



Solar Chemicals and Materials

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Knowledge for Tomorrow



Overview

- Main work performed on
 - Limestone (see Dr. Meiers presentation)
 - New projects are expected in EU HORIZON 2020 as industrial processes is a special topic
 - Sulfuric acid
 - Ongoing projects like the FCH-JU SOL2HY2, a development is expected as well
 - Aluminum
 - New South African – German project SOLAM is under negotiation



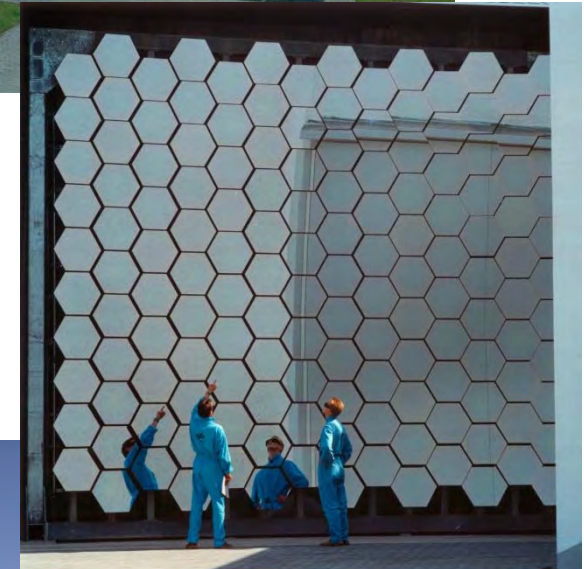
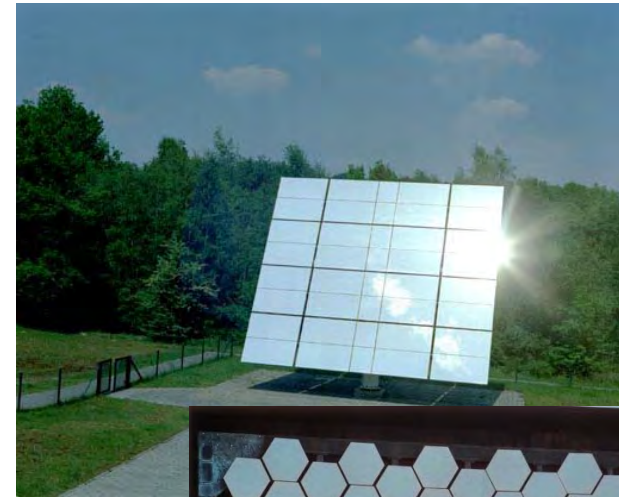
Solar Aluminium Recycling – Work performed in a National German Project

- Partner was VAW, now HYDRO
- Development of a rotary kiln
 - Batch reactor to be operated in DLR's solar furnace
 - Kiln made from SiSiC to be able to handle different materials
 - Up to 10 kW_{th} heat input
 - Up to 3 kg of UBC (Used Beverage Cans)
- Development of strategies for solar aluminium scrap (UBC) recycling
- Control of the materials quality
 - Solar Aluminium is about 0.2% „cleaner“ than industrial recycled aluminium
- Technology is able to deal with even more difficult scrap like Mg

