

Pure hydrogen from natural gas using oil-free reciprocating compressors

It sounds like a recipe from a cook book: Take 30 m³ of natural gas, 100 kg tap water and convert the mixture, using 36 kW of electrical energy, to 70 m³ of high-purity hydrogen. True, it's not quite as simple as that, but the HRR (Hydrogen Recuperative Reformer), from Scandiuzzi, of Italy, does provide a reliable system for generation of ultra-pure (99.95 %) hydrogen. The hydrogen product can be used, for example, to power fuel cells. The dimensions of a 70 Nm³/h hydrogen system are a compact 2.4 m in width, 9 m length, and 2.7 m height, equipped with HAUG compressors from Switzerland.



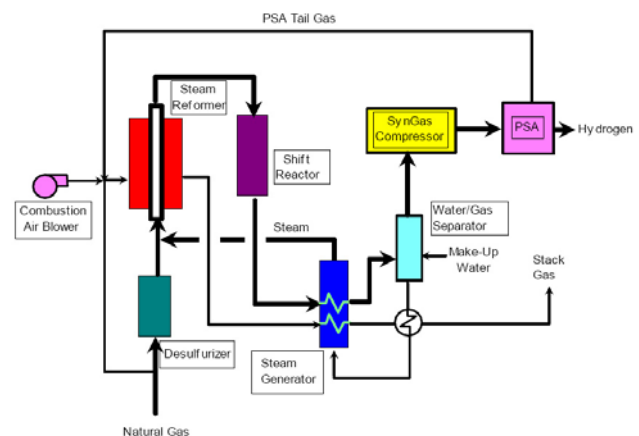
Scandiuzzi hydrogen generator plant with oil-free HAUG compressor

Production of hydrogen

Current annual production of hydrogen is above 500 billion standard cubic meters (scm). By far the greatest percentage of this total originates from fossil sources (natural gas and oil), from the chemicals industry, where it is yielded as a byproduct of chlorine production, and from crude-oil refining processes. Hydrogen is the smallest but most widespread element on our planet, alongside oxygen and silicon, since it occurs in water and in organic compounds. It is colourless and odourless at ambient temperature. Quite apart from the fact that hydrogen is a first-line industrial gas, numerous research projects are now also focusing on this element. Hydrogen is an environmentally friendly source of energy which leaves only water vapour (steam) after yielding energy (via reaction with oxygen). It enjoys great importance as a renewable resource with a high energy efficiency.

Hydrogen production using the Scandiuzzi HRR (Hydrogen Recuperative Reformer)

Scandiuzzi hydrogen generators are built under license from Harvest Energy Technology for production of high-purity hydrogen. All fossil fuels containing a relatively high percentage of hydrogen molecules (e.g. natural gas, methanol and biogas) can, in principle, be used as the feedstock for this process. A hydrogen-rich gas mixture is generated in a reformer in the first process stage, by means of input of steam and heat. Nickel catalysts assist in initiating this reaction. The gas mixture produced at this point still contains a large proportion of carbon monoxide, which is converted with steam to carbon dioxide in two downstream catalytic converters (shift reactors). The downstream gas-cleaning stage removes the non-reacted CO from this process down to a low residual content. The hydrogen can then be fine-cleansed of other disruptive constituents in a pressure swing adsorption process.



Hermetically-sealed compression across two stages

The synthesis-gas compressor used by Scandiuzzi is an absolutely oil-free VTOG 160/90 WM-W reciprocating compressor from Switzerland. It compresses the synthesis gas, with its principal constituents of hydrogen (70%) and carbon dioxide (16%) from 1 to 9.3 bar (abs.) using the plunger piston principle. Flow is around 60 Nm³/h. The internal temperature of the container is not increased excessively, thanks to the use of this water-cooled compressor. Compression takes place in two stages, which are implemented in two cylinders. Following the first stage, the synthesis gas is cooled by an intercooler to ambient temperature, improving system efficiency and lowering compression temperature. Contamination of the hydrogen can be dependably excluded, thanks to totally oil-free operation, i.e., there is not a single drop of oil in the entire machine. In addition, the compressor is hermetically sealed, thanks to its non-contact, maintenance-free magnetic-coupling drive system. This permanently prevents both escape of the explosive gas and contamination of the gas with pollutants from the surrounding air.



Oil-free two stage piston compressor VTOG 160/90 WM-W, water cooling, with gas tight magnetic coupling drive

Hydrogen in fuel cells

It is necessary, for practical use of hydrogen as a fuel, to differentiate between its conventional use as an industrial gas and its future potential as an energy source in a solar-based hydrogen economy, with the gas being used either in reciprocating-piston engines or in fuel cells.

Fuel cells are used, in principle, in small and ultra-small consumers, and also in large power generating plants. Pilot plants for supply of entire housing complexes already exist, as do demonstration systems for laptops, mobile telephones, vacuum cleaners and bicycles.

Ueli Eigenmann
Marketing Manager