SAACKE

PLAIN SAILING FOR THE CLIMATE.

Setting the course for new maritime fuels now.

On the journey to carbon neutrality, innovative technical solutions are needed to meet increasing energy demand. The SAACKE Group is making an important contribution to this. We are combining our experience and expertise in industry on land with applications on the water.

This is one of the many areas in which we are thinking ahead. We believe low-emission, highly efficient and reliable solutions offer significant added value to the shipping industry. If you want to prepare for the future, you need to start moving forward with a clear view now.

INHALT

ARE YOU GOING WITH THE FLOW OR ONE STEP AHEAD OF IT?

CHALLENGE.

We have been in the midst of the energy transition for a long time. Business and industry are under pressure. And the maritime sector is urgently looking for alternatives to fossil fuels. The problem: What is currently available will be obsolete in the future. As a result, more and more ship operators are turning to options such as LNG for fuel. But the combustion process releases CO2, and the liquefaction and transport processes are by no means climate-friendly.

Therefore, solutions for truly clean fuels in shipping are needed urgently. Not least because the IMO has also adopted binding measures. Sooner or later, the maritime industry will have to reduce its emissions. But which technologies and alternative fuels are in the pipeline? Is it even possible to know today what will be the case tomorrow?

No, and even we cannot know that. But we support development, see potential and set new standards with our solutions. SAACKE systems are already on board more than 6,000 ships. Ships are heading towards the future with our marine boilers, marine burners and gas combustion units. And we are thinking ahead so that carbon-neutral fuels can be used effectively in the maritime business. This is where we are making our contribution.

THE IMO HAS SOMETHING TO SAY ABOUT THIS.

The International Maritime Organization (IMO) adopted the 'Initial IMO Strategy' in 2018. One of its objectives is for the total annual emissions from global shipping to be reduced by at least 50% in 2050 compared to 2008. In addition, greenhouse gas (GHG) emissions should be completely eliminated as soon as possible. In 2021, the IMO then published a work plan with specific measures. Among these is the requirement for companies to switch to low-carbon and zero-carbon fuels.

Furthermore, the organisation stipulated the amount of fuel that each ship type may consume at its loading capacity. Anyone who has a ship built in the future must therefore ensure that it is in line with – or under – the limit values, in order to be prepared for future decisions by the IMO.

WHO DOES THE FUTURE BELONG TO?

To reduce the environmental and climate impacts of the maritime industry, there are some fuels available as alternatives to LNG, heavy fuel oil and diesel. Biofuels, methanol, ammonia and hydrogen have moved into the spotlight. Which candidate wins the race certainly depends on the use case. Short-haul or long-haul, ship type, storage capacity, handling? The major challenge for ship operators is deciding now on a new-build ship with a lifespan of around 25 years, which must meet future framework conditions and targets.

At SAACKE, we provide you with innovative solutions that are already available but will not be obsolete tomorrow. We have answers to your current needs, but we also go one step further. In collaboration with you, we would like to set the course for a sustainable transition to carbon-neutral fuels in shipping.

	Past Conventional fuels	Present Transition fuels	Future Climate neutral fuels
Fuels	HFO, MGO, MDO, VLSFO	LNG, LPG, CNG	Biofuels, Methanol, Ammonia, Synthetic fuels
Fuel Source	Fossil sources, not renewable		Renewable fuels
Global warming potential	high	Lower than conventional, if used correctly	None, if used correctly

POTENTIAL

Green thumbs up

Methanol, ammonia, hydrogen or biofuels – they all have their advantages and disadvantages. In some cases availability is the problem, in others it is load volume or temperature. This does not make far-reaching investment decisions easy. However, for the environmentally and climate-friendly fuels to be future-proof, they must be both safe and economical to use. For ship operators, it is therefore important to weigh things up on an individual basis and allow for a certain degree of flexibility. This is because a subsequent retrofit can be planned in advance, making modification easier.

> ***We have solutions for all current fuels. Retrofitting is also possible with our burners and boilers. One exception is currently still ammonia. However, the development of a suitable boiler system is almost complete.***

The challenge of storage

The marine fuel transition

	Oil	LNG	Methanol	Ammonia (liquid)	Hydrogen (liquid)
Volume Factor	1	1,6	2,3	2,8	4,1
Temperature	Ambient – 100°C	-163°C	Ambient	Ambient / -33°C	-253°C
Max. pressure	Ambient	700 mbar (g)	Ambient	10 bar (abs) / ambient	aprrox. ambient
Remarks	High viscosity at ambient temp.	Liquified Natural Gas	boiling temp. of 65°C at atm. pressure	Toxic to humans	High pressure storage also possible but less space efficient

OPTION 1

BIOFUELS.

