

ET 282

Industrial electrolyser for H₂ (PEM)



Description

- PEM electrolysis for hydrogen production
- all process stages on an industrial scale
- water purification and monitoring of conductivity
- system control and acquisition of process data via GUNT software

In energy supply systems with a surplus of electrical energy from renewable sources, hydrogen can be produced cost-effectively by electrolysis and later serve as an energy reserve when needed. PEM electrolysis is a widely used electrochemical process for the production of hydrogen in industry. The proton exchange membrane is used to split water (H₂O) into hydrogen (H₂) and oxygen (O₂).

The ET 282 trainer contains all the components needed to investigate hydrogen production on an industrial scale. The typical process stages are divided into: water purification, hydrogen production and hydrogen purification and storage.

Water purification uses an ion exchanger to produce water for the process in accordance with DIN ISO 3696 type 1. Hydrogen is produced in a PEM electrolyser with Catalyst Coated Membrane (CCM), which is supplied via an

electrical DC voltage source.

The hydrogen, which is heavily saturated with water, is then purified with water separators, a cooling section and a drying unit for intermediate storage in a buffer tank. The hydrogen from the buffer tank can be filled into a gas cylinder for further use. Unused or excess hydrogen is safely released via a vent line. As a safety procedure, the pipes are purged with nitrogen before the system is shut down (N₂ not included in delivery).

Two adsorber filters are installed in parallel for maintenance of the drying unit. The remaining service life of the filters is recorded and displayed.

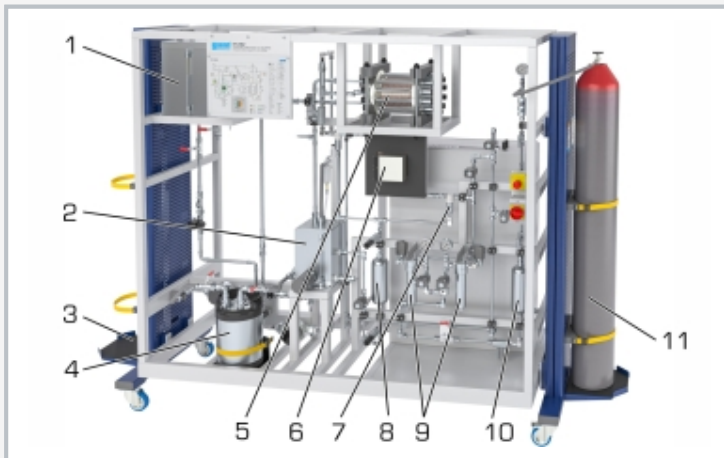
The experimental plant is controlled and operated via GUNT software (external PC required). Level, temperature and conductivity of water are monitored. The measured values for hydrogen flow rate, temperature and pressure, as well as current and voltage at the electrolyser are also recorded. The GUNT software is used to analyse the energy balance.

Learning objectives/experiments

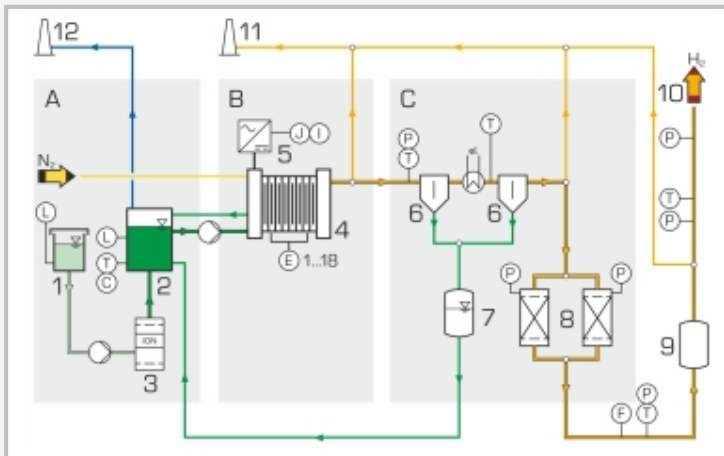
- conversion of electrical energy into chemical energy (hydrogen) on an industrial scale
- function and design of an electrolysis system with typical components
- production of H₂ by means of PEM electrolyser
- relationships between operating parameters of the electrolyser
- factors affecting the performance of the electrolyser
- recording and visualisation of all relevant characteristics
- calculation of relevant parameters
- determination of the energy balance

