Services along the hydrogen value chain

H_2 generation: Electrolysis

TÜV®

TÜV NORD GROUP

H_2 competence @ TÜV NORD

1. Energy generation

Wind energy ■ ■ ■

2. H_2 generation

Electrolysis ■ ■ ■

Seawater desalination plants ■ ■ ■

3. Distribution/transport

Electrical grid ■ ■ ■

Pipelines ■ ■ ■

District heating ■ ■ ■

Intelligent networks ■ ■ ■

Pipelines ■ ■

Refuelling stations/ filling systems ■

Tankers (lorry, train, ship) ■

4. Storage

Battery storage ■ ■ ■

Gas tanks ■ ■ ■

Cavern storage (H_2 and CO_2) ■ ■ ■

Pressure vessels ■ ■ ■

H_2 hybrid storage ■

5. Consumption/use

Fuel cell systems ■ ■ ■

Methanol synthesis units ■ ■ ■

Refinery ■ ■ ■

Mobility ■ ■

In every field of services, we support you in the following phases:

■ Concept/planning ■ Production ■ Operation

Concept/planning

We support you in the concept phase with comprehensive services that will give your project the security it needs in technical and legal aspects from the very start. From product design through the assessment of requirements and technical specifications to plant development and process optimisation, our specialists have the details and the desired goal in view and are equipped and prepared for your tasks with ultra-modern IT and AI instruments as well as a broad spectrum of risk analysis, certification, test and evaluation services.

Production

With specific testing,auditing and approval services, we provide neutral and technically competent support as a notified and accredited body for manufacturers. This includes assessment and certification as a material manufacturer, obligatory for the production of certain products. Our range of services also includes the assessment of manufacturing processes, material assessments, stress tests, damage appraisal and product certifications. In addition, on top of monitoring production, we also support commissioning, assembly works and personnel instruction in production processes.

Operation

After setup and commissioning, we help you when operations are up and running to avoid shutdowns, eliminate technical sources of danger and reduce costs with the use of software-supported maintenance systems. We take on the task of carrying out all recurring inspections and specific tests of electrical and mechanical plants and systems. We can also create risk-based maintenance plans and provide you with tailor-made strategies to reduce operational risks and increase plant safety over the long term.

Electrolysers – the technology of hydrogen generation

For the electrolysis of water, various processes are used, achieving various levels of energy efficiency based on the specific technologies, materials, current densities, temperatures and other factors. What links all these techniques is the principle of splitting water into hydrogen and oxygen using an electrical current. Here, two water molecules ($2H_2O$) can be converted into two hydrogen molecules ($2H_2$) and one oxygen molecule (O_2). By using electricity from renewables, so-called “green hydrogen” results.