Biofuels are made from renewable raw materials, including rapeseed, soy, maize, palm oil and biomass. Mixing these with fossil fuels is already practised in the shipping industry. The major advantage of liquid biofuels is that they are easily implemented in existing systems. However, there is still a long way to go before ships are completely powered by biofuels. This is because they are not yet produced in the required quantities.

	Oil		Methanol 👍	Ammonia (liquid) 👍	Hydrogen (liquid) 👍
	1		2,3	2,8	4,1
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Requirements	Biofuels (gaseous)
Main engines, propulsion and burners	✓
Boiler	✓
Trace heating of fuel pipes	–
BOG Handling	✓
GVU (Gas Valve Unit)	✓
IGF Code requirements applicable	✓
SO_2 and NO_x flue gas cleaning	–

Fuel overview – Biofuels (gaseous)

Gaseous Biofuels – The fuel in detail

- ✓ Gaseous Biofuels must be handled like LNG
- ✓ In addition H_2S content must be considered and fuel supply materials must be selected accordingly
- ✓ Unburnt gaseous fuel emissions must be avoided by BOG handling

OPTION 2

AMMONIA.

Ammonia is an important raw material for fertiliser production. We can therefore benefit from the experience of the chemical industry, which is well acquainted with the handling of this. Ammonia is easier and cheaper to store and transport than hydrogen, which requires a lot of storage space. With a factor of 2.8, its load volume is only slightly higher than that of LNG and it can be stored at ambient temperature under moderate pressure. In addition, it is already liquid at -33 degrees. One disadvantage, however, is that ammonia is very toxic and appropriate precautions must be taken when handling it.

Requirements	Ammonia
Main engines, propulsion and burners	(✓)
Boiler	✓
Trace heating of fuel pipes	–
BOG Handling	–
GVU (Gas Valve Unit)	✓
IGF Code requirements applicable	✓
SO_2 and NO_x flue gas cleaning	NO_x

Fuel overview – Ammonia

Ammonia – the fuel in detail

- Burners and engines are under development, the latter are expected in 2024
- No BOG handling is required, as ammonia can be stored similar to LPG
- Secondary NO_x reduction (SCR/SNCR) is inevitable, due to the fuel bound nitrogen
- Definition of regulations is an ongoing process

„Personally, I think ammonia will win the race. We are technically much further along with the use of methanol, but the need for a climate-neutral carbon source will limit the availability of methanol in the long term, unlike ammonia.“

	Oil	LNG	Metha	Ammonia (liquid)	ogen
Volume Factor	1	1,6	2,	2,8	
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OPTION 3

METHANOL.

Green methanol is produced from a climate-neutral carbon source and green hydrogen. Its space requirement is significantly lower than that of hydrogen, with a factor of 2.3. Methanol remains liquid at ambient temperatures and is easy to handle. However, it is highly flammable and currently many times more expensive than conventional fuel. For it to be carbon neutral, a climate-neutral carbon source is needed for production. This may limit the availability of green methanol in the long term.

	Oil		Methanol	nonia d)	Hydrogen (liquid)
Volume Factor	1		2,3	8	4,1
Temperature	Ambient – 100°C	-163°C		Ambient / -33°C	-253°C
Max. pressure	Ambient	700 mbar (g)	Ambient	10 bar (abs) / ambient	aprrox. ambient
Remarks	High viscosity at ambient temp.	Liquified Natural Gas	boiling temp. of 65°C at atm. pressure	Toxic to humans	High pressure storage also possible but less space efficient

Requirements	Methanol
Main engines, propulsion and burners	✓
Boiler	✓
Trace heating of fuel pipes	–
BOG Handling	–
GVU (Gas Valve Unit)	–
IGF Code requirements applicable	✓
SO_2 and NO_x flue gas cleaning	–

Fuel overview – Methanol

Methanol – The fuel in detail

- ✓ Burners and Engines are available, even though experience is limited
- ✓ Methanol is liquid at ambient conditions. Nevertheless it is a low flashpoint fuel and must be handled according the IGF code
- ✓ Definition of regulations is an ongoing process

OPTION 4

HYDROGEN.

