

# A Guide to Supplemental Hydrogen Injection

Hydrogen 4 Gas



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# **The Science of Hydrogen**

## **What is Hydrogen?**

Hydrogen was discovered in 1766 and is the lightest element we know of today, containing one proton and one electron. It is also the most plentiful gas in the universe. Stars are made of primarily hydrogen. Hydrogen has a specific gravity of 0.070 and is 15 times lighter than air. Scientists estimate that 90% of all atoms contain hydrogen. Hydrogen gas is not found by itself on earth. It is found only in compound form with other elements.

Water (H<sub>2</sub>O) is made up of Hydrogen and Oxygen. The details of this are explained later in the book. Like electricity, hydrogen is an energy carrier and must be produced from another substance. Hydrogen is not widely used today but it has great potential as an energy carrier in the future.

## **What is Supplemental Hydrogen?**

Supplemental Hydrogen refers to the use of hydrogen as a supplemental fuel with internal combustion engines. Hydrogen Fuel is made up of a mixture of oxygen and hydrogen gases, prescribed to be in perfect balance at a 1:2 atomic ratio.

This same proportion is found in H<sub>2</sub>O. Supplemental Hydrogen is also known as Oxy Hydrogen, Brown's gas, Rhodes gas and HHO.

## **How to make Hydrogen**

Hydrogen can be produced from a variety of resources (water, fossil fuels, and biomass) and is a by-product of other chemical processes.

Since hydrogen does not exist on earth as a gas, we must separate it from other elements. We can separate hydrogen atoms from water, biomass, or natural gas molecules. The two most common methods for producing hydrogen are steam reforming and electrolysis (water splitting). Scientists have even discovered that some algae and bacteria give off hydrogen.

## **Fuel from Hydrogen**

Since Hydrogen is an energy carrier, it makes a great fuel. It is so effective that it has been used to power the rockets from NASA since the 1960's.

When the space shuttle takes off, the rockets let off plenty of steam. Looking closely, you will notice that actual flame is a light blue color. This color comes from the hydrogen in the on board rocket.

Hydrogen is not only used to get shuttles off the ground, but to fuel the space shuttle and satellites as well. Manned shuttles recombine hydrogen and oxygen in fuel cells to generate electricity and the by-product is pure distilled water for the crew to drink.

If hydrogen fuel can power a rocket, it is definitely an energy carrier. Harnessing that energy would create a powerful fuel source.

## **Benefits as a Fuel**

There are many benefits in using hydrogen as a fuel source when compared to conventional fuel options.

First, hydrogen is incredibly inexpensive. It is literally all around us, in an unlimited quantity, waiting to be harvested and used. Hydrogen is a renewable fuel source, unlike fossil fuels that rely on a finite reserve, which, one day, will be completely depleted.

Second, hydrogen is a clean fuel. The only by product of hydrogen fuel is water. When hydrogen fuels an engine, there is no carbon dioxide produced.

Third, hydrogen is safer to burn than any other fuel source currently being used. This is a big benefit, because the environment is on our minds these days.

Fourth, hydrogen is far more affordable than fossil fuels. Hydrogen can be isolated using either solar power or wind power, both of which cost the consumer nothing. Estimates indicate that producing hydrogen fuel on a widespread basis would end up costing the equivalent of \$1.20 to \$1.50 for a gallon of traditional gasoline.

Lastly, hydrogen creates more energy per pound than any other conventional fuel, making it an ideal energy efficient fuel source. Hydrogen is two to three times more energy efficient than gasoline when powering vehicles.

Using hydrogen will save us money and protect our environment.

## **Hydrogen in the Open Market**

Even with all the benefits and the dream of the hydrogen economy, we still do not use hydrogen to power our cars on a widespread scale. The main reason is that hydrogen is not found in its own individual state. Hydrogen always bonds with itself or other gases around when it's free floating.

Using pure hydrogen fuel in your car requires extensive and expensive engine modifications. Converting a gasoline dependent society into a hydrogen dependent society would require a complete overhaul of the existing fuel industry infrastructure.

Hydrogen is a major component of fossil fuels such as methane (CH<sub>4</sub>). It can be extracted through heat, but leaves behind carbon residue.

To use hydrogen, we need to obtain it from materials that contain a high proportion of hydrogen and without using too much energy. It wouldn't be to our advantage if we use lots of energy to extract it.

Hydrogen is also difficult to store. It has no color or smell and is so light; it dissipates quickly. A hydrogen leak is hard to detect. Since it highly flammable and burns with a nearly colorless flame, storage of hydrogen would need to be under tight regulations and control.

Current research is looking at methods of using hydrogen to supplement the fuel systems of existing engines.

## Using Water as Fuel

Water has two elements, two hydrogen and one oxygen molecule. These molecules are easily separated by the process of electrolysis. In a sample of water, some of the molecules have broken apart and are floating around as charged particles (ions). These ions conduct electricity. The number of ions floating around depends on the water's temperature. When the two elements recombine to form water, a tremendous amount of energy is released.