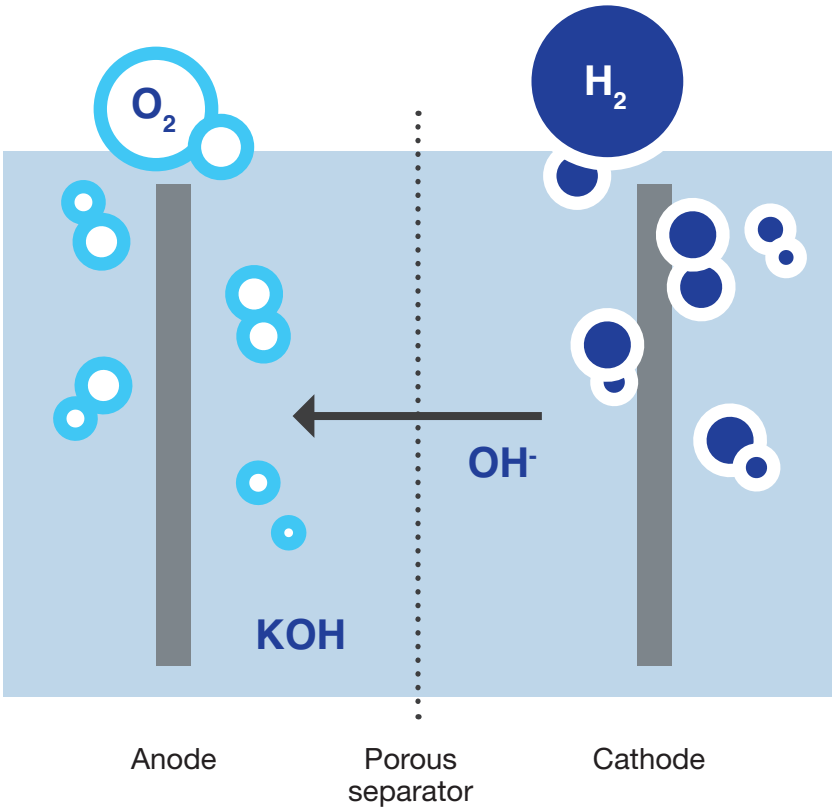
We are your partner for the development, assessment and integration of powerful electrolysers in your process chains – from the use of smaller systems in research institutes or the mobility sector all the way to larger plants for energy-intensive industries. With the most modern analytical methods, measurement processes and competent specialists, we are at your side to carry out your project safely and successfully, and to help you benefit from subsidies as available. Do get in touch.

Overview of the processes of water electrolysis

AWE (alkaline water electrolysis)

Alkaline water electrolysers are used worldwide on an industrial scale, as they work with comparatively cheap materials. The electrolyte is a potassium hydroxide solution (KOH) with a concentration of 20–40 %. Under a direct current of at least 1.5 volts, hydrogen is formed at the cathode and oxygen at the cathode. The electrodes are nickel-based or made of ruthenium oxide or iridium oxide-coated titanium.

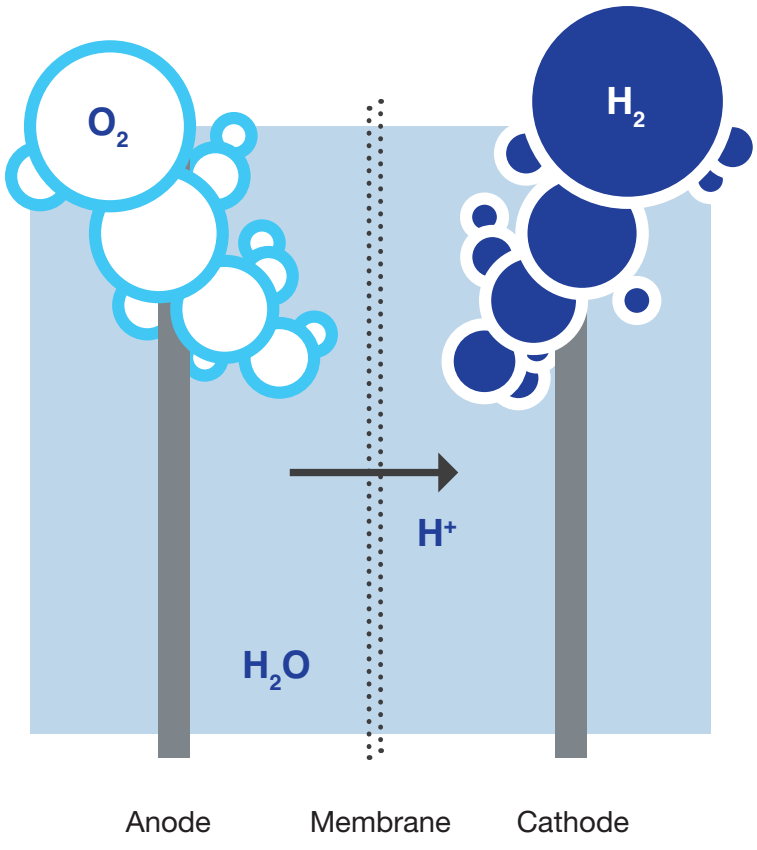
Limited efficiency: the anode and cathode are separated, in alkaline water electrolysis, by a porous, semi-permeable Zirfon membrane which only resists a limited level of pressure and can only be operated at low current densities (max. 600 milliampere per square centimetre of membrane area). The hydrogen must then be compressed at great energy cost so it can be stored and transported.



