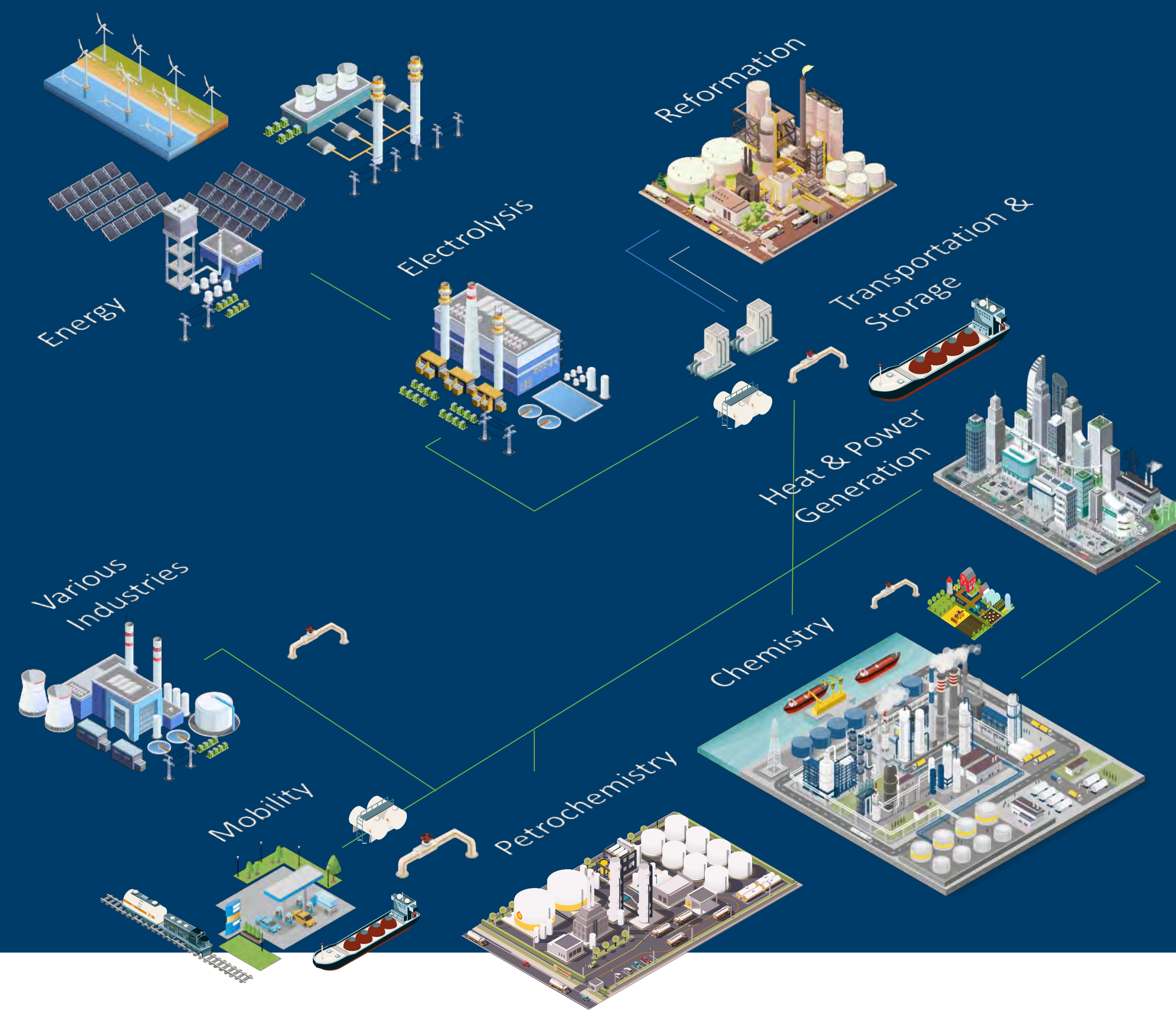
Hydrogen and Energy Industry

Industrial Valves



Industrial valves for the hydrogen economy

Optimization of the hydrogen value chain with reliable and proven valves from KLINGER SCHÖNEBERG

Hydrogen can be produced in various ways. In addition to electrolysis, for which surplus electricity from renewable energies can be used (green hydrogen), thermal processes such as steam reforming (gray hydrogen) are among the most common processes for meeting hydrogen demand.

