Karlsruher Institut für Technologie

Institut für Technische Chemie

Oxyfuel Combustion of Waste Streams with Oxygen from Electrolysis and Analysis of Utilization Paths of Captured CO_2 with H_2 (WOxyfuel)

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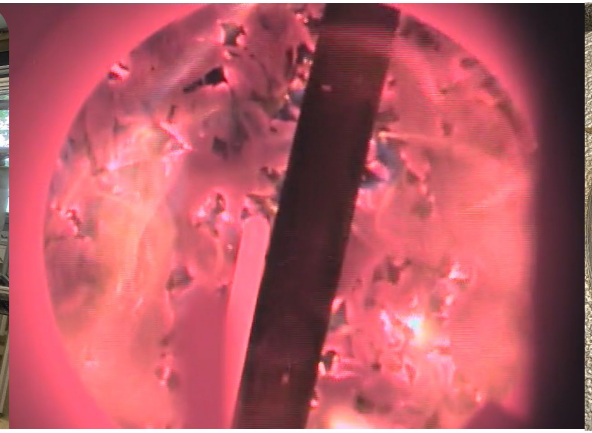
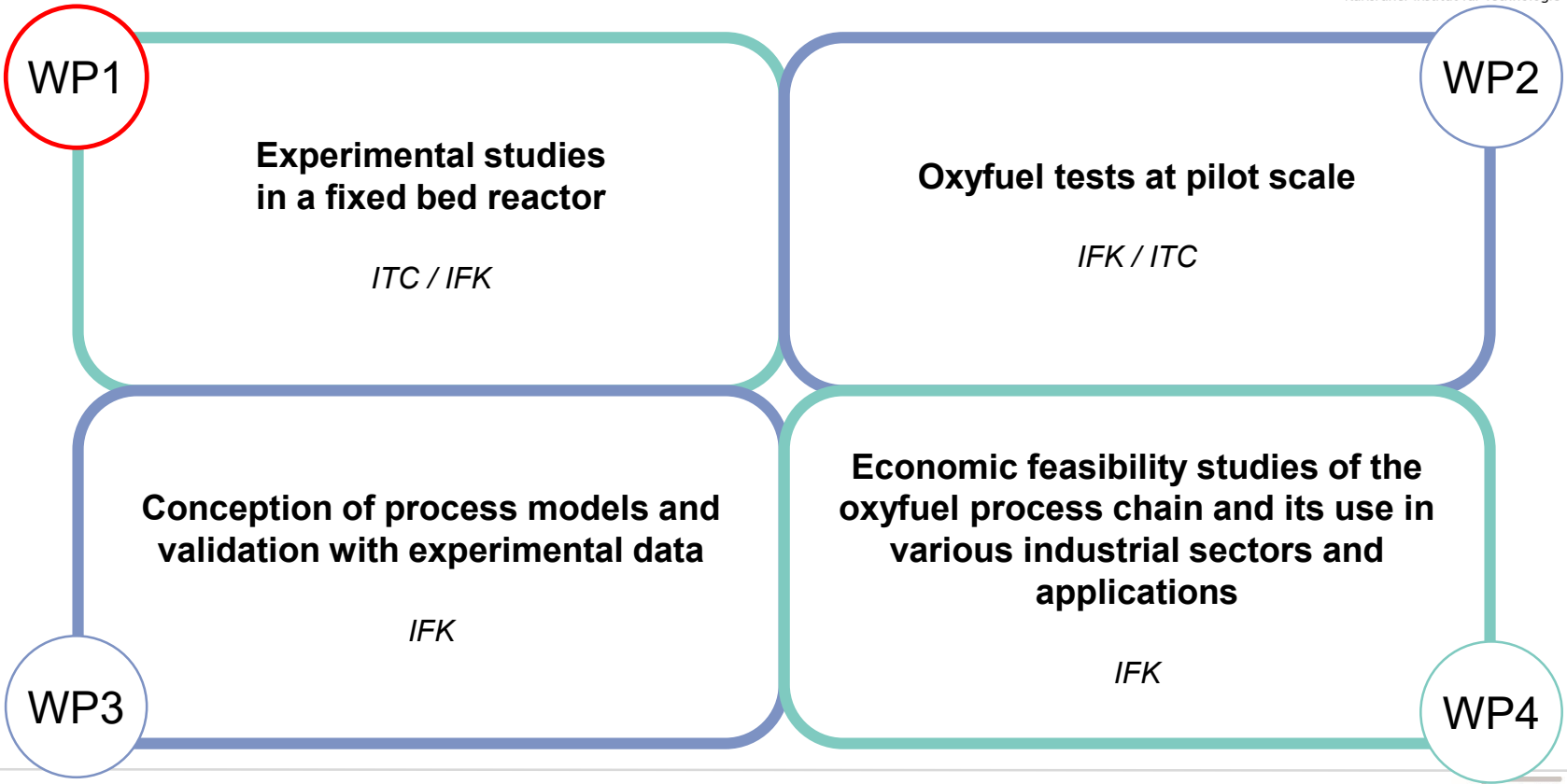
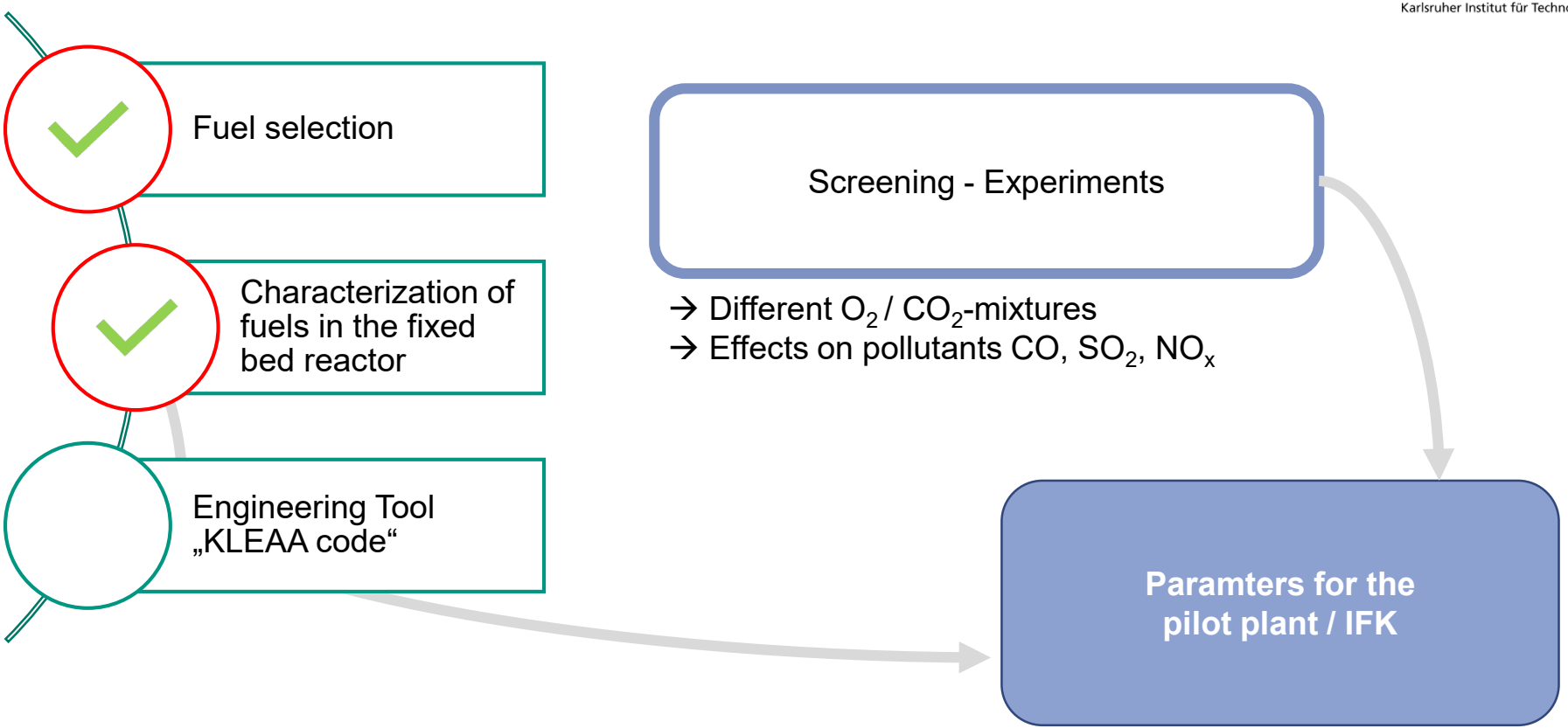


