First results of glass melting with H_2-firing

(Assumed) Risks of H_2 firing in glass melting

Situation and hypotheses at start of project:

- No burners available for 100% H_2
- Flames are too long → overheating of superstructure
- Flames are hotter → increased refractory corrosion
- Flames are hotter → increased NOx emissions
- Heat transfer to glass melt is significantly reduced → higher crown and superstructure temperatures or more electric boosting necessary
- Flames are not visible → problems in process evaluation and control
- Atmosphere of pure water vapor → increased refractory corrosion

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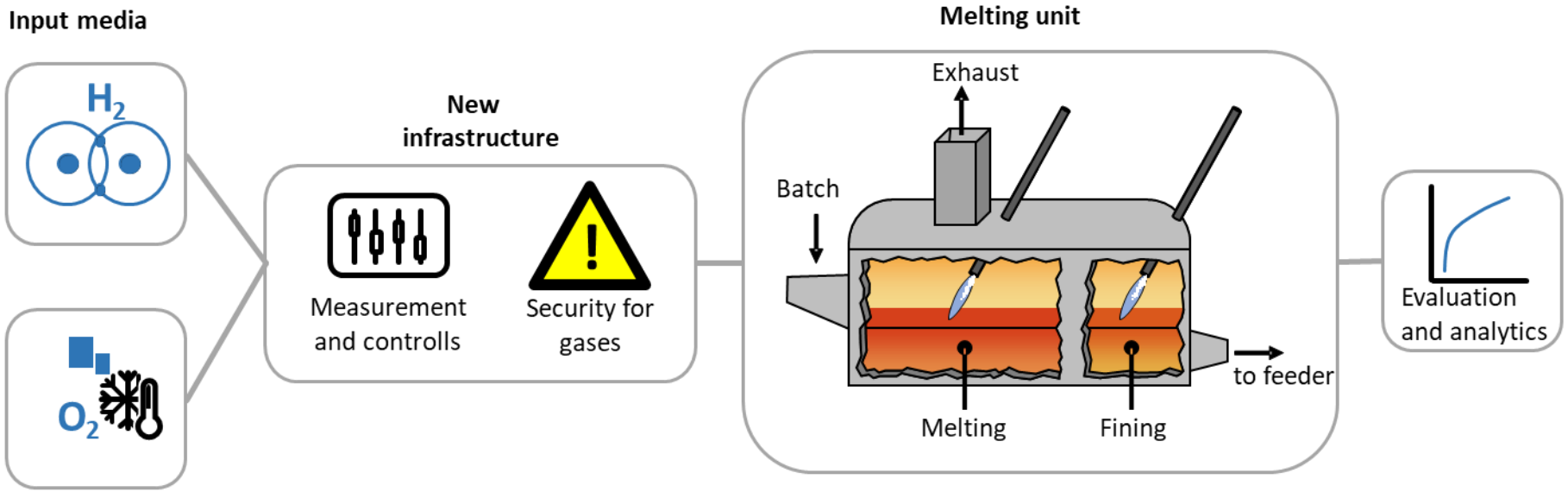
Setup of small melting aggregate with H_2 firing

- Installation of special infrastructure required for H_2 storage and handling, technically audited by German „TÜV“
- Implementation of a control loop according to DIN 746-2 („Industrielle Thermoprozessanlagen“), technically audited by German „GTÜ“
- Setup of a glass melting unit with suitable sensors
- Choice of suitable burners by open-air tests



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Testing programm and H_2 supply

- Tests of various special glasses, approx. 2 weeks for each glass
- H_2 supply from bundles