The applications are as diverse as the valves needed for hydrogen production, storage, and transportation to use. Valves used along the hydrogen value chain must meet stringent requirements for safety, design, material durability, and quality.
Furthermore, they have to withstand extreme pressures and temperature ranges.
As an industrial valves specialist, we place high demands on the design and material selection of the individual valve components.
For the design of our valves we use our own developed analysis and design tool CHOICE INTEC, with which we develop an economically and technically optimal solution.

At KLINGER SCHÖNEBERG GmbH you will receive comprehensive industrial valves tailored to your individual requirements. In doing so, we not only consider the entire process, the investment and operating costs as well as the energetic requirements, but also the technical framework conditions.

Geothermal Energy

KLINGER SCHÖNEBERG
warmly recommended

Process description

Geothermal energy complements the mix of renewable energies from wind power and solar energy and has the advantage of "constant availability", as there is independence from climatic conditions and from the time of day and season. In geologically favorable locations, there are natural deposits of hot thermal water deep below the earth's surface. Deep geothermal energy involves the thermal utilization of the subsurface from approx. 400 m to several thousand meters by means of deep boreholes and is used to generate electricity and heat. Due to the rarity of such deposits, the hot dry rock process is becoming increasingly important. In this process, cold water is pumped into the earth to a depth of about 5,000 meters. There, the water heats up and is pumped back to the earth's surface.

Requirements

» The temperatures of the thermal water are approx. 140°C
» Lime-containing medium and hardly any lubricating properties
» Settling of the lime on the valve components
» Dissolved gases, which diffuse over time
» Delivery rates with 165 l/sec.
» Delivery pipe diameter up to 340 mm
» Pressure up to 344 bar (5,000 PSI)

Solutions

High temperatures and flow rates, aggressive gases and crystallized salts demand optimum performance from industrial valves.

INTEC K211
INTEC K212

INTEC K811
INTEC K814

Solar Power Plants

Green hydrogen thanks to solar energy

Process description

Solar thermal power plants convert the sun's radiation into heat. Here, the sunlight is concentrated and heats thermal oil, water or a molten salt.
In this case, for example, synthetic thermal oil is heated up to 400°C by the concentrated solar radiation and fed to a central point in the solar power plant. There, the heat from the oil heats the water, producing steam that drives a turbine to generate electricity.
In addition, molten salts are often used as a heat transfer medium in solar thermal power plants because of their better properties. While thermal oil can only be used up to approx. 400°C, molten salts are stable up to approx. 565°C. In this way, steam can be generated at a higher temperature, which has a positive effect on the efficiency of the steam turbine and thus on the energy generated in the power generator. The salt then flows into a storage tank, where it must be kept at a constant temperature. By integrating thermal storage, power generation is decoupled from the available solar radiation and is thus demand-driven. The plant then pumps the salt on to a steam generator, where the heat from the salt turns water into steam. During this process, the salt cools and is then fed back into the cycle. On the way of the molten salt from the steam generator back to the central tower, there is a risk that the temperature of the salt falls below a specific limit of approx. 228°C and the salt solidifies.

Requirements

» High temperature resistance up to 565°C
» The medium thermal oil is very creepable
» High demands on the tightness of the valve, as thermal oil flames atmospherically
» The molten salt is a crystallizing medium
» Corrosion resistance

Solutions

Unique operational challenges in handling thermal oil and molten salts require high quality isolation valves from KLINGER SCHÖNEBERG to minimize impact on cost, risk and personnel.

INTEC K811

Electrolysis

Power to Valve for green hydrogen

Process description

Hydrogen can be produced in large quantities by electrolysis without CO_2 using energy from renewable sources. In large-scale production, ordinary demineralized water is split into oxygen and hydrogen by means of electric current in an electrolyzer.
Commercial water electrolysis systems for industrial use are currently designed as alkaline electrolysis with the electrolyte potassium hydroxide or as membrane electrolysis "Proton Exchange Membrane (PEM) Electrolysis" with a proton conducting polymer membrane.

