SORG GROUP

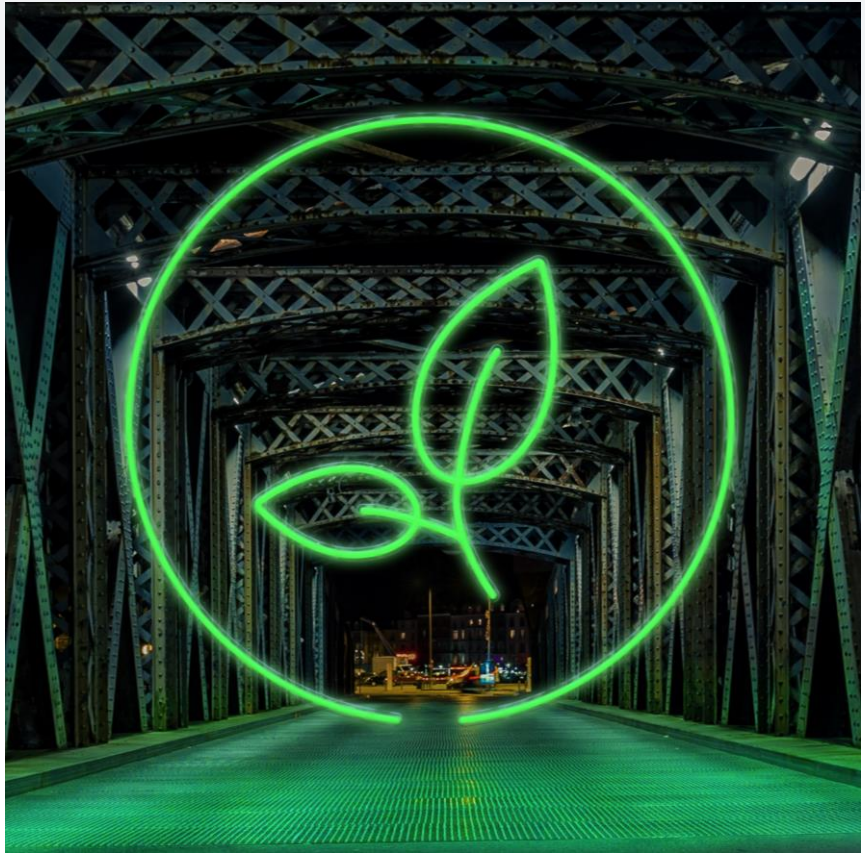
THE WORLD LEADER IN RAW MATERIAL PREPARATION, MELTING AND CONDITIONING TECHNOLOGY, AND SERVICES FOR THE GLASS INDUSTRY.

THE POWER OF THREE

EME SORG SKS

AGENDA

- SORG introduction
- Our vision
- Situation of Glass Industry
- SORG activities
- Burner tests
- SORG hydrogen safety and control concept
- Outlook



SORG Group combines leading technologies in furnace and batch house design and engineering. We provide optimal furnace design, glass melting, glass conditioning and installation as an integral part of our services.

The global leader in batch and cullet treatment systems.

The global leader in designing ground-breaking glass furnaces.

The global leader in the installation, repair and maintenance of glass melting furnaces.

SORG GROUP IN NUMBERS

500+
EMPLOYEES

80+
COUNTRIES

45+
LARGE-SCALE PROJECTS PER YEAR

100+
PATENTS REGISTERED

50+
YEARS OF SUSTAINABLE INNOVATIONS


OUR VISION

OUR VISION

We are on a mission to reduce our carbon footprint. To innovate technology and fuel positive change through sustainable melting. We are investing all of our research and development efforts into saving energy and producing cleaner glass.

Today, we are already well on the way to sustainable melting. In the near future, we aim to have the technology in place to slash emissions and ultimately deliver net zero glass on a large scale.