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1 storage tank with distilled water, 2 tank with purified water, 3 holder for N₂ gas cylinder, 4 ion exchanger, 5 PEM electrolyser, 6 gas cooling, 7 filter, 8 condensate tank, 9 adsorption dryer installed in parallel, 10 H₂ buffer tank, 11 H₂ gas cylinder



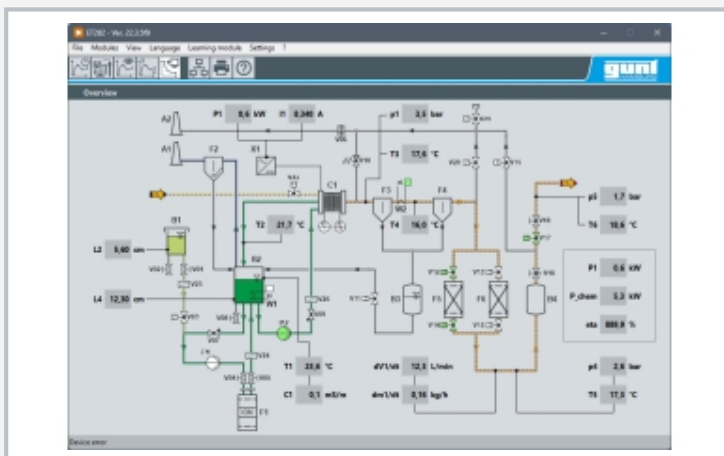
Process stages of H₂ production

A water purification

B H₂ production

C H₂ purification

1 storage tank with distilled water, 2 tank with purified water, 3 ion exchanger, 4 PEM electrolyser, 5 DC voltage source, 6 filter and gas cooling, 7 condensate tank, 8 adsorption dryer, 9 H₂ buffer tank, 10 H₂ gas cylinder, 11 H₂ blower, 12 O₂ blower; P pressure, F flow rate, T temperature, L level, C conductivity, E voltage, I current, J el. power; orange: H₂, blue: O₂, green: H₂O, yellow: N₂



Software screenshot

Specification

- [1] PEM electrolysis for hydrogen production on an industrial scale
- [2] water purification: ion exchanger and tank for purified water (DIN ISO 3696 type 1); monitoring of temperature, conductivity and fill level
- [3] H₂ production in the PEM electrolyser with CCM and monitoring of single cell voltage
- [4] DC voltage source for electrical supply
- [5] H₂ purification: water separator with gas cooling and exchangeable drying units with recording of the remaining service life
- [6] intermediate storage of the H₂
- [7] nitrogen for purging the pipes (N₂ not included)
- [8] recording of H₂ flow rate and pressure; current, voltage at the electrolyser
- [9] modern, digital system control and data acquisition via GUNT software
- [10] multimedia instructional materials online in GUNT Media Center

Technical data

Electrolyser (PEM technology) with 18 cells

- stacking voltage 26...39V
- max. hydrogen production: 1 m³/h
- max. oxygen production: 0,5 m³/h
- max. pressure: 40bar
- min. water flow rate: 480L/h
- water quality: DIN ISO 3696 type 1, conductivity: max. 0,01 μS/cm
- operating temperature: 65...80°C
- electrical connection power: 0,2...6kW

DC power supply

- voltage: 0...80V
- current: 0...150A
- power: max. 5kW

Ion exchanger, capacity: 2000L

- power: max. 450L/h
- pressure: max. 10bar

Buffer tank: volume: 1L, max. pressure: 125bar

Measuring ranges

- current: 0...150A
- voltage: 0...80V
- conductivity: 0...100μS/cm
- flow rate: H₂ 0,2...20NL/min
- pressure: 0...50mbar, 0...40bar

400V, 50Hz, 3 phases; 400V, 60Hz, 3 phases

LxWxH: 2934x790x1988mm, Weight: approx. 165kg

Required for operation

7 litres of distilled water, N₂ gas cylinder, PC with Windows

Scope of delivery

experimental plant, H₂ gas cylinder, GUNT software, on-line access to the GUNT Media Center, set of instructional material