Working Packages



WP 1: Experimental studies

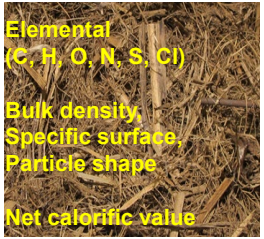


Tools for the Characterization of the Combustion Behaviour for Grate Firings

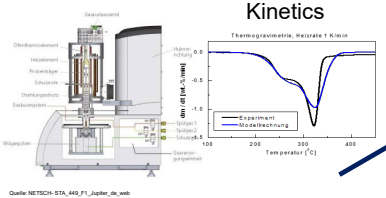
SBS1®	unit	value
Water	wt.-%	14,9
Ash		15,5
Volatiles		62,2
C_{fix}		7,4
C		44,9
H		5,8
O (by diff.)		16,9
N		1,7
S		0,3
LCV	[MJ/kg]	18,0
ρ_{bulk}	[kg/m³]	140
mass	[kg]	1,4

Analytics

Chemical, physical, calorific analysis

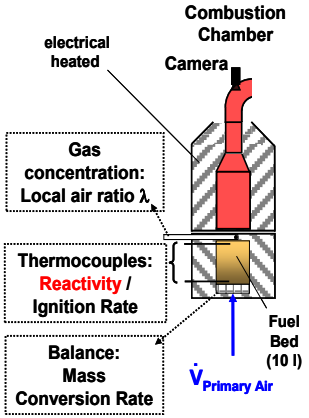


Thermogravimetry with FTIR-coupling

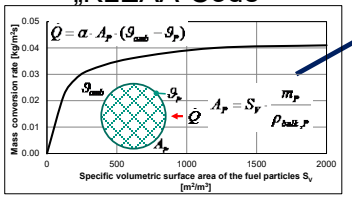


Standard method

Fixed Bed Reactor KLEAA & Modelling

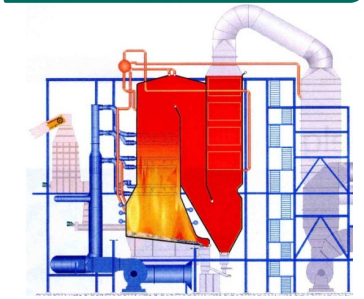


„KLEAA-Code“

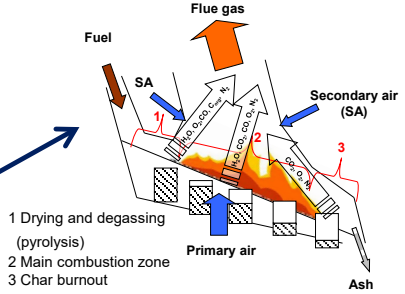


