TECHNISCHE UNIVERSITÄT WIEN

VIENNA UNIVERSITY OF TECHNOLOGY

Institute for Chemical Engineering,
Fuel and Environmental Technology

Particularities of the combustion chamber in a dual fluidized bed biomass gasifier

IEA-FBC Workshop
Combustion and gasification in FBC

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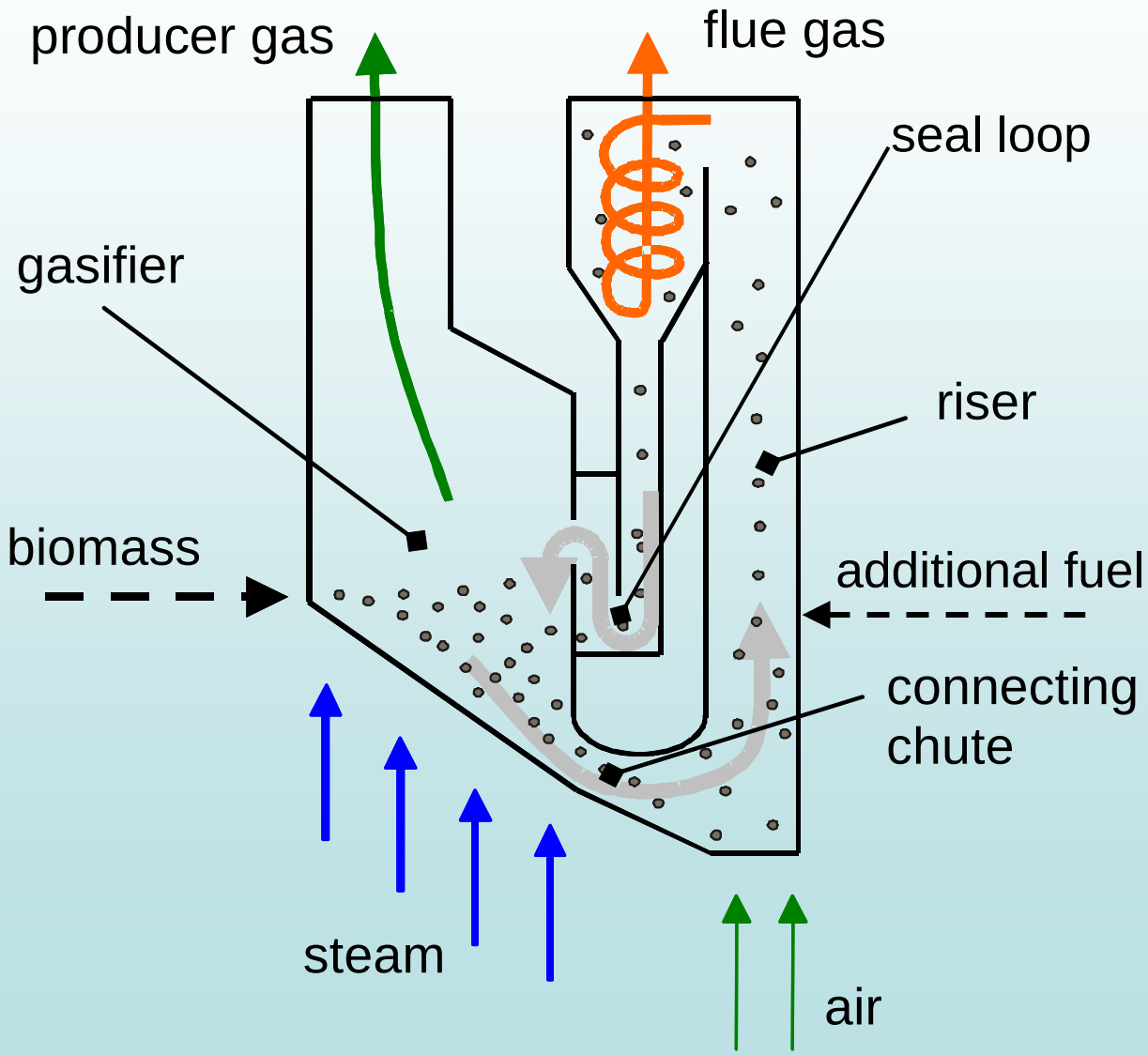
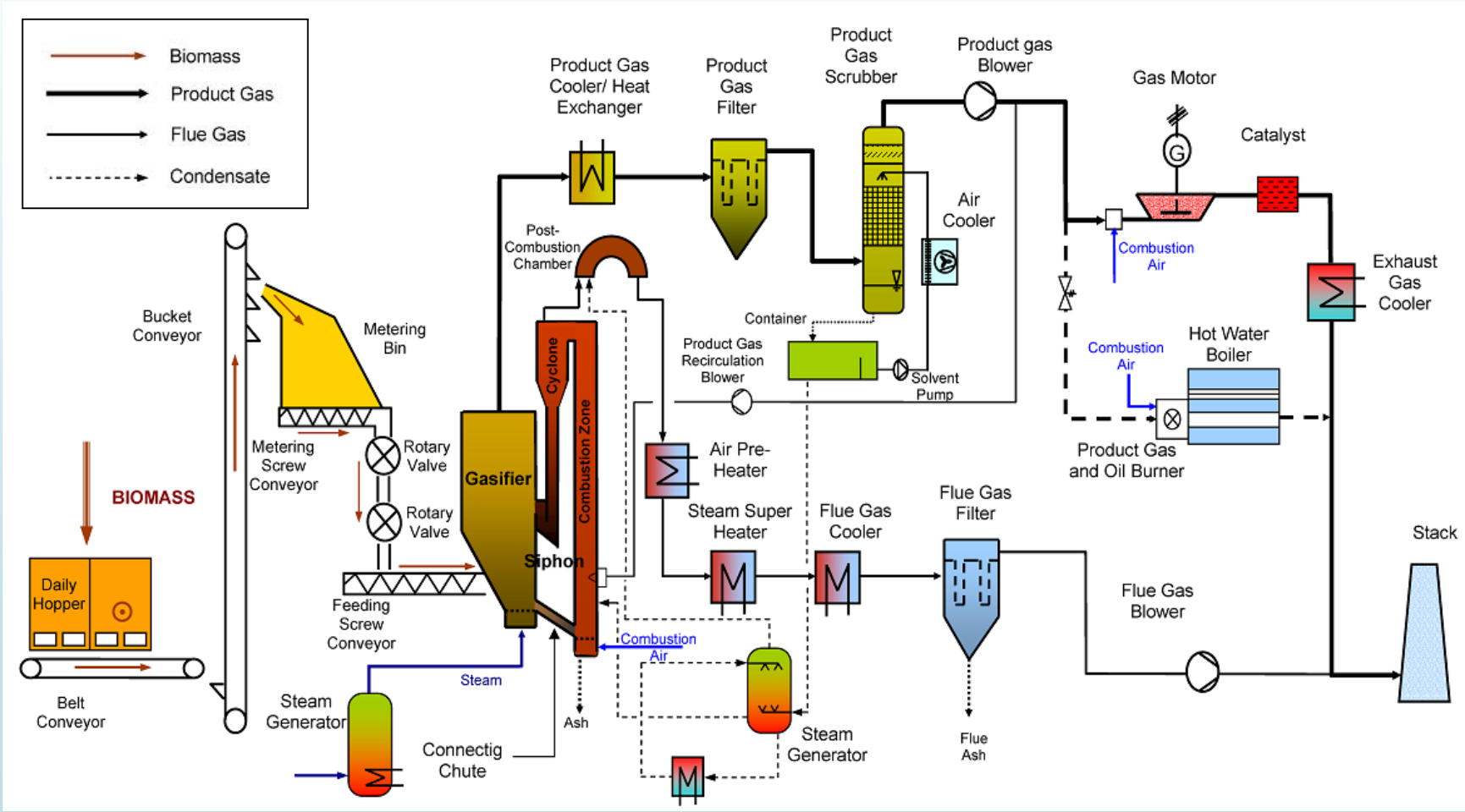
Outline

