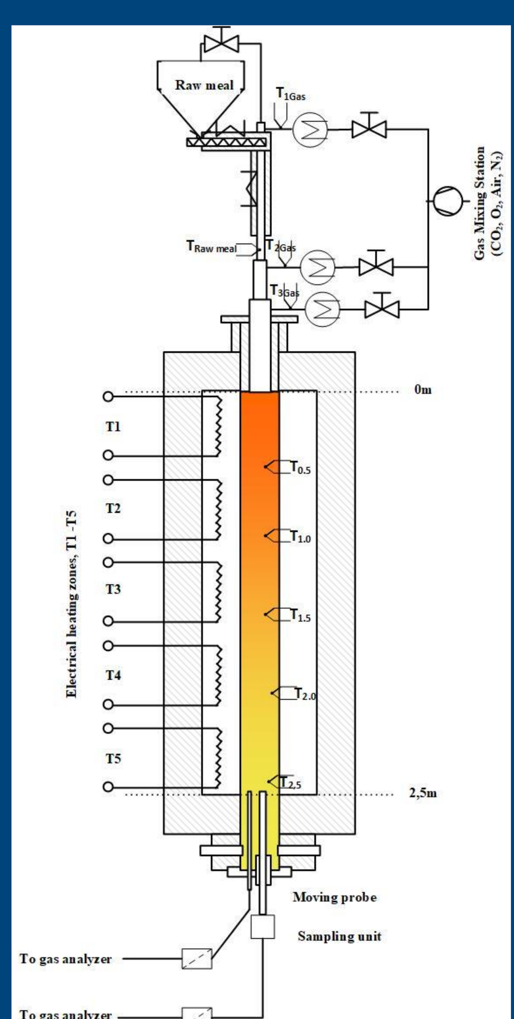
CEMCAP

CEMCAP is a Horizon 2020 project with the objective to prepare the grounds for cost- and resource-effective CCS in European cement industry.

Fig. 1: Entrained calcination test facility (IFK)



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www.sintef.no/cemcap
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Paneru, Manoj; Mack, Alexander; Maier, Jörg; Cinti, Giovanni; Ruppert, Johannes [2018] Oxyfuel suspension calciner test results (D8.2)

Results & Publications

https://www.sintef.no/ projectweb/ cemcap/results/

This project is funded by the European Union's Horizon 2020 Framework Program for research and innovation

Calciner Technology for Oxyfuel Process

Conclusions

- Higher temperature is required for oxyfuel calcination in comparison to existing operational experience of industrial calciners operated with air;
- Average temperature increase is in the range 50-70 K.
- The actual level of temperature increase depends on the heat transfer characteristics. The entrained calcination tests performed during this study showed that a temperature up to 940 °C is required.
- The short term tests did not show increased tendency of raw meal coating/sintering even at elevated oxyfuel temperature. However, this phenomenon needs further study regarding long term behaviour in industrial scale calciners.

Calcination Process for Cement Clinker Production:

- Chemical decomposition of limestone; endothermic reaction

$$CaCO_3 \rightarrow CaO + CO_2$$

- Equilibrium temperature: depends on partial pressure of CO_2, which changes from air fired process to oxyfuel process from 20 to 80 vol.%

WP8-Research

Experimental Setup for calcination in industrial relevant oxyfuel conditions

- Tests performed in an electrically heated entrained flow reactor (see Fig. 1)
- Two calciner operation scenarios for :
  - ✓ firing with air: 20 vol.-% CO_2 (AF) and oxyfuel process conditions: 80 vol.-% CO_2 (OF)
  - ✓ Heat input either electrically heated (w/o fuel) or with addition of fuel to the calciner (w/ fuel)

Test Results

- The temperature increase observed for oxyfuel calcination (Fig. 2) is in line with findings in comparable studies
- Lower calcination temperature with(w/) fuel is due to improved heat transfer (Fig. 2)
- Increased temperature is mandatory. An increase in residence time alone could not improve calcination (Fig. 3)

