SAACKE

Hydrogen burner for industrial decarbonization

Get ready for the revolution in combustion technology now!

SAACKE H2 ready

Source: BMW Group

Introduction

In the public debate, hydrogen (H_2) has become the beacon of hope in the energy mix of the future, as its potential in industries that are difficult to decarbonize (steel, cement, chemicals) and mobility (ships, air traffic, automotive) is enormous. Unlike solar and wind power, H_2 is easy to store - either as a gas or in liquid form. In the summer of 2020, the German government adopted the "National Hydrogen Strategy" and the EU Commission is aiming for a real system change with its Green Deal: 55% less CO_2 is to be emitted by 2030 and Europe is to become a climate-neutral continent by 2050.

In 2024, the production of clean hydrogen amounted to 0.5 million tons, by 2030 it is to increase to ten million tons. On this path, H_2 should not only be the lifeline for the climate and energy transition, but also a growth engine for technical innovation.

A bluish-transparent hydrogen flame on a low-NO_x hydrogen burner from SAACKE.

Technology is tried and tested and can be used immediately

Integrating hydrogen into the energy mix requires experience and specific expertise. As a technology leader, we have been manufacturing low NO_x firing systems for several decades, also in conjunction with hydrogen, and are therefore "H_2-ready". We can support you immediately in switching to H_2-based heat generation in order to exploit the potential of a climate-neutral and ultra-modern energy industry. We come into play where viable technology is needed for the efficient processing of large quantities of "blue" or "green" H_2 in industrial thermal processes. And this is already the case today - for example, when using residual materials from the chlor-alkali industry or titanium dioxide production or for propulsion and heating systems on ships. Using the H_2 here instead of additional natural gas or marine diesel oil not only saves emissions, but also costs.

