Low Voltage Electrolysis

(Under Construction)

I think everyone should probably start where they feel they will have the most success. Although low voltage is a completely different approach and has nothing to do with the Water Fuel Cell, I and many others are open minded and optimistic that low voltage electrolysis might give rise to new efficiencies over 100%. The ultimate goal would be able to supply enough gas to power a vehicle on demand.

Before you waste time experimenting on something that has already been done before or asking people silly questions on forums, read this information below and refer to books in the resource section. I am going to compile a great resource for experimenters in low voltage electrolysis.

I have created this section on low voltage electrolysis to give answers or a guide to these topics.

- **How to produce a efficient electrolyser?**
- **How much hydrogen/oxygen do I have to generate per minute to run a small engine?**

First Things First: Understand Electrolysis

Click here to learn about Electrolysis

There are plenty of people building different types of electrolysers on the forums.

I will try and fast track the learning process by teaching you what I have learned. I will base this on what I have read in books and observed from other experimenters.

How to Produce a Efficient Electrolyser

Things that need to be considered

- **Electrical Efficiency**
- **Temperature**
- Pressure
- **Cell design**
- **Electrolyte**
- **Different types of hydrogen production**

Electrical Efficiency

Hydrogen/oxygen generated during electrolysis is dependent on current (amperage)

If voltage is to rise higher than the lower limit then power is wasted. (refer below)

For example: An electrolyser using 2000 volts and 2amp would produce approximately the same amount of gas as a 2 volts and 2amp electrolyser.

When calculating the power in watts, you can really see how much power you are wasting. (refer below)

2000 volts x 2amp = 4000watts

Compared to:

2 volts x 2amp = 4 watts

That's pretty amazing !

The lowest voltage, theoretically, is 1.24 volts for electrolysis.

This is the best explanation I have on why, is that 1.24 volts is the minimum.

Quote from this link

> "This theoretical figure was determined by taking the energy released per mole when hydrogen is burned. Using that figure, and knowing how many amp hours are needed to produce 1 mole of gas, they calculated the theoretical minimum voltage."

Definition of a mole here

I need a better explanation why the minimum voltage is 1.24 Volts. I am open to your input. Please also provide a link if possible. contact me.

Lowering the voltage means higher efficiencies.

Temperature

At 25 degree Celsius Using voltages between 1.24 and 1.47 Volts **will not produce heat** it actually absorbs heat from the environment. This is called a endothermic reaction.

1.481 volts is referred to as a thermo neutral reaction. This is the critical limit. Our electrolysis chamber will actually remain cold or similar temp to the environment you have it in, if you don't go over the 1.481 Volt limit. If you do go over, you will produce heat this is called a Exothermic reaction.

See this information that explains a thermo neutral reaction (need a link....contact me)

Raising the voltage means the cell temp will rise. This occurs when exceeding the 1.481 limit. We don't wont to exceed this upper limit too far because of the risk of boiling/evaporation. We waste power and it may produce steam/Water vapor. This will enter the combustion chamber leading to a decrease in power.

I have recently read an article that pulsing the voltage will regulate the temperature when exceeding voltages above 1.481. See here

Important Fact on Temperature

At 25 degrees Celsius the necessary voltage needed to electrolyses water is 1.24 volts. Increasing the cell temperature will actually lower the 1.24 volt limit.

For Every 1 degree Celsius raised during this voltage level you can drop the 1.24 Volt minimum by 0.82mv.

I believe the best way to heat the cell will be to capture any heat that will be given of by the engine friction or exhaust gases. thoughts?

Important fact on Pressure

Raising cell pressure means you raise the lower voltage limit. bad news !

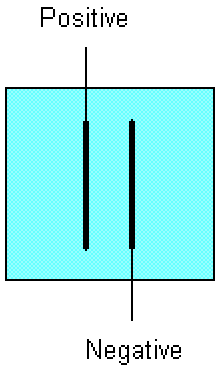
With rising cell temperature for every degree Celsius it increases the necessary voltage by 44.4 mv when the pressure is increased 10 times.

What sought of design should I choose for my cell design?