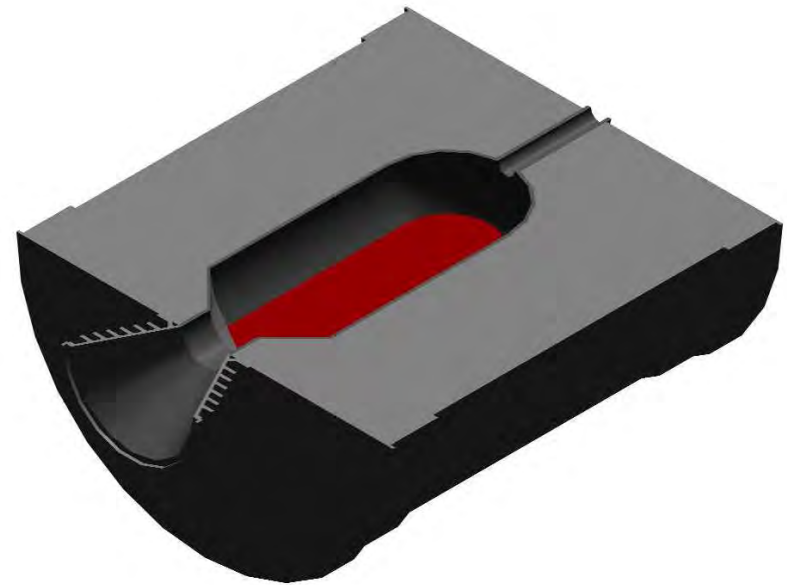
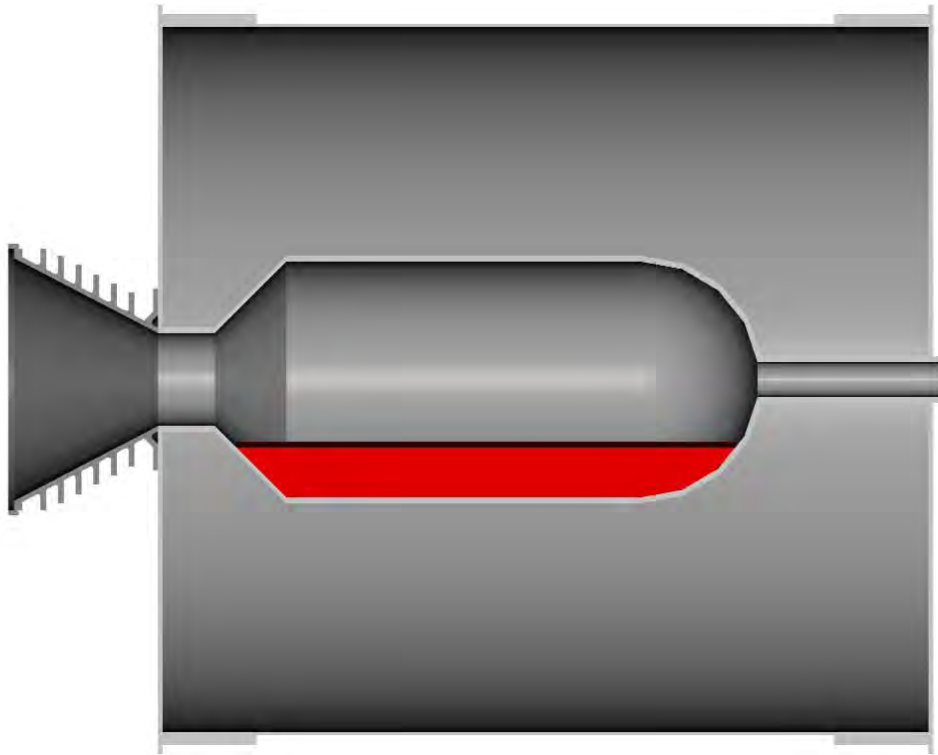