Advanced methods

Grate Incinerator

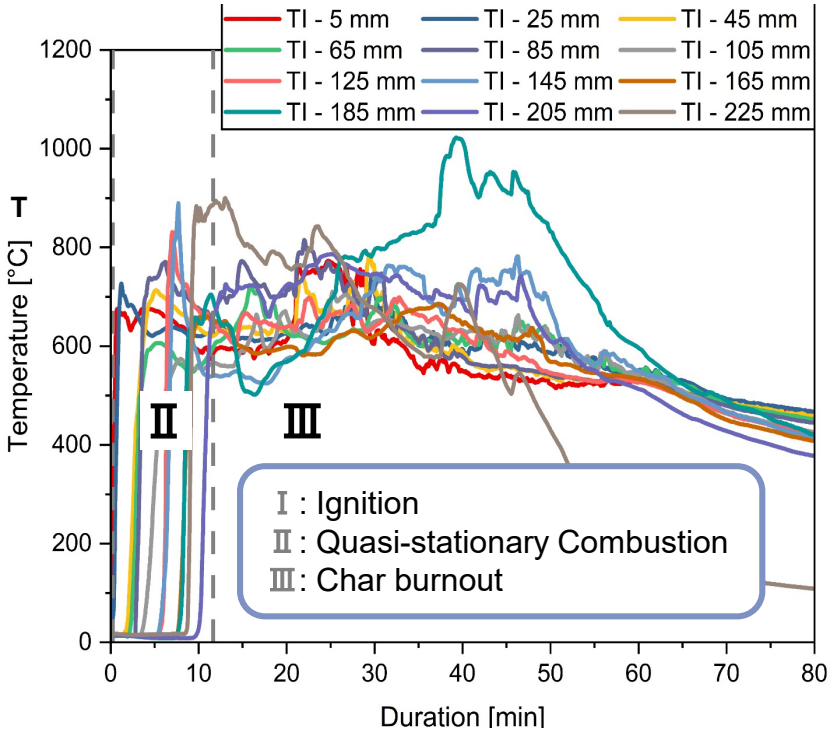


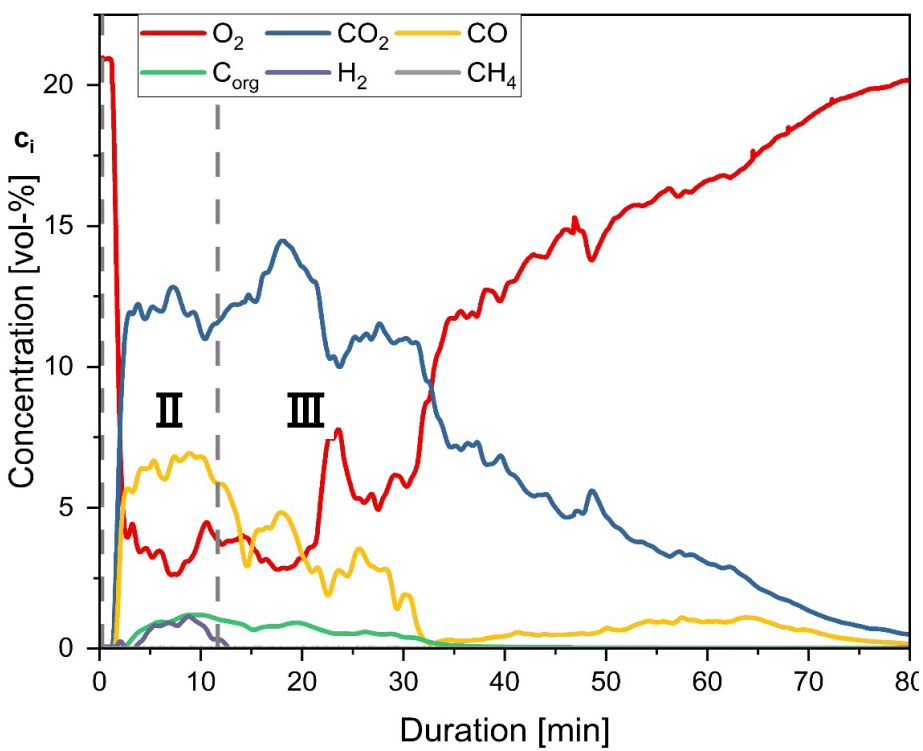
Biowanze, Babcock & Wilcox



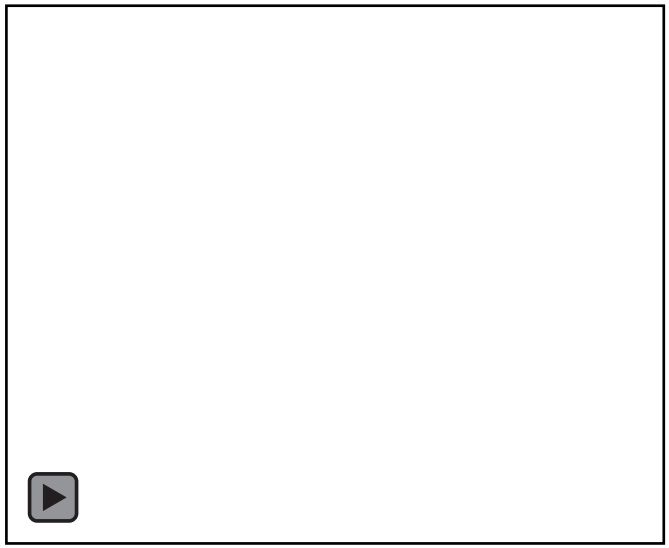
Scale up, emission, slagging, validation

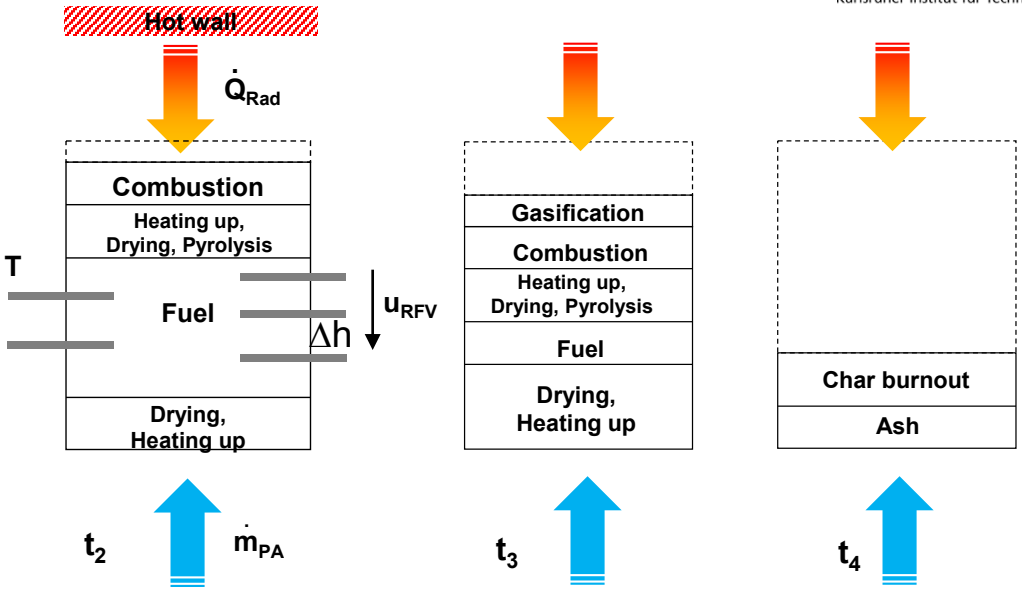
Characterization of the combustion behavior - Air





