Hydrogen Energy California

hydrogen safety

Hydrogen is a basic element with tremendous potential. When oxidized, or combined chemically with oxygen, its only by-products are heat and pure water. This is why hydrogen bears so much promise as a source of clean energy.

At normal temperatures, hydrogen exists in a gaseous form. It is handled in a similar fashion to natural gas. And, since hydrogen has long been a component of the petroleum refining process and is being used more and more frequently as a fuel, techniques for the safe handling and storage of hydrogen are well established.

Like other common gaseous fuels, such as natural gas, hydrogen is only combustible in the presence of oxygen. It cannot burn when contained by itself in a tank or a pipeline. Hydrogen also has certain properties that make it advantageous with respect to safety. For example, it is non-toxic -- harmless to people and the environment. It is also the lightest element on earth, twice as light as helium. Thus, if released into the air, it disperses very quickly, reducing the potential for unwanted or accidental combustion.

sources of hydrogen

Hydrogen is the simplest and most common chemical element on earth. It can be extracted from many sources, including water or fossil fuels such as natural gas or coal. The Hydrogen Energy California project will be extracting hydrogen from petroleum coke, a refinery by-product, as well as locally-delivered coal.

At this project, the coke and coal will not be burned. Through a chemical process called “gasification”, the fuels will be broken into their component parts, including hydrogen, carbon, and sulfur. If the coal or coke were “burned” in a traditional way, its carbon would be released into the atmosphere as carbon dioxide, the “greenhouse gas” believed to contribute to global climate change. With gasification, these environmentally harmful components can be captured and contained instead of being released into the air.

By using petroleum coke as a source for hydrogen, the HECA project will take advantage of a common by-product that has little value as a standard hydrocarbon fuel. And, by processing it through gasification, around 90% of its carbon -- which would normally end up in the air as pollution and CO_2 -- will be kept out of the atmosphere.

gasification

Gasification has been reliably used on a commercial scale worldwide for many decades in the refining, fertilizer, chemical industries, and the electric power industry.

When introduced into a hot, oxygen starved environment, hydrocarbons like petroleum coke break into their component parts. At the HECA project, this will take place in a “gasifier”, which is basically a large, kiln-like oven.

At the correct temperature and pressure, the coke’s primary chemical elements will rise to the top of the gasifier’s chamber as hydrogen, hydrogen sulfide, carbon monoxide and carbon dioxide gas. This combination of gases, or “syngas”, will then be piped into a “scrubber”, which will wash out any solid,

particulate impurities that may have traveled with it. The syngas then passes through a “shift reactor” that uses water to convert the carbon monoxide into non-toxic carbon dioxide (CO_2). A “sulfur recovery unit” then captures the sulfur from the hydrogen sulfide. This leaves hydrogen which will be used to power the plant, and CO_2 which will be captured and kept out of the atmosphere in deep underground geological formations.

Scrubbers and sulfur recovery units are common equipment in natural gas plants (they are used to remove impurities from the gas), and safety measures are well established. At the Hydrogen energy California project, all of these practices will be employed. State of the art electronic measuring devices will be used to monitor conditions inside the gasifier. Were the temperature and pressure to rise above a certain level, the unit would automatically shut down. And, if necessary, release valves would open to relieve excess pressure inside the chamber. Any toxic gas that might escape into the area immediately surrounding the gasifier would be minimal, and standard safety protocols would protect plant workers from harm.

hydrogen as a fuel

The project’s electrical generators will be “combined cycle turbines”, the very same systems used in clean natural gas power production. These are essentially jet engines, similar in operation to those in commercial aircraft. They turn a turbine that produces electricity. They also produce hot air which is used to power a steam generator, producing more electricity, thus maximizing efficiency. The generators will be the same in almost all respects to those in natural gas plants, but they will operate on hydrogen fuel.

The project’s hydrogen will be produced at the plant site, and most of it will be consumed by the power generation process. However, over time additional hydrogen could become available for other uses.

When used as a fuel, hydrogen is similar to natural gas, except that it does not have elemental carbon as natural gas does. The Hydrogen Energy California project will already have captured the carbon from its feedstock fuel and thus the project will have prevented that carbon from being oxidized into the atmosphere as CO_2. However, since hydrogen combustion occurs within the existing ambient air, which already has limited amounts of nitrogen, particulates and other pollutants, there will be some emissions associated with hydrogen fuel usage, including nitrous oxides (NOx) and particulate matter (PM). These emissions will meet or exceed all of California’s stringent air quality standards, including the Air Pollution Control District’s BACT (Best Available Control Technology) standards. The project’s overall NOx and PM profile will be similar to, or better than, that of the cleanest natural gas power plants.

a new hydrogen energy economy

In the face of global climate change, a growing consensus - including environmental organizations, the Department of Energy, major automobile companies, public utilities and power companies - is looking towards hydrogen as the viable alternative to standard fossil fuel energy. Already, there are hundreds of miles of hydrogen pipeline in the United States. Hydrogen fuel cell powered cars have been tested successfully under accepted consumer conditions, and in Iceland and Norway, fleets of city buses run on hydrogen.

This all suggests that the emergence of a new, hydrogen based economy is a real step. It is a viable approach to solving today’s energy and air quality problems. Taking advantage of hydrogen’s clean-burning properties is a way of addressing the global climate change challenge. In addition to providing clean power to over 150,000 homes in the Bakersfield area, the Hydrogen Energy California project may produce sufficient supplies of hydrogen fuel to create the option for it to be used in other applications such as for transport.