DLR's Solar Furnace

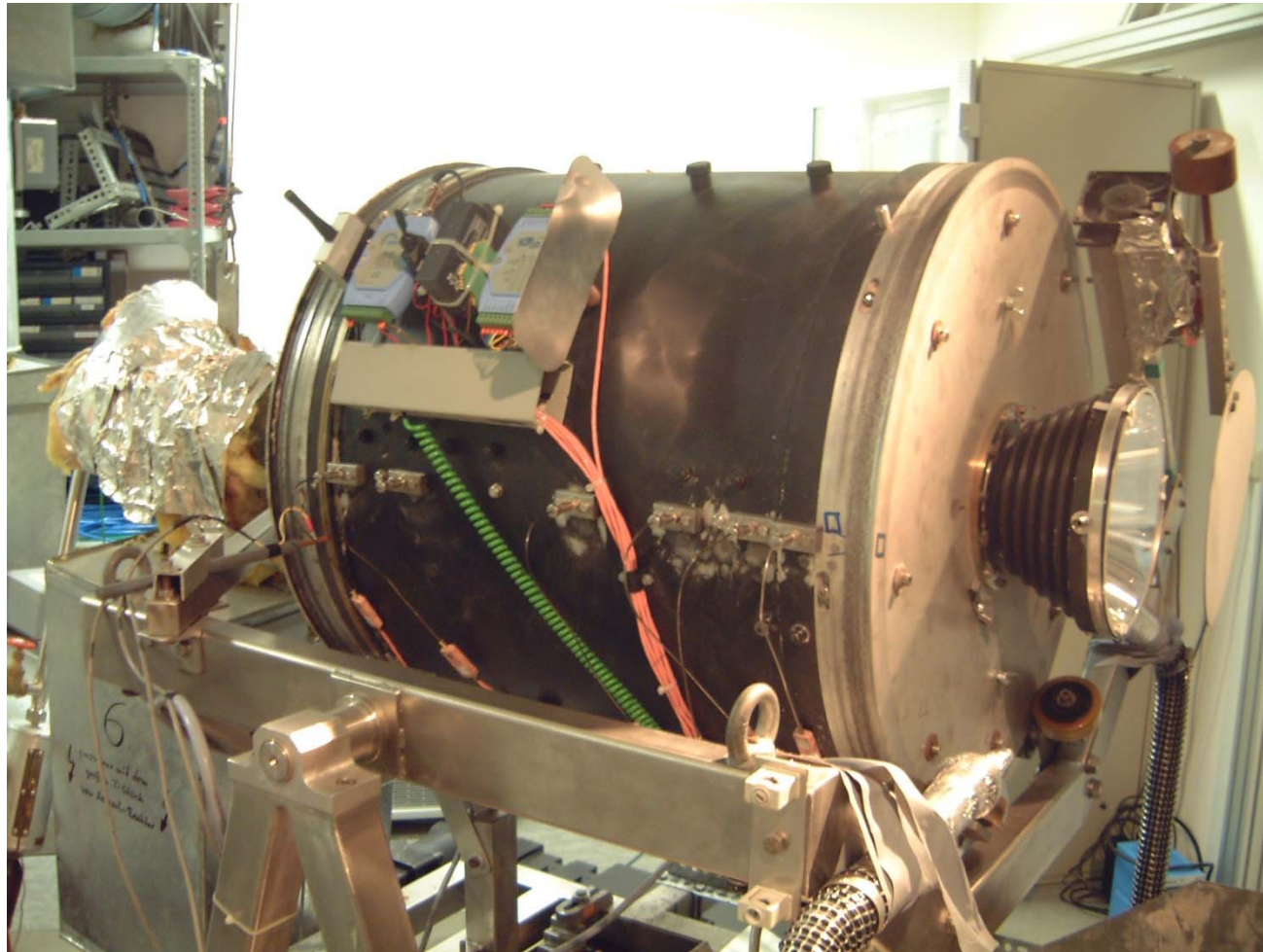
- Off-axis design
- 160 hexagonal facettes
- Concentration factor up to 5500 =
5 MW/m²
- 25 kW_{th} maximum power
- Up to 2700°C
- In operation since 1994 (20th
Anniversary this June)
- About 200 experiments since then