Well that's a difficult question I will try and guide you in a good direction.

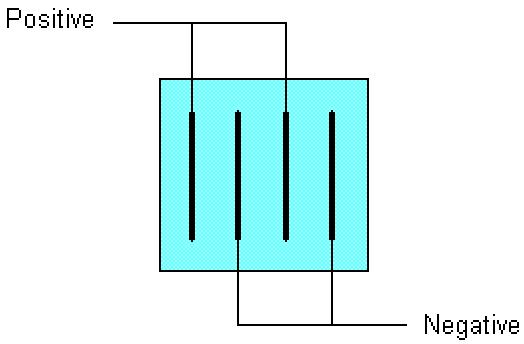
First thing first lets get familiar with cell configurations I will use a 12volt source in the examples

12 volt Single cell Design

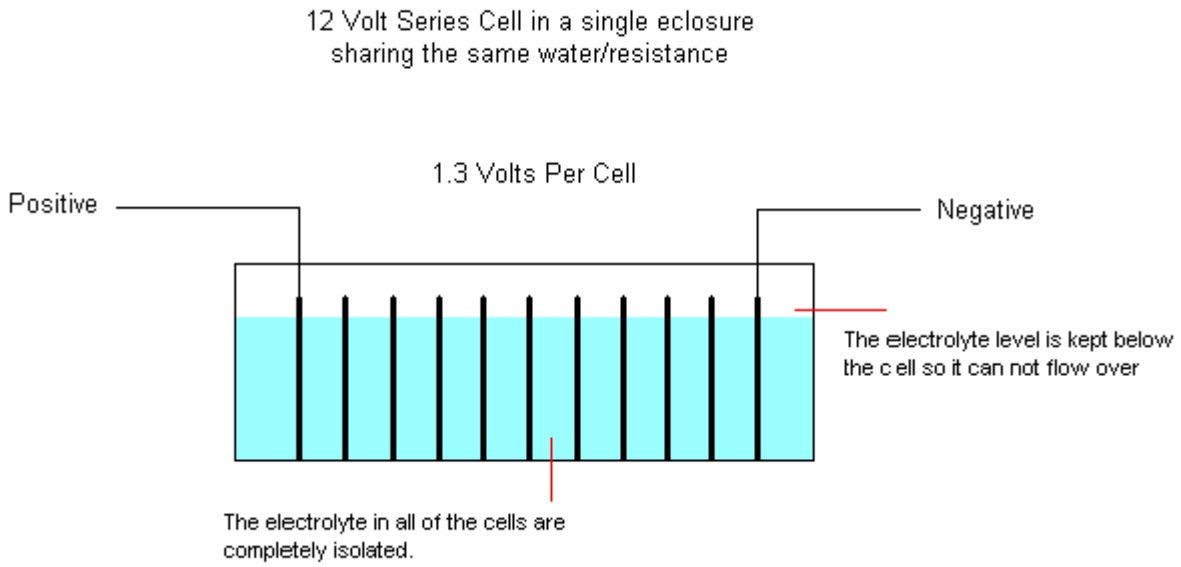


The parallel plate cell design

12 volt parallel design



1st series cell design



Important Note

If you don't isolate the cells like I have described above your voltage per cell will look like this