H_2 feed-in into the natural gas grid - ensuring operational safety

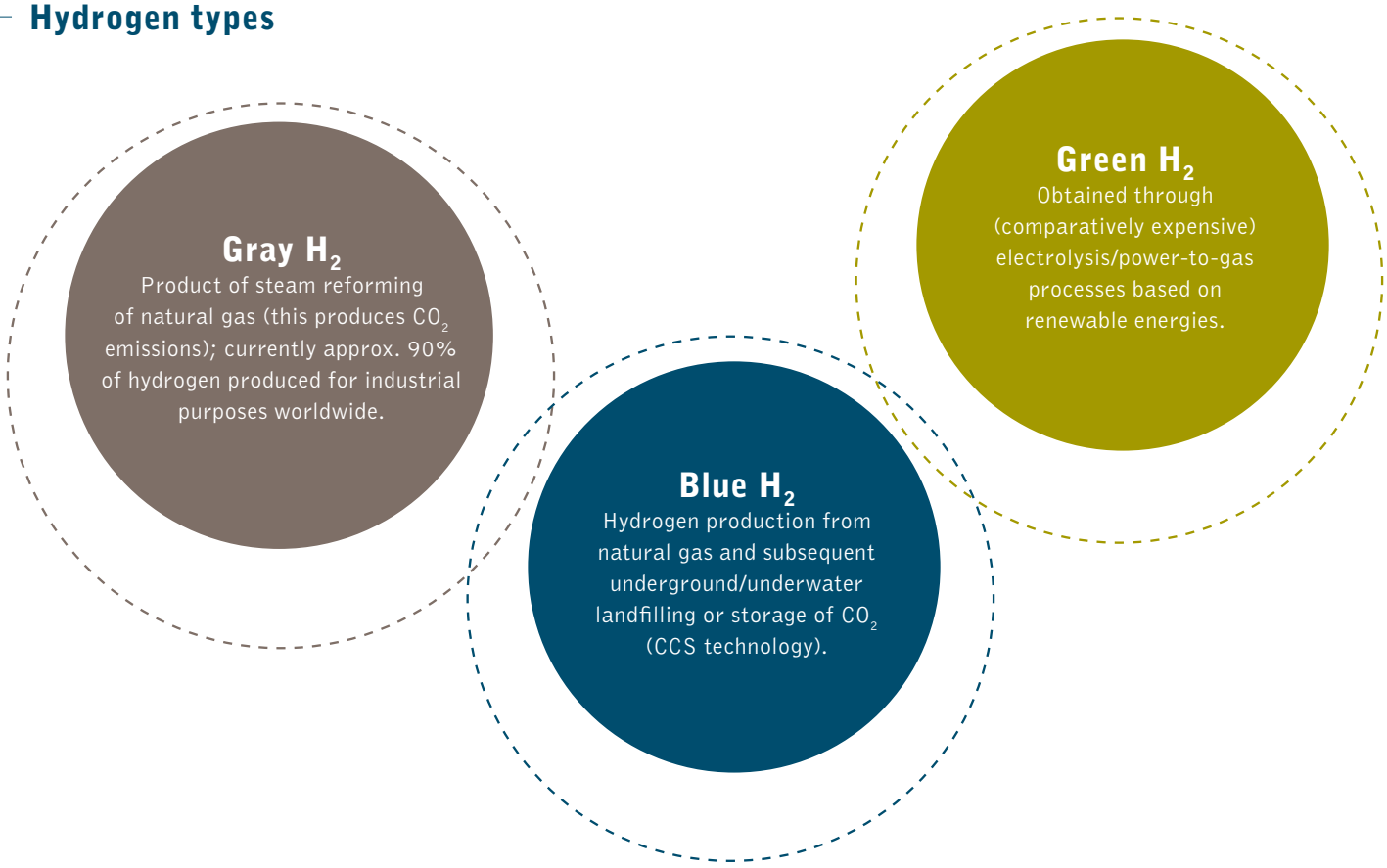
The volume of H_2 will increase significantly as a complementary fuel to natural gas. Experts expect the permissible proportion of H_2 blended into the existing natural gas network to increase to up to 20% in the coming years. Two thirds of the current German natural gas infrastructure could be used for hydrogen blends in the future. The Federal Network Agency in Germany recently approved a hydrogen core network with a length of over 9,000 km. By 2032, 40% of this will be newly built and the rest will be converted from natural gas to hydrogen. All of this places demands on system operators and the technology itself. Those who opt for an H_2-compatible burner today will avoid costly conversions in the future and secure the operation of their systems in the long term.

Excursus hydrogen

What properties does this promising energy source have, in what variants does it exist and what else is there to consider?

