Roth: What the H?

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What the H?

Those early, and perhaps forgotten, lessons from middle school chemistry class of the periodic table may be coming around again as America and the world explore new fuel sources for our future.

Hydrogen, that chemical element with the symbol H and the atomic number of 1, is the lightest element on the periodic table. It has the lowest density of all gases, which makes it attractive as a fuel source, plus it is the most abundant chemical substance in the entire universe known to man, with NASA estimating its abundance at 75 percent of known particles.

Because of this abundance and this weight advantage for travel, some see hydrogen gas as the clean fuel of the future – generated from water and returning to water when it is oxidized.

Yet hydrogen has been put to good use for centuries, having been first artificially created in early 16th-century industrial application of acids to metals. Today, its uses can be found across industries as it:

- Is used to make ammonia for fertilizer (the Haber process).
- Is used to make cyclohexane and methanol, which are intermediates in the production of plastics and pharmaceuticals.
- Helps remove sulfur from fuels in oil refining.
- Filler for balloons; and previously for "airships" until the Hindenburg caught fire.
- Compressed hydrogen is the fuel for hydrogen-powered vehicles.

This last use is growing faster than any other is and many think the positive attributes of H mean it has a very promising future in a carbon-constrained future world. As the simplest element in existence, by weight, it has the highest energy content of any fuel. It is not found on Earth as a gas, because it is lighter than air, so it rises into the atmosphere; thus, it must be manufactured.

The U.S. produces about 9 million tons per year. It is associated with other elements such as water, coal and petroleum. Since it is generated from water and returns to water when it is oxidized, it is a low-polluting fuel. It can be shipped by pipeline, sometimes cheaper than electricity over wires, which again adds to its allure as a fuel.

Hydrogen must be separated from other compounds due to it not being naturally found on Earth existing by itself. There are

two ways to accomplish this: electrolysis (water splitting) and steam reforming, with the latter being the less expensive, commonly seen in industries to separate hydrogen from carbon atoms in natural gas, which consists primarily of methane, which unfortunately does emit greenhouse gases.

Electrolysis on the other hand, emits no greenhouse gases, but is still very expensive today. The process splits water into its basic elements through an electric current. Experimental methods include photo-electrolysis and biomass gasification.

The U.S. Department of Energy has some interesting ideas for a future hydrogen energy infrastructure across America. The hydrogen is compressed up to pipeline pressure and then fed into a transmission pipeline. The pipeline transports the hydrogen to a compressed gas terminal where the hydrogen is loaded into compressed gas tube trailers. A truck delivers the tube trailers to a station where the hydrogen is further compressed, stored, and dispensed to fuel cell vehicles for consumers or business.

Fuel cell vehicles, also known as FCV, look like conventional vehicles, but use innovative technologies with fuel cells instead of gasoline tanks or electric vehicle batteries. Similar to a compressed natural gas vehicle's "vessel," the heart of the FCV is the fuel cell stack. The stack converts hydrogen gas stored onboard with oxygen from the air into electricity, which powers the vehicle's electric motor. The fuel cell market is in its infancy but poised for growth as Toyota's 2015 rollout of the Mirai joins Hyundai's FCV Tucson as the only commercially available today. They refuel in five minutes and drive approximately 300 miles. Unfortunately, there are very few hydrogen-dispensing pumps, although California is making good headway.

And before you jump to this new, albeit exciting fuel source vehicle, please know that today South Carolina and California are the closest fuel locations to Oklahoma. But the times,

they are a changin’ – come H or high water.

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