SITUATION OF EUROPEAN GLASS INDUSTRY

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The industry landscape – at a glance

European Container Glass Industry facing CO_2 Issues

- 160 plants
- 20 countries
- 20 million tons glass/year
- 66% of total EU (incl. UK) glass production
- 74% cullet recycling rate in average

4,4 GJ/t glass @ 70% cullet

300 kg CO_2/t glass = a representative value

→ 4.700.000 t CO_2 /t year glass industry Europe

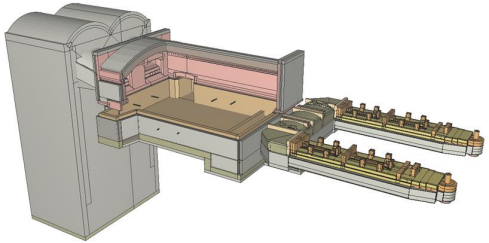
~ 4.000.000.000 t CO_2 /t year total Europe

= 0.1%

Source: FEVE April 2018

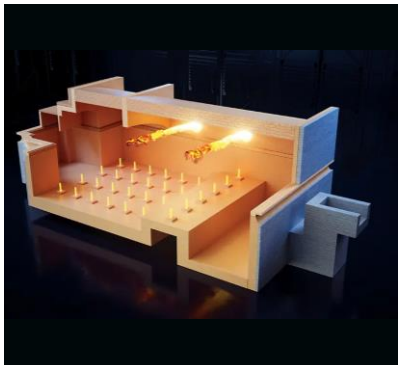
SORG ACTIVITIES

SORG CONCEPTS TO REDUCE GHG

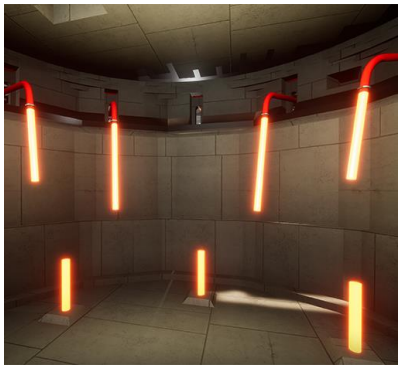


Optimized reg. end-port:

- → **more E-boost**
- → **heat recovery (BPH / CPH)**
  + mix of NG with H_2 (10vol%)
  Bio-CH_4

