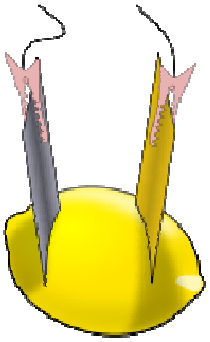
Direct current sources

Electrical devices require a supply of voltage and current to function. Portable devices are usually powered by direct current which is obtained from batteries.

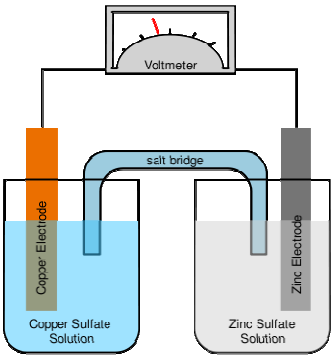
An electrical battery, first named by Benjamin Franklin in 1748, is a combination of two or more electrochemical cells used to convert stored chemical energy into electrical energy. There are two types of batteries: **primary batteries** (disposable batteries), which are designed to be used once and discarded when they are exhausted, and **secondary batteries** (rechargeable batteries), which are designed to be recharged and used multiple times. Strictly, a battery is a collection of two or more cells, but in popular usage battery often refers to a single electrical cell.



Note: Almost any liquid or moist object that has enough ions to be electrically conductive can serve as the electrolyte for a cell. As a novelty or science demonstration, it is possible to insert two electrodes made of different metals (copper; zinc) into a lemon, potato, etc. and generate small amounts of electricity.

1 lemon = 0,83 V (approximate, reaction ranges from 0,8 V – 0,98 V) × 0,00015 A = 0,0001245 W = 124,5 μW

Primary electrochemical cells



An electrochemical cell consists of two half-cells. Each half-cell consists of an electrode, and an electrolyte. The two half-cells may use the same electrolyte, or they may use different electrolytes. The two half-cells are linked by a salt bridge carrying ions between them. Electrons flow in the external circuit.

Secondary electrochemical cells

Secondary electrochemical cells must be charged before use; they are usually assembled with active materials in the discharged state. Rechargeable electrochemical cells or secondary electrochemical cells can be recharged by applying electrical current, which reverses the chemical reactions that occur during its use. Devices to supply the appropriate current are called chargers or rechargers.

The oldest form of rechargeable cell is the lead-acid cell. Other portable rechargeable cells are (in order of increasing power density and cost): nickel-cadmium cells (NiCd), nickel metal hydride cells (NiMH), and lithium-ion cells (Li-ion). By far, Li-ion has the highest share of the dry cell rechargeable market. Meanwhile, NiMH has replaced NiCd in most applications due to its higher capacity, but NiCd remains in use in power tools, two-way radios, and medical equipment.

Durability

Most chemically based rechargeable batteries will last up to three years which roughly corresponds to 1000 recharge cycles. Lead and nickel-cadmium batteries last up to 6 years, but with age they lose capacity. The capacity of a rechargeable battery is calculated by multiplying current the battery is capable of supplying by time the current can be supplied for. For example a 40 Ah rechargeable battery can supply 4 A for 10 hours or 2 A for 20 hours. The optimal current drain for a rechargeable battery is 1/10 of its capacity. Durability is affected by:

- Using the battery at temperatures of 35 °C and higher
- not maintaining the battery's charge for a long period
- frequent overcharging

Battery classification:

- lead-acid battery ⇨
- alkaline battery
- nickel-cadmium battery
- nickel metal hydride battery
- lithium-ion battery
- lithium-ion polymer accumulator

Li-ion cell

AA Ni-MH cells

Use

AA, AAA cells

Batteries are used in many devices as an auxiliary power supply. Lead-acid batteries are present in every car to start the motor. They are also integral to consumer electronics. Batteries are found in every notebook, cell phone or flashlight.

Car battery

Recycling

Battery recycling is a recycling activity that aims to reduce the number of batteries being disposed as municipal solid waste. It is widely promoted by people concerned about contamination, particularly of soil contamination and water pollution, by the addition of heavy metals and other toxic chemicals from batteries.

VOCABULARY

battery – batéria, akumulátor
disposable – jednorázové
rechargeable – dobíjacia
moist – vlhký
liquid – kvapalný, tekutý
amount – čiastka, množstvo, význam
assembled – zmontované
occur – vyskytovať sa, nastať, udiať sa
two-way radio – vysielač-prijímač
share – podiel
power tool – ručné elektrické náradie
aim – cieľ
dispose – likvidovať, odstrániť
promoted – podporovaný
soil – pôda, zem
strictly – prísne, presne
approximate – približný
novelty – novinka, nová vec
science – veda
demonstration – dôkaz, predvádzanie, demonštrácia
appropriate – vhodný
by far – zďaleka
meanwhile – dokonca
electric vehicle battery – autobatéria
durability – trvanlivosť
flashlight/flashlamp – baterka
municipal – obecný, mestský
waste – odpad
pollution – znečistenie