PEM electrolysis (acid electrolysis)

In PEM electrolysers, instead of a liquid electrolyte, a solid polymer is used (proton exchange membrane). The membrane is suspended in distilled water or drinking water. The aggressive, acidic environment places a great burden on the materials, for which reason the polymer membrane is fitted on the cathode side with a porous, platinum-coated carbon electrode and, on the anode side, with a ruthenium or iridium oxide-coated one.

High efficiency: With 2,000 milliamperes per square centimetre of membrane, the solid, semi-permeable polymer membrane achieves three times the current density of the Zirfon membrane in AWE plants. In addition, it can withstand greater load fluctuations. As PEM electrolysers can be operated under high pressure, they also reduce the energy needed for subsequent hydrogen compression for storage and transport. The higher efficiency of PEM electrolysis makes it possible to use smaller electrolysers to generate the same quantity of hydrogen as with larger AWE units. Replacing the expensive platinum catalyst with molybdenum sulphite also allows investment costs for production to be reduced.



HTE (high-temperature or steam electrolysis)

A high temperature electrolyser works in the range between 100 °C and 900 °C, where efficiency increases in line with temperature. Unlike AWE and PEM electrolysers, they do not need noble metal components. The steam enters a solid oxide electrolysis cell, in which the water molecules are split between nickel cermet steam electrodes, for hydrogen, and electrodes consisting of mixed oxides of lanthanum, strontium and cobalt, for oxygen.

Top efficiency: With efficiency rates up to 90 %, high-temperature electrolysis is a particularly effective way of generating industrial hydrogen. It offers its advantages to energy-intensive sectors such as the steel industry, where great quantities of waste heat are available for use in high-temperature electrolysis.

Our services

With comprehensive services in the fields of testing, inspection and certification, we support manufacturers and operators of electrolysers in the following phases:

	Concept / planning	Production	Operation
Inspection of concepts to current legal requirements, standards and regulations	■		
Inspection of requirements specifications	■		
Inspection of technical specifications	■		
Inspection of component designs on the basis of standards, third-party requirement catalogues or customer demands	■		
Certification of protective devices	■		
Inspection of staggered power system protection plans, protection tests	■		
Analysis of electrical grids	■		
Certification of the grid connection	■		
Certification of protective devices, inspection, safety design	■		
Conformity assessments of electronic components/systems	■		
Inspection of the design, construction, functioning and reliability of hoists, cranes and load handling equipment	■		
Inspection of risk analyses to determine the potential risk of intervention by unauthorised persons	■		
Inspection of safeguarding concepts	■		
Inspection on determination of intervention measures by guarding/security company or police	■		
Inspection on determination of administrative security measures	■		

Services along the hydrogen value chain: H_2 generation

	Concept / planning	Production	Operation
Inspection commissioning and periodic inspection concepts	■		
Testing electromagnetic compatibility	■		■
Certification of electrolysers, incl. to ISO 22734	■		
Individual material assessments for the use of plastics in the field of design testing under the Pressure Equipment Directive for electrolysers	■		
Technical due diligence	■		
Technical, financial, legal due diligence (with external partners)	■		
Inspection on installation and operation of alarm receiving stations		■	
Production monitoring and auditing		■	
Inspection and support for commissioning and assembly works		■	
Acceptance and functional tests		■	
Acceptance tests (commissioning, periodic inspection) of isolated grids with involvement of e.g. decentralised generator units, electrolysers and any necessary storage systems (on and offshore)		■	
Inspection of switchgears/control cabinets to EN 61439-1			■
Inspection of electrical and mechanical safeguarding systems			■
Recurring inspections			■

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