The direct use of hydrogen is very expensive. Firstly, it requires an extremely large load volume; secondly, it has to be stored under high pressure or at very low temperatures (-253 °C) and is highly explosive. However, hydrogen can also be mixed with natural gas or processed into synthetic methanol or ammonia to be used as a fuel.

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Remarks	High viscosity at ambient temp.	Liquified Natural Gas	boiling temp. of 65°C at atm. pressure	Toxic to humans	High pressure storage also possible but less space efficient

Requirements	Ammonia
Main engines, propulsion and burners	✓
Boiler	✓
Trace heating of fuel pipes	–
BOG Handling	✓
GVU (Gas Valve Unit)	✓
IGF Code requirements applicable	✓
SO_2 and NO_x flue gas cleaning	(✓)

Fuel overview – Hydrogen

Hydrogen – The fuel in detail

- ✓ Two forms of propulsion: Fuel cells and electric engine or hydrogen engine
- ✓ Experience with heat generators from land based applications
- ✓ Definition of regulations is an ongoing process
- ✓ BOG handling is required for liquid storage
- ✓ High pressure storage is an alternative for specific applications
- ✓ Primary or secondary NO_x reduction methods are possible

SOLUTIONS. WE ARE DRIVEN BY THE FUTURE.

LNG is the beginning and can only be the transition. The maritime industry will develop further in the next few years – towards low-emission fuels. With SAACKE on board.

You can rely on low-emission, highly efficient and safe combustion systems for seagoing vessels, offshore plants and LNG tankers. Thanks to our extensive experience in the development, design and construction of new systems and retrofits, you will be well equipped for what is to come. Our solutions help you move forward now and keep you on course for the future.

Requirements	Hydrogen	Ammonia	Methanol	Biofuels
Main engines, propulsion and burners	Individual for each fuel, but dual fuel options are available			
Boiler	All SAACKE boilers can be used but heat balances may be different			
Trace heating of fuel pipes				
BOG Handling	✓	(✓)		(✓)
GVU (Gas Valve Unit)	✓	✓		(✓)
IGF Code requirements applicable	✓	✓	✓	(✓)
SO2 and NOx flue gas cleaning		NO_x		

EFFICIENT, HOLISTIC AND RELIABLE.

SAACKEs hydrogen GCU is sailing on the worlds first hydrogen carrier

Vessel:
Susio Frontier (2020)

Shipyard:
Kawasaki Heavy Industries

Transported good:
Liquified hydrogen at -253°C
(GCU for BOG handling required)

SAACKE marine boiler plants and systems are suitable for all fuels without exception. The Boil-Off Gas (BOG) management system we developed burns the BOG safely and uses the energy released, provided that an appropriate consumer is available. The Gas Combustion Unit (GCU) solution also makes the safe transport of liquefied natural gas at sea possible in the first place.

There will be no one-size-fits-all solutions in shipping for now. While short-distance ferries may be able to run on electricity, operators of large container ships will have to rely on liquid or gaseous green fuels. We are open to all technology and adapt our solutions to the latest developments.

Tank capacity: 174.000 m^2
Tank filling ratio: 98 %
Type of insulation: Mark III Flex+
Boil Off Rate: 0,07 % / day

Resulting BOG: 2337,5 kg/h

This amount should be handled by a GCUevo.

ABOUT US

SAACKE GMBH

specialises in thermal processes and systems in both industrial and maritime energy management. We are among the world leaders in these areas. In everything we do, we are aware of our environmental and social responsibility. We want to contribute to meeting the ever-growing energy demand of the global population with increasingly energy-efficient solutions. Since the early 1980s, we have been developing modern combustion systems that can also process hydrogen efficiently and safely. More than 6,000 SAACKE systems are currently in operation on seagoing vessels all over the world.

Founded in 1931, we are still a medium-sized family business and employ around 1,000 people in total – including some 350 engineers. We have production sites in Germany, Croatia, China and Argentina, as well as a global service and sales network. Our headquarters, main production site and the research and development department are located in Bremen in northern Germany. We are also a member of a working group of the German Mechanical Engineering Industry Association (Verbands Deutscher Maschinen- und Anlagenbau e. V.), which deals with hydrogen and synthetic liquid fuels from surplus electricity generated by wind and solar power (power-to-gas) as well as the intermediate storage of renewable energies.

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