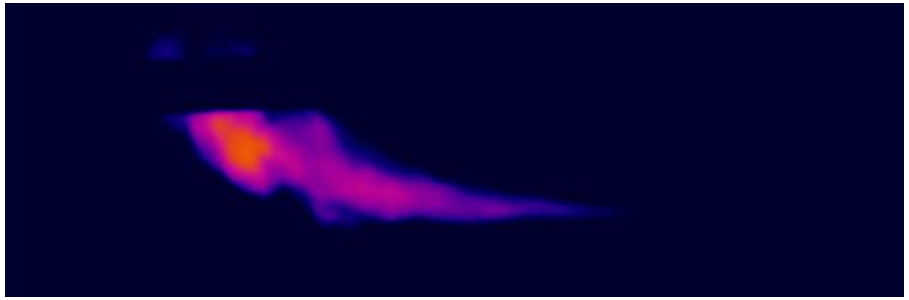
+ Less space required, smaller space for explosion safety

– High maintenance for replacement and change

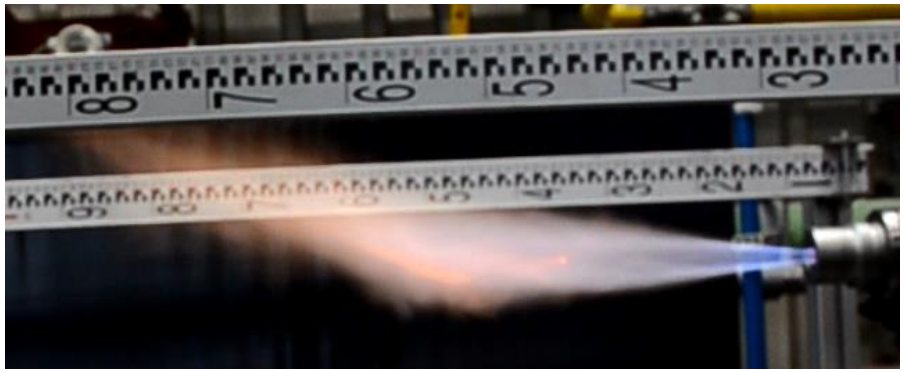
- Test program for each glass:
  - Start with pure natural gas firing
  - then change to H_2 firing
  - then reproduce results with pure natural gas firing

