

# Use of pelletized wood for glass melting

A pilot scale study to verify CO<sub>2</sub>-neutral high-temperature modern process technology in glass applications

Project partners:

- Växjö university – Combustion and bioenergy expertise
- Glafo – Glass process and glass quality expertise
- OKB – Glass process expertise and co-financing
- Stem – Financing

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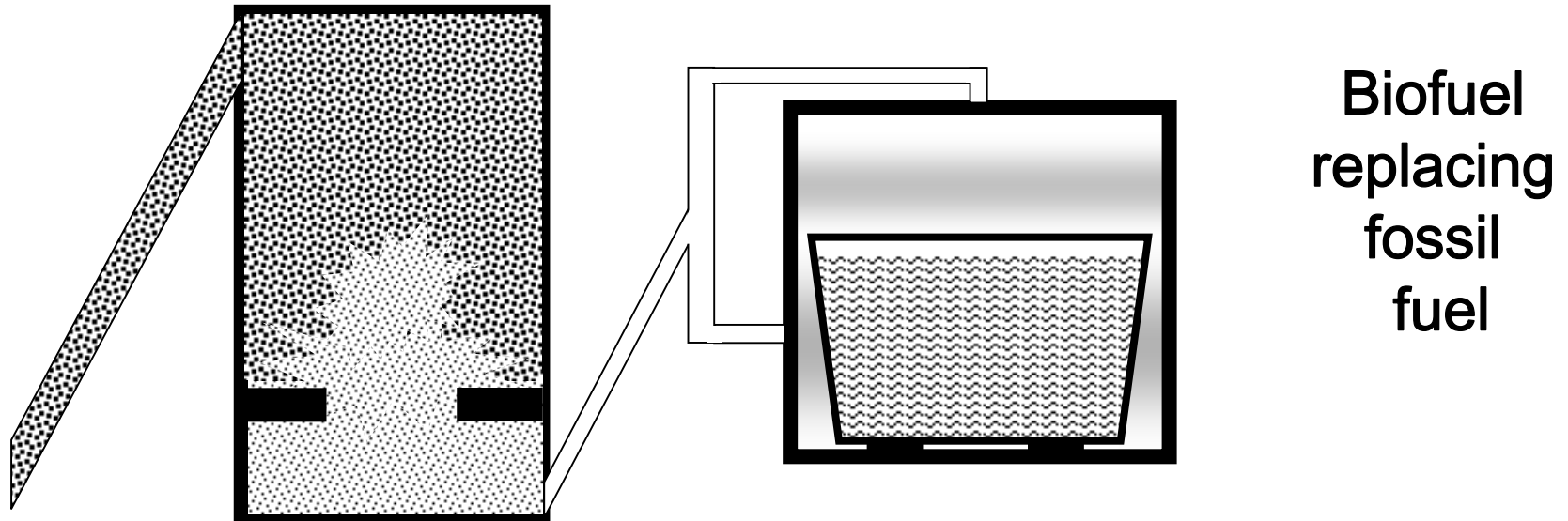
# Use of pelletized wood for glass melting

The aims of the project were to demonstrate modern technologies to utilize biofuels in high-temperature applications:

- Biofuel replacement of fossil fuel (global warming)
- Flameless oxidation (avoid hot-spots, ladle lifespan)
- - “ - (improve heat transfer)
- Staged combustion ( $\text{NO}_x$ -reduction)