A brief overview

Hydrogen types



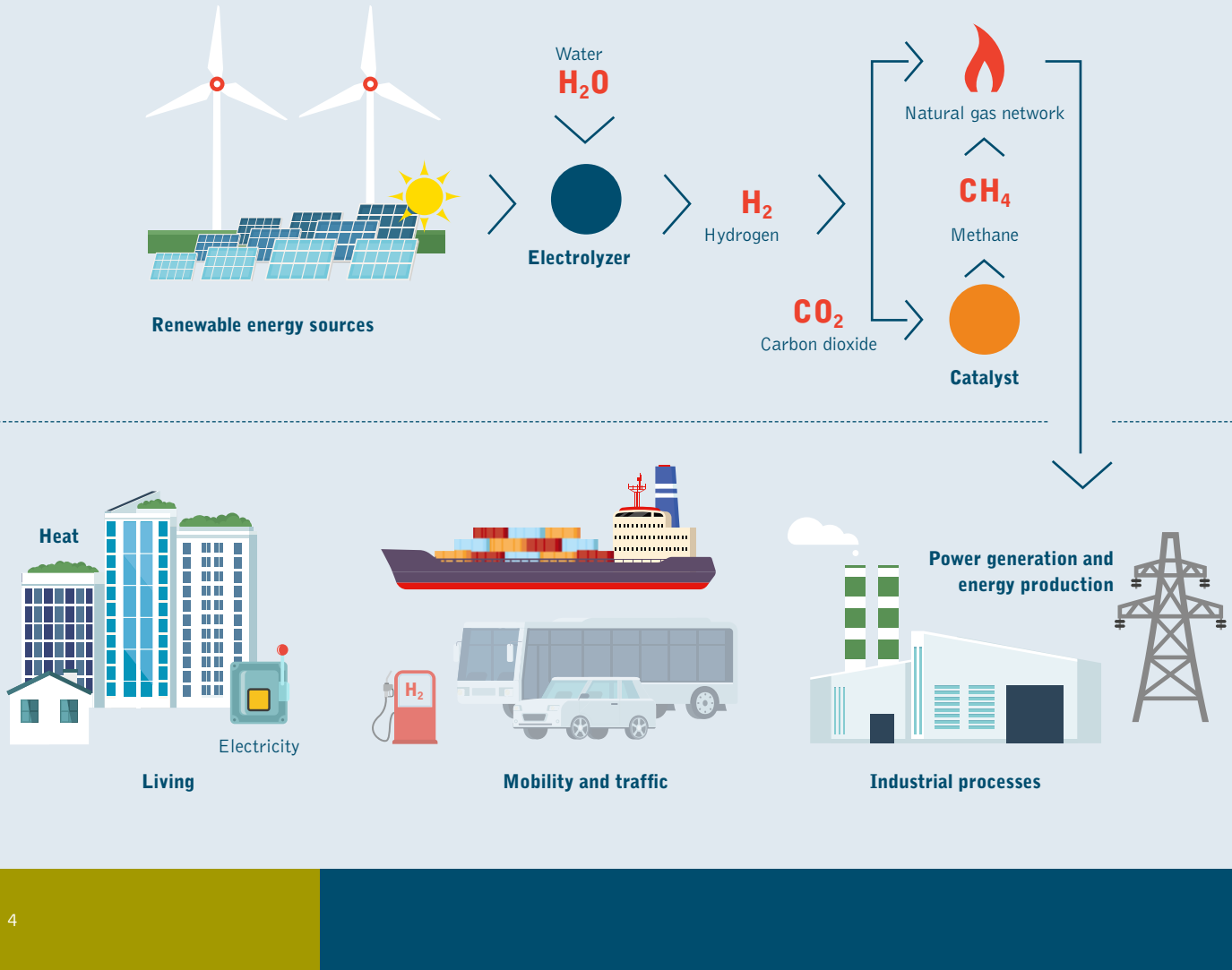
Characteristics of hydrogen combustion

- The H atom is the lightest and smallest element in the periodic table
- H_2 is colorless, odorless and tasteless
- H_2 is 8 times lighter than natural gas
- The calorific value is 3 to 3.5 times lower than that of most commercially available natural gases
- The flame burns about 8 times faster than natural gas
- Extremely wide flammability range (4 to 77 vol% compared to 4 to 16 vol% for natural gas)
- 15 times less spark energy required for ignition than with natural gas (0.02 mJ)

Facts and figures

- The German government is planning a program to develop H_2 production plants. By 2030, industrial production plants with a total capacity of up to 10 GW are to be in place (including the offshore and onshore energy generation required for this).
- The production of green hydrogen exempt from the EEG levy is being sought and the promotion of "H_2-ready" plants via the CHP Act is being examined. The following applies to green hydrogen: If the requirements of Section 69b EEG 2021, which are specified in Section 12i of the Renewable Energy Sources Ordinance (EEV) in the version dated June 30, 2021, are met, the electricity used to produce green hydrogen is fully exempt from the EEG surcharge. An application is not required in this respect. The exact scope of the regulation is still to be determined by the Federal Network Agency (BNetzA).
- The amount of electricity required to produce hydrogen is enormous. For Germany alone, some scenarios forecast an additional 450 terawatt hours - that is more than 2.5 times as much as was generated from lignite and hard coal combined in Germany in 2019.
- H_2 has huge potential for environmental protection - example calculation: A 7.5 MW burner that runs continuously at maximum output (24 hours a day) and is converted to hydrogen saves around 35 tons of CO_2 emissions per day compared to natural gas combustion.
- The German government expects Germany to require 95 to 130 TWh of hydrogen and derivatives in 2030, with an import share of 50 to 70%. By 2045, the forecast demand will increase to around 360 to 500 TWh for hydrogen and 200 TWh for hydrogen derivatives.