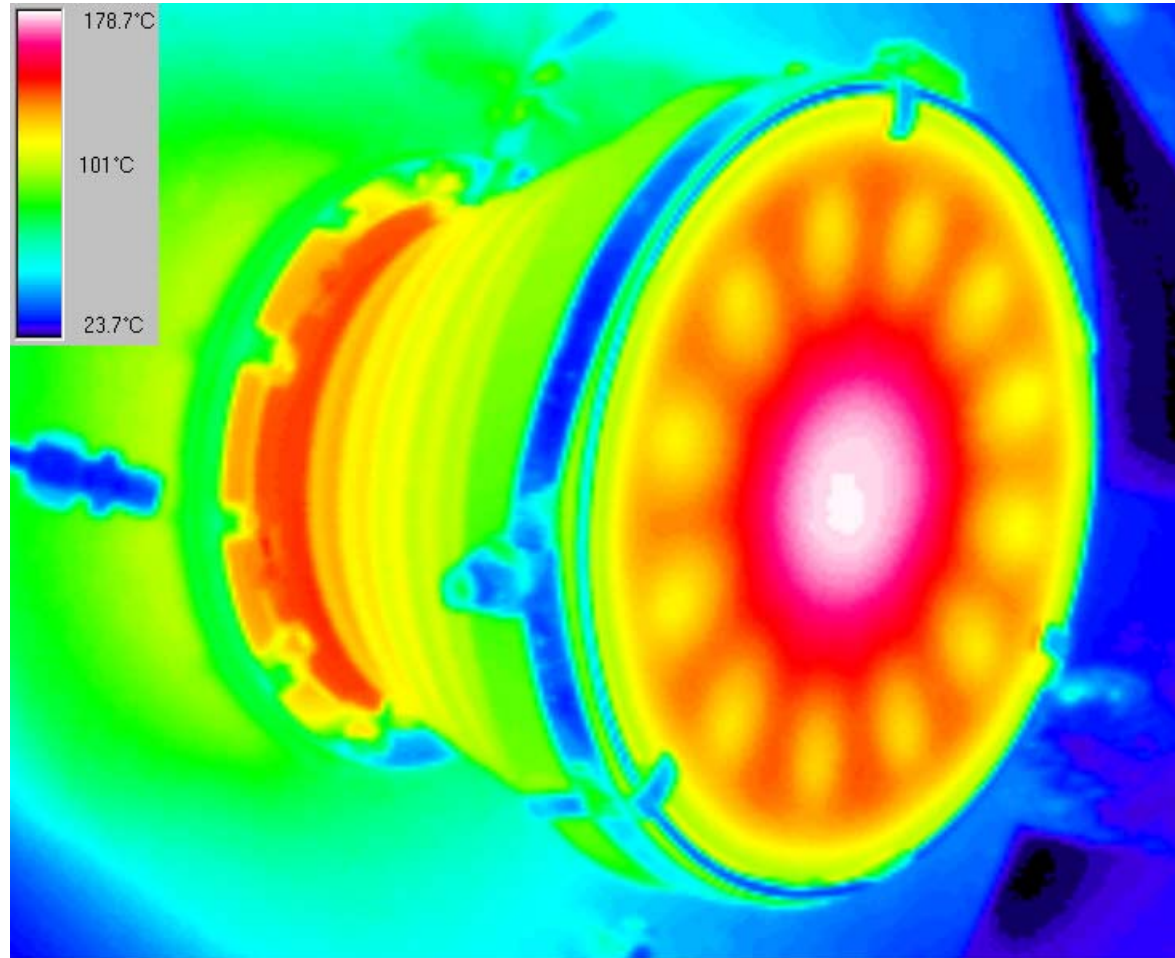
Rotary Kiln Development



Rotary Kiln in the solar furnace

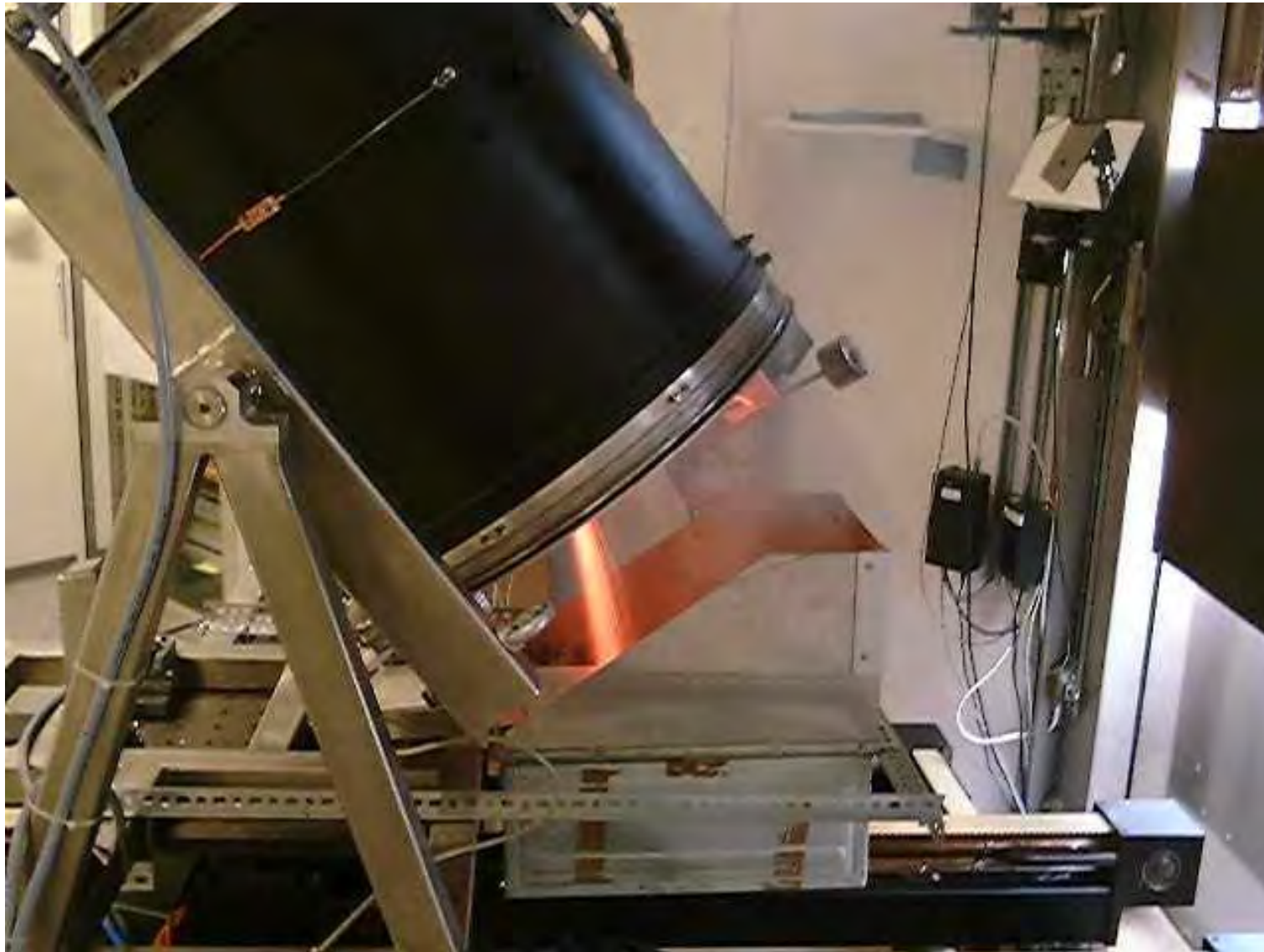


Secondary Concentrator and Window