Harnessing and controlling this energy is one of the keys to using hydrogen as an alternative fuel. In addition, when separated into their gaseous states, oxygen and hydrogen can be burned efficiently to create energy without creating dangerous byproducts.

## Electrolysis of Water

Electrolysis is the process where a liquid undergoes a chemical change while conducting an electrical current. An electric current is a flow of electrically charged particles (electrons in metals such as a wire, and ions in a liquid). Liquids that conduct electricity must contain freely moving ions in order to complete a circuit.

The electrolysis of water breaks the water molecule apart into hydrogen and oxygen ions. Heat is needed to break up a water molecule into ions. The higher the temperature, the more ions there are and the more conductive water is.

When you put both ends of a wire, connected to a battery, into a container of water, electrons from the negative terminal of the battery will collect on the submerged end of the wire. The positive ions (hydrogen) floating around in the water will be attracted to the negatively charged electrons on the wire.

All ions strive to become neutral. For a hydrogen ion to become neutral, it will need to collect an electron from the negatively charged end of the wire. This creates a neutral hydrogen atom. These two hydrogen atoms form together make hydrogen gas. This is seen as a bubble rising from the negative end of the wire. At the other end of the wire, electrons are being pulled towards the battery, leaving behind charged metal ions. The negatively charged oxygen ions are attracted to the positive wire. They give two extra electrons to the wire; leave behind an oxygen atom, which joins with another oxygen ion to form oxygen gas.

If you didn't know which battery terminal was which, how would you know which one was hydrogen and oxygen? They both form colorless, odorless bubbles. Electrolysis produces twice as much hydrogen gas as oxygen. The side with the most bubbles is hydrogen.

Electrolysis needs an energy supply. This energy needs an outlet. The particles in a gas move about much more rapidly than those in liquid. Some of this energy has been transferred to movement (kinetic energy).

With all the extraction and storage problems that come with using hydrogen, electrolysis is highly attractive because it's an on-demand way of producing hydrogen. You don't need expensive storage vessels or heavy toxic materials to produce hydrogen. You won't have any by-products that need to be disposed of and it won't create supply problems for our source material. Since electrolysis produces small quantities of gas as needed, this is a much safer option than storage-type hydrogen systems.

# **The Future of Hydrogen**

## **Can Hydrogen Powered Cars Become the Future?**

Hydrogen holds a lot of promise as an alternative fuel. Will we someday be filling our cars with water or hydrogen, rather than gasoline?

All of the major vehicle manufacturers are currently working on hydrogen-powered cars. Some have unveiled their existing models at car shows and conventions across the country. A few models are even on the road today.

Hydrogen can be the fuel of the future. Car manufacturers and other automotive related companies are working on building or retrofitting internal combustion engines to run on hydrogen.

Some hydrogen cars use electric motors powered by hydrogen fuel cells. Inside the fuel cell, a reaction occurs between hydrogen and oxygen producing enough electricity to power the motor without the need for gasoline.

## **Hydrogen Cars on the Road?**

So why aren't we driving these cars today? Some people are, but only in a few test markets. The main problem that keeps these cars from hitting the open market in full force is the fact that fuel cells are extremely difficult and expensive to produce.

One problem with hydrogen fuel cells is that they are fragile. When you put a fragile fuel cell in a car that is going to go over bumps and ruts in the road, these fuel cells can be easily damaged.

While the tank that holds the hydrogen is not fragile, if the internal workings of the fuel cell are damaged the car will not receive the power it needs. Research is currently underway to make these fuel cells more durable.

Another problem with the fuel cells is that they often require rare elements to work as catalysts for the reaction between the oxygen and the hydrogen. If you need platinum, for example, to complete a fuel cell, it is going to be an extremely expensive way to fuel a car. These catalysts sometimes have to be replaced because of contamination by impurities present in the hydrogen.

## **Cold Weather Start-Up**

When hydrogen and oxygen are 'burned', the exhaust is water. This is excellent for our environment, but can be hard on your car, particularly if you live in a cold climate. The liquids in the fuel cell will freeze when the car isn't running.

Once the car is running, the heat from the engine keeps the water from freezing. However, if you park the car overnight in a cold climate, the car may not start in the morning because the liquid will be frozen. Until researchers are able to solve the cold weather starting problem, hydrogen powered vehicles will not be practical for those living in cold northern climates.

## **Hydrogen Production on a National Scale**

There is one more roadblock to creating hydrogen-powered vehicles. It would be extremely difficult to produce hydrogen on such a large scale, to make it our main fuel source, in our current fuel economy.

Most methods used to produce hydrogen, are not practical on a large scale. Researchers must find a cost-efficient way to produce hydrogen that does not require too much energy, or create dangerous by-products.

Geothermal power, wind power, and solar power appear to be promising ways to produce hydrogen on this grand scale, but more research is needed.

## **Converting Our Fossil Fuel-based Infrastructure to Hydrogen**

We would need to change our current fuel infrastructure before we could drive hydrogen cars. Gas stations would need to install hydrogen fuel dispensers, or new hydrogen stations would need to be built in every town.

