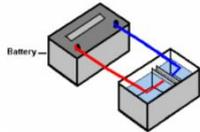


## Electrolysis of water

It is important that you understand the basic principles of electrolysis as used in the basic hydrogen generator. An electrolysis unit in any vehicle must use electrical power delivered by a car battery.

The basic outline involves Two metal plates are placed in water and an electric current is passed between the plates. This causes the water to break down into a mixture of hydrogen gas and oxygen gas . The greater the flow of current, the larger the volume of gas which will be produced. The arrangement is like this:



Just like the fact that a very useful chain saw is a dangerous device which needs to be treated with respect, so too, please understand that the very useful Hydrogen and oxygen gas mix contains a lot of energy and so needs to be treated with respect.

This style of electrolysis of water was investigated by the very talented and meticulous experimenter Michael Faraday. Faraday showed the amount of Hydrogen and oxygen gas produced is proportional to the current flowing through the water, so to increase the rate of gas production, you need to increase the current flow.

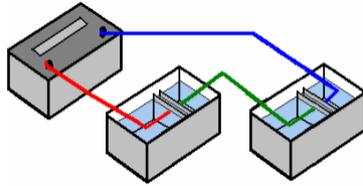
Please note I do not talk about HHO Gas as there is no such thing as monatomic hydrogen and /or monatomic oxygen gas and any fool that says it does exist is just that , a fool.

When a DC electrical power source is connected to two [electrodes](#), or two plates (typically made from some inert metal such as [platinum](#), [stainless steel](#) or [iridium](#)) which are placed in the water. Hydrogen will appear at the [cathode](#) (where [electrons](#) enter the water), and oxygen will appear at the [anode](#).

Assuming ideal [faradaic efficiency](#), the amount of hydrogen generated is twice the amount of oxygen, and both are proportional to the total [electrical charge](#) conducted by the solution. However, in many cells [competing side reactions](#) occur, resulting in different products and less than ideal faradaic efficiency

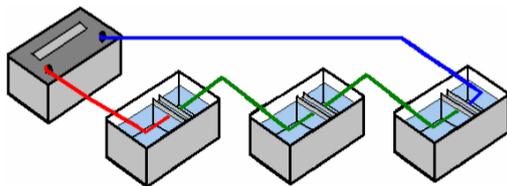
In the arrangement shown above, twelve volts is being connected across two plates in water. Faraday tells us that only 1.23 volts of that twelve volts will go to make hydrogen gas and the remaining 10.77 volts will act as an electric kettle and just heat the water, eventually producing steam. As we want to make hydrogen gas and not steam, this is bad news for us. What it does tell us is that if you choose to do it that way, then only 10% of the power taken by the single electrolysis cell actually makes hydrogen gas and a massive 90% is wasted as heat.

We really don't want a low electrical efficiency like that. One way around the problem is to use two cells like this:



This arrangement uses our 1.24 volts twice while the twelve volts stays unchanged and so the electrical efficiency goes up to 20% and the heat loss drops to 80%. That is quite an improvement but even more important is the fact that twice as much hydrogen gas is now produced, so we have doubled the electrical efficiency and doubled the gas output, giving a result which is four times better than before.

We could go one step further and use three cells like this:



This time we are using three of our 1.23 volt sections and this gives us an electrical efficiency of 30% and three times the amount of gas, making the system nine times more effective.

This is definitely going in the right direction, so how far can we take it when using a twelve volt battery? When we use the construction materials which years of testing has shown to be particularly effective, there is a small voltage drop across the metal plates, which means that the very best voltage for each cell is about 2 volts and so with a twelve volt battery, six cells is about the best combination, and that gives us an electrical efficiency of 62% and six times as much gas, which is 37 times better than using a single cell, and the wasted electrical power drops down from 90% to 38%, which is about as good as we can get.

A common thought is why not use more and more cells to get more gas. The answer is that although the oxidation/ reduction potential is only 1.23 volts, that this voltage is for an ideal solution having no internal resistance and using platinum electrodes which are prohibitively expensive. It is found the optimum voltage required to reduce water into hydrogen and oxygen is 2.2 volts. Modern batteries are not 12 volt but rather 13.2-13.8 and so 6 cells using 2.2 volts is the best combination.

The cells in an HFS pty ltd generator is arranged to current/ voltage leakage between cells using the patented geometrical array and three double cells as well as specialized fluid mechanics that reduces energy wastage as heat.

This is a disaster for us as now we will not get your six times the gas production or our massively reduced heating. Thankfully, there is a very simple fix for this problem, and that is to divide the box up into six watertight compartments using thin partitions like this:

Some Common US designs use the so called Neutral plate arrangement that has holes in the plates to allow fluid flow and consequently allows for electro-stripping to occur starting at the edges of the hole until the whole system collapses and produces a short circuit , destroying the vehicles electrics.

Electrolysis of *pure* water requires excess energy in the form of [overpotential](#) to overcome various activation barriers. Without the excess energy the electrolysis of *pure* water occurs very slowly or not at all. This is in part due to the limited [self-ionization of water](#).

Pure water has an [electrical conductivity](#) about one millionth that of seawater. Many [electrolytic cells](#) may also lack the requisite [electrocatalysts](#). The efficiency of electrolysis is increased through the addition of an [electrolyte](#) (such as a [salt](#), an [acid](#) or a [base](#)) and the use of [electrocatalysts](#).