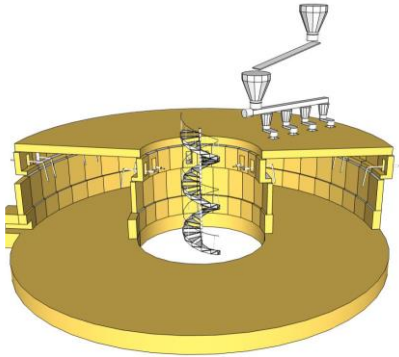


CLEAN Melter®



VSM®

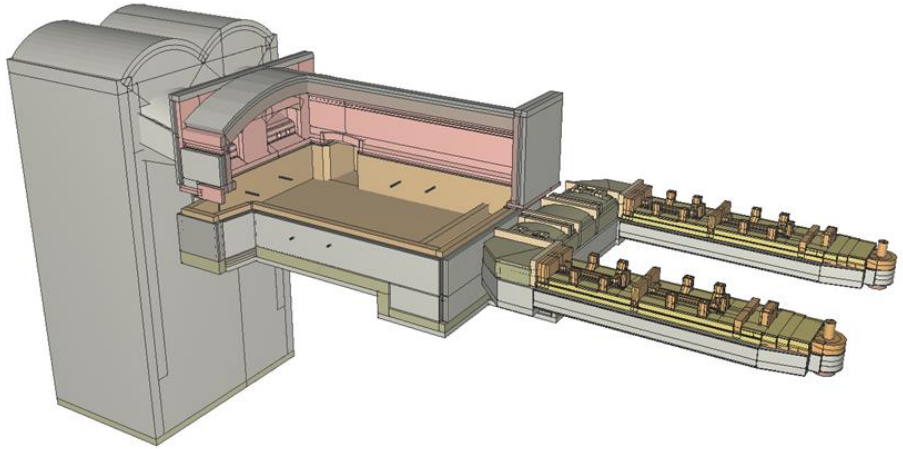
All-electric Furnaces



VSM®++
Large Scale All-electric Furnaces

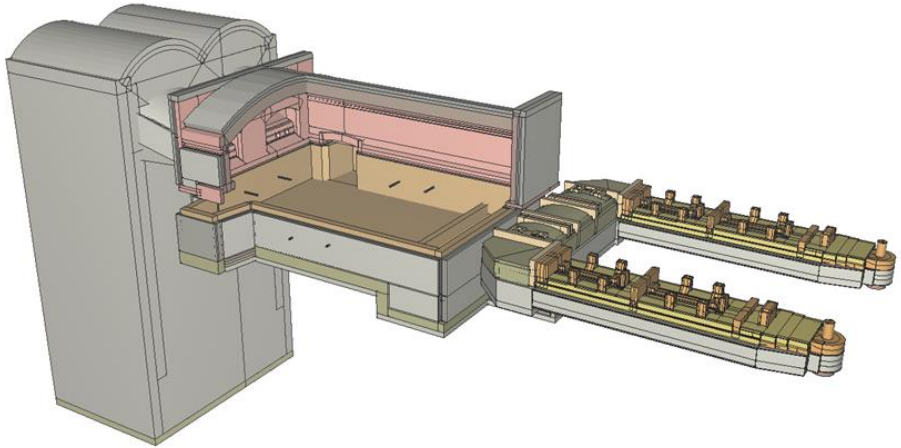
Marinha Grande

- → SORG has 6 glass melting furnaces in operation
  - Melting capacity 80 to 500 t/24h – total approx. 1700 t
  - Natural gas consumption approx. 180.000 m^3/24h
    - → CO2 from combustion approx. 140.000 t/a
  - Electric boosting power approx. 260.000 kWh/24h



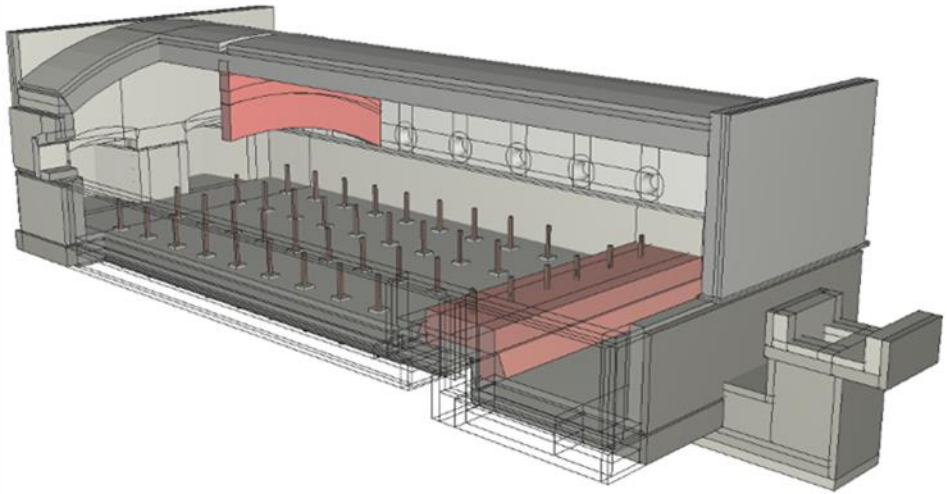
Marinha Grande - measures to reduce GHG emissions?

- on conventional melting furnaces = mostly regenerative end-port
  - Increase cullet ratio
  - Increase electric boosting share with green electricity
  - Increase pull / m^2
  - Reduce average weight of containers
  - Improve waste gas heat-recovery
  - Mix of green hydrogen to natural gas or use bio-methane



Marinha Grande

- → SORG has 6 glass melting furnaces in operation
  - Melting capacity 80 to 500 t/24h – total approx. 1700 t
  - Natural gas consumption approx. 165.000 m^3/24h
    - → CO2 from combustion approx. 130.000 t/a
  - Electric boosting power approx. 260.000 kWh/24h
  - One furnace to be converted to CLEAN-MELTER® technology by end 2024



Advantages of CLEAN Melter®

01

Electric share of melting energy → up to 80%

02

Flexibility in regards of pull variations

03

Flexibility in regards of raw materials and raw material changes (no glass quality instabilities)

04

Melting of oxidizing and reduced glasses

05

No limitations using CO_2 – neutral combustibles (Hydrogen / Bio-CH4…)