The power-to-gas process - how green H_2 is produced



The SAACKE solution in detail

We have been researching H_2 for around 50 years and, thanks to this technological lead, **we are one of the few companies in the world that already offers safe and low-NO_x hydrogen burners on the market and can provide CO_2-neutral heat** - both in industry and in maritime shipping.

Thanks to our experience in special plant construction, we can offer a wide range of natural gas-based burner families for steam generation that can utilize alternative fuels such as H_2.

SAACKE burner type	"H_2-ready" up to ... possible
TEMINOX	100% hydrogen content by volume
ATONOX	100% hydrogen content by volume
ROTONOX	100% hydrogen content by volume
SSB	100% hydrogen content by volume

Your one-stop store

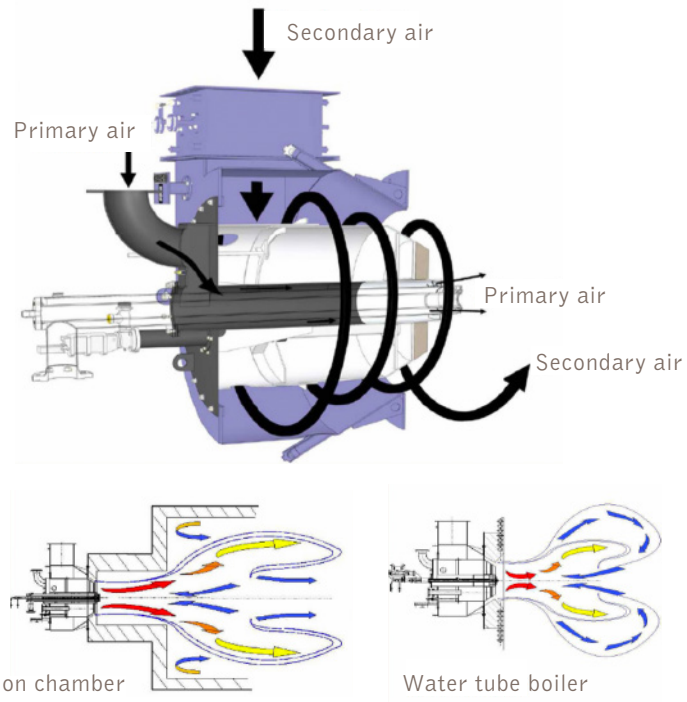
With us you get everything from a single source, because we are your one-stop store for complete H_2 firing systems - from engineering whether engineering, assembly, retrofit, after sales or spare parts service.

Our unique selling point

Our technological edge lies in sophisticated flue gas recirculation and the special design of the gas injection. These two crucial components ensure that the higher flame temperature and up to three times higher NO_x emissions are minimized to a similar level when burning hydrogen compared to natural gas.

From customer needs to our solution

- Engineering and CFD analysis
- Fuel fittings, combustion chambers and burners
- Flame monitoring systems and burner controls
- Control systems for air and recirculation
- 24/7 remote monitoring (on request)



In a nutshell: The challenge and the technical solution

Task
Future-proof burner system for up to 100% hydrogen in compliance with all required emissions and equipped for low-maintenance and trouble-free operation.

Solution
Ultra-low NO_x burner with sophisticated flue gas recirculation and a special gas injection design based on decades of experience and engineering expertise.

Most important industries for hydrogen burners (excerpt)

- Refineries
- Chemistry
- Automotive
- Textile and paper industry
- Steel and metal production
- Food industry
- Building materials industry
- Energy and heat supply (operators of boiler systems and district heating networks of all kinds)
- Shipping

SAACKE references

50 years ago, H_2 was still an exotic fuel. However, as specific project inquiries have steadily increased in recent years, we have been able to commission around 30 H_2 firing systems for customers - for example in the chemical industry for steam generation or for hot water for district heating. In China, there are around 20 SAACKE burners based on natural gas that achieve emissions < 30 mg/m³ NO_x. These ultra-low NO_x burners could also be converted to hydrogen operation at any time.

