

Water Electrolysis for Hydrogen Production

Ensuring Process Safety and Product Quality
Using Oxygen, Hydrogen, and Moisture Analyzers

Electrolyzer by-products include water vapor and oxygen. Precise measurements of hydrogen, oxygen and moisture content can provide an index of the efficiency of the electrolyzer. Maximizing an electrolyzer's safety and efficiency requires highly reliable and accurate sensor technology.

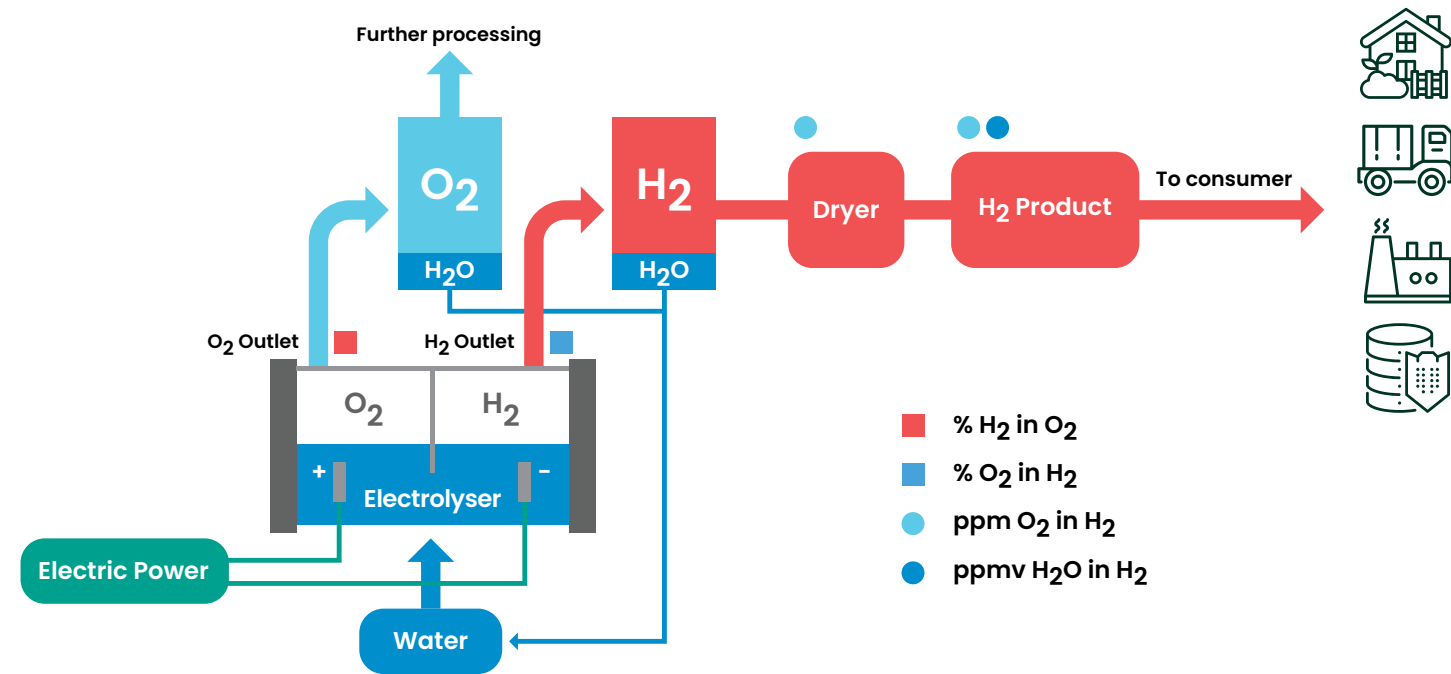
As a recognized leader in process analyzers, Panametrics offers a complete system for hydrogen, oxygen and moisture measurement for water electrolysis.

Hydrogen: The fuel of the future

Developments in recent years to reduce greenhouse gases have prompted many countries to achieve a net-zero target by 2050. To achieve these goals, these countries seek to maximize energy sources that minimize emissions. Hydrogen as a fuel offers one such path.

Hydrogen, a versatile energy carrier, doesn't produce carbon emissions, such as CO and CO₂, when burned. Also, when it's produced in a climate-friendly manner, hydrogen significantly contributes to reducing CO₂ emissions in industry and transportation. As such, it will play a vital role in the success of the global energy transition.

One process that will make a major contribution to this effort is hydrogen production via water electrolysis, using renewable energy to power the process. The hydrogen produced in this way is called "green hydrogen."



Typical Electrolyser Process

Water electrolysis

An electrolyzer passes an electrical current to split water molecules into hydrogen and oxygen. The cell, the core of the electrolyzer where this process takes place, features two electrodes. The electrodes are immersed in an electrolyte separated by a membrane. Water splits into oxygen and hydrogen at the electrodes, while the membrane separates these produced gasses.

The membrane keeps these two gases separate during the splitting process, moving the oxygen to its own outlet. Crossovers of these gases on the membrane may occur, however.

Hydrogen measurement

Hydrogen is highly flammable and can react explosively with oxygen. It is important to know if the oxygen content approaches the lower explosive limit in the hydrogen stream, due to any leaks or membrane cross-over.

It is also critical to continuously monitor for leaks on the oxygen and hydrogen side of the electrolysis cell, so that this does not approach the explosive limit of the gas mixture. This safety-relevant measurement indicates the health of the overall process and efficiency of the membrane. It always should be done with reliable, robust and proven technology.



