The Chemistry Of Batteries Essay, Research Paper

The Chemistry Of Batteries

People use batteries in their everyday life without thinking of their

impact. Batteries help us get around, keep in touch, have fun, and tell the

time. They do this by powering our cars, cell phones, pagers, portable CD

players, watches and many other useful tools. They can even save our lives

by powering things like smoke detectors, carbon dioxide detectors and

glucose meters. In this term paper I will discuss how batteries function,

what types of batteries exist, what gives them their power and many other

topics related to batteries.

The battery, also known as an electric cell, is a device that converts

the energy from chemicals into electricity. Chemical reactions that are able

to produce electrons are called Electro-chemical reactions. A battery

basically consists of two or more cells that are connected in a series or

parallel. All cells are made of a liquid, paste, or solid electrolyte and a

positive electrode, as well as a negative electrode. The electrolyte works as

an ionic conductor, this causes one of the electrodes to react. This reaction

produces electrons while the other electrode accepts the electrons. Every

battery has two terminals, one positive and the other negative. Electrons

collect on the negative terminal of the battery. If the negative and positive

terminal are connected together, then connected to whatever device that

needs to be powered, also called a load, the electrical current will flow freely

into the device.

The speed of the electron production by the chemical reaction is called

the battery s internal resistance. This controls how many electrons can flow

between the two terminals. Because electrons must flow from the battery

into a wire, and then must travel from the negative to the positive terminals

in order for the chemical reaction to take place. This is why batteries can go

unused for a year and still have plenty of power.

There are two general types of batteries. Batteries that have chemicals

that cannot be reconstituted into their original form after the energy has been

used are called primary cells or voltaic cells. Batteries that contain

chemicals which can be reconstituted when an electric current is passed

through them in an opposite direction of normal cell operation are called

rechargeable cells, storage cells, secondary cells, or accumulators.

Primary cells or dry cell batteries are the most common type of battery

used today. Primary cells were invented by the French chemist Georges

Leclanche in the late 1860 s. During that period this invention was very

important and helped the start of the industrial revolution. It is commonly

know as a dry cell or flashlight battery. The Leclanche cell is very similar to

the dry cell that is used today. The electrolyte is made of zinc, on the

outside shell of the cell, the positive electrode is made of carbon and is

surrounded by a mixture of carbon and manganese dioxide. zinc-carbon

chemistry is used in all AA, C and D dry cell batteries. When the cell is in

use, atoms of the zinc in the outer cases are oxidized, giving up electrons and

forming zinc ions.

Another type of primary cell is a mercury cell. This cell uses zinc as

the negative electrode, mercuric oxide as the positive electrode and an

electrolyte made of a solution of potassium hydroxide. This cell can be

made in the shape of a very small flat disk and is used in electric

wristwatches, hearing aids, and photoelectric cells.

The lead acid cell, also called commercial secondary or storage cell

was invented in 1859 by French physicist Gaston Plante. As mentioned

before, this cell can be recharged by reversing the chemical reaction.

Plante s original cell was a lead acid battery, which is still widely used

today. Just as with Leclanches s cell, it has been vastly improved on over

time. It consists of a lead negative electrode, a sulfuric acid electrolyte, a

porous polymer or glass separator and a lead dioxide positive electrode. As

the cell is used, lead sulfate forms at both electrodes and the sulfuric acid is

consumed. When it is recharged, the lead and lead oxide are remade and

more sulfuric acid is formed. This secondary cell produces 2V, a number of

these cells are typically combined in series to make up 6 or 12V batteries.

Advances in technology have recently made it possible for lead batteries to

have useful lives of 50 to 70 years. Lead acid batteries are commonly used

in automobiles for starting, lighting, and ignition. Another very important

use is for uninterruptable power supply systems for computer and telephones

systems.

The lead acid battery is known to be the lowest costing of secondary

batteries. When it is used in a way where it is never fully discharged, like

starting an automobile, it can last for up to 20 years and for many recharging

cycles. It has a much shorter lifetime when it is used for other applications,

for example powering a golf cart, when it is greatly discharged. If the

battery is overcharged it will quickly wear out due to internal corrosion and

loss of water. During these times when environmental pollution is such a

problem, over 95 percent of lead acid batteries are recycled into new

batteries.

An improvement on the nickel iron battery that was developed by

inventor Thomas Edison in the 1900 s, is the nickel cadmium battery. The

nickle cadmium battery has a cadmium negative electrode, a potassium

hydroxide electrolyte, a nonwoven fabric separator, and a nickel positive

electrode. It produces 12V and endures many more full discharges cycles

than the lead acid battery ( up to 1000). It s a small cell that is commonly

used in portable tools like telephone, electric toothbrushes and shavers.

Interestingly enough it is also used in air planes where long life is truly

important.

An improvement of the nickle-cadmium cell is the nickel metal

hydride cell, the cadmium negative electrode is replaced with a complex

metal alloy that, absorbs hydrogen gas as it is charged and sends it to the

electrolyte as it discharges. This solves the problem of the hydrogen

potentially causing an explosion. The nickel metal hydride cell has 50

percent more power then the nickel cadmium cell. It has mostly replaced the

nickel cadmium cells in notebook computers and cellular phones

Batteries are a vital tool to our everyday lives. With technology

rapidly expanding by the day, researchers in battery technology are

continually exploring different ways to make batteries. There is now more

then ever, an expanding array of technologies that need batteries to power

them. There are numerous types of batteries that have been developed for

electric cars and more powerful portable devices. Size, short range,

environmental issues and high expense are all problems to be solved for

these new endeavors. Cutting edge batteries that show promise for electric

vehicles are sodium sulfur, lithium ion sulfide, zinc chlorine, and nickel

metal hydride all seem to show promise. Solar batteries are another kind of

cell technology. They produce electricity by a photoelectric conversion

process. Electricity is made from a photo sensitive semiconducting

substance like silicon crystal. It s functions by light hitting the crystal

causing electrons to be dislodged from the surface of the crystal. These

electrons then move to an opposite surface. They are then collected as a

currant of electricity. Solar batteries have the advantages of long lifetimes.

They are used in space to provide electricity for operation of equipment

abord spacecraft s.

Research is currently being done on the possible use of organic

polymers and solid inorganic conductors as electrolytes. New materials for

the use of both positive and negative electrodes is also being researched.

Batteries play a very important role in our everyday lives. Many different

devices we have come to reply upon require batteries to supply them with

the power they need. Advancement in battery technology are working to

reduce environmental hazards caused by batteries and to make them more

compact.

The battery is a true universal source of energy that is used around the

world. Learning about how batteries function and about the many different

types of batteries has helped me to appreciate them a lot more. Batteries are

a valuable source of power that people use everyday but also take for

granted. Batteries will continue improving the quality of our lives.

Bibliography

Battery Funk & Wagnalls New Encyclopedia. 1987, Volume 3, pp.

346-347

Funk and Wagnalls. (on line) Available http://www.funkandwagnalls.com/

May 3, 2000

Marshall, Brian How batteries work (online). Available

http://www.hotstuffworks.com/ April 25, 2000

Microsoft Encarta 97 Encyclopedia. On CD-Rom. 1993-1996 Microsoft

Corporation.