Project example on land

The Audi e-gas plant in Werlte in northern Germany was the first industrial-scale plant in the world to generate feed-in synthetic natural gas from CO_2 and renewable electricity. The methane produced is fed into the natural gas grid and used as fuel (Audi e-gas). The CO_2 required for methanation comes from an on-site biogas plant. The resulting energy carriers hydrogen and methane are extremely versatile - in the case of the plant in Werlte, up to 1,300 cubic meters of hydrogen can be produced per hour, and with an assumed operating time of 4,000 full-load hours, almost 1,000 tons of methane are produced per year - a quantity with which 1,500 compact class CNG vehicles (e.g. Audi A3 g-tron) can each travel 15,000 km. In this case, around 2,800 tons of CO_2 are absorbed per year during the production of this energy source called e-gas. That is as much as a forest with around 200,000 deciduous trees can absorb. The waste heat from the power-to-gas plant, which is generated during electrolysis and subsequent methanation, can be used to meet the heat requirements of the biomethane plant. This heat requirement arises in particular during CO_2 capture and during the hygienization of the delivered bio-residues. We supplied an SSBG 10 burner with se@vis pro burner control for this project, which is operated with biogas or a biogas/H_2 mixture.

Project example on water

The world's first liquid hydrogen tanker, christened "Suiso Frontier" in Japan in December 2019, is equipped with a hydrogen-compatible and patented Gas Combustion Unit (GCU) and an SSBG burner from SAACKE. They ensure that the LH_2 is transported by sea just as safely as liquid natural gas. The ship is operated by the Hydrogen Energy Supply-chain Technology Research Association (HySTRA), a consortium of several companies and organizations founded four years ago under the leadership of Kawasaki Heavy Industries, Ltd. The aim of the pilot project is to demonstrate the smooth operation of an international hydrogen energy supply chain from production to transport and use.

So-called "blue" hydrogen, which is produced and liquefied in Australia and undergoes carbon capture on site, is to be shipped to Japan in large quantities at 1/800th of its original volume. The GCUs burn excess boil-off gas in large quantities and with maximum availability. These gases are produced by slight vaporization during the crossing. With our 100% free-flow solution, the boil-off gas is completely combusted without a compressor and at a pressure of just 0.15 bar.

SAACKE H_2 burner in small output size

Hydrogen firing is reliable, efficient and low-emission even in the lower output range. We are the first company in the world to have successfully developed an H_2 burner for this purpose.

SAACKE scope: H_2 gas burner

1. Research, development and engineering
2. Prototyping (500 kW/1000 kW)
3. Manufacturing, installation + commissioning

BMW Group plant project example

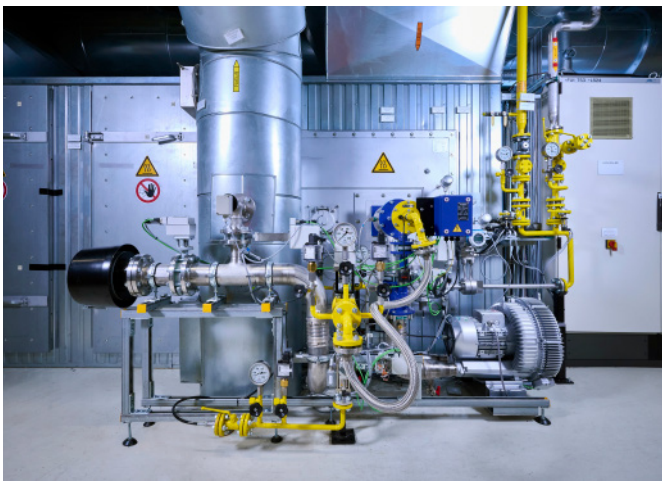
As part of a pilot project, we are supporting the BMW Group on its way to decarbonizing production.

For the Leipzig plant, a tried-and-tested SSBG micro combustion system was converted to H_2 operation and the significantly smaller output range, which differs from the usual portfolio. With an output of several 100 kilowatts, the H_2 burner is used in the paint drying line and the thermal post-combustion and finally also in the boiler house.

