Method For Zero Emission Liquid Hydrogen Production From Methane Sources and Landfill Gas

Advantages

• A single step liquid H₂ production process is more than 85% efficient while approximately 100% of the H₂ recovery efficiency
• This environmentally friendly zero emissions process captures greenhouse gas, CO₂, in liquid form and that can be applicable for industrial applications
• The current liquid hydrogen industrial markets already exceed $1 billion per year in sales and amount is still climbing

Invention

Processes, methods, systems and devices for zero emission liquid hydrogen production directly from a variety of methane sources (landfills, natural gas, etc.) [U.S. Patent 7,332,146]

Background

Every day the demand for oil increases while the supply and availability of the resource continues to plummet, ever increasing our need to develop and utilize alternative fuels. One such alternative, hydrogen, is predicted to be the solution to our fossil fuel addictions, yet it still requires a more efficient production process before it can be embraced by the general public. As a high energy storage material, liquid hydrogen has found its application aerospace and potentially for on-board hydrogen driven vehicles. Current liquid hydrogen production consists of three steps: (1) Gaseous hydrogen production. (2) Separating hydrogen from a gaseous mixture containing CH₄, CO, CO₂ and H₂O. (3) Liquefying gaseous hydrogen. During the second step, hydrogen purification is carried out via absorption columns in which only 85% of the hydrogen is captured and liquefied. The remaining 15%, together with CO and methane are then burned producing CO₂ and water. This process has low process efficiency (60% to 70%), low hydrogen recovery (85%) and a high CO₂ to H₂ ratio (11.8kg of CO₂ produced per 1kg of H₂).

University of Central Florida scientists have designed a number of plant schematics in which more efficient liquid hydrogen production can be carried out using variable sources of natural gases as well as landfill gas. All of the processes described within the single step processes produce highly purified liquid H₂ with efficiency greater than 85% and 100% of H₂ recovery. Instead of producing CO₂ gas, the novel processes produce purer CO₂, which can then be utilized in other industrial applications and no greenhouse gas emissions. Unlike conventional process, low concentration CO and CH₄ in gaseous mixture are cycled for the production of more liquid H₂ without burning.

Application

Hydrogen production facility manufacturers could utilize the invention to create more efficient and profitable hydrogen production from everyday a wide range of methane resources. In addition the technology is utilized in the direct production of liquid hydrogen that can be immediately utilized for application in industries such as the aerospace industry. Liquid H₂ is also a promising energy storage means for hydrogen fuel cell cars.

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