negative plate

2.22 V

1.16V

.89V

.77V

.72V

.69V

.92V

1.06V

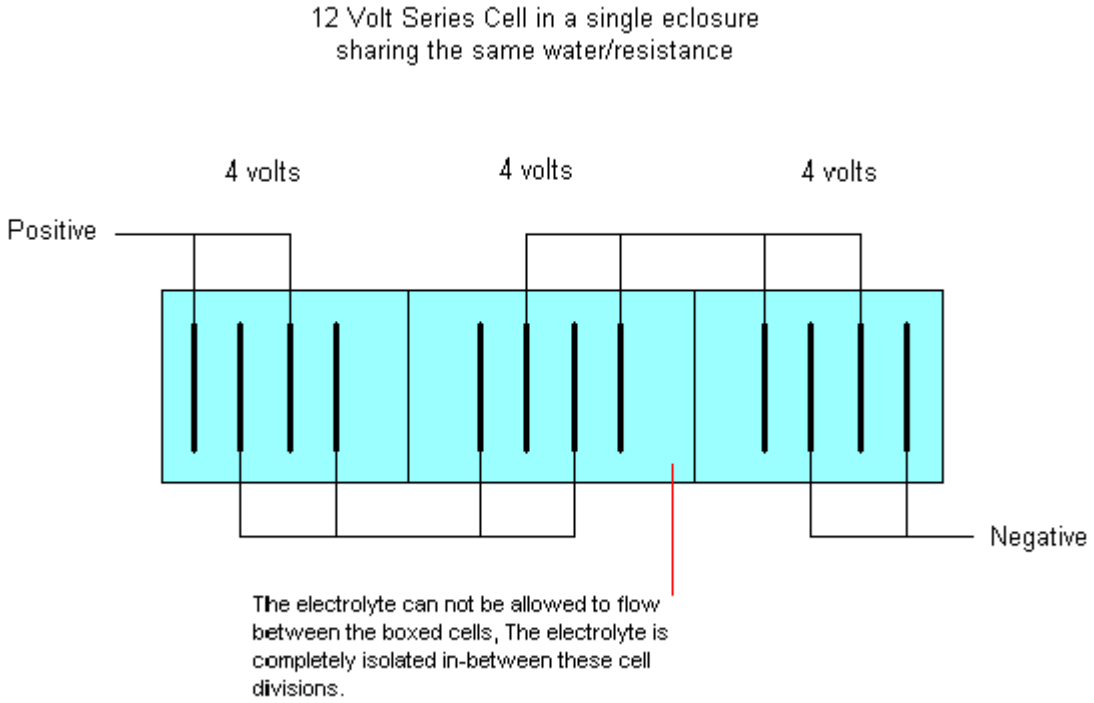
1.41V

1.80V

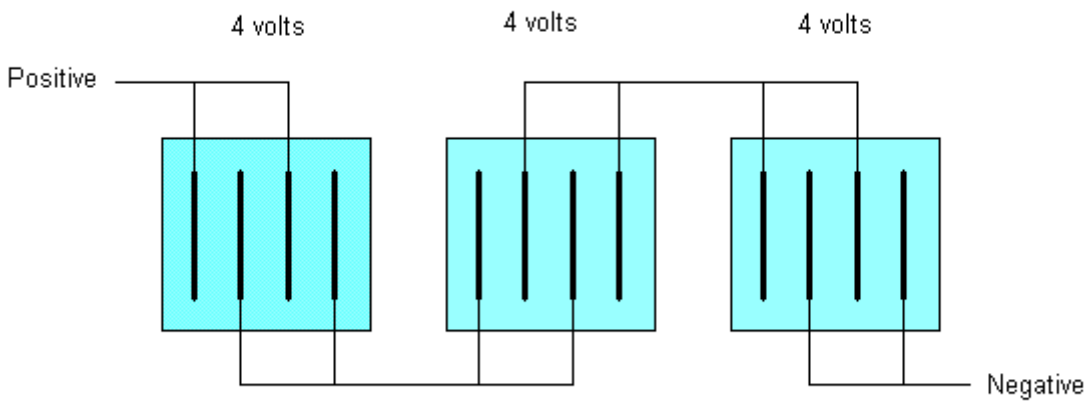
Positive plate

I have been informed that the above is due to bypass leakage currents so the only way to stop this from happening is to isolate the cells within the container so no electrolyte can pass to between like I have shown.

2nd Series Cell Design



3rd Series Cell



The above cell the same principle as series cell 2 but just in separate containers

If your wonting to See how efficient your cell is use this calculation at the Electrolysis Site or just plug in the values here titled (hydrogen.exe executable) and it will spit it out.

The most economical and innovative cell design I know of to date is as follows.

