Nuclear power plants can produce hydrogen to fuel the 'hydrogen economy'

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The long-sought technology for enabling the fabled "hydrogen economy" — an era based on hydrogen fuel that replaces gasoline, diesel and other fossil fuels, easing concerns about foreign oil and air pollution — has been available for decades and could begin commercial production of hydrogen in this decade, a scientist reported here today.

Speaking at the 243rd National Meeting & Exposition of the American Chemical Society (ACS), the world's largest scientific society, Ibrahim Khamis, Ph.D., described how heat from existing nuclear plants could be used in the more economical production of hydrogen, with future plants custom-built for hydrogen production. He is with the International Atomic Energy Agency (IAEA) in Vienna, Austria.

"There is rapidly growing interest around the world in hydrogen production using nuclear power plants as heat sources," Khamis said. "Hydrogen production using nuclear energy could reduce dependence on oil for fueling motor vehicles and the use of coal for generating electricity. In doing so, hydrogen could have a beneficial impact on global warming, since burning hydrogen releases only water vapor and no carbon dioxide, the main greenhouse gas. There is a dramatic reduction in pollution."

Khamis said scientists and economists at IAEA and elsewhere are working intensively to determine how current nuclear power reactors — 435 are operational worldwide — and future nuclear power reactors could be enlisted in hydrogen production.

Most hydrogen production at present comes from natural gas or coal and results in releases of the greenhouse gas carbon dioxide. On a much smaller scale, some production comes from a cleaner process called electrolysis, in which an electric current flowing through water splits the H_2O molecules into hydrogen and oxygen. This process, termed electrolysis, is more efficient and less expensive if water is first heated to form steam, with the electric current passed through the steam.

Khamis said that nuclear power plants are ideal for hydrogen production because they already produce the heat for changing water into steam and the electricity for breaking the steam down into hydrogen and oxygen. Experts envision the current generation of nuclear power plants using a low-temperature electrolysis which can take advantage of low electricity prices during the plant's off-peak hours to produce hydrogen. Future plants, designed specifically for hydrogen production, would use a more efficient high-temperature electrolysis process or be coupled to thermochemical processes, which are currently under research and development.

"Nuclear hydrogen from electrolysis of water or steam is a reality now, yet the economics need to be improved," said Khamis. He noted that some countries are considering construction of new nuclear plants coupled with high-temperature steam electrolysis (HTSE) stations that would allow them to generate hydrogen gas on a large scale in anticipation of growing economic opportunities.

Khamis described how IAEA's Hydrogen Economic Evaluation Programme (HEEP) is helping. IAEA has designed its HEEP software to help its member states take advantage of nuclear energy's potential to generate hydrogen gas. The software assesses the technical and economic feasibility of hydrogen production under a wide variety of circumstances.

More information:

Abstract

The interest in hydrogen production using nuclear power plants as heat sources is growing rapidly in a number of nations. A considerable focus is being devoted to explore the option of current and future nuclear power reactors for hydrogen production. The use of current types of nuclear power reactors are foreseen as a short-term option for the production of hydrogen using low temperature electrolysis. Whereas the later one are seen as mid-term option as they will provide high temperature steam for the production of hydrogen using high temperature steam electrolysis or other promising thermochemical cycles.

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