Abstract

Process Economics Program Report 32B

SMALL-SCALE HYDROGEN PLANTS

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A great deal of enthusiasm is currently noticeable for so-called environmentally clean and alternate fuels. These fuels that are synthesized from the primary fossil fuels such as natural gas, petroleum oil and coal, include gas-to-liquid fuels (diesel, gasoline and kerosene), methanol, dimethyl ether, liquefied petroleum gas, and hydrogen. Lately organically generated fuels, known as biofuels, such as ethanol and biodiesel have also invoked immense interest in the energy industry. However, no other fuel is being envisioned as the fuel of next century (21st century) as much as like hydrogen. Clean fuel advocates and energy zealots are presenting hydrogen as fuel of the future and future energy economy as hydrogen economy.

Hydrogen can be produced on large scale in centralized plants, or on small scale in localized production facilities. Large-scale, centralized production benefits from economies of scale, but suffers from disadvantages due to costly hydrogen storage and transportation infrastructure. Small-scale production, on the other hand, eliminates or reduces the problems of hydrogen storage and transportation, but comparatively has poorer investment and operation economics. A balance, thus, needs to be determined between the two to find out the better economic option for a given situation. This report evaluates factors (type of technology, feedstock, scale of production, gas storage, gas transportation, etc.) that affect, and are taken into consideration in bridging the balance between the economics of two alternatives. The report reviews the industrial work going on small reformers technology development and appraises technoeconomic aspects of small-scale, onsite hydrogen manufacture; the report also examines economic conditions for competitiveness of small-scale hydrogen plants with large plants. Three technologies are currently commercially viable, and used for onsite hydrogen production. They are described under the following headings:

- Small-Scale Hydrogen Production by Steam Reforming of Natural Gas (Sec 5)
- Small-Scale Hydrogen Production by Catalytic Partial Oxidation of Natural Gas (Sec 6)
- Small-Scale Hydrogen Production by Electrolysis of Water (Sec 7)

The report further examines the economic viability of hydrogen production from renewable-energy resources (solar and wind). Finally, hydrogen potential as energy source is compared vis-à-vis major conventional and alternate fuels (Sec 8). The overall conclusion is:

Small-sized, onsite hydrogen plants are in commercial market now, and can compete with large-sized plants under several circumstances (Sec 8). Minimum competitive capacity for small plant is 5,000–6,000 Nm3/hr. Natural gas-steam reforming currently is the most economic technology and will dominate as the main technology for hydrogen production for the next ten to fifteen years, even though efforts for more economic harnessing of renewable energy would gain more momentum.

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