06

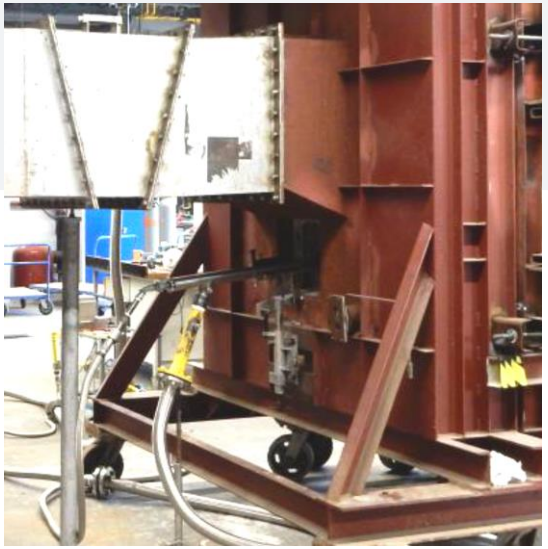
Flexibility in the mix of different heating sources (top-fire/electric)

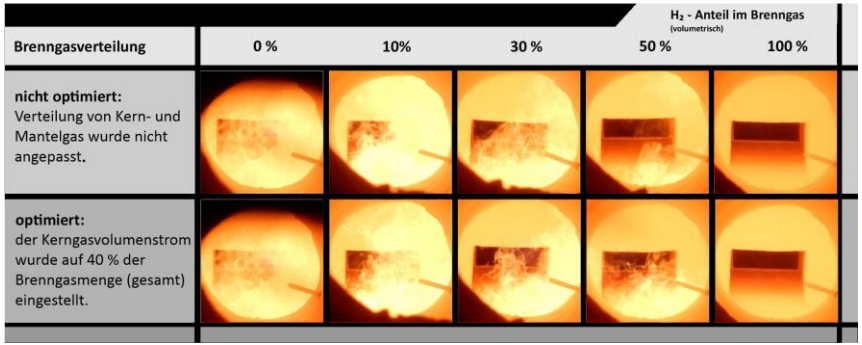
BURNER TESTS WITH HYDROGEN

SORG

UNDERPORT BURNER TESTS

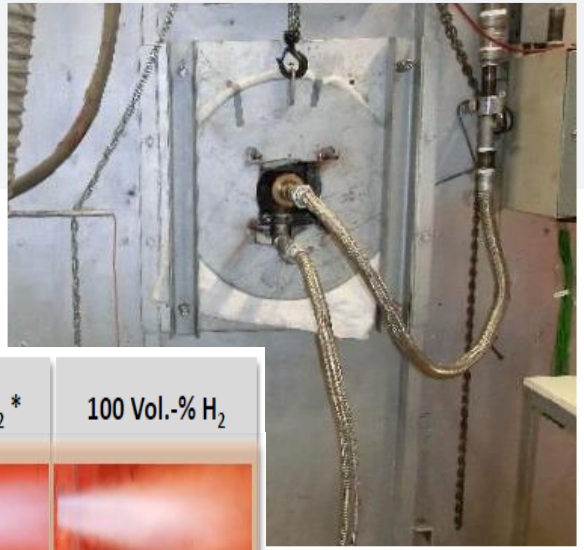
SORG SDB underport burners have been tested at GWI successfully with varying mixtures of natural gas and hydrogen up to pure hydrogen.

