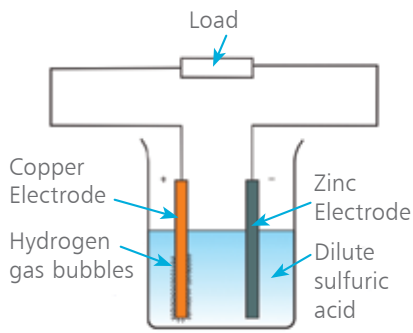
Primary Cells

Electrical energy can be produced by a number of means, including mechanical and chemical. A device that generates a charge when a chemical reaction takes place is called a *cell*. There are two main types: primary and secondary. First, we look at primary cells.

The simplest primary or *voltaic* cell consists of the following:

1. A positive electrode (anode) consisting of a copper plate
2. A negative electrode (cathode) consisting of a zinc plate
3. An electrolyte of dilute sulfuric acid

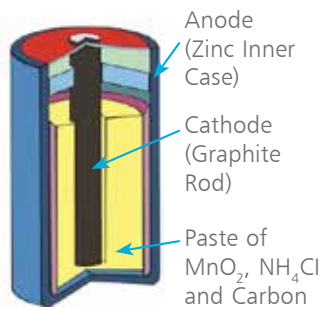


The sulfuric acid is poured into a container, and the electrodes are placed into the electrolyte. If the two electrodes are then connected together outside of the cell, a current will flow from the copper electrode to the zinc electrode, and through the electrolyte back to the copper electrode.

In this simple form, the voltaic cell only works properly for a short time. As it generates current, a layer of hydrogen bubbles starts to build up on the copper electrode, causing its output to become less and less. Also, the zinc electrode has to be totally pure. If not, any impurities will react with the zinc and the sulfuric acid, again reducing the cell's output.

Dry cell

The energy produced is called *electromotive force* (*emf*). A typical simple primary cell described above has an emf of about 1 volt. More common is the *dry cell*, as used in torches, producing about 1.5 V. This is an electric cell in which the electrolyte is in the form of a paste to prevent any spillage.



In 1799, a year after discovering methane, the noted pioneer of electricity and power, Alessandro Volta, proved that electricity can be produced by chemical means when he invented the voltaic pile: a crude form of battery.

Connecting several cells together forms what is called a *battery*.

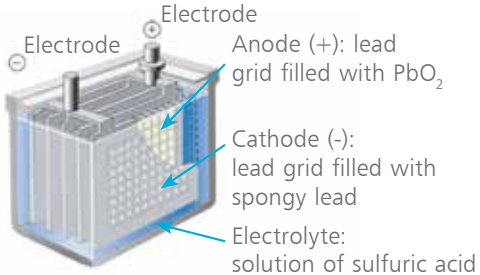
Primary cells use up the chemicals they contain. They cannot be recharged, as the action is non-reversible.

Secondary Cells

The lead-acid cell

This is one of the most common secondary cells and does not, on its own, generate electricity. The cell has to be initially charged with electrical energy from an external source; this energy then being stored in the cell as chemical energy.

1. The construction of the lead-acid cell is quite complex
2. Cells contain special interlaced positive and negative plates



3. The electrolyte is a mixture of sulfuric acid and water
4. A charged lead-acid cell has an emf of approximately 2.0 V when in use

The advantage of the lead-acid cell is that the charging process is reversible so that once charged, the chemical energy can be released in the form of an electric current as required.

When the cell has released all of the stored energy and has become discharged, then it can simply be recharged again from the external source and the process repeated.

You will actually be more familiar with this type of cell than you think. A car battery is, in fact, a number of lead-acid cells joined together. It stores and provides the electrical energy required by the motor vehicle, and is recharged when the engine is running.

Although not lead-acid, here are some popular everyday types of small rechargeable secondary cells you will recognize.

Secondary cells are reusable in that they can be charged from an external source and then discharged during use many times over.

Small rechargeable batteries in everyday use contain a chemical paste or *solid* electrolyte instead of sulfuric acid. Typical types include:

- Ni-Cd (Nickel Cadmium)
- Ni-MH (Nickel Metal Hydride)
- Li-ion (Lithium Ion)

The voltage rating of a Ni-Cd or Ni-MH rechargeable battery is usually a little lower than that of its dry cell equivalent. They should not be mixed in use!