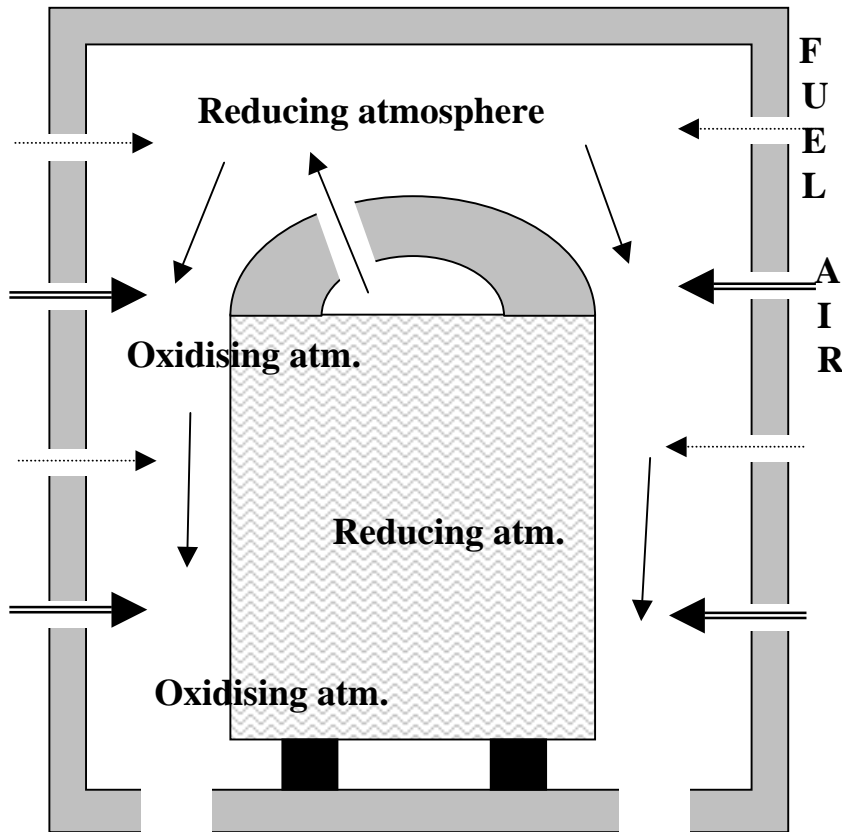
These technologies are widely used in other industrial branches – Why not in the glass industry?

# Use of pelletized wood for glass melting



Replacing ash-free LPG with (relatively) ash-rich solid fuel (wood) requires gasification to keep the ash out of the glass

# Use of pelletized wood for glass melting

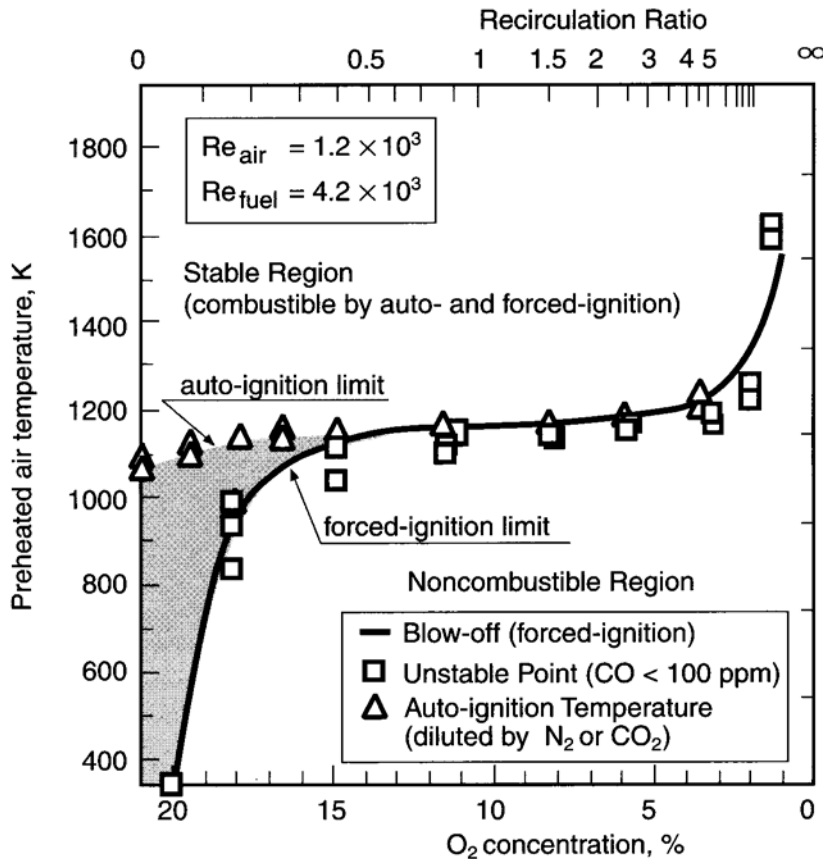


## Staged combustion

Alternating oxidising and reducing conditions provide an efficient means for NO<sub>x</sub> reduction.

