Hybrid batteries have as main characteristics:
1) they are ready to use as they are already charged. Sanyo seems to have solved the "Self-Discharge" problem (a rechargeable battery discharges slowly when it's not being used).
2) the batteries are "eco-friendly" and can be recycled.
3) the battery life is greater than a Dry Cell type of battery. Sanyo did some tests and they say that you can take 4.4 times more pictures with their batteries than with a normal Dry Cell battery. They can be recharged more than 1000 times too before they start losing their initial capacity.



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