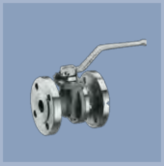
In alkaline electrolysis, valves are also used to handle the aqueous electrolyte solution.
Currently, electrolysis plants are largely operated at atmospheric pressure. In principle, increasing the operating pressure has the advantage that the hydrogen produced at high pressure does not have to be recompressed as much for storage purposes, which results in potential energy savings.

Requirements

- Alkaline electrolysis at approx. 90°C and an operating pressure between atmospheric and 120 bar (commercially up to approx. 30 bar).
- Membrane electrolysis at approx. 90°C and an operating pressure of 350 bar
- High requirement for tightness - gas tightness at high pressures
- Safety of the valve
- High demands on pressure-bearing materials to avoid hydrogen-induced stress corrosion cracking
- Long service life even at high pressures

Solutions

The electrolysis processes for hydrogen production, including water treatment, cooling, hydrogen purification and the generation of high-purity hydrogen, require reliable and safe valves from KLINGER SCHÖNEBERG.



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INTEC K204
INTEC K210
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INTEC K214
INTEC K220
INTEC K221

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Reformation

Valves for gray and blue hydrogen

Process description

On an industrial scale, steam reforming is now the most common process for producing hydrogen.
This involves the endothermic catalytic conversion of hydrocarbons such as methane and naphtha to synthesis gas (a mixture of carbon monoxide and hydrogen). These processes are carried out on a large scale under pressure and at high temperatures. To produce pure hydrogen, the carbon monoxide is largely converted with water vapor to carbon dioxide and hydrogen (so-called shift reaction). The carbon dioxide and other components (e.g. unreacted methane and carbon monoxide) are then removed from the gas mixture by adsorption or membrane separation. This is referred to as gray hydrogen. The separated residual gas (H_2, CH_4, CO) is used together with a portion of the feed gas to fire the reformer.
If the CO_2 produced after hydrogen production is captured and stored (carbon capture and storage, CCS) or reused (carbon capture and utilization, CCU), this is referred to as blue hydrogen. This is also climate-neutral as long as the captured carbon dioxide is not released into the atmosphere.

Requirements

- High temperature requirements up to 950°C
- Nominal pressure up to 50 bar
- Reforming process using supercritical water on heterogeneous catalyst at 250 - 300 bar and 400 - 550°C
- Operating safety

Solutions

The high requirements in handling synthesis gases and supercritical water are fully met by KLINGER SCHÖNEBERG valves.

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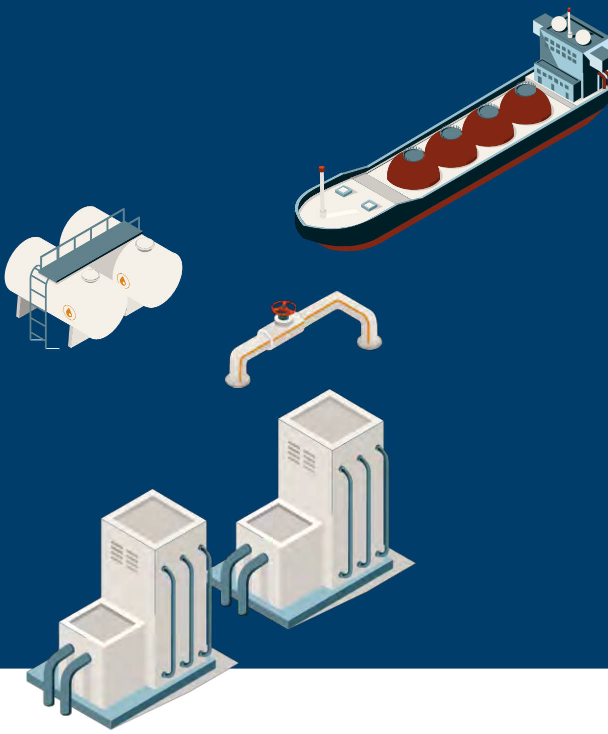