Chris at Oupower has a good option for people See this here (Electrolysis and Prototype Water Engine)

Electrode spacing and Electrolyte

A 3mm gap is thought to be a good clearance to have between plates in a electrolyser

You must choose a electrolyte such as Potassium hydroxide (KOH) and use distilled water. It has always been the recommended electrolyte for the main reason that it stays in the electrolyte and does not cause a toxic gas such as chlorine when using salt as a electrolyte.

more on choosing the appropriate ratio of KOH and other information/dangers See here

Power source

The most common is a 12-volt battery but as we discussed above voltage must be around 1.24 and 1.47 or just over for efficient production. A series cell design may be the most economical approach. This will reduce the voltage. Refer to series cell designs above.

A regulated, pulsed, or variable power supply may be suitable, but large amperage is needed for most cells these types of power supply can be expensive and hard to find. Twelve volts batteries in parallel will supply a lot of current. Make sure you use a series cell design to cut down the voltage.

A computer power supply may be an alternative as they may output around 15 amp with low voltage (around 5 volt). These could be used in parallel to boost amperage.

Someone has recently informed me they used a step down transformer and 5 amp variac to produce 50 amp dc power supply. I will try to elaborate later on and give plans.

I was also thinking of rectifying the output of a AC arc welder and feeding this into a series cell design. An arc welder usually produces around 50 volt and pumps out around 100amp. More information to be given on this later. I will give it some more thought.

Backflash Arrestor

Many people use bubblers. See here at oupower.

Bubblers help in giving you some sought of protection from the cell exploding, so don't think you don't need it. There is no backflash arrestor I know of that is quick enough to stop a hydrogen/oxygen flame.

Stanley Meyer worked on the principle of the gas traveling through very small holes stopped the backflash, but it needed to be mixed with non combustible gasses.

See the Hydrogen Fracturing Process book
section 2 Titled Quenching circuit technology (specifically 2-3 for written information) and figure 2-4, 2-6, 2-7

There may be another way!

If the hydrogen/oxygen is injected before spark ignition occurs, then the injector will be closed before the gas is even ignited. It also has another advantage of being precisely metered. I think port injection might be the best option, but a specific hydrogen injector might have to be used and definitely a bubbler.

A problem that exists with single cylinder four stroke engines is that the spark occurs on the exhaust stroke as well as the firing stroke. The combustion occurs on the exhaust stroke (Backfire). This is because the unburnt hydrogen gases reignite!

I think all of the methods above are dangerous and I do not advise anyone to use any methods, so it's at your own risk.

Different Types of Hydrogen

There are four different atomic forms of hydrogen these are:

Orthohydrogen

Parahydrogen

Monatomic Hydrogen

Diatomic Hydrogen

At atmospheric pressure and 25degress Celsius hydrogen gas is 75% orthohydrogen and 25% Parahydrogen. When Hydrogen gas is liquefied, it all converts into Parahydrogen.

Orthydrogen

Orthohydrogen electrons spin in the same direction and the gas is very explosive.

The Xogen Patent seems to think it is ideal for combustion engines.

quote from patent

> "As is well understood by those skilled in the art, orthohydrogen is highly combustible. Therefore, any orthohydrogen produced can be transported from the container 111 through valve 102 and outlet tube 101 to be used by a device such

as an internal combustion engine."

Parahydrogen

Parahydrogen has electrons spinning in opposite directions , is slower burning, and is safer to use.

Quote from Xogen Patent

> "Parahydrogen is not as highly combustible as orthohydrogen and hence is a slower burning form of hydrogen. Thus, if Parahydrogen is produced by the cell, the Parahydrogen can be coupled to a suitable device such as a cooker or a furnace to provide a source of power or heat with a slower flame."

Monatomic hydrogen

Monatomic hydrogen is thought of as more explosive because it travels as a single gas atom (H) and doesn't cling to other hydrogen atoms. This makes it great for combustion because it is less work to break it down.

See this information on Browns gas (See both pages)

also these definition and story on Bob Boyce

Diatomic hydrogen

Diatomic hydrogen is thought of as less explosive because it travel in groups of hydrogen (H_2) atoms. There is more work needed to combust this gas and is thought of as less explosive.

