E&E NEWS

Scientists discover new way to create clean hydrogen

By Ester Wells

12/23/2021 07:24 AM EST

Researchers have discovered a new process to turn toxic “sewer gas” into low-carbon hydrogen, an advance they say that can be a cleaner, cost-competitive way to produce the fuel.

In a study by the American Chemical Society in the *ACS Sustainable Chemistry & Engineering* journal, scientists at Ohio State University demonstrated that they could efficiently convert hydrogen sulfide, a noxious gas emitted from sewer pipes and manure piles and known for its pungent “rotten egg” smell, into hydrogen fuel.

The new SULGEN process adds a trace amount of the element molybdenum to a cheap chemical material, iron sulfide, to produce hydrogen without emitting carbon dioxide, provided clean fuels are used to supply heat for the reaction. Currently, about 95 percent of hydrogen produced in the United States is made through steam methane reforming derived from natural gas. Globally, that method generates around 830 million metric tons of carbon emissions per year, according to the International Energy Agency.

“The gas process is really cost- and energy-intensive, so compared to that, this approach has very good potential to be competitive,” said Kalyani Jangam, lead author of the study and a graduate student in Ohio State’s Clean Energy Research Laboratory.

Unlike hydrogen fuel, which can be used to power vehicles and produce electricity, hydrogen sulfide is extremely toxic both to human health and to the environment, the researchers said. Hydrogen sulfide is also produced in industries like mining and oil and gas refining.

The scientists created the SULGEN process by modifying a process known as chemical looping, developed by the same Ohio State research team in 2017. Chemical looping uses metal oxide particles in high-pressure reactors to burn fuel without the fuel coming into direct contact with air.

In the new study, which was published earlier this winter, they adapted the chemical looping process to produce hydrogen fuel, using the iron sulfide-molybdenum combination to break down the hydrogen sulfide into hydrogen and sulfur.

Jangam said they are now working to optimize the SULGEN process so it can be used to generate hydrogen on an industrial scale, potentially having the twofold benefit of transforming a toxic chemical into a useful fuel and offering a way to more cleanly produce hydrogen.

“Any time you can solve one person's problem and generate something that's of value to somebody else, to me, that’s a win-win and should definitely be pursued to the degree that it's economically feasible and doesn't harm the environment,” said Keith Wipke, a laboratory program manager with the National Renewable Energy Laboratory’s fuel cell and hydrogen technologies program who did not participate in the research.

Wipke said NREL is currently focused on developing renewable electrolysis, an alternative to steam methane reforming that uses electricity to produce hydrogen.

While electrolysis, like the SULGEN process, can result in zero greenhouse gas emissions, depending on where the electricity is sourced from, it is more expensive than steam methane reforming, which makes it challenging to generate hydrogen that is cost competitive with conventional transportation fuel, according to the Department of Energy.

But Wipke said investing more in research into the clean production of hydrogen is necessary to meet energy needs through hydrogen on a large scale.

“One of the benefits of hydrogen is its ability to couple the renewable power sector or the electricity sector to a number of other sectors such as transportation and industry,” he said. “It really gives you a lot of flexibility, and that's what we call hydrogen at scale is that vision of using hydrogen as a common denominator to affect all these other sectors.”