In the United States alone, it is estimated that adding hydrogen as a major fuel source would cost half a trillion dollars. That is a huge amount of money, and money talks in today's economy.

At this point, hydrogen cars are not practical for the average driver. Research into more powerful home generators, that would allow the user to produce sufficient hydrogen at their homes, will be the answer.

## **So, Can You Buy A Hydrogen Car Today?**

The answer is yes!

Several vehicle manufacturers now sell hydrogen cars. Some companies are taking popular modern cars, like the Hummer or the Shelby Cobra, and converting them into hydrogen cars.

You will soon be able to purchase sports cars, pickups, and SUVs, that have been modified so that their existing internal combustion engines run on pure hydrogen.

There is one catch, though. These cars cost plenty of money!

Cars that are designed specifically to run on hydrogen are hitting the open market. According to CNN.com, Honda offers their FCX hydrogen car to the public in limited quantities. These cars are only available in areas where hydrogen filling stations currently exist. These cars do not use internal combustion engines; they are powered instead through fuel cells.

The cost for these vehicles alone is enough to deter many who would like to purchase them.

## **Fill Up With Hydrogen**

Let's say that, despite the expense, you purchased a hydrogen car. You now face the problem of finding hydrogen to fuel your car. There are a handful of hydrogen filling stations in the world, most of which are still in the testing stages.

You would need to find a way to make hydrogen at home, if you were serious about owning a hydrogen car. One of the best ways to do this is through electrolysis.

## **At Home with Hydrogen**

Hydrogen is an extremely promising fuel for the future. Many people want to know how they can use hydrogen in their homes. This would be in the area of home energy production. Hydrogen can be used to heat your home, cook your food, and warm your water.

One promising application of hydrogen fuel cells in the home is micro-combined heat and power. This system will produce heat and a constant source of electricity simultaneously.

The heat can be used to heat both the air and the water in the home, while the electricity can supply all of the electrical needs of the home. These systems create more electricity than the home needs. The excess electricity can be sold back to the power grid in the area.

Solar or wind power can be used to create the hydrogen that powers the micro-combined heat and power system in your home. This saves you a huge amount of money on your energy bills.

### **Applications for hydrogen in your home include:**

- Power supply for those 'off of the grid'
- Power for laptops and computers when AC power is not available
- Auxiliary power supplies (your 'hotel load', hairdryers and toasters)
- Portable chargers for hand held electronics

## **Using Hydrogen Today**

The prospect of driving a hydrogen-powered vehicle in the future, and perhaps the near future for those of us with money, is quite exciting. Nevertheless, how can we save money with hydrogen today?

How can we begin to protect the environment with our existing gas-powered cars? After all, most of us cannot afford \$60,000 to have our cars retrofitted!

While hydrogen powered vehicles are not yet a part of our lives, we can benefit from the power of hydrogen through the electrolysis of water.

Using hydrogen in your car engine requires a special device that will keep the process controlled and direct the hydrogen to the precise place in your car's engine where it will be of the most use. Currently, there is no simple, affordable process to replace your current fuel system with a hydrogen fuel system.

However, here is a safe, innovative way to harness the power of hydrogen in order to increase the performance you get from every gallon of fuel you put in your vehicle.

### **Supplemental Hydrogen Generators**

Hydrogen engine performance boosting systems are known as supplemental hydrogen generators. A supplemental hydrogen generator is a tank that holds distilled water and an electrolyte, such as potassium hydroxide.

The water is charged to induce electrolysis, which separates the hydrogen and oxygen molecules. The hydrogen and oxygen is then collected and forced into the engine through the air intake system. The added oxygen increases the octane level of the fuel.

Once the supplemental hydrogen is in the engine, it helps increase the flame spread during the combustion process. In other words, the hydrogen makes the flame in your engine burn faster.

Even if you do not understand exactly how your engine works, what you need to know is that accelerating the flame spread in this manner causes more of the vaporized fuel in your engine to combust during the initial phase of the power stroke.

### **Is This the Same as Brown's Gas?**

If you have heard the term Brown's Gas, then you have heard about supplemental hydrogen. Supplemental hydrogen is often called Brown's gas, because of the work of an Australian professor named Yul Brown. He is credited with inventing the process of using hydrogen collected from the electrolysis of water.

Yul Brown is famous for creating a device that took water and created usable oxygen and hydrogen without any spontaneous combustion. Through electrolysis, one liter of water can be made into 1860 liters of hydrogen gas.

## **Benefits of Supplemental Hydrogen**

You too can benefit from hydrogen in your car today with the addition of a supplemental hydrogen generator to your existing engine. Not only will you have better fuel mileage, you'll also be protecting the environment, making your car more powerful, and cleaning up your engine.

All of us are concerned about the environment and do what we can to take care of the world we have been given to enjoy. We also know that car exhaust emissions are some of the most dangerous environmental pollutants.

Unburned fuel is the largest component in your vehicle's emissions. Hydrocarbon fuels are extremely dangerous to both humans and the atmosphere. Unburned fuel, released through your vehicle's exhaust, pollutes our air and surrounding environment.