This requires multi-level fuel and air ports

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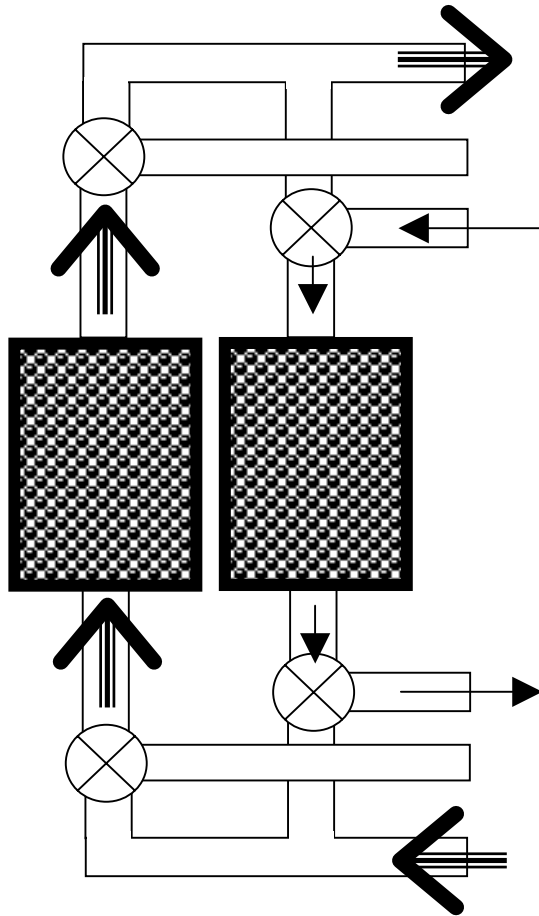
## Flameless oxidation

Can be achieved by controlled and intensive recirculation and high air preheat temperature.