The conversion to hydrogen operation could be realized with comparatively little effort - a decisive advantage for industrial use. In principle, the technology used can also be transferred to other automotive locations and therefore offers the industry great potential for decarbonizing entire production networks. There are plans to gradually integrate further SAACKE burners at the Leipzig plant in the coming years in order to further reduce CO_2 emissions and consistently drive forward the transformation process.

Project goals at a glance

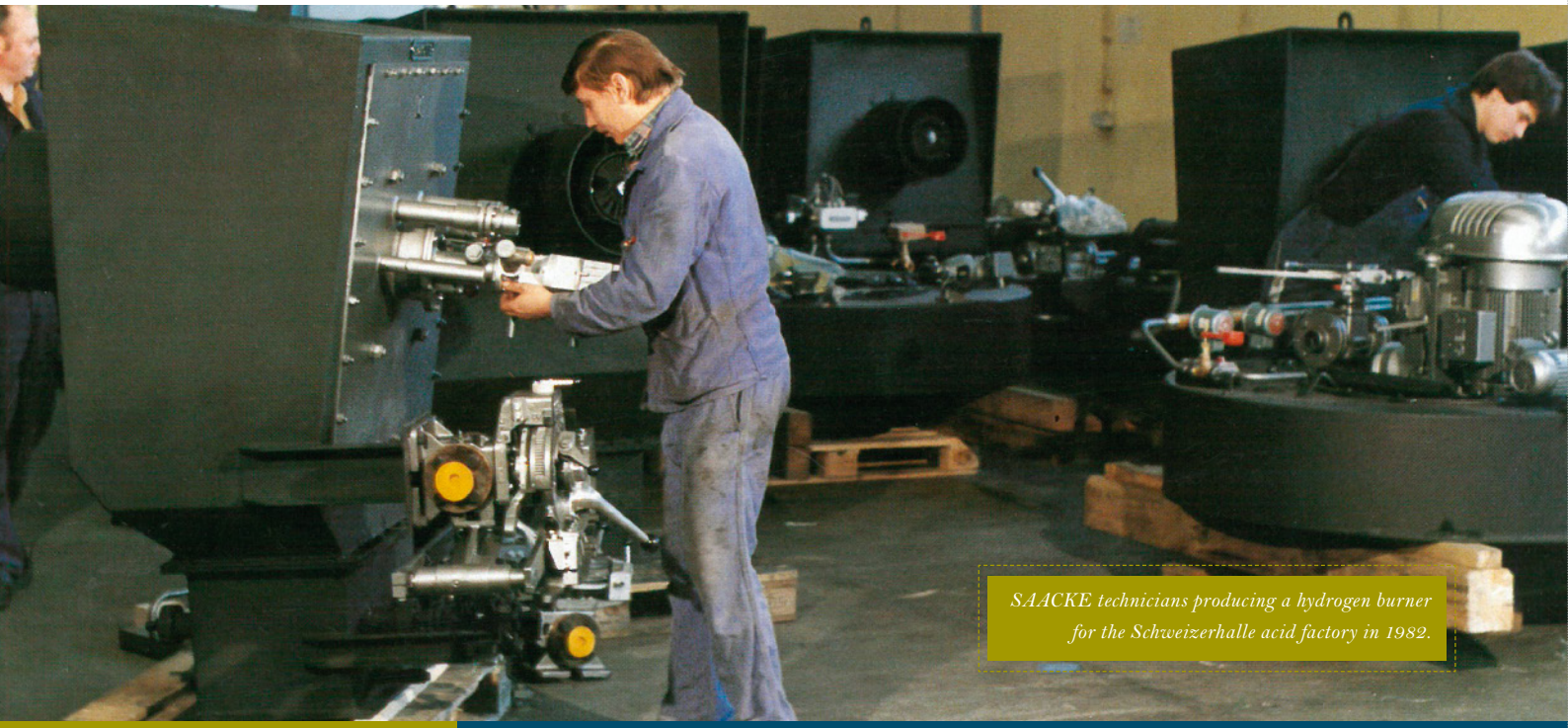
- CO_2- free production achieved until 2026
- Thermal capacity: 50 MW (500 ... 20.000 kW) (generating steam, hp-hot water, hot gas for drying process)
- Fuel change: 100% natural and 100% H_2 gas
- Low-No_x combustion of H_2 and natural gas