When hydrogen is mixed into the combustion process, it makes the flame burn faster and accelerates combustion overall. As a result, fewer of these hydrocarbon fuel particles are allowed to escape without being used. How does hydrogen accomplish this?

As you know, hydrogen is the smallest known molecule in the universe. When it is forced into the combustion chamber, its small size allows it to enter quickly. In addition, the lightweight molecules move quickly, creating more molecular collisions than any other molecule.

The hydrogen molecules burn faster than gasoline alone, so this actually decreases the time it takes combustion to occur within the combustion chamber of your vehicle's engine.

By having a more complete burn earlier in the stroke, more energy is converted into power and less heat (energy) leaves the engine during the exhaust stroke. More fuel is converted into usable energy, you get more power out of your engine, and fewer dangerous emissions are emitted through your vehicles exhaust.

### **Reducing Carbon Build Up and Increasing Power**

Traditional fuels leave behind by-products during the internal combustion process. The burning process also leaves behind carbon. Most of this carbon is vented through the exhaust system; however, a thin layer of solidified carbon does build up within your engine.

The excess carbon in your engine decreases the power of the engine, causing the engine to generate less horsepower and torque. Because your engine loses efficiency over time, you will not notice the change unless you keep very accurate mileage records. Higher-octane fuels help burn off some of this residue.

When you use a supplemental hydrogen generator, you essentially increase your fuel octane level. A higher-octane level means that the engine burns more cleanly.

Burning hydrogen to improve the combustion process cleans up the carbon that is building up on your engine. When this buildup is removed, your horsepower increases. Cleaning the engine makes it run smoother and increase the horsepower.

## **The Money Issue**

Ok, this is fine. Save the environment, more horsepower, less carbon, better mileage. However, the bottom line is that we need to save money on our fuel costs.

While all of us are concerned about controlling emissions and saving the environment, the high price of gas has most of us clutching our wallets in fear. Each week you put in \$50 to \$100 in the gas tank, only to do it all over again next week.

If you have a long commute to work, you are forking out even more money each month to pay your weekly fuel bill. Supplemental hydrogen generators increase your vehicle's gas mileage anywhere from 25% to 50%.

Consider for a moment, that your vehicle has a 20-gallon gas tank and averages around 25 miles per gallon. If your vehicles mileage falls into the middle of that range with the use of a supplemental hydrogen generator, at around 35%, you would be getting 175 more miles out of each tank of gas you put into your car.

That averages out to \$21.00 of savings each time you fill up. That means a savings of almost \$100 per month.

If your vehicle's mileage increases by 50% by installing a supplemental hydrogen generator, you will save \$30.00 each time you fill up your tank. These savings add up month after month, year after year.

### **Are there Tax Savings for Installing a Supplemental Hydrogen Generator?**

The government realizes how important fuel efficiency is to our economy and our future. They have created tax incentives for those who choose to take action to make their cars more fuel-efficient.

### **Tax Deductions in the United States**

The IRS gives a tax deduction for any property that you purchase in order to allow your car to run on a clean-burning fuel. The clean-burning fuels accepted by the IRS are:

- Hydrogen
- Liquefied natural gas
- Natural gas
- Liquefied petroleum
- Electricity
- E85 (or higher alcohol content fuels)

You can deduct some of the cost of your supplemental hydrogen generator on your taxes the year you purchase it. It must be installed properly in your engine the year you bought it in order to claim this deduction. Since supplemental hydrogen generators allow your car to run on a cleaner burning hydrogen injected fuel, they qualify for this deduction.

More information available here: <http://www.mimousa.com/hydrogen/tax-deduction.asp>

## **How Much Does It Cost to Run a Hydrogen Generator?**

You will need to add some potassium hydroxide, which at \$5.00 /lb will last you for several years. You will also have to buy mineral-free (distilled) water, readily available at your local grocery store for about a dollar a gallon. Considering the average hydrogen generator uses a quart of water per 600 miles, this will cost you around 10 to 20 dollars each year in mineral-free water.

A supplemental hydrogen generator is hardly an expensive device to run, and the fuel savings and environmental benefits far outweigh the small cost to use the device. Today, you can use supplemental hydrogen in your own car in a simple, cost effective way simply by installing a supplemental hydrogen generator in your existing engine.

## **Operating a Supplemental Hydrogen Generator**

To make sure you do not forget to add water to the supplemental hydrogen generator on your vehicle, make this step part of your normal routine when you fill up your gas tank.

Our generator has a low water indicator, but we recommend that you top off the water tank with every fill up. This ensures you will always have enough water to produce the hydrogen gas that your car needs. If you forget, don't worry. The reservoir really only has to be filled every 1000 miles. You should only use distilled water to fill your reservoir.

Why is distilled water so important? Minerals stay behind in the generator after the electrolysis process is complete. This leaves behind a muddy substance that can affect how well the generator works. Check your hydrogen generator often, to ensure it is clean, and mud free. Let me emphasize again, with distilled water, the amount of maintenance you will need to do is almost nil.