Process steps at Combustion - Video



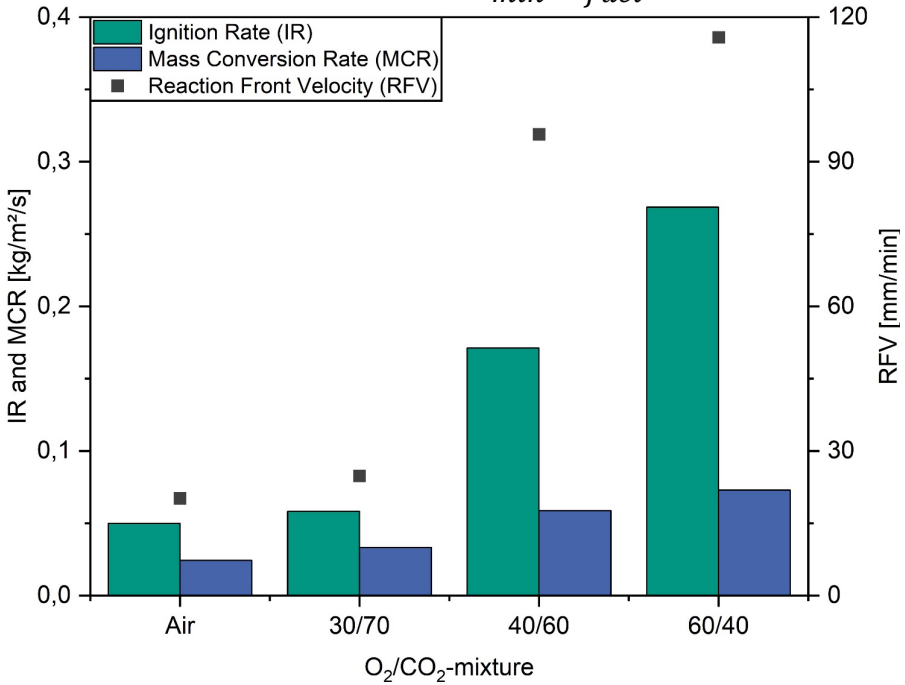


II: $u_{RFV} = \frac{\Delta h}{\Delta t} \left[\frac{mm}{min}\right]$ $\quad IR = u_{RFV} * \rho_{bulk} \left[\frac{kg}{s*m^2}\right]$ $\quad MCR = \frac{\dot{m}_{fuel}}{A_{grate} * (1 - \xi_{Ash,fuel})} \left[\frac{kg}{s * m^2}\right]$ $\quad TL = MCR * LCV \left[\frac{MW}{m^2}\right]$

Rad → **Rad**iation; PA → **P**rimary **A**ir; RFV → **R**eaction **f**ront **v**elocity; IR: **I**gnition **R**ate; MCR: **M**ass **C**onversion **R**ate; TL: **T**hermal **L**oad

Results

$$Ox.-fuel\ ratio = \frac{\dot{m}_{oxygen,in} \cdot t}{o_{min} \cdot m_{fuel}}\ [-]$$



	Unit	Air	30/70	40/60	60/40
Ox.-fuel ratio$_{total}$	*[-]*	2,4	1,7	1,8	2,4
Ox.-fuel ratio$_{primary}$		1,0	0,8	0,6	1,1
Duration phase II	*[min]*	11,4	8,44	1,88	1,41
T_{max}	*[°C]*	950 to 1000			1100
NO_X	*[mg/ MJ]*	206	162	162	101
SO_2		35	38	54	55
CO		0,9	6	30	58
Specific thermal load	*[MW/ m²]*	0,43	0,58	1,06	1,31

Summary

- Combustion Behaviour:
  - From **Air** to Oxyfuel: **We recommend** (O_2/CO_2) **30/70** up to **40/60**
    avoid: sudden ignition and combustion at high temperatures
    → slagging, high temperature corrosion
    → thermal load may damage grate (> 1 MW/m^2)
- Pollutants:
  - NO_x is reduced by 50 %, less reduction measures required
  - CO ↑ → further optimization, validation in pilot plant
  - SO_2 ↑ → further optimization, validation in pilot plant
    (temperature distribution along the grate)

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