See this information: Browns gas (See both pages)

Also these definition and story on Bob Boyce

Xogen seem to have the orthohydrogen part under control with the pulsing of the plates see the patent work needs to be done on our behalf to figure out how to produce these gases. I need more information for this section Please Help.

Brown gas seems to have the monatomic hydrogen solved.

What I think we need to produce is monatomic hydrogen that is in a orthohydrogen state.

That's my thought, but I might be wrong?

This may suit our electrolysers and Combustion engines. We may only need 1% of gas in the combustion chamber.

How Much Hydrogen and Oxygen Do I Have to Generate Per Minute to Run a Small Engine?

By what I understand using a stoichiometric air fuel ratio will result in high NOX emissions. This is not good for the environment and is a waste of fuel. It needs to be diluted with more air.

Hydrogen can run at ratios 180 to 1 by mass ratio or in other words about 5% of the combustion chamber. The stoichiometric ratio is a lot higher 34 to 1 by mass, that's about 30% of the combustion chamber. Using the 5% ratio suits the environment and us!

So lets do the math and see how much hydrogen we need to power a 100cc engine running at 1000rpm.

A four stroke engine doing 1000 revolutions per minute will fire 500 times, so we only need to supply fuel for that 500 compression strokes. If you are not familiar with the four stroke cycle see this.

The minimum required fuel air ratio is 5% hydrogen in the combustion chamber, so that equals 5cc in a 100cc engine.

500 ignitions x 5cc of hydrogen = 2500cc

So that means for a **100cc engine,** we need **2.5 liters** of hydrogen per minute for a engine running at **1000rpm**.

I wonder if I am correct?

Now if we use this calculator here titled (hydrogen.exe executable) we can work out using electrolysis how much current we need to pump through a electrolyser. See results below:

Hydrogen Gas .....**2.5 liters**

Water required .....3ml (disassociated)

Electrical current required.... **328 amps**

Time to generate.....**60 seconds**

Design Considerations

I feel that a pipe feed electrolyser going to a small 100cc engine, that is not properly regulating, will result in huge wasteful amount being uncombusted and would run out of gas very quickly! The first few strokes would gobble up all the gas. I think either a proper injection system or a regulated hydrogen/oxygen gas supply will be the only way.

Some people speculate you can go even lower than the minimum 5% ratio. I don't know. This is why we need to experiment and build a electrolyser and get a small engine running.

Also something that I have not equated for in the calculation above was the extra oxygen being created by the electrolyser and entering the combustion chamber as well as the hydrogen. This must certainly help in aiding the combustion process, doesn't it?

For more information see download this called *Module 3 Hydrogen: Use in a Internal Combustion Engine.*

What Do We Need to Find Out?

We all need to experiment and work as a team to find solutions to the possibility of running a car on water and find answers to the following:

- Minimum plate surface area to produce maximum gas efficiently?
- Different frequencies may increase gas production?
- 100 % orthohydrogen production maybe from electrical pulsing?
- Vacuum electrolysis. This is what I am interested in. The theory is from others who have experimented with this approach is that you may be able to suck of the bubbles from the electrodes, so electrolysis can continue to produce more gas. Also there might be other mysteries associated with the vacuum?
- different ways to Electrolyze water below 1.24 Volts
- Different metal used with in the electrolyses (Galvanic series inert electrodes)
- Using different types of hydrogen to lower the 5% minimum requirement in occupying the combustion chamber for combustion to occur.
- Direct Injection system to precisely meter/monitor gas supply and prevent gas wastage.
- Back flash arrestor that can handle the speed of Hydrogen and oxygen flame

To date there is only one person that I know of who has successful powered a small engine continuously from a battery source. This was Linnard at Oupower. His work can be viewed here (Linnard's Water Engine)

Any more relevant information will be appreciated. I would like to extend this resource:

A lot more detailed information is in this book Fuel from water and also other books and information in the resource section.

I would really appreciate if you could contact me concerning any positive or negative feedback on this topic. There may be flaws in my logic. Please try to give me a reference or other factual evidence to back up your thoughts.

Good Luck,

Murray