## **How Are Supplemental Hydrogen Generators Powered?**

Supplemental hydrogen generators are powered by the vehicle's alternator. The alternator sends an electrical charge through the liquid in the reservoir, a mix of distilled water and electrolyte. This small electrical charge is enough to separate the oxygen and hydrogen gases. These are quickly channeled into the engine, where they help to improve the burn from your vehicle's fuel.

Some hydrogen generator models draw up to 30 Amps. This can put a strain on the alternator. Other models only draw between 4 and 10 Amps, which puts very little strain on your engine.

## **Your Bottom Line**

What can you expect to happen if you install a supplemental hydrogen generator?

### **What a Supplemental Hydrogen Generator Is Not Going to Do**

Supplemental hydrogen generators will not replace your existing fuel source.

You will still have to buy fuel for your vehicle. You will be buying less fuel because you will have better fuel mileage. Do not expect this product to convert your car to a completely hydrogen- run system. That capability is available, but it is extremely expensive.

Supplemental hydrogen generators may not increase your fuel economy over 50%.

Many things affect how much mileage you get out of your vehicle, including driving skill, terrain, and whether you are driving on the freeway, or in town.

The government does not allow manufacturers of these products to make promises about the amount of increase you will see with your fuel mileage. Most people who install hydrogen generators on their vehicles and change nothing about their driving, see an increase between 25% and 50%.

### **What Supplemental Hydrogen Generators Will Do**

Supplemental hydrogen generators will increase your fuel mileage.

We all understand, with gas around \$3.00 a gallon, even a small increase in gas mileage translates into a huge increase in monetary savings at the end of each month. Installing a supplemental hydrogen generator on your existing vehicle is the best option to increase your car's fuel efficiency.

Supplemental hydrogen generators will increase the power of your vehicle.

You will notice a difference the first time you fill up after installing one of these devices, because you will have gone much farther on your tank of gas than you had been able to before installing the supplemental hydrogen generator. There is also more burnable fuel now available for your engine to use. This is what translates into increased horsepower for your vehicle.

Supplemental hydrogen will also help your car to run smoother & cleaner.

You will have fewer emissions from your engine, which is particularly helpful if you live in areas that require emissions testing, such as the state of California. In fact, these generators or similar devices that reduce emissions may be necessary on vehicles that belong to Californians as early as 2009, as the state is expected to increase the emissions test requirements. Without having one of these products on your car, you may not pass future emissions tests.

In addition, burning hydrogen helps clean out the carbon residue inside your engine, giving you fewer costs for repairs and maintenance on your vehicles. It will also clean up the O2 Sensor.

## **Is This Really Safe?**

If you are like most consumers, you're probably a bit skeptical about the safety of adding hydrogen to your existing fuel system.

### **Is It Safe to Be Near Hydrogen?**

Hydrogen will not likely explode when used as a fuel in your car. It does require special handling considerations, in much of the same way as fossil fuels. Hydrogen is as safe to use as gasoline.

Gasoline is extremely flammable, and can only be dispensed into approved containers. There are specific steps you need to take to clean up spilled gasoline to avoid fire hazards. Hydrogen is very similar. Yes, it is a gas, you do have to be careful with hydrogen, and it can catch on fire.

Some wonder if hydrogen is dangerous for them if they touch or breathe it. Hydrogen is difficult to touch since it is a gas, so that is not really a concern. The liquid in a supplemental hydrogen generator is water, and there is no danger in touching water. Hydrogen does not harm you if you breathe a small amount. The gas is non-toxic to humans and other living things.

### **Won't the Hydrogen Explode?**

Many people are understandably afraid that their car will explode if they start using hydrogen in their fuel system, whether through supplemental hydrogen or hydrogen fuel cells.

This fear comes from scientific fact. Pure hydrogen gas is extremely flammable and ignites easily in the right situations. If a tank of pure hydrogen is punctured and ignited, a magnificent explosion can happen. Many fear that the same would happen with supplemental hydrogen.

### **Wasn't Hydrogen used in the atomic bomb?**

Yes, hydrogen is one of the materials used to make nuclear bombs (the H-Bomb). Of course, none of us want to think that we are driving around with a nuclear bomb in our trunk or engine! There is one main difference between using hydrogen as a fuel and using it in a nuclear bomb.

When hydrogen is burned to release energy through a chemical reaction, electrons are shifted, new compounds are created, but the atom itself is not changed. However, the explosion in the nuclear bomb is a thermonuclear explosion. It is caused by a nuclear fusion reaction, not a chemical reaction. In this fusion reaction, the hydrogen's two isotopes, deuterium and tritium, collide with one another with so much energy that they fuse with the nuclei of the hydrogen molecules contained in the bomb. This releases the tremendous amount of energy that causes the devastating explosions. Now, this fusion reaction requires temperatures in the hundreds of millions of degrees, and these temperatures are provided through the atomic reaction, or the fission reaction.

