1 Description of the FHT Separation Process

Hydrogen will play an increasingly important role as an energy carrier and industrial raw material in the future.

For fuel cells, which generate electrical energy in stationary or mobile applications, this hydrogen gas must be exceptionally pure so that the cells do not clog (poison) over time and lose their efficiency. For industrial chemical processes this purity is also essential. The service life and performance of a fuel cell depends to a large extent on the purity of the hydrogen gas.

Until now, hydrogen could only be purified by complex and expensive processes using, for example, pressure swing adsorption systems (PSA) or porous palladium membranes. Electrolysers, where a chemical reaction is induced by means of electricity, require immense amounts of energy.

A novelty is now the production of pure hydrogen gas via a patented device in which a passage in the form of protons is created, through the wall of a pure and ferritic metal at low temperature and low energy demand.

The patented system works exclusively with elemental hydrogen, which gives off electrons on one side of the wall and takes them back on the other side after the passage.

All other substances and elements cannot pass through this metal lattice due to their ion diameter. It thus takes advantage of the fact that hydrogen is the only chemical element that can tunnel through metal. The energy input is considerably lower, since the hydrogen gas contained in the synthesis gas from biomass power plants is merely separated and does not have to be generated by electrolysis or other conventional processes. The climate-neutral biomass gasification thus produces genuine "green hydrogen". The A.H.T. dual-fired gasifiers with their efficient gas scrubbing are predestined to produce a correspondingly pure product gas.

2 Operation Principle

With moderate pressure, pipes made of pure iron are impinged from the outside with a hydrogen-containing gas mixture. Inside the tubes, the pure hydrogen is extracted under a slight negative pressure.

This process supplies absolutely pure hydrogen for the operation of fuel cells and for other industrial and chemical applications. In addition, long transport routes via pipelines or in hydrogen-liquid tanks are no longer necessary, since A.H.T. synthesis gas power plants can be installed directly at the place of use.

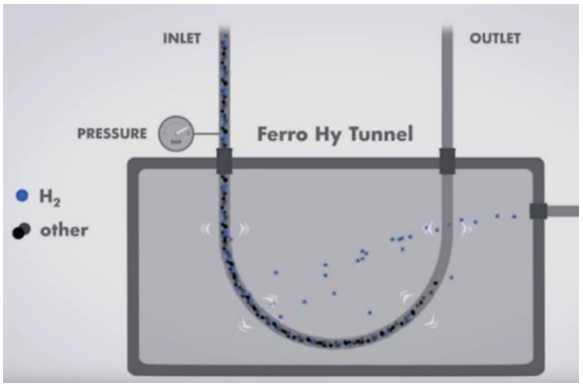

Illustration: Operating principle of FHT process

3 From sewage sludge to hydrogen - the process steps

3.1 Hydrothermal Carbonisation (HTC)

By means of pressure, time and temperature, high-moisture residues such as sewage sludge, liquid manure or fermentation residues are converted into hydrocarbons. After briquetting and water separation, this is available for synthesis gas production. The advantage is that energy-intensive pre-drying is not necessary. Hormones, antibiotics and other impurities are destroyed as a result of the operating conditions. The process water contains valuable fertiliser components which can be separated.

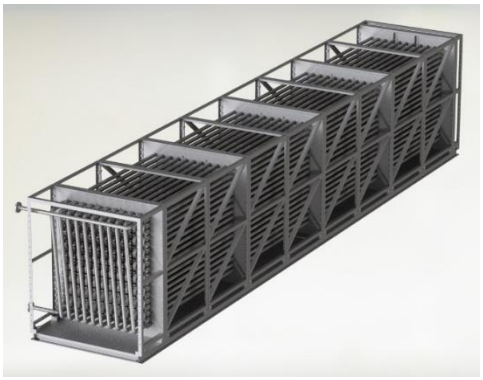

Illustration: 3D Model HTC Facility

3.2 Synthesis Gas Production and conditioning

A clean product gas is already produced in the twin-fire gas generator with two gasification zones and the combination of ascending and descending gasification. The gasification material is almost completely converted, leaving only ash without valuable non-gasified material. This process allows a wide range of feedstock to be used - in addition to the above-mentioned, harvest residues or even treated wood.

Illustration: 3D Model Syngas, Heat and Power Plant

The product gas is now fed to the wet gas scrubber: remaining particles and other impurities are washed out, so that a high-purity synthesis gas is available for further use. The water is purified and returned to the process. In addition to being used for process heat, this can also be used to generate electricity in a CHP unit - and of course to separate hydrogen or other synthesis gas components for chemical processes.

3.3 Hydrogen Separation

In the final process step, hydrogen is separated according to the mechanism described above, as it is already present in the synthesis gas - with minimum energy input and at ambient temperature. Thus, hydrogen production is already worthwhile on a decentralised scale. The purity is ≥ 99.999999 % (8.0) already in the first separation pass. The metal screen makes the separation plant very low-maintenance and modularly scalable.