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US Fuel Cell Council

Hydrogen: Non-Fossil Fuel Based

A hydrogen economy aims to sustain our energy needs far into the future, fueling the world's economy as the world's supply of oil, coal and natural gas becomes more expensive and supplies decline. Some sustainable hydrogen production approaches involve well known renewable energy technologies such as solar, hydro, geothermal and wind power. Others utilize current waste products. Scientists are experimenting with bugs, microscopic organisms and other strange sources of hydrogen as well as with advanced chemical and electrochemical processes.

Electrolysis

Water is the most abundant compound on earth. It is made up of hydrogen and oxygen. Water can be separated into hydrogen and oxygen by running an electric current through it. This process, called electrolysis, is a well known and commercial technology. By utilizing a renewable source of electricity such as solar, hydro, geothermal or wind energy, hydrogen can be generated in a truly pollution-free, sustainable way.

Steam electrolysis (a variation on conventional electrolysis) uses heat, instead of electricity, to provide some of the energy needed to split water, making the process more energy efficient.

Industrial Wastes

Hydrogen can be generated from industrial or municipal waste gases. Today, there are several fuel cell systems generating electricity from waste gases at wastewater treatment plants, landfills, and even breweries.

Other waste products are finding a potential use as a hydrogen source. The combustion gas of hazelnut shells is 15 percent hydrogen. In Turkey which burns 250,000 tons of hazelnut shells each year, this waste could yield 6,000 tons of hydrogen.

Thermal Processing

Thermal processing techniques for plant material (biomass) and fossil fuels are very similar. Using agricultural residues and wastes, or biomass specifically grown for energy use, hydrogen can be produced via gasification. Gasification uses heat (pyrolysis) to break down biomass into a gas from which pure hydrogen can be generated.

Thermochemical Water Splitting

Thermochemical water splitting uses chemicals and very high heat (700 to 900 degrees Celsius) to efficiently split water into hydrogen and oxygen. This has been demonstrated in the laboratory using concentrated sunlight.

Today's nuclear power plants are water-cooled, thermal reactors where the water does not rise above 400 degrees Celsius - too low for thermochemical water splitting. Next generation reactors may be gas-cooled, high-temperature reactors, with the coolant temperatures high enough for efficient large-scale hydrogen production. The U.S. Government is financing research in this area.

Photoelectrochemical Systems

Photoelectrochemical production of hydrogen can be performed through two types of electrochemical systems. One uses soluble metal complexes that are dissolved in water. The complex absorbs solar energy and produces an electrical current that splits the water into oxygen and hydrogen. This process mimics photosynthesis. The second method uses semiconducting electrodes in a photochemical cell to absorb solar energy and split water to produce hydrogen.

Biological and Photobiological Systems

Biological systems use microbes to break down a variety of biomass feedstocks into hydrogen. Many herbivorous insects like termites, grasshoppers and scarab beetles produce hydrogen gas when digesting organic (waste) components.

Photobiological systems use micro-organisms to split water using sunlight. Cyanobacteria, abundant single-celled organisms, can produce hydrogen in this way because they contain enzymes that absorb sunlight for energy and split water molecules, producing hydrogen.

For more information, visit our web site at www.usfcc.com.