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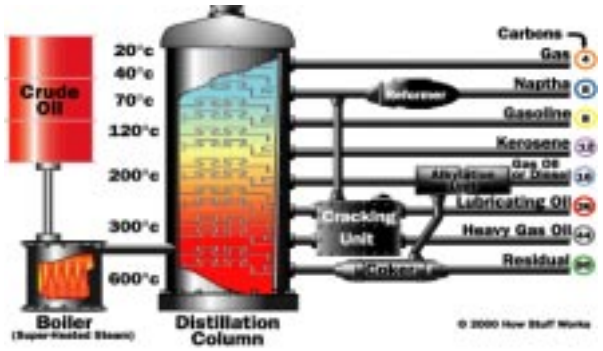
US Fuel Cell Council

Hydrogen: Fossil Fuels

In the long run, hydrogen will be made renewably, from local sources, providing secure supplies of clean fuel worldwide. Renewable hydrogen production technologies from non-fossil sources generally are in their infancy or expensive as is the case with most renewable energy options.

In the meantime, any hydrogen-rich material can serve as a possible source of hydrogen fuel. This includes fossil fuels like natural gas, petroleum, propane and even coal. Most of today's hydrogen is produced from natural gas. Fossil-based hydrogen production will play an important role in transitioning to a sustainable hydrogen economy.



Reforming

Hydrogen generally is produced from fossil fuels and other compounds by a process known as reforming, or fuel processing. There are three main types of fuel processing technologies: catalytic steam reforming, auto-thermal reforming, and catalytic partial oxidation reforming. Reformers can be used with most liquid and gaseous hydrocarbon fuels, including methanol, ethanol, propane, natural gas, gasoline, diesel, jet fuel, and others. These technologies can be used in a central location or closer to the point of demand such as at a gas station, at home, and even onboard vehicles.

A catalytic steam reformer (CSR) brings together hydrocarbon fuel, catalyst, and steam and applies a small amount of additional heat from an external source to generate a chemical reaction. One advantage of this system is high efficiency.

Auto-thermal reformers (ATR) bring together a hydrocarbon fuel, catalyst, steam and oxygen. One feature of this system is its ability to reform many different types of fuels.

IdaTech's natural gas/ propane fuel reformer

Catalytic partial oxidation reformers (CPOX) are similar to auto-thermal reformers, but the technology allows for a simpler and smaller operating system.

In the future, ceramic membrane reactors may be commercialized which can simultaneously separate oxygen from air and perform partial oxidation of methane. If successful, this process could result in improved production of hydrogen compared to conventional reformers.

Efficiency

Reforming today is about 85% efficient, depending on the fuel and reforming process used. When the energy needed to compress and deliver hydrogen is included, the overall efficiency "at the pump" is about 60%. Gasoline, like hydrogen, does not occur naturally. It must be refined from petroleum and delivered to the end user. This process is about 80% efficient overall. But fuel cell vehicles will be two to three times as efficient as gasoline powered vehicles, which more than makes up the difference.

Coal Gasification

Hydrogen can be produced from coal - an abundant source of energy for the U.S. - by coal gasification. Coal gasification mixes coal with steam and air or oxygen under high temperatures and pressures. This breaks apart the chemical bonds in coal's complex molecular structure and starts a series of chemical reactions resulting in a gaseous mixture, typically hydrogen and carbon monoxide.

During the process, as much as 99% of sulfur and other pollutants can be removed and processed into commercial products such as chemicals and fertilizers. Unreacted solids can be collected and marketed as a co-product such as slag (used, for example, in road building).

The basic gasification process can be applied to virtually any carbon-based feedstock, such as biomass, petroleum coke, municipal waste, or blends of these fuels.

Carbon Sequestration

As part of the coal gasification process, carbon dioxide, one of the most potent of greenhouse gases, can be captured and stored ("sequestered") more or less permanently in deep geologic formations, used to help extract oil from wells, or sold as a commercial product.

Sequestration can help make fossil-based hydrogen production very clean environmentally.

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