Increases heat transfer and reduces (potentially) NO<sub>x</sub>

Figure from  
*High temperature air combustion*,  
Tsuji & al., CRC press 2003

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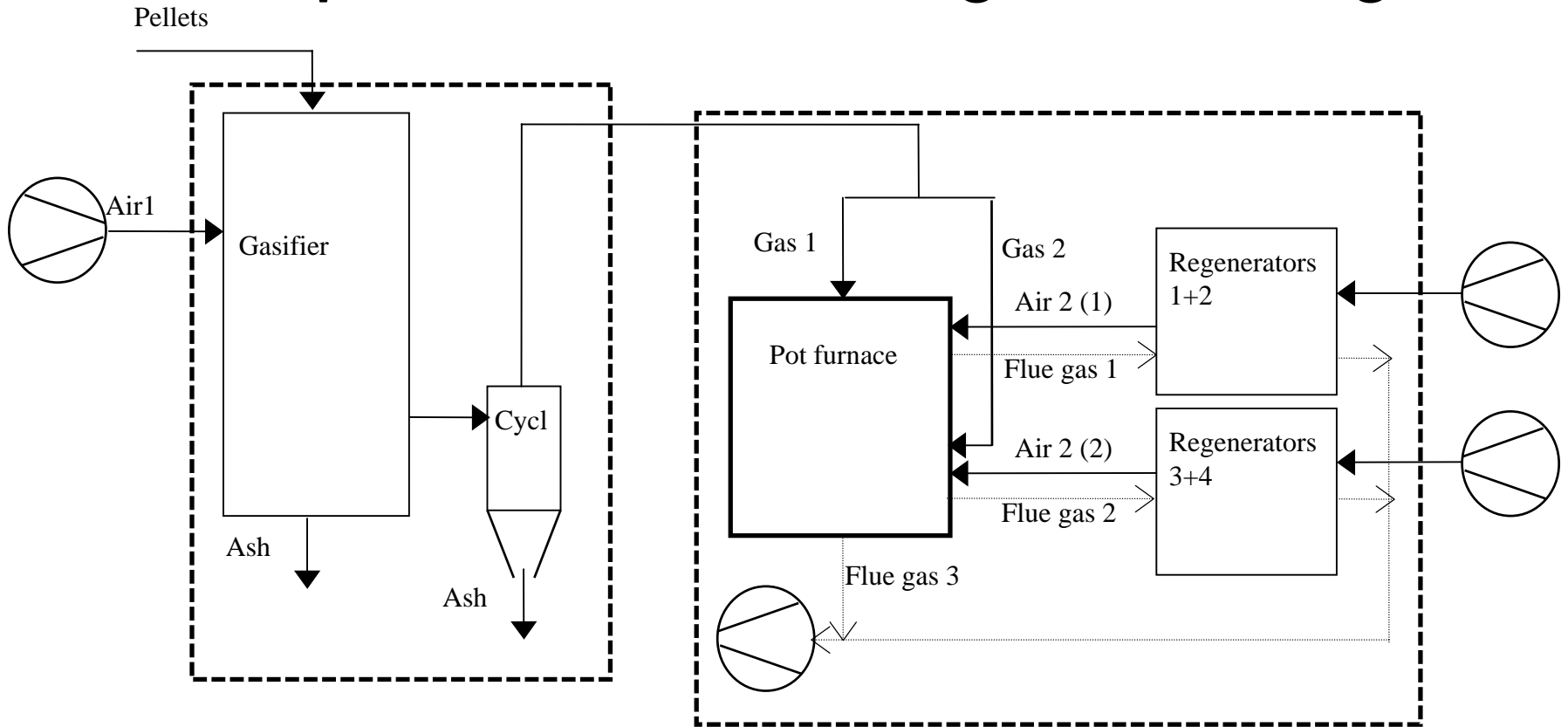
## High temperature air preheat

Is achieved by the use of regenerative instead of recuperative heat exchangers.

The mean air temperature is determined by the valve shifting time (typically 20-40 seconds)

Air temperatures 1000-1150 °C, flue gas temperatures < 300 (250) °C

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Pilot installation at Kosta glasswork

# Use of pelletized wood for glass melting



Connected to process control system

Initial tests March 31 2004:

- Combustion not perfect but improved in later tests
- No ladle in the furnace meant flow field not optimised initially
- Testing for temperature stability and gasifier control

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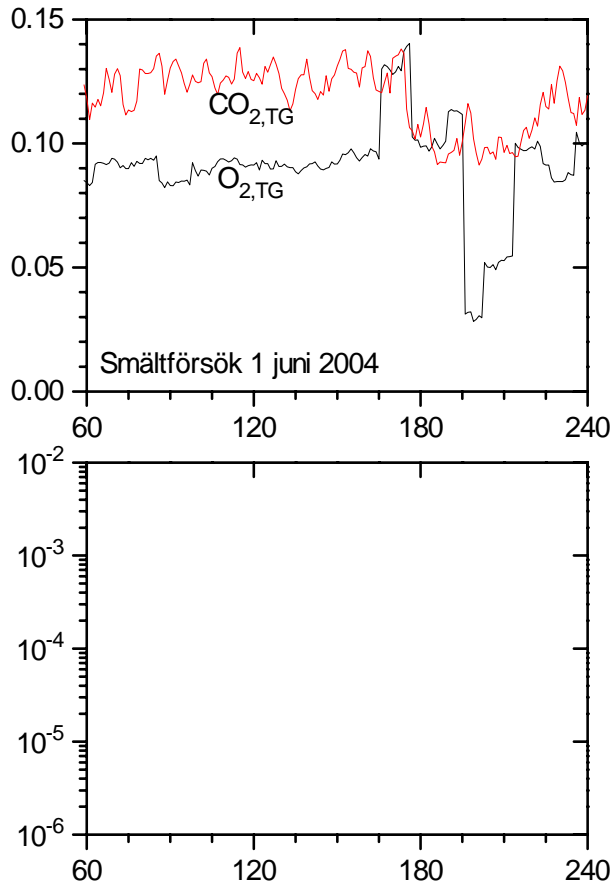
## Test period April-May-June 2004

