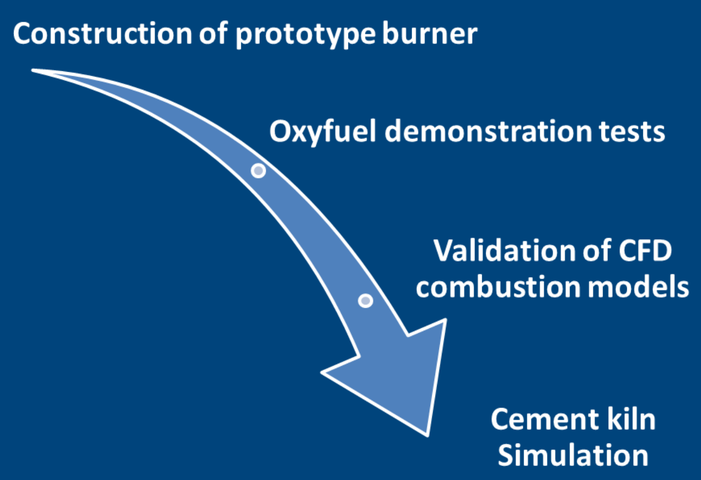
Oxyfuel Burner Technology

CEMCAP

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

Work package methodology



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Results & Publications

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

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Objective

- Develop through demonstration tests and simulation analysis an optimized oxyfuel firing concept for a downscaled cement kiln burner.

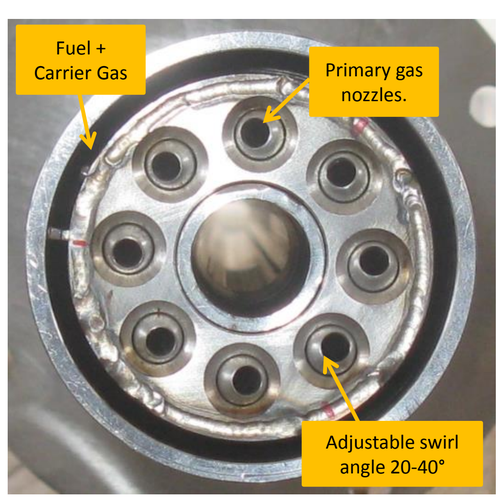
Conclusions

- Modern high momentum jet burners could be used for oxyfuel operation without modifications necessary (limitation in max. O_2 concentration apply). Flue gas recycle ratio, gas distribution in burner outlets and swirl adjustment are key parameters in order to obtain similar flame formation and heat transfer behavior as in air combustion.
- Incident radiant heat flux to furnace walls (and therefore, to material bed in a rotary kiln) is altered under CO_2/O_2 oxidizing medium.
- An oxygen enrichment in primary gas of 60 vol.% favors full oxidation to CO_2 (dominance of heterogeneous gasification reaction $C_{(s)} + CO_2 \rightarrow 2CO$ is mitigated).

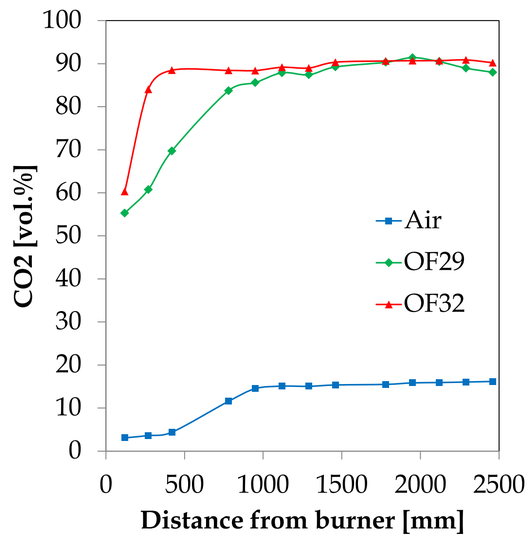
Work Package 7 Research Activities

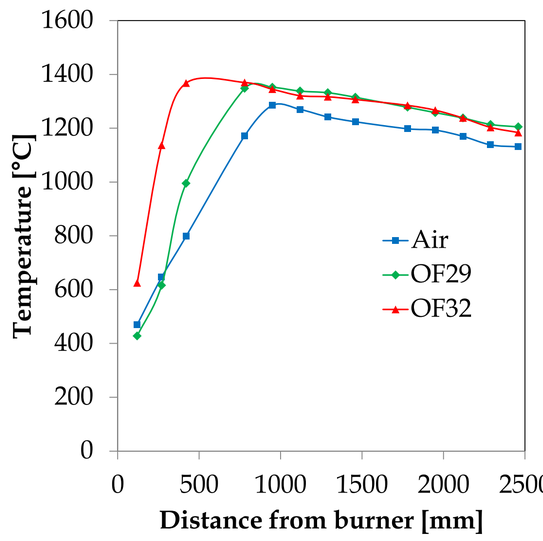
Demonstration tests:

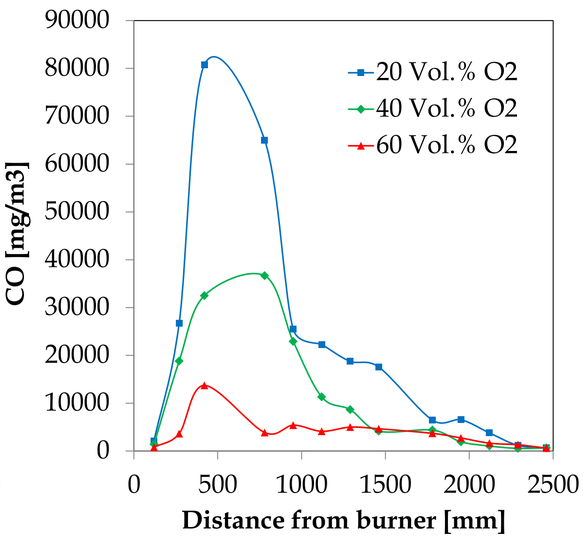
- Demonstration tests carried out in a modified 500 kW top-fired furnace at University of Stuttgart.
- Fuels used: pre-dried lignite and petcoke.
- Parameters varied: oxygen enrichment in total gas for combustion (27-32 vol.%), oxygen enrichment in primary gas (20-60 vol.%), and swirl angle (0°-40°).
- Comparative analysis of diverse oxyfuel settings vs. conventional air combustion in terms of: heat fluxes to the wall, gas temperature, species concentrations (O_2, CO_2, CO, NO_x and SO_2), and fuel burnout.



Burner tip of downscaled burner (design based on ThyssenKrupp´s POLFLAME® burner).







CFD Simulation analysis:

- Following the validation of CFD models using results from the demonstrations tests several CFD simulations have been performed for an upscaled oxyfuel burner.
- A set of input parameters (inlet flow rates, temperatures, compositions, swirl angle) for oxyfuel generates a flame in the kiln delivering a heat radiation profile to the material similar to that in the reference air case.