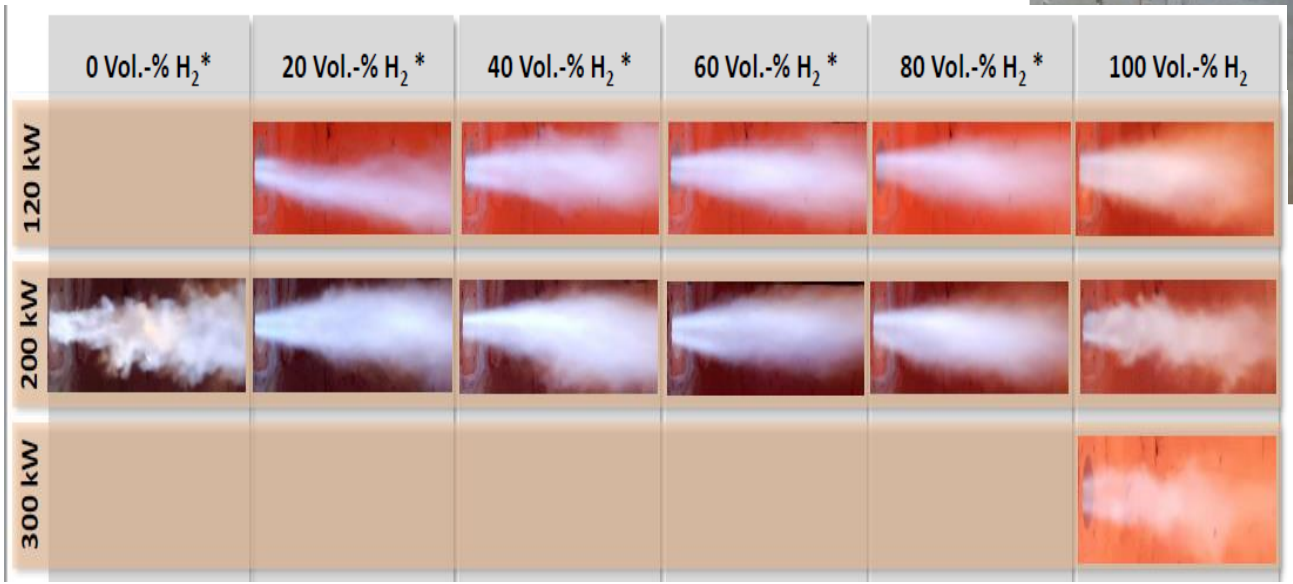




OXYGEN BURNER TESTS

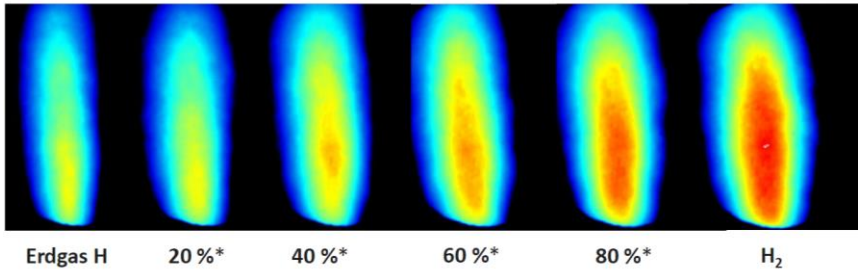
Maxon LE 600 – GWI test





OXYGEN BURNER TESTS

SORG Flatflame burner at GWI



HYDROGEN SAFETY AND CONTROL CONCEPT

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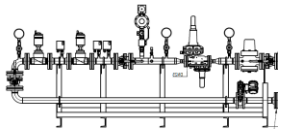
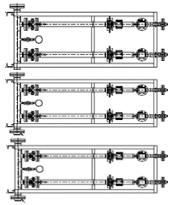
existing oxygen station