- Total operating time about 100 h
- Constant temperature tests
- Temperature ramping tests
- Four melting tests
- Heat- and mass balances evaluated

## General conclusions

- Gasifier control is the most crucial
- Works well from a technical standpoint
- NO<sub>x</sub> reduction could not be verified
- No adverse effects on glass quality encountered

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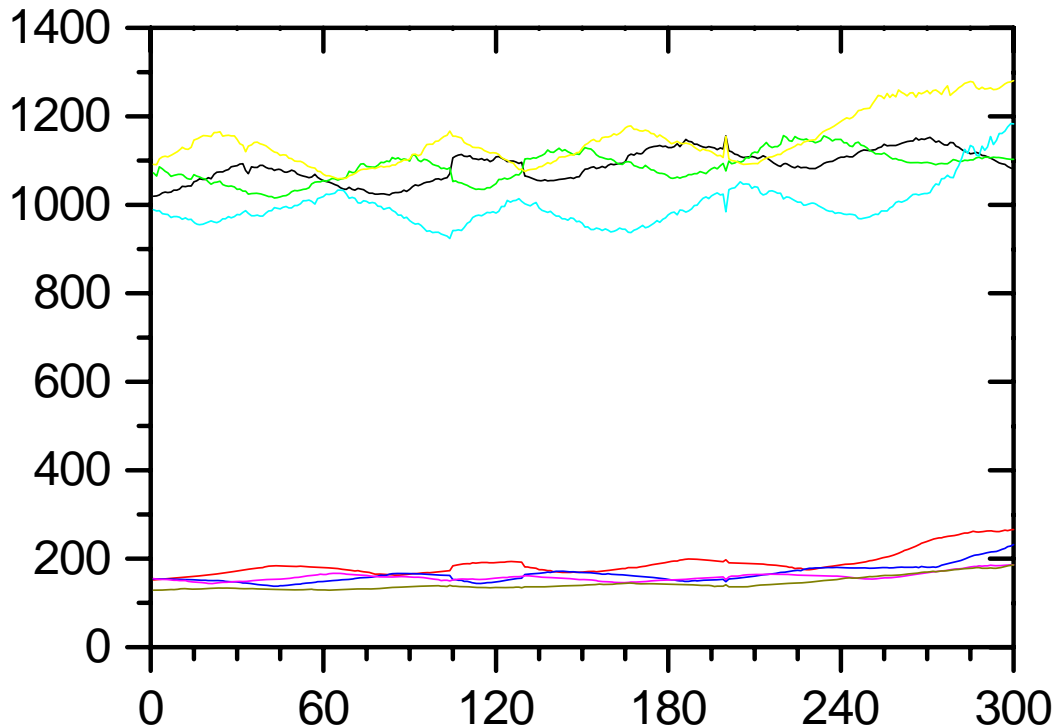


Sample gas analysis from the melting experiment June 1 2004.

NO<sub>x</sub> emission from the planing agent (salpetre)