It is not possible to reach such high temperatures in your car without the special conditions that are created in an atomic bomb. In addition, the hydrogen that is produced for commercial usage, whether as a fuel or some other commercial use, does not have any tritium or deuterium. This makes it physically and chemically impossible for a thermonuclear reaction to occur with this hydrogen in your vehicle.

## **Supplemental hydrogen generators are safe!**

Supplemental hydrogen generators are also closed systems. They do not contain any stored hydrogen, but instead create hydrogen through electrolysis as the engine operates. This hydrogen is then channeled instantly into the car's internal combustion chamber. Any amount of stored hydrogen is quite small.

As such, the hydrogen is not exposed to the air. Moreover, since there is no pure hydrogen in the chamber when the car is not running, there is no danger of a fire even if the chamber were to be opened or punctured. All that would happen is that the water inside would leak out.

So whether you choose to add hydrogen to your existing car through a supplemental hydrogen generator, or simply decide to wait until hydrogen cars hit the market, you can be certain that you will not be in any more danger of having a car fire from your fuel source than you are now with your gas-powered vehicle.

## **Can You Put a Generator in a Car with a Small Engine?**

Many modern cars have little room under the hood. To save on weight and size, the engine fits precisely into the engine compartment, not leaving much room to add a supplemental hydrogen generator. For this reason, some vehicle owners think that there is no way they can install a generator on their cars because there is no place to put it in the engine compartment.

The generator will need to be near the engine, but the units are not excessively large, so you can find a creative place to install yours. One place that is a good option is underneath the front fender. Another option is to install it in front of the mud flap in the front of the car. On the other hand, you could install it in front of the radiator, behind the bumper. We have never come across a situation where we could not find a way to fit a generator in a vehicle.

Small models are also available for smaller engines, such as those in gas-powered lawn mowers. No matter what type of engine you are powering with gasoline, you can save money by adding a supplemental hydrogen generator to the equation from semi trucks to lawn mowers to motorcycles and powerboats.

If it has a gasoline or diesel internal combustion engine, it will benefit from the addition of hydrogen.

## **What about Diesel Engines?**

Supplemental hydrogen generators work on both diesel and gas engines. While most sources have focused primarily on the gasoline market since gas-powered vehicles are what the majority of the population drives, recently research has turned to the diesel engine market as well.

Truckers and trucking companies are anxious to find a way to save on their fuel consumption just as other drivers are. Current products can increase the mileage of most diesel-powered vehicles by a rate of 5% to 20%, depending on the load and driving conditions that the vehicle is enduring.

In 2007, Purdue University students did a research study into the effectiveness of supplemental hydrogen on diesel vehicles. This study indicated that diesel engines saw an average of 15% increase in overall performance, including power and gas mileage, when they were fitted with the equipment necessary to utilize supplemental hydrogen. As most truckers will tell you, a 15% increase in fuel efficiency translates into hundreds of dollars when on the road.

According to Wired.com, a Salina, Kansas trucking company saves \$700 per month per truck on their fuel costs after installing supplemental hydrogen generators on their trucks. Since supplemental hydrogen also produces greater horsepower, these trucks run much more efficiently than they did on diesel fuel alone.

For those who own personal vehicles that run on diesel, this is good news, since diesel is no longer the more affordable fuel choice as it once was.

### **What about Motorcycle, Boat, or Lawnmower Engines?**

Supplemental hydrogen generators work on any vehicle that is powered by an internal combustion engine. Some people have even installed them on their boats. While we don't often think of this fact, most boats are powered by internal combustion engines that require expensive fuel to run, and installing a supplemental hydrogen generator will increase the fuel efficiency of the vehicle.

They even work on internal combustion motors found on lawnmowers. The reason that supplemental hydrogen generators work on any engine is that they work with the existing air intake system, channeling Brown's Gas into the engine through the air intake hose or air cleaner.

If the engine has an air intake hose or air cleaner, the supplemental hydrogen will work.

### **My Car Is Under Warranty. Is That a Problem?**

If your vehicle is still under a warranty, we suggest you contact your dealer and consult with them. It would be highly advised to have a trained professional install the unit on your vehicle. The device is simple to install, yes, but if you do not know what the systems of your car look like, you could inadvertently connect it incorrectly.

Another way that some people cause damage to their cars with a supplemental hydrogen generator is by putting the wrong liquids into it. If you put a solution that has strong chemicals in it into the generator, it will malfunction.

These generators cannot damage your car's engine if they are installed and used properly. If you understand something about your car's engine and can read directions, you will be able to install and use the device correctly.

## **I Live in a Cold Climate. Won't the Water in the Generator Freeze?**

If you live in a particularly cold climate, then you know that cold weather can cause your gas mileage to drop considerably. The good news for you is that using supplemental hydrogen generator will increase that gas mileage considerably.

Most of the components of these systems work well no matter what the temperature. However, the concern you likely have is that the water in the unit will turn to ice, thus stopping the process of electrolysis and possibly damaging your engine.

This does not happen because of the electrolyte in the solution. Provided you use an electrolyte that doesn't freeze, you should be safe. If you live where winter temperatures are regularly close to or below freezing, we do recommend you install an item that is called "the polar pad".