Panametrics XMTC

The Panametrics XMTC Thermal Conductivity Binary Gas Analyzer reliably monitors hydrogen in oxygen and oxygen in hydrogen. Typical measurement ranges are 0 to 5% to signal a membrane malfunction. The XMTC is certified for Class 1/Zone 1 environments.

Reliable and accurate analysis of hydrogen concentration in a compact, robust package.

Benefits

- Proven technology in a simple, easy-to-use, compact design reduces system solution costs
- Rugged construction and no moving parts means extremely stable output with real-time error detection
- Doesn't require frequent field calibration
- Basically maintenance free by design
- Stands up to harsh environments, withstanding shock and vibration

Key features

- Weather- and explosion-proof versions
- Extremely stable measurement thermistors
- Button-activated calibration
- PC interfaces for digital output
- Standard and custom calibration ranges between 0% and 100%

Trace oxygen analysis

The hydrogen produced during electrolysis typically contains high levels of moisture and varying amounts of oxygen. This moisture and oxygen are removed to produce high purity hydrogen. This is necessary to meet gas quality specifications for compressed hydrogen in applications such as fueling stations.



Reliable oxygen measurement in a compact, unique design.

Panametrics **oxy.IQ** galvanic cell transmitter detects the lowest possible oxygen impurities in the hydrogen stream, delivering 17 different percentage and ppm measuring ranges. It delivers reliable measurement in a compact design.

Benefits

- Proven galvanic fuel cell sensor technology provides superior performance, accuracy, stability and long life
- Compact analyzer design provides easy installation and system solution flexibility
- Innovative design eliminates the potential for negative signal output, reduces sources of contamination
- Built-in microprocessor with intuitive user interface to easily select range, trim outputs and perform calibration
- User-selectable ranges, calibration, sensor diagnostics with keypad simplifies programming
- Background gas insensitivity and acid gas sensor options ensure accurate measurement and analysis

Key features

- Display with keypad, user interface with diagnosis function
- Sensor-failure and lifetime monitoring features
- User-programmable, low maintenance, economical, compact
- Wide range of different calibrations covering ppm and % O₂ ranges



Trace moisture measurement

In most electrolyzer applications, the exit gases are saturated with water. Since water vapor doesn't burn or carry energy, dehydration is necessary to effectively transport, store and use the hydrogen produced during electrolysis.



Intrinsically safe, moisture transmitter general purpose and hazardous area use.

Panametrics was founded in 1960 with the introduction of the patented thin-film, aluminum-oxide moisture sensor. Today, we use this technology in the intrinsically safe and highly versatile **HygroPro** transmitter. The **HygroPro** combines moisture measurement with built-in temperature and pressure sensors to meet the demands of rugged industrial applications, including hydrogen production.

Benefits

- Compact transmitter with moisture, temperature, and pressure sensors mounted on a single probe allows installation where space is at a premium.
- Measurements at pressures up to 5000 psig (345 bar)
- Large dynamic dew/frost point measurement range (-110 °C to +60 °C)
- Sensors are easy to replace in the field

Key features

- Intrinsically safe
- Ambient to ppb moisture levels using aluminium oxide moisture sensor
- Built-in temperature and pressure sensors
- Integrated display/user interface
- HART communication over the 4 – 20 mA analog output

Industrial moisture transmitter

The **DewPro Moisture Transmitter** is an ideal, low-cost, explosion-proof moisture transmitter for the dryer application in water electrolysis.

Benefits

- Provides long calibration stability and quick response times
- MMY30's integral flow cell for filtration and flow regulation is ideal for moisture monitoring in various process environments

Key features

- Loop powered, 4-20mA transmitter
- Integral filtering and flow regulation
- Hazardous area configurations available



Turnkey measurement solutions

Any analyzer's performance depends on the sample system integrity. Panametrics **pro.iQ** and **O2.iQ**, are complete plug-and-play systems, delivering moisture and oxygen measurements every time. Simply mount the transmitter, connect power and inlet gas, and the analyzers are ready for use.



Features & benefits

- Compact footprint, stainless-steel package and loop-powered transmitters provide solutions that work in safe and hazardous areas
- Package design provides easy access to transmitter for effortless maintenance
- Wall-mounted NEMA 4X and IP66 stainless steel package
- The sample conditioning system provides isolation, filtration, pressure regulation, flow and pressure indication along with a clear window for easy viewing of all readings



Panametrics, a Baker Hughes Business, provides solutions in the toughest applications and environments for moisture, oxygen, liquid and gas flow measurement. Experts in flare management, Panametrics technology also reduces flare emissions and optimizes performance.

With a reach that extends across the globe, Panametrics' critical measurement solutions and flare emissions management are enabling customers to drive efficiency and achieve carbon reduction targets across critical industries including: Oil & Gas; Energy; Healthcare; Water and Wastewater; Chemical Processing; Food & Beverage and many others.

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For us, it is safety first! The critical measurement is hydrogen in oxygen, to ensure that we do not have leakage from the high-pressure hydrogen to the low-pressure oxygen side of the membrane. Oxygen can [...] get below the upper explosive limit resulting in a safety issue. The other measurements are concerns for our customers who use the hydrogen. As an example, there are gas quality specifications for moisture in the compressed hydrogen in a fueling station.



– Electrolyzer Manufacturer

Contact us

For more information please contact your local Panametrics representative, or visit:

panametrics.com