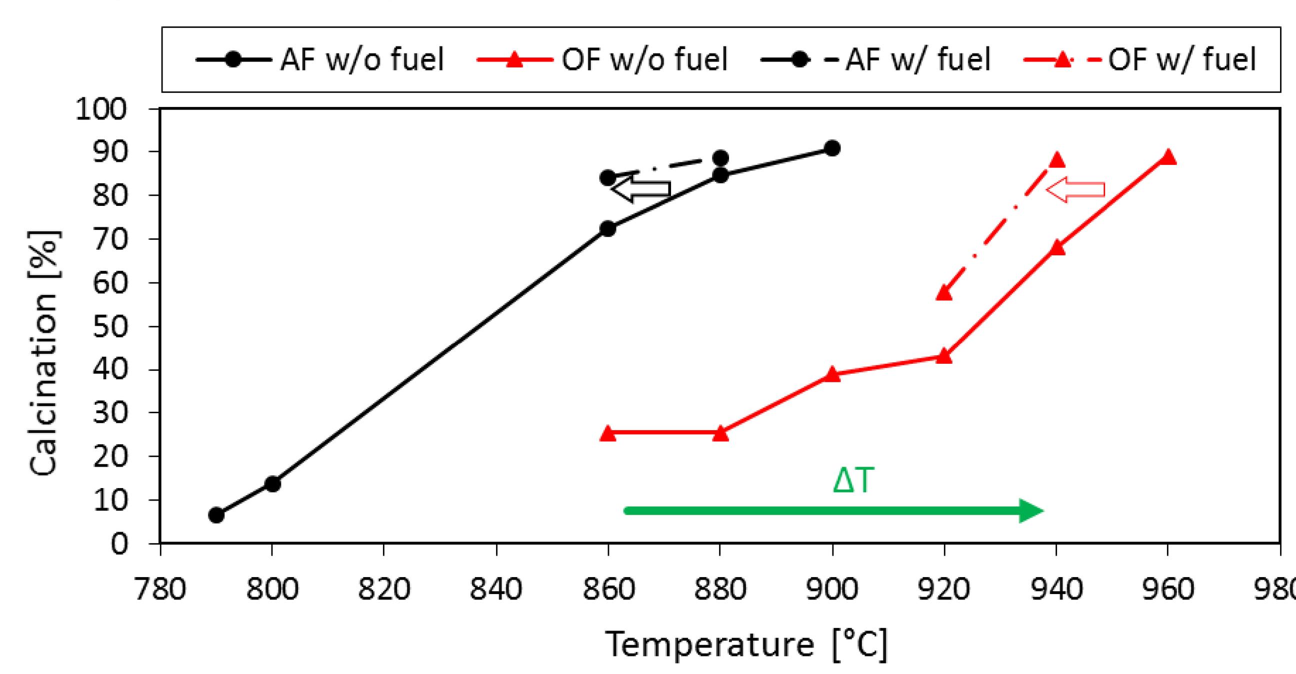

Fig. 2: Calcination [%] at different temperature; Air calcination (AF) and Oxyfuel calcination (OF); without (w/o) and with (w/) fuel, and corresponding temperature increase ΔT for oxyfuel calcination

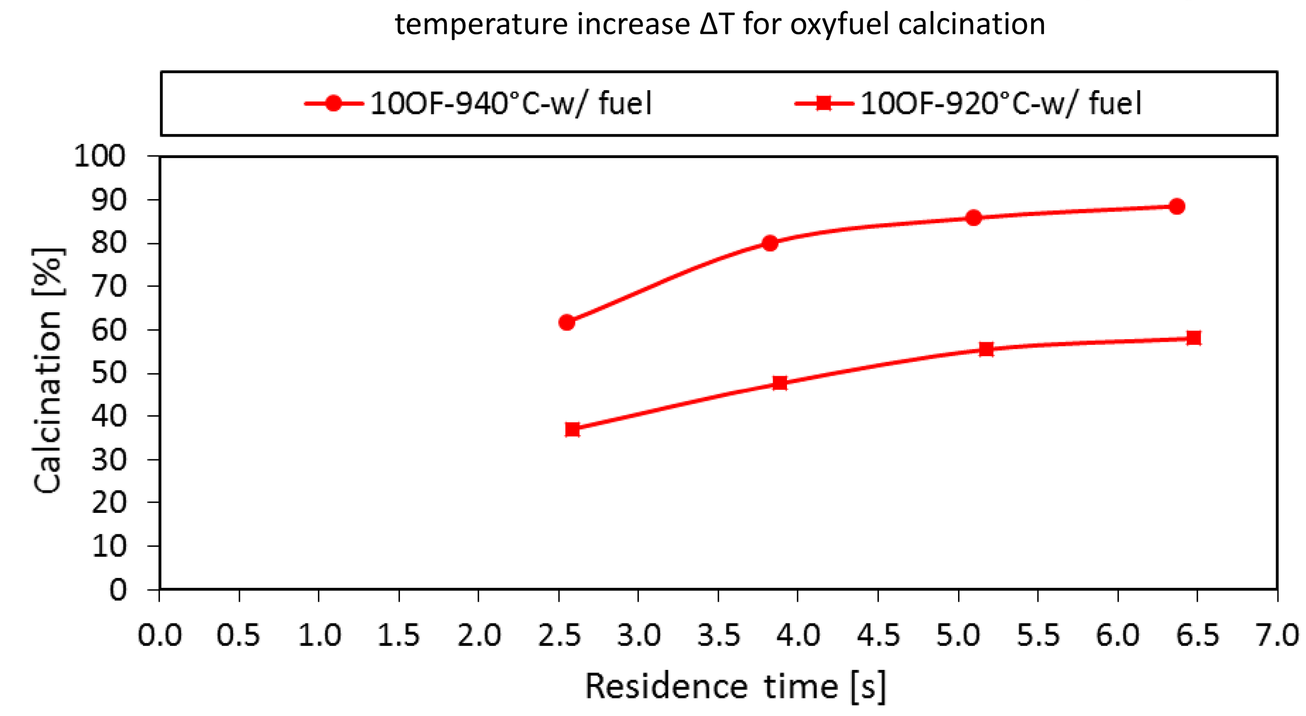

Fig. 3: Calcination [%] vs residence time; 920°C and 940°C-Oxyfuel calcination (OF), with (w/) fuel

Industrial Oxyfuel Calciner Operation

- Operational issues at elevated oxyfuel temperature requires long term investigation to evaluate the impact of sulfur and alkali cycles (associated with fuel impurities) existing in the preheater-calciner-kiln system
- To keep the calciner outlet temperature in the range of existing operational experience (≤ 900°C) there are two possible solutions :
  - ✓ Shifting a certain level of calcination towards the kiln entrance
  - ✓ Improving the heat transfer to raw meal particles inside the calciner itself to lower the difference between equilibrium temperature and actual entrained temperature required for calcination