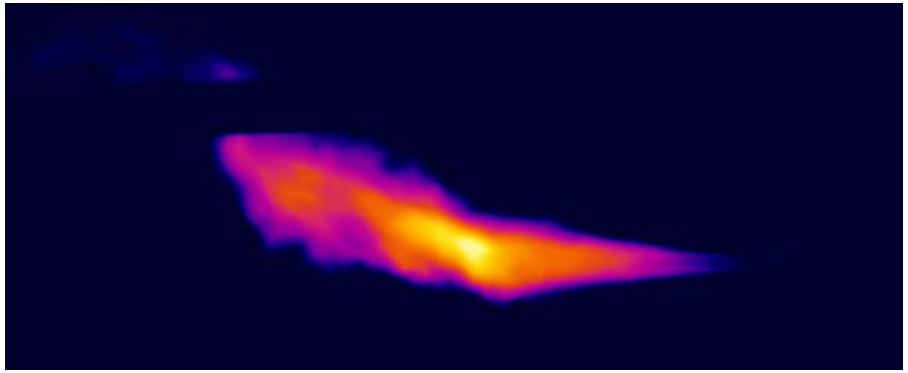
Burner tests (open air) at 50 kW

- 0 Vol.-% H_2

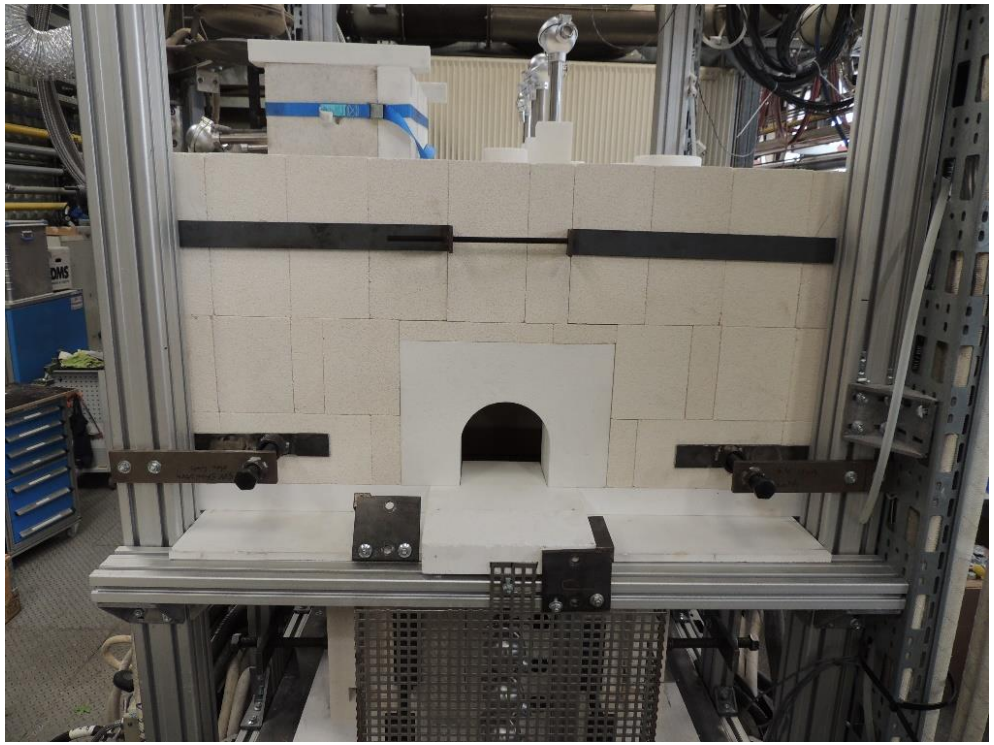


- 100 Vol.-% H_2

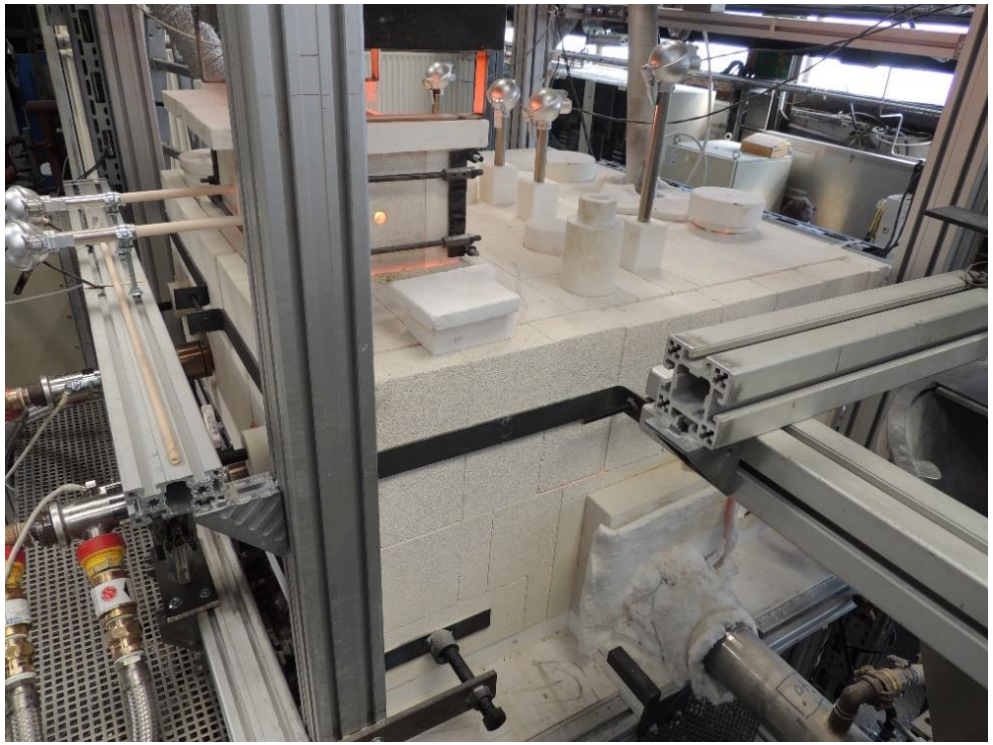




Lab-scale melting unit



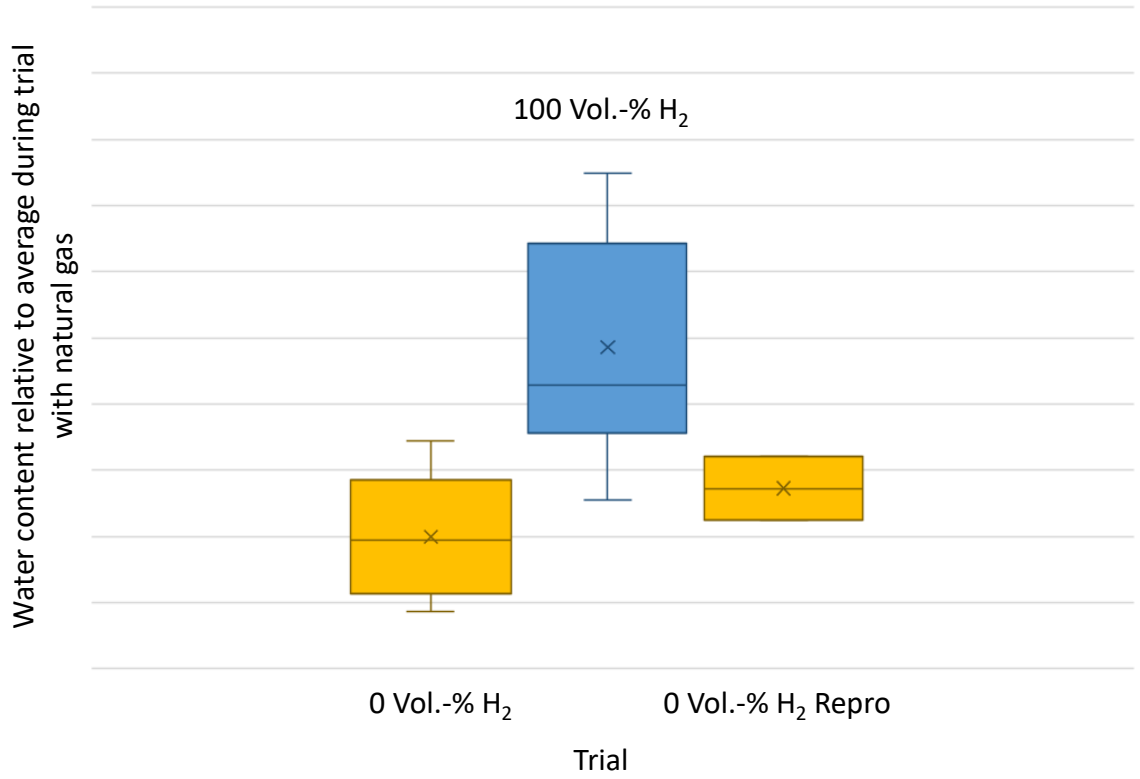
After setup



Unit in use

Effects to the glass melt

- Chemical composition and water content was measured
- The results vary within the expected range



Key learnings so far

- The use of conventional refractories (HZFC, AZS, ZS, fused silica) is possible also with H_2 firing
  - Different flue gases and a potential flame contact do not show a negative influence
- Conventional burners can be used
  - No significant temperature increase at the burner tip / root of the flame is observed
- Redox-fining is possible with H_2 firing
  - However, process adjustments may be necessary
- Long term effects cannot be evaluated

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