This is essentially a block heater for your hydrogen generator. This will keep the generator heated. This is not necessary to keep the water from freezing, but it helps the solution inside the generator to warm up to its optimal temperature faster.

Even when the temperature is not freezing, the reason for that is warm water conducts electricity better than cold. So when the hydrogen generator is pre-warmed. It produces more hydrogen.

To install these, tools are not required and a 75W or 125W model would be more than enough.

## **If Using Hydrogen Fuel Creates Water, Won't That Damage the Engine?**

As we have discussed, the only by-product of burning hydrogen fuel is water. Since supplemental hydrogen generators add hydrogen to the fuel burning system in your engine, you may be concerned that you will have to deal with water in your car's exhaust system.

While this is a valid concern, you should realize that burning gasoline alone still creates water. The exhaust system is able to handle water. These generators reduce the amount of fuel being burned by 25% to 50%.

Let's be highly conservative with our numbers. If installing a hydrogen generator only reduces your fuel consumption by 20%, this will cut down the amount of water produced every hour by burning gasoline by 56.7 ounces.

These generators typically add no more than 0.7% of water to the vehicle's engine. Even if the electrolysis process adds this tiny bit of water to the exhaust, the reduction of water far outweighs this addition.

Therefore, using a supplemental hydrogen generator will actually reduce the amount of water that your car's exhaust system has to deal with, greatly reducing the effect of any water added to the system through the injection process.

Also, remember that your vehicle will likely experience a much higher reduction in fuel consumption than was used in this example when you install one of these supplemental hydrogen generators, which will cut down on the water in your exhaust system even more.

## What about Hydrogen Embrittlement?

Hydrogen embrittlement is something that people often fear when it comes to using hydrogen in cars. Hydrogen embrittlement causes metals, like steel and aluminum, to become quite brittle when they are exposed to hydrogen. This is dangerous, because these brittle metals can crack easily.

This embrittlement happens as hydrogen atoms diffuse in the metal. Almost all metals have atom-sized voids in their makeup, and the tiny hydrogen ions recombine with the metal by filling these voids. This combining occurs before the hydrogen ion has a chance to bond with another hydrogen ion to create a diatomic molecule. However, this diatomic bond occurs *after* the hydrogen ion has entered the metal, thus creating heavy pressure to build up in the lattice of the metal's molecular structure. There is suddenly not enough room in the cavities of the metal's molecular structure for the diatomic molecule. This creates intense pressure.

This pressure causes the metal to become less ductile, and thus more brittle. Soon cracks will appear. Vehicle owners fear the irreparable damage that can be caused. Theoretically, hydrogen embrittlement can occur any time metal is in contact with hydrogen. However, when the metal is in contact with stable, diatomic hydrogen, it is far less likely to occur.

So, is this a danger when incorporating hydrogen into your car's engine through a supplemental hydrogen generator? The answer is no. There are several reasons for this.

First, when hydrogen is produced through electrolysis, the molecules that are produced are almost all diatomic. Diatomic hydrogen molecules will not enter the metal and cause this dangerous pressure.

Of course, the electrolysis process creates not only hydrogen, but also oxygen. In a perfect world this combination, known as Brown's Gas, would only contain diatomic molecules. However, there are usually some ions of hydrogen in the Brown's Gas obtained through electrolysis, although most of the molecules will be diatomic. This does not pose a danger for your car, however, because the hydrogen is burned in your car's combustion chamber so quickly that it does not have time to bond with the metal in the engine. Remember, supplemental hydrogen generators pump the Brown's Gas directly into the car's combustion chamber through the air intake system.

Another reason that this is not a danger for your engine, is the fact that hydrogen embrittlement occurs most frequently when hydrogen is created in an environment containing highly charged plasma. Since supplemental hydrogen generators contain no plasma, there is not a threat of hydrogen embrittlement occurring when you use one of these products.

## Won't Using a Leaner Fuel Mixture Cause My Engine to Get Too Hot?

Some people who are considering using a supplemental hydrogen generator are concerned that the process will make their cars run too hot, creating exhaust temperatures that are too high, and putting them at risk for burning valves in their engines.

This fear comes from the world of aviation. In a plane that runs on a piston engine, the take off and climb use the maximum power possible. Once an aircraft has reached cruising altitude, a leaner mixture of fuel is used. To keep the aircraft's engine at a safe temperature, the pilot must continually watch the EGT (exhaust gas temperature) gauge on the instrument panel. As long as the EGT gauge reads in a safe level, the pilot assumes that he is not in danger of burning the valves on the engine.

Let's consider what happens in an internal combustion engine in a land vehicle. Vehicles that we drive today have electronic fuel injection systems (EFI). The EFI allows the car to burn a rich fuel mixture during the time that the engine is warming up and accelerating.

Like a plane, the engine needs the richer fuel to start the action. However, when an engine warms up and begins to cruise, the engine control unit (ECU) changes the fuel mixture to be near the target of 14.7 to 1 in the air/fuel ratio. This is called a closed loop operation. This mixture is considered the perfect ratio to mix air and fuel in order to get the best possible result out of combustion. Having the mixture in this state is known as stoichiometry.