Hydrogen Infrastructure

Proven valves for compression, pipeline transport and storage

Process description

Hydrogen can be stored after production, transported via gas networks and industrial pipeline systems, and made available.
If the hydrogen is not produced directly at the site of industrial or private use, it must be transported, regardless of the type of production. Various technical methods are used for this: for example, as gas in high-pressure containers, as liquid gas in insulated containers, further processed into methanol and ammonia, or in liquid form in a carrier medium.
Pipeline transport has established itself as the most economical method, since existing networks are used in some cases.
To be fed into pipeline networks, the hydrogen must be compressed to the operating pressure of the pipeline network. In this process, piston and turbo compressor stations at certain intervals ensure that the pressure is maintained despite flow losses in the pipeline.

To compensate for differences between hydrogen production and consumption or to balance out fluctuations, hydrogen can be stored in caverns, for example. Cavern storage can assume dimensions of 70 m in diameter and a height of 400 m. In addition, there is the possibility of storage in other underground storage facilities. In some cases, 3,800 tons can be stored there to feed local industry as well as private households.

Requirements

» Processing and compression up to 1,000 bar
» Supply of chemicals, power plant technology and filling stations in the low-pressure and high-pressure range (70 mbar to 700 bar)
» Storage at over 200 bar
» High demands on tightness - gas tightness at high pressures
» Safety of the valve
» Long service life even at high pressures

Solutions

The handling of hydrogen requires high material quality, safety and process-proven valves. KLINGER SCHÖNEBERG valves offer all this and more.

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Chemistry

Chemistry is in our DNA

Process description

Hydrogen is used as a basic material in many chemical processes. The largest share is used for ammonia synthesis, in refineries and for methanol production.
The starting point for the power-to-chemicals process is first the electrolysis of water. In the next step, the hydrogen produced in this process is used together with carbon dioxide to produce a synthesis gas for a methanol synthesis to methanol or gaseous and liquid hydrocarbons. These in turn form the starting material for a variety of other processes for the production of ethylene, propylene or other downstream products based on them.
Reacted with atmospheric nitrogen, the hydrogen can also be used for ammonia synthesis, a catalytic production process in the Haber-Bosch process. In this process, hydrogen and nitrogen can be obtained separately and mixed or used immediately as a nitrogen-enriched synthesis gas. The reaction takes place at high temperatures and pressures as follows:
First, the necessary pressure level is established in the compressor. In the gas purifier, the gas is cleaned of adverse impurities and fed into the contact furnace. There, the gas mixture is heated and reacts with the catalyst to form ammonia gas. It is then cooled in the cooler and separated from unreacted hydrogen and nitrogen in the separator. The ammonia produced can then be used for the production of urea or fertilizers, for example in the form of ammonium carbonate.
In the context of food chemistry, hydrogen is used for the preservation of foodstuffs as well as for the hardening of vegetable oils.

Requirements

- High pressure and high temperature requirements
- Ammonia synthesis at 150 to 350 bar and about 400°C to 530°C
- Methanol production at 50 to 350 bar and about 200°C to 380°C

Solutions

Our shut-off valves have already been used successfully for decades in the large-scale chemical industry in the most diverse processes and also under extreme conditions.

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Petrochemistry

Safe shut-off of liquid and gaseous media as well as high pressure and temperature

Process description

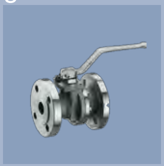
Among the largest industrial consumers of hydrogen are the petrochemical industry and the upstream oil and gas industry. However, both industries require hydrogen less as a raw material than as a cleaning agent. Crude oil and natural gas, as well as the refinery products derived from them, contain sulfur-containing compounds that must be removed. This is because the combustion of these compounds, for example in fuels, produces sulfur oxides that are harmful to the environment and damage both catalytic converters in motor vehicles and in other petrochemical processing operations.
To prevent this, the industry uses what is known as hydrodesulfurization on a large scale. In this process, added hydrogen reacts with sulfur on a catalyst to form hydrogen sulfide. This, in turn, can be isolated to produce a considerable proportion of the sulfur produced worldwide, an important basic chemical. The hydrogen used thus also contributes indirectly to sulfur chemistry.
Hydrocracking is another petrochemical process with a high hydrogen demand. It allows heavier and more viscous residues from petroleum refining to be converted into lighter components, from which fuels such as kerosene and diesel can be obtained.