Extract from the SAACKE reference overview

Plant/Operator	Country	Heat generator output	Number of burners	Fuel 1	Fuel 2
Suizo Frontier	JAP		1	Hydrogen	
HaloPolymer	RU	8,0 MW	1	Hydrogen	Natural gas
AGC Chemicals	TH	5,0 MW	1	Hydrogen	Natural gas
Vapormat (Ehersa)	ES	4,5 MW	1	Hydrogen	Natural gas
Changzhou Zongyan	CN	4,5 MW	1	Hydrogen	Natural gas
Chemfab	IN	3,0 MW	1	Hydrogen	HFO
AkzoNobel, Ibbenbüren	DE	5,7 MW	1	Hydrogen	LFO
Esso Slagen (Metso)	SE	10,3 MW	6	Hydrogen	LFO
AkzoNobel, Ibbenbüren	DE	6,0 MW	3	Hydrogen	LFO
Finnish Chemicals, Äetsä	FI	15,0 MW	1	Hydrogen	
Finnish Chemicals, Joutseno	FI	10,8 MW	1	Hydrogen	LFO

If you are interested in further projects or specific details, please contact us at H2@saacke.com.



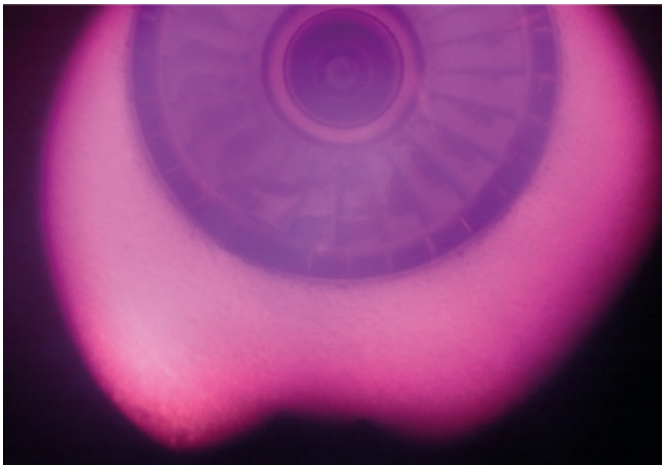
SAACKE technicians producing a hydrogen burner for the Schweizerhalle acid factory in 1982.

Conclusion and outlook

Science, politics and industry all agree that hydrogen is the ideal energy carrier for the transition to a carbon-neutral future. But without compromising on flexibility, safety, efficiency and performance. The tried and tested technology can be used right now!

Get ready for the efficient and cost-saving use of surplus hydrogen in the production process and the increasing large-scale feed-in of H_2 into existing natural gas grids. A large number of infrastructure projects are currently driving the development of a nationwide hydrogen network and provide important guidance for future supply and integration.

Avoid costly conversions under time pressure - secure the future viability of your systems today.



This is us

SAACKE GmbH specializes in thermal processes and systems for industrial and maritime energy management. We are one of the world market leaders in these areas. We have been developing modern combustion systems that can also process **hydrogen** efficiently and safely since the early 1980s.

Founded in 1931, we are still a medium-sized family business today and employ a total of around 1,200 people - including a good 450 engineers and technicians. We have production sites in Bremen, Croatia, China and Argentina as well as a global service and sales network. Our headquarters, main production facility and research and development are located in Bremen in northern Germany.

We are also a member of a working group of the Verband Deutscher Maschinen- und Anlagenbau e.V. (German Engineering Federation), which focuses on hydrogen or synthetic liquid fuels from surplus electricity generated by wind and photovoltaics (power-to-gas) as well as the intermediate storage of renewable energies.

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