Mass balance for nitrogen reveals that 100 % of the fining agent N is converted

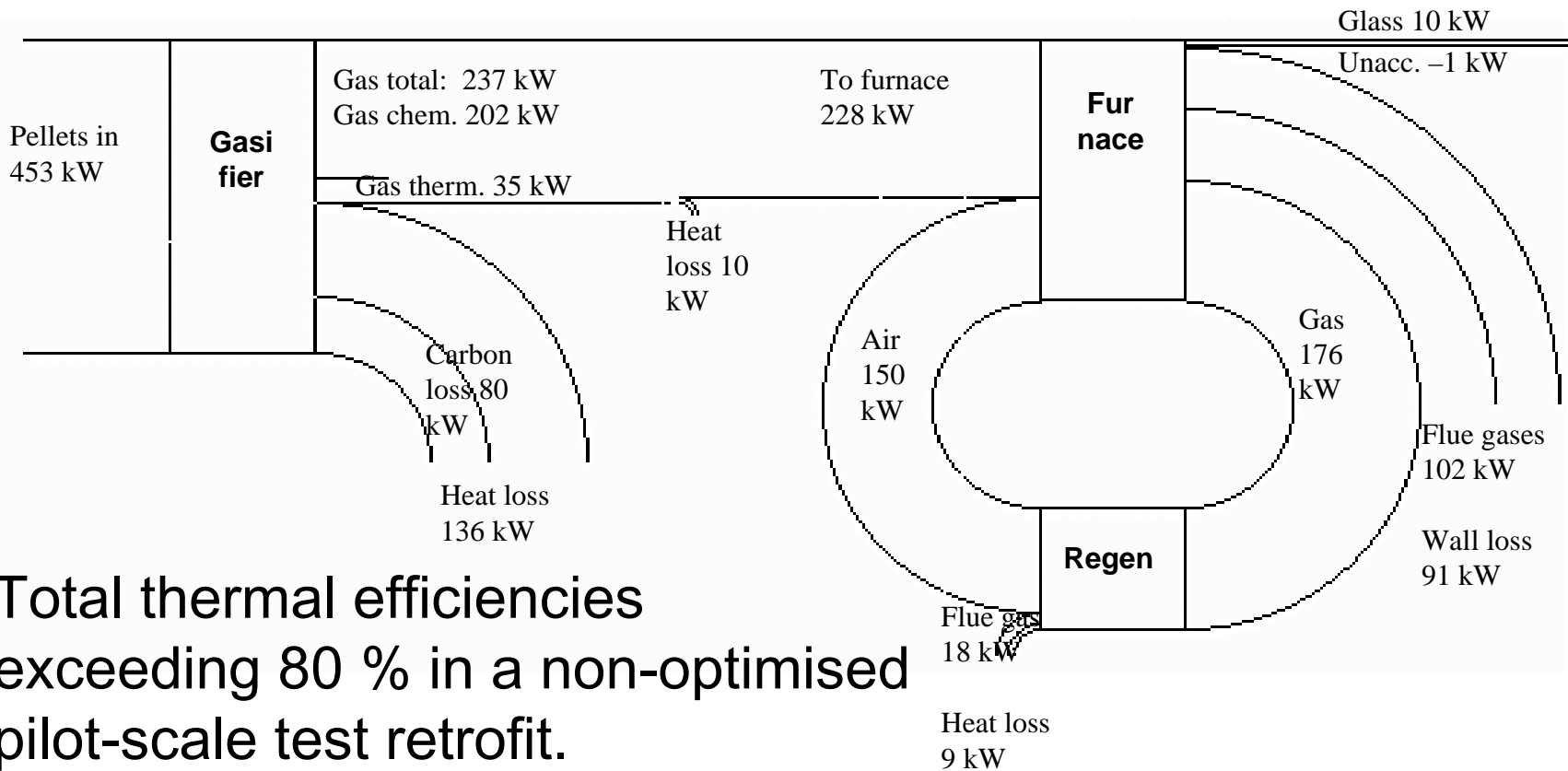
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**Air- and flue gas  
temperatures June 16**

Shut-down period  
commencing at about 200  
minutes gives a  
temperature rise because  
gasifier approaches  
combustion mode

# Use of pelletized wood for glass melting



Total thermal efficiencies exceeding 80 % in a non-optimised pilot-scale test retrofit.

**SUCCESS!!!**

## Use of pelletized wood for glass melting

Glass production can be made CO<sub>2</sub> – neutral using known technology and without interfering with the glass quality.

Anyway for art glass

Special quality glass may require special attention.