Recycling of UBC





Recycled Aluminium

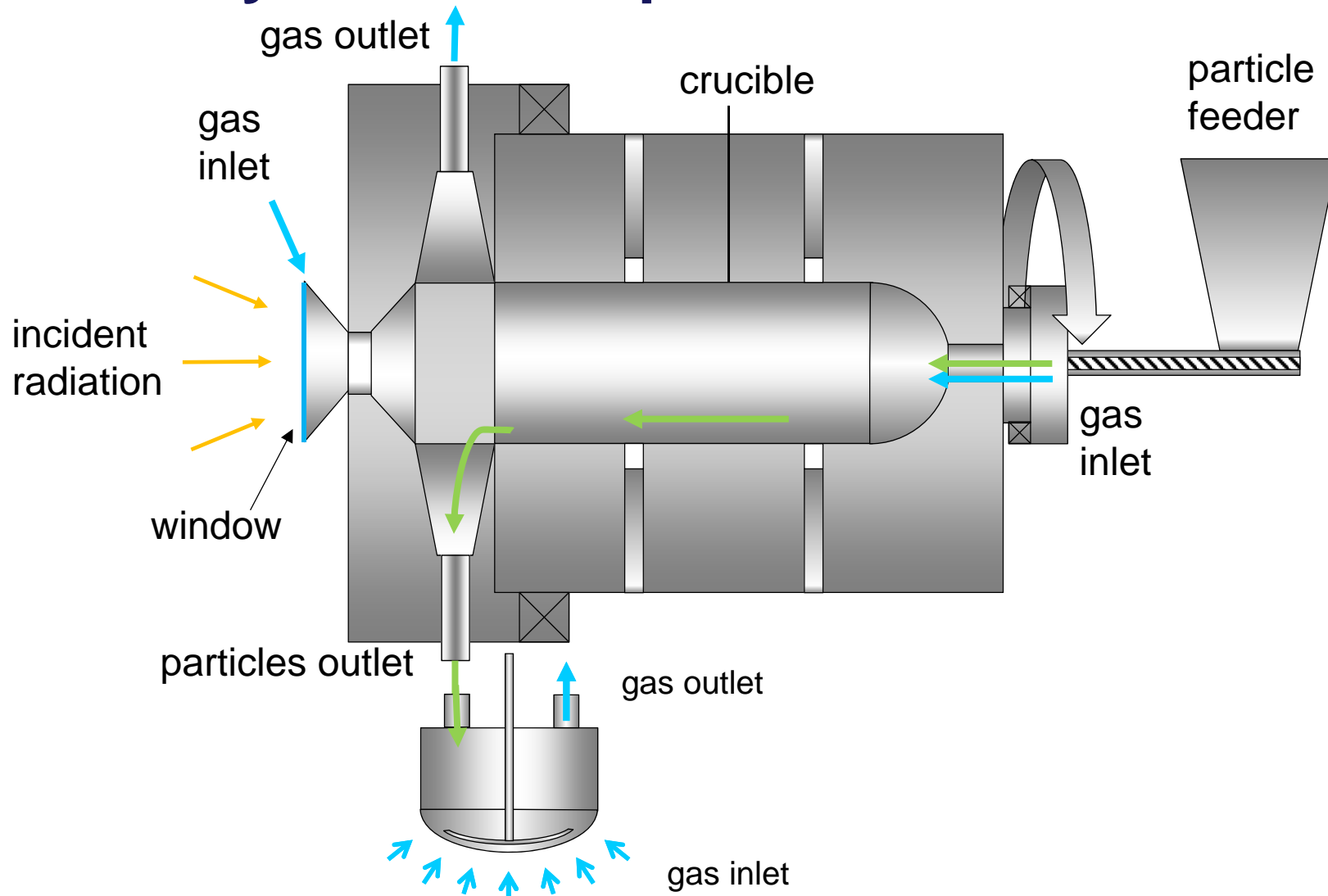


Present Status

- Design of a new rotary kiln for continuous feeding
- Tests since summer 2013