This ratio also gives the highest temperature of combustion and the highest EGT. If you add more air to create a leaner mixture, you would have a cooler combustion temperature and EGT. If you added more fuel to create a richer mixture, you would also have a cooler combustion temperature and EGT. According to [www.sdsefi.com/techeft.htm](http://www.sdsefi.com/techeft.htm), peak or highest EGT will only occur at stoichiometry, or at this 14.7-1 air fuel ratio. This ratio, however, is too lean to provide good power to the vehicle. If you increase the richness of the fuel, the EGT automatically drops. If you go leaner, you will still see a drop in the EGT.

So what does all of this mechanical science have to do with installing a supplemental hydrogen generator on your vehicle?

If making the fuel leaner does not increase the EGT temperature, then you will not be at risk for burning any valves on your vehicle if you add some hydrogen to the combustion process. In addition, because the hydrogen combustion increases power, you will not have to worry about a decrease in power that normally comes from burning leaner fuel. You can burn leaner, more affordable fuel safely and still attain the maximum power output in your vehicle.

There is one exception to this rule. If you run your car at a lean mixture at wide-open throttle for an extended period, you will see increased EGT and thus risk burning your valves. This would only happen if the supplemental hydrogen generator was set to deliver the precise 14.7 to 1 mixture and the driver was driving with a wide-open throttle for an extended period. Driving your vehicle in this manner is not recommended, and most supplemental hydrogen generators can be adjusted to a higher, leaner ratio than 14.7 to 1.

## **Safely Producing Hydrogen at Home**

The beauty of supplemental hydrogen generators is that with their help and the innovative technology that went into the design of these tools, you can safely, effectively, and inexpensively produce hydrogen through electrolysis in your home or, more specifically, in your car. All it takes is the generator, some water, and an occasional dose of potassium hydroxide or sodium hydroxide to create hydrogen.

Safety is a major concern for those interested in supplemental hydrogen. Again, we all know that hydrogen gas can be extremely combustible. If you stop and think about it for a moment, though, so is gasoline. Combustion is what powers an engine.

Supplemental hydrogen generators are safe because they carefully contain the hydrogen so that it is delivered into the combustion chamber of your car's engine through the air intake system.

Since the combustion of hydrogen produces only water, there is no danger from any flammable fumes or toxic emissions caused by the hydrogen. Of course, you will still need to use caution with your car's exhaust, because it will still be using traditional fuels and creating carbon dioxide.

## **Final Words**

Hydrogen fuel cells are likely the fuel of the future, but it will be years before hydrogen cars are parked in every garage in the nation. Until that time, we need an option to help us save money on the ever-increasing cost of fuel. We also need a way to protect our environment from further damage caused by the emissions that come from cars.

One option that seems to hold much promise is the use of a supplemental hydrogen generator. The generator can be installed in a few hours and provide instant fuel savings. By utilizing the electrolysis of water while the car is driving to produce hydrogen and oxygen, supplemental hydrogen generators do not need to store any pure hydrogen in any form in your car. These generators are safe, effective, and extremely necessary.

It is extremely affordable, once you have a hydrogen generator on hand, to make supplemental hydrogen for your vehicle on your own. In fact, it is more economical to make supplemental hydrogen at home for your vehicle using a supplemental hydrogen generator, than it would be to try to purchase the gas from a supplier.

All it takes is water and an occasional addition of the electrolyte, and you are going to be making supplemental hydrogen every time you drive your vehicle. You will not even have to think about the process, because the generator will be making supplemental hydrogen automatically every time you drive.

They increase fuel efficiency, decrease emissions, increase power, and clean your engine. If you are tired of shelling out at least \$50 every time you fill up your gas tank, you need a supplemental hydrogen generator.

## Resources:

We used the following websites to research the information in this book. They are excellent sources to use if you are interested in learning more about hydrogen fuel and supplemental hydrogen generators.

<http://www.oxy-hydrogen.com>

<http://www.mimousa.com/hydrogen/tax-deduction.asp>

<http://www.cra-arc.gc.ca/agency/budget/2007/excise-e.html>

[http://www.consumeraffairs.com/news04/2005/oil\\_price\\_probe.html](http://www.consumeraffairs.com/news04/2005/oil_price_probe.html)

<http://www.energyoptions.com/tech/browns.html>

<http://www.hydrogen-boost.com/index.html>

<http://www.geocities.com/hydrogenpower1/essays/main/hydrogen.html>

<http://periodic.lanl.gov/elements/1.html>

<http://www.future-wave.com/>

<http://www.wired.com/cars/energy/news/2005/11/69529>

<http://www.hydrogenassociation.org/general/faqs.asp>

<http://www.switch2hydrogen.com/h2.htm>

<http://maps.unomaha.edu/Peterson/funda/Sidebar/OilConsumption.html>

<http://auto.howstuffworks.com/fuel-cell.htm>