What are the Colors of HYDROGEN?

BY JEFFREY WINTERS

Many energy experts are excited about the potential for hydrogen as a fuel. It burns cleanly and produces no carbon emissions at the point of use. But since hydrogen must be manufactured—there are no reservoirs of hydrogen gas to be exploited—the overall cleanliness of the fuel depends on the feedstock. To simplify this for the general public, engineers have taken to labelling the different processes by color. Here's what the different colors of hydrogen mean.

BROWN HYDROGEN

The least expensive way to make hydrogen is to turn coal into a gas and then react it with high-temperature steam, a process called steam reforming. Unfortunately, that process creates a lot of carbon dioxide as a byproduct, and that CO_2 is vented into the atmosphere. In fact, it isn't clear whether brown hydrogen is better for the environment than simply burning the coal to make power.

GRAY HYDROGEN

Instead of gasified coal, natural gas can be reacted with steam to make hydrogen. This process is a little better than brown hydrogen because methane molecules have hydrogen atoms that they can contribute, but it still results in greenhouse gases added to the atmosphere.

BLUE HYDROGEN

The downsides of brown and gray hydrogen are the carbon emissions. Some engineers are working to capture the carbon dioxide produced by steam reforming coal or natural gas and sequestering it underground. As long as the gases don't reach the atmosphere, the process can be considered low- or even zero-carbon.

GREEN HYDROGEN

The cleanest option is to not start with fossil fuel feedstock. The most common way to do this is through a process called electrolysis, in which electricity splits water molecules into oxygen and hydrogen. Paths to electrolysis using renewable electricity are considered green. Another pathway involves steam reforming waste biomass instead of coal or methane. Either way, there are no net greenhouse gas emissions. Unfortunately, while both these methods are proven, they are more expensive than conventional ones.

OTHER COLORS

Some engineers want to differentiate electrolysis that uses electricity or heat from nuclear power plants, calling the product red, purple, or pink hydrogen. Others are promoting a methane pyrolysis process that results in a solid carbon byproduct, calling that turquoise hydrogen. With so much interest in making and using hydrogen, new pathways are being developed. Luckily, there are still plenty of colors left.

MECHANICAL ENGINEERING
THE MAGAZINE OF ASME