- Test results will be reported in the forthcoming conferences
(SolarPACES 2014, ASME ES2015 ...)



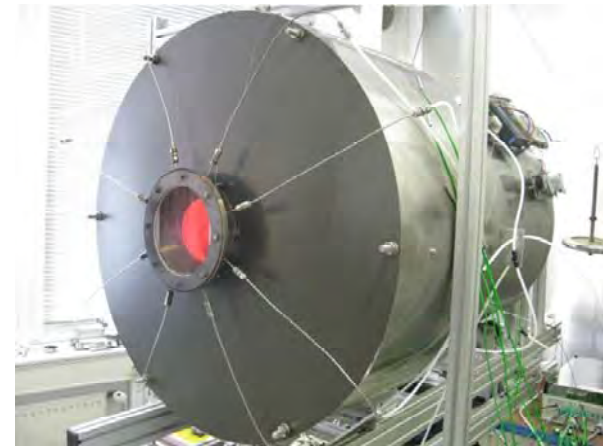
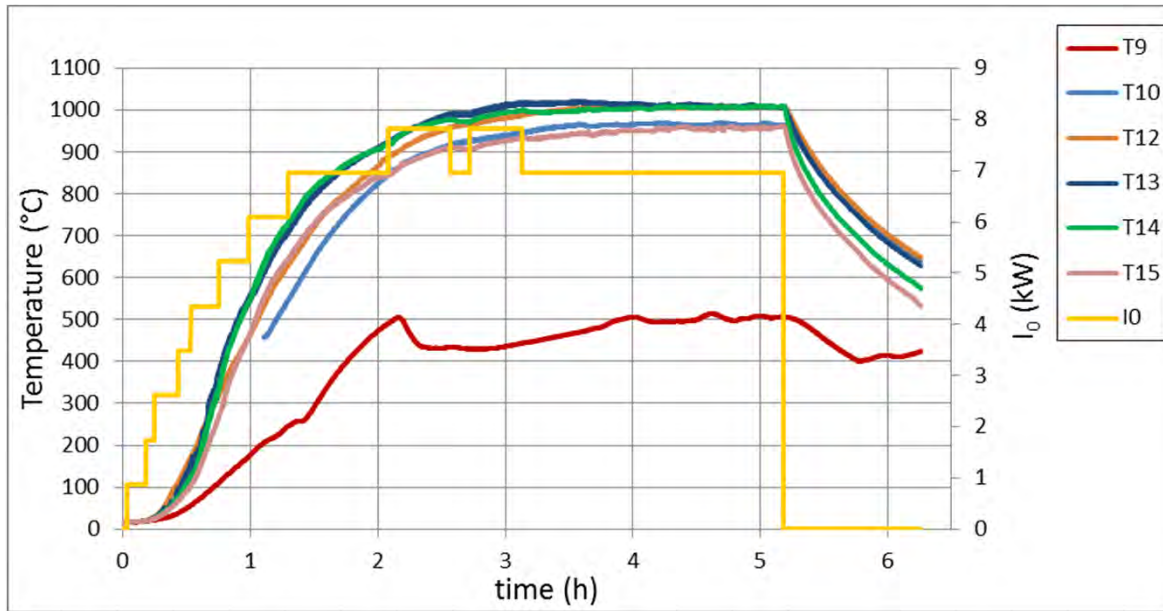
Rotary kiln: concept