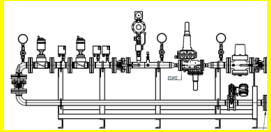


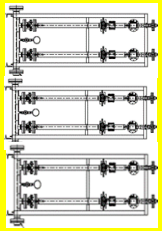


Oxy-Pressure-Safety-Station

Oxy-Single-Burner-Control-Station

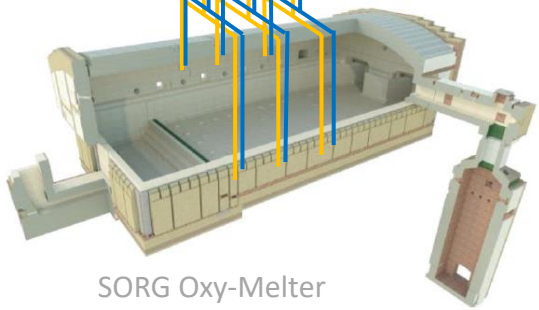
existing gas station





Gas-Pressure-Measuring-Safety-Station

Gas-Single-Burner-Control-Station

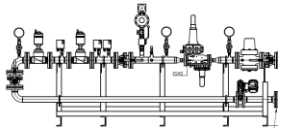


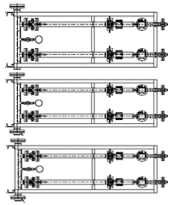
SORG Oxy-Melter with 3 burner pairs

Hydrogen safety and control concept

Example: Oxy-Melter

existing oxygen station

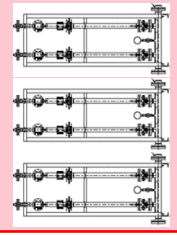




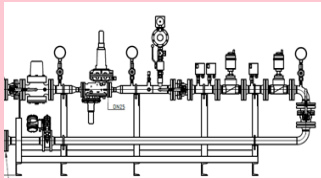
Oxy-Pressure-Safety-Station

Oxy-Single-Burner-Control-Station

1bar(g)
max. 6x300 Nm3/h



new hydrogen station



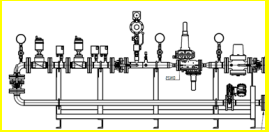
H2-Single-Burner-Control-Station

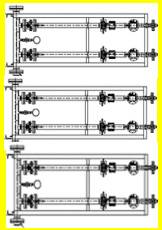
H2-Pressure-Measuring-Safety-Station

Hydrogen
max. 5bar(g)

Hydrogen source

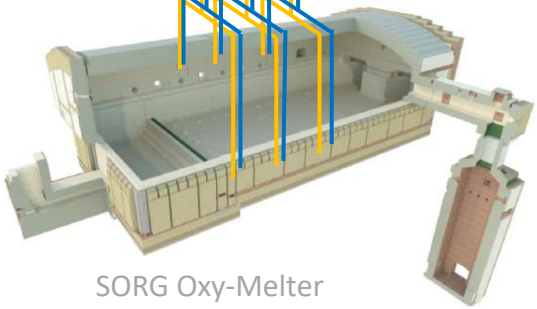
existing gas station





Gas-Pressure-Measuring-Safety-Station

Gas-Single-Burner-Control-Station



SORG Oxy-Melter
with 3 burner pairs

Hydrogen safety and control concept

Example: Oxy-Melter

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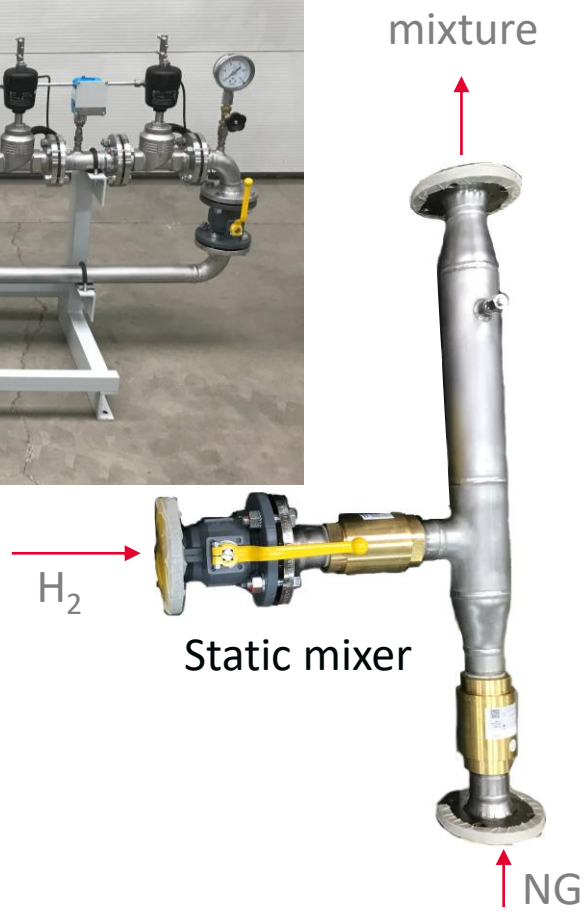
Gas safety station



Static mixer

Single burner stations

SORG components:

→ ready for use with 100% hydrogen

→ also possible for reg. end-port furnace

OUTLOOK

OUTLOOK

- Hydrogen could get a key technology in future glass melting furnaces
- We continue testing equipment together with our customers
- We are ready to supply 100% H_2-ready equipment

Nikolaus SORG GmbH & Co. KG
Stoltestraße 23
97816 Lohr am Main, Germany

Thank you!

SORG