- The dual fluidized bed gasification process
- The 8 MW CHP plant in Güssing
- Combustion chamber and flue gas line
- Air preheater design
- Conclusions

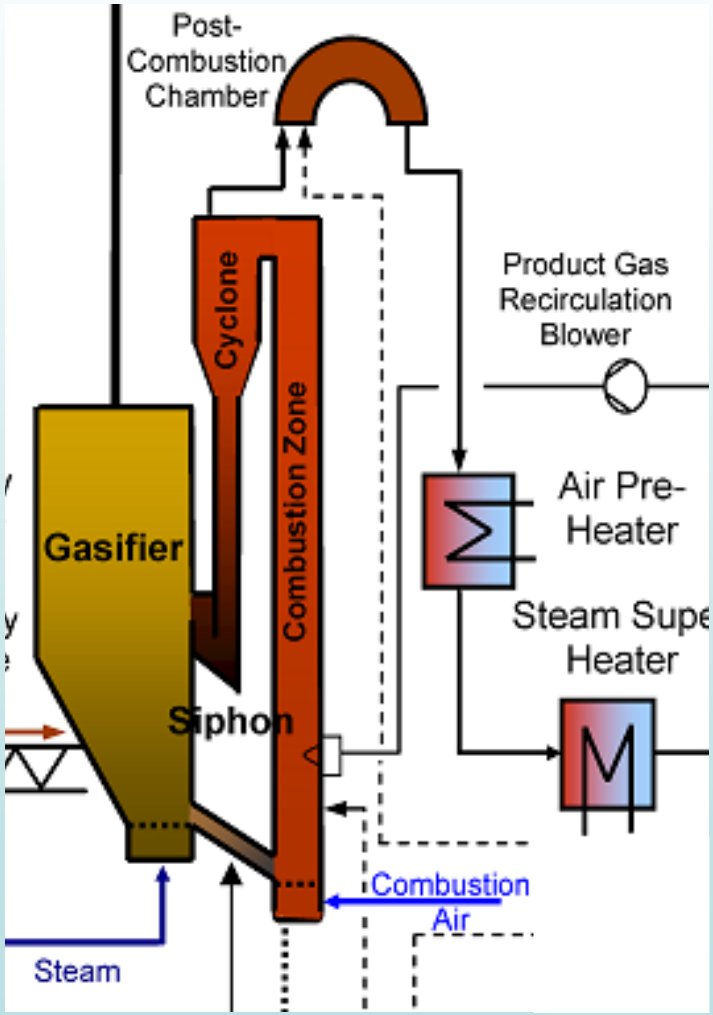
Dual fluidized bed gasification



The dual fluidized bed steam gasification CHP plant in Güssing/Austria



Combustion chamber and flue gas line



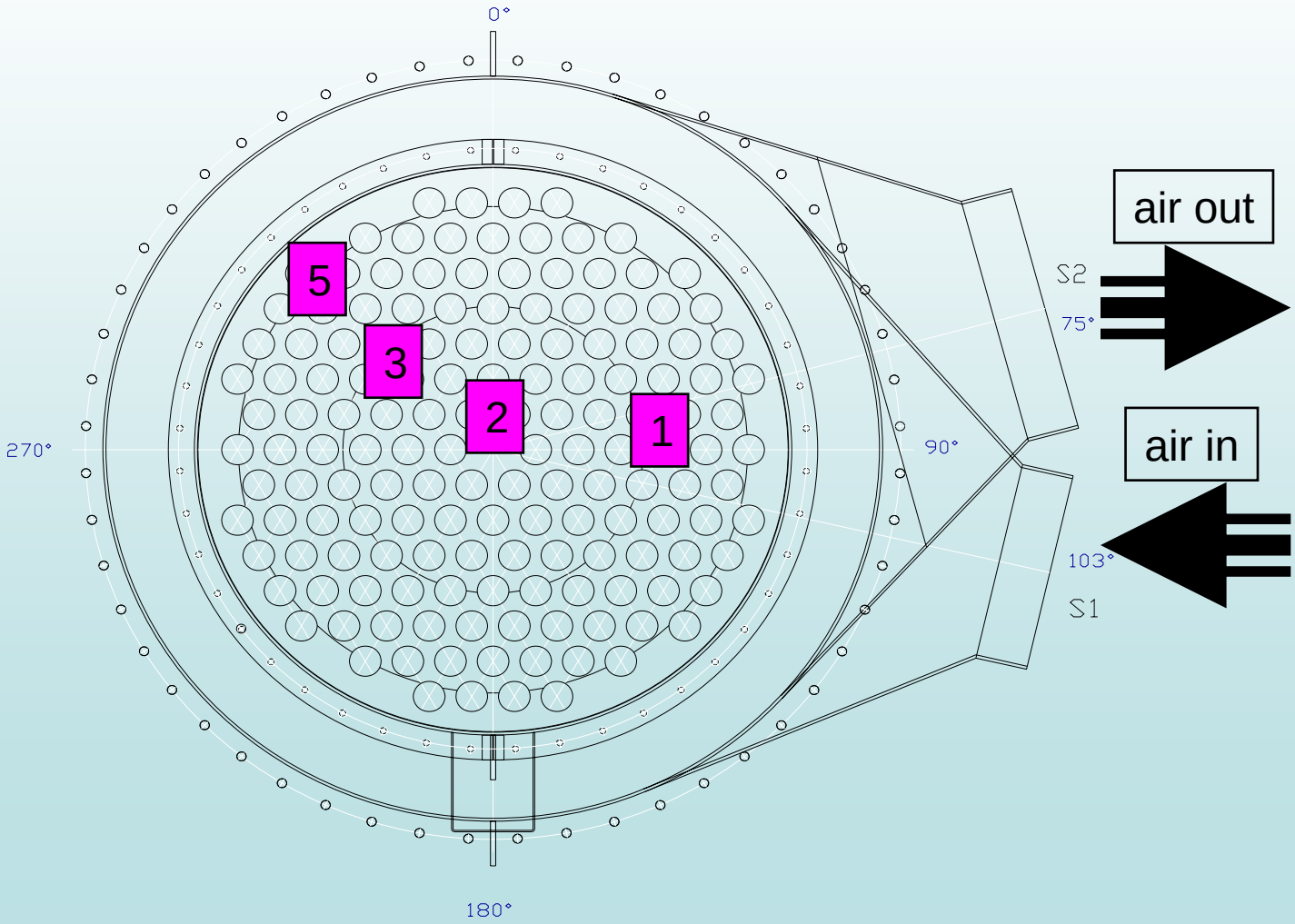