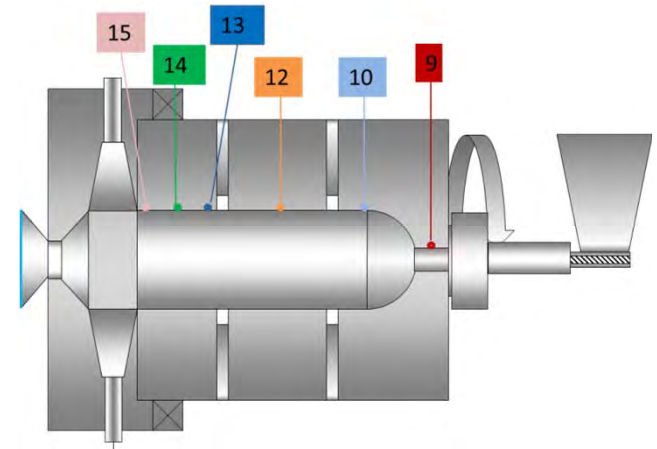
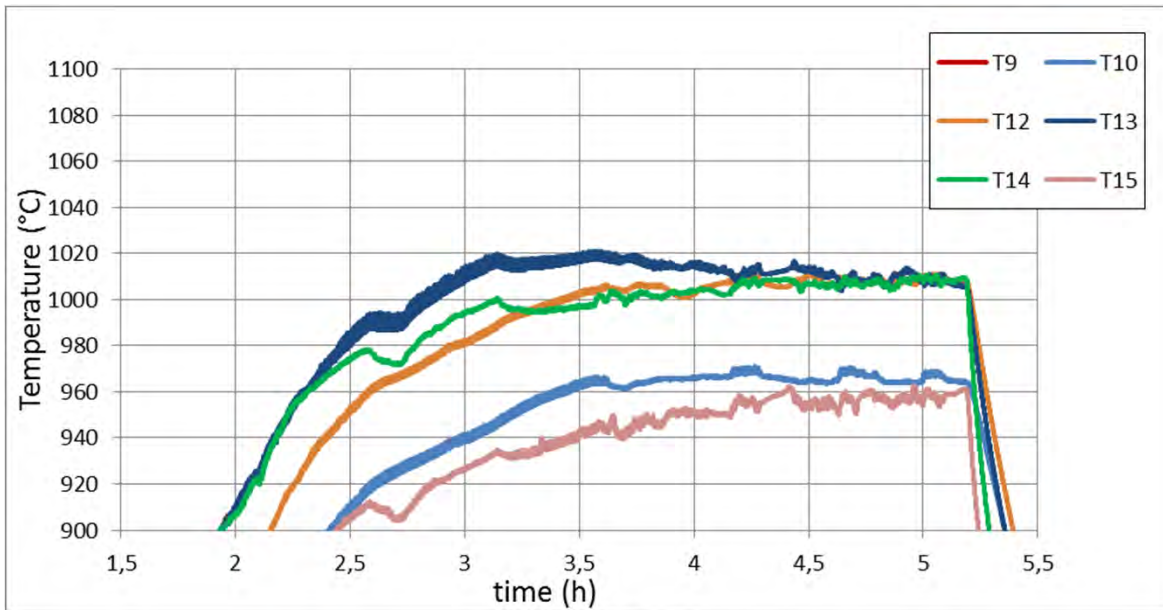
Final reactor



Experiments



I_0 = incident power



RESULTS

A maximum cavity temperature of 1000°C could be obtained in less than 3 hours with a maximum temperature difference $\Delta T_{\max} = 80^\circ\text{C}$

The hottest point on the lateral wall is at 20cm from the cylinder aperture

The coldest points, except the gas outlet pipe (TC9), are the peripheral (both front and back)

After 2.4h, all the lateral wall is hotter than 900°C.

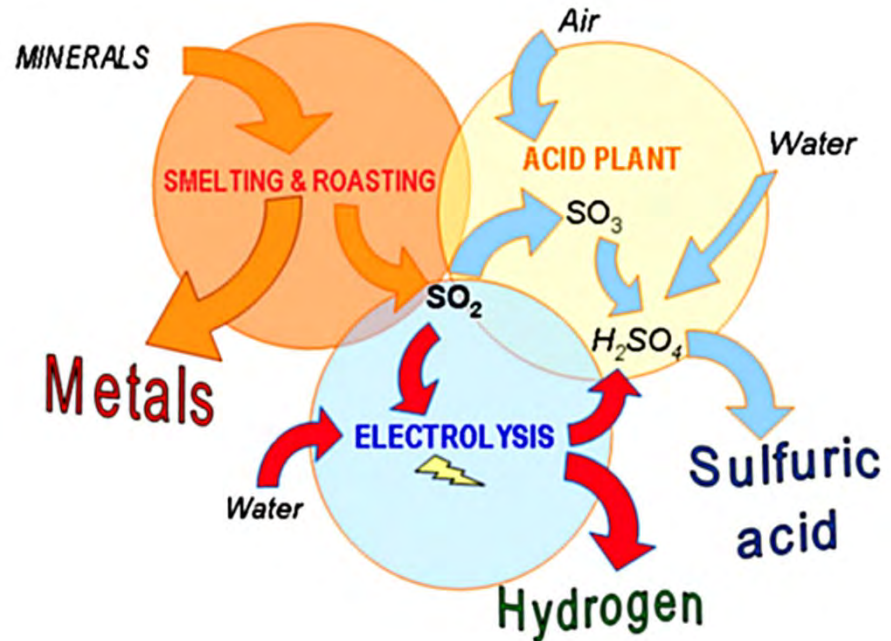
After 4h, the whole lateral wall is hotter than 950°C, the central part is at 1000°C