Requirements

- High pressure and high temperature requirements
- Hydrosulfurization at 20 to 80 bar and about 320°C to 360°C
- Hydrogenation process at high temperatures up to 500°C and high pressures up to 250 bar

Solutions

KLINGER SCHÖNEBERG offers a wide range of design features and resistant materials such as Monel and Hastelloy that ensure safety and reliability in handling sulfuric acids, ethylene, etc. guarantee safety and reliability.



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Various Industries

Made of steel for green steel

Process description

Hydrogen can not only reduce CO_2 emissions, it is also considered an effective chemical reducing agent. As such, it is used in metallurgy, for example.
In steel production, direct reduction plants can be operated with (green) hydrogen. The result is no longer liquid pig iron but a solid sponge iron which is refined into crude steel in an electric arc furnace. The reduction of metal ores using hydrogen is particularly suitable for metals such as copper for electrical engineering, which require a particularly high degree of purity.
In addition, carbon capture and storage play a key role in reducing emissions in the steel industry. This involves the capture of carbon dioxide and subsequent storage.

Requirements

- Handling blast furnace gas, oxygen and hydrogen
- Flammable, toxic and abrasive media
- BAM-approval

Solutions

High-quality valves from KLINGER SCHÖNEBERG support the entire steel production process in order to achieve the emission targets. Depending on pressure and temperature, the valves are designed to be soft-sealing, metal-sealing or PEEK-sealing.

INTEC K200

Heat & Power Generation

Valves for sector coupling

Process description

An essential prerequisite for sector coupling is a synthetic energy carrier that can be made available from electricity, can be used in other sectors, and can also be stored easily and flexibly. Hydrogen meets these requirements.

At present, hydrogen produced in the chemical industry that cannot be used for other purposes is used to generate heat. The latest generations of fuel cell systems, which are operated on the basis of pure hydrogen, can be used in single-family homes for heating as well as for electricity generation.

Furthermore, hydrogen offers the possibility of storing renewable energy, for example in the existing natural gas grid. Subsequently, it can be converted back into electricity using the usual methods for generating electricity from natural gas (gas turbines, combined cycle and CHP power plants). This could be used in the future, especially in times of increased electricity demand and low renewable electricity production.

Requirements

» Gas pipelines with a nominal pressure of 80 bar and a nominal diameter of up to 1,000 mm

Solutions

KLINGER SCHÖNEBERG offers valve solutions from the feed to pipeline transport and processing at the consumer.

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Mobility

An important application area for hydrogen

Process description

For electric vehicles with fuel cell technology, hydrogen is used as an energy carrier in many applications: Forklifts, cars, buses, trucks or even rail vehicles.
To ensure that refueling can be carried out safely and quickly, precise pressure equalization is necessary. The same applies to the hydrogen filling of tank containers in filling stations. Pneumatically driven valves ensure optimum distribution of the hydrogen in the container tanks.

Various valves are required in the filling station for control, automation and fulfillment of safety functions. Typically, manual valves for maintenance and pneumatic shut-off valves in explosion-proof design are used.
Depending on the refueling and acceptance concept of the plants, the valves must withstand pressures between 50 and 1,000 bar. In addition, the valves for fast refueling procedures must withstand temperatures down to -40°C.

Requirements

» High pressure and low temperature requirements
» Refueling down to -40°C
» Storage and refueling up to 1,000 bar

Solutions

Compatibility with hydrogen is necessary for all valve components that come into contact with the medium and is mastered by KLINGER SCHÖNEBERG through the appropriate selection of materials.

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Distribution partner:

Subject to technical modification.
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