- riser height 9 m, 0.5 m^2 riser section
- co-combustion of
  - biomass char
  - spent tar solvent/water
  - producer gas (recycled)
- riser fuel power 2…4 MW
- ***recent observations:***
- significant part of the combustion shifted to post combustion chamber
- depositions on the air preheater surfaces

Operating conditions of the air preheater

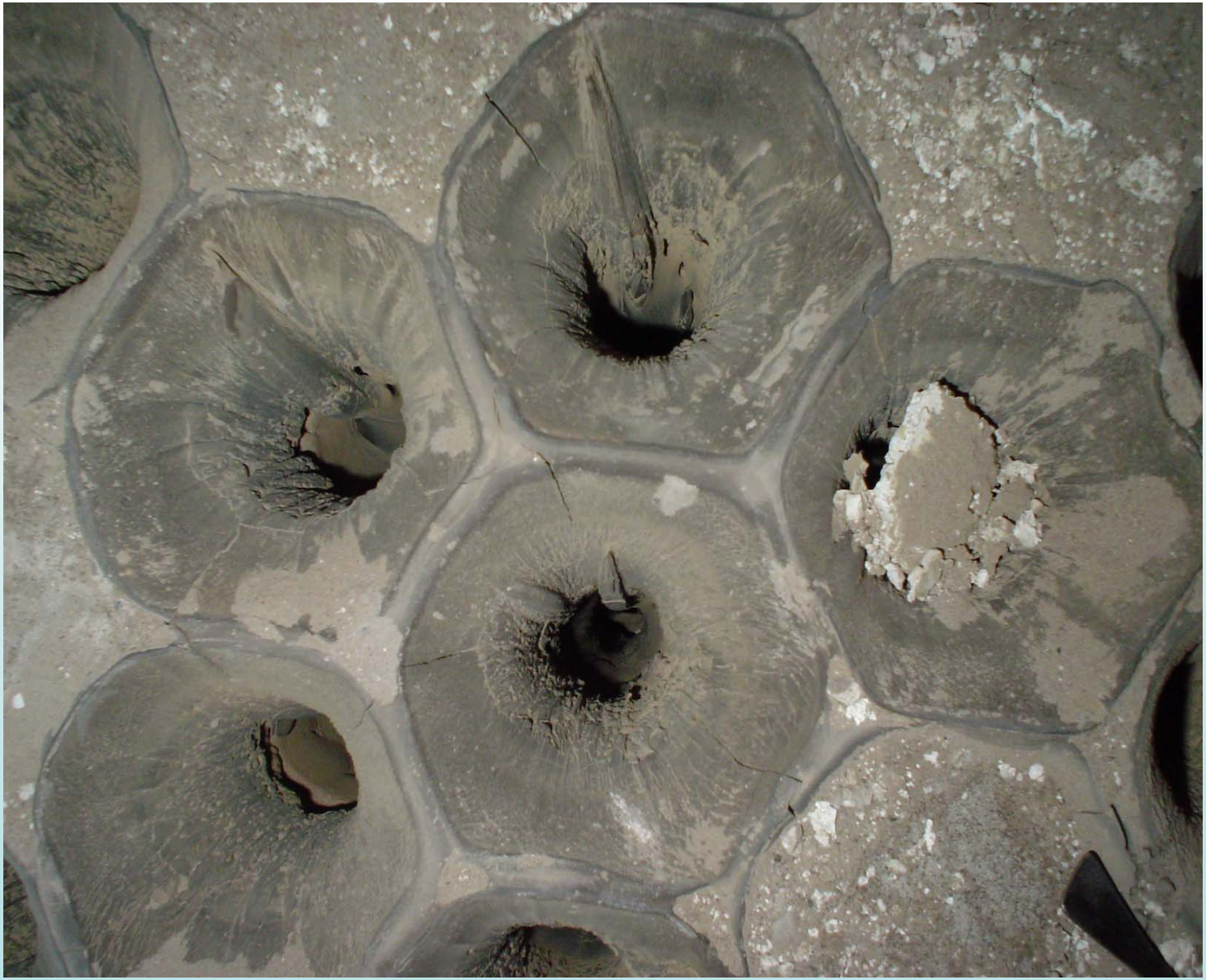
Co-Current Flue gas in tubes design:

air inlet temperature:	ca. 60°C
air outlet temperature:	ca. 400°C
flue gas inlet temperature:	800-900°C
air flow rate:	4000-5000 Nm^3/h
flue gas flow rate:	ca. 7000Nm^3/h
dust content:	30-50g/Nm^3

Heat exchanger design



Depositions



Melting behaviour of deposits


600°C


700°C


800°C


900°C


1000°C

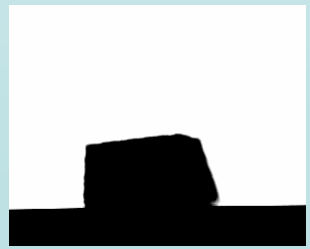

1100°C

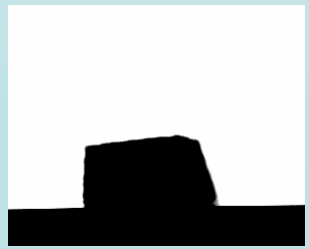

1200°C


1300°C


1330°C


1350°C


1380°C


1400°C

Elementar comp. deposits

	Pr1-04	Pr1-05	Pr1-06
Element	**At%**	**At%**	**At%**
C	5,24	7,34	15,61
O	41,43	32,67	33,71
Na	2,61	n.d.	n.d.
Mg	4,16	22,84	14,12
Al	9,25	1,44	1,25
Si	25,88	7,22	4,19
P	n.d.	0,64	0,83
K	4,48	5,02	11,69
Ca	6,48	20,15	17,42
Mn	0,13	0,58	0,37
Fe	0,35	2,1	0,78
Total	**100**	**100**	**100**

Cristallographic Anal.

	mol%	Limestone	Ash	Smpl. 1	Smpl. 5
Quartz	SiO_2	0,5	0,4	4,8	
Calcite	$CaCO_3$	21,5	23,6		9,9
Dolomite	$CaMg(CO_3)_2$	78,0			
CaO	CaO		18,4		2,5
Periclase	MgO		18,5	57,8	23,9
Portlandite	$Ca(OH)_2$		3,8		
Forsterite	Mg2SiO4		19,8		
Ca-Silikat	Ca6Si3O12		15,5		
Antigorite-M	Mg26Si14O80			2,4	
Tilleyite	Ca5Si2C2O13			17,9	
Fairchildite	K2CaC2O18			17,1	4,2
Monticellite	MgCaSiO4				8,9
Monticellite	MgCaSiO4				3,7
Spurrite	Ca5Si2C1O11				47,0

Interpretation