The longer the cavity is heated, the more uniform the temperature becomes: after 5.2h, $\Delta T_{\max} = 50 \text{ K}$

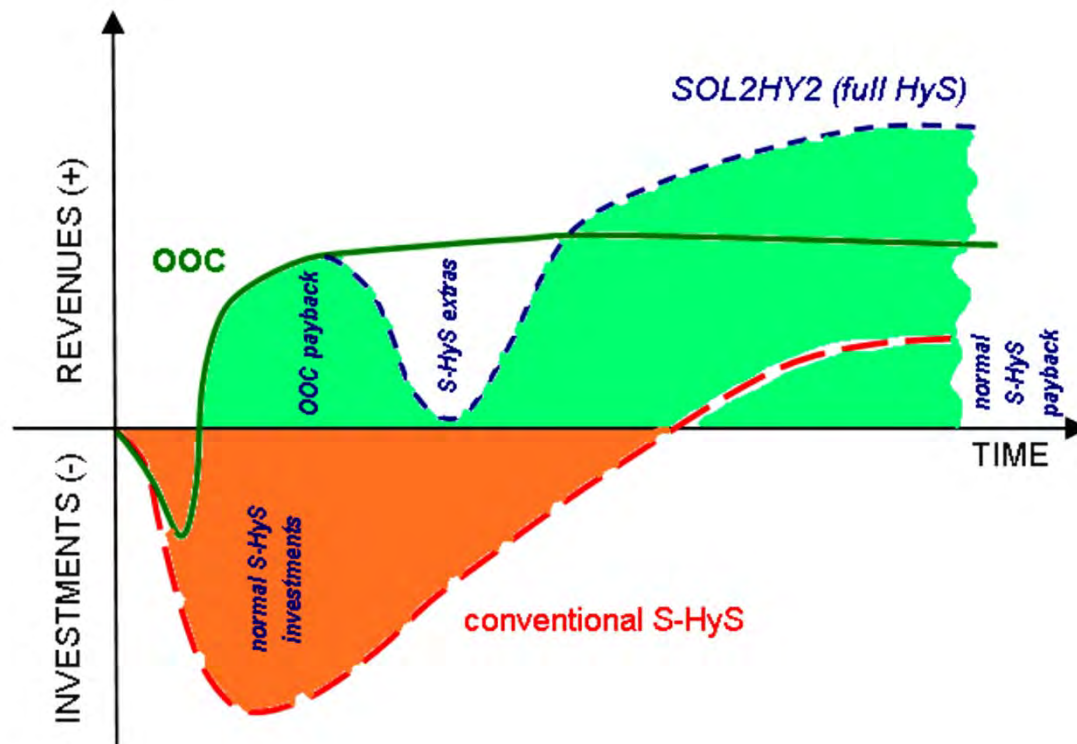


SOL2HY2 – Open TCC

- FCH JU project on the solar driven Utilization of waste SO_2 from fossil sources for co-production of hydrogen and sulphuric acid
- Hybridization by usage of renewable energy for electrolysis
- Partners: EngineSoft (IT), Aalto University (FI), DLR (DE), ENEA (IT), Outotec (FI), Erbicol (CH), Oy Voikoski (FI)
- > 100 kW demonstration plant on the solar tower in Jülich, Germany in 2015



Investments vs. revenues



- Reduction of initial investments
- Financing of HyS development by payback of OOC
- Increase of total revenues



Acknowledgement:

We thank AG Solar of the Federal State of Northrhine Westphalia for funding of the Solar Fuenace and the Rotary Kiln project and the FCH-JU for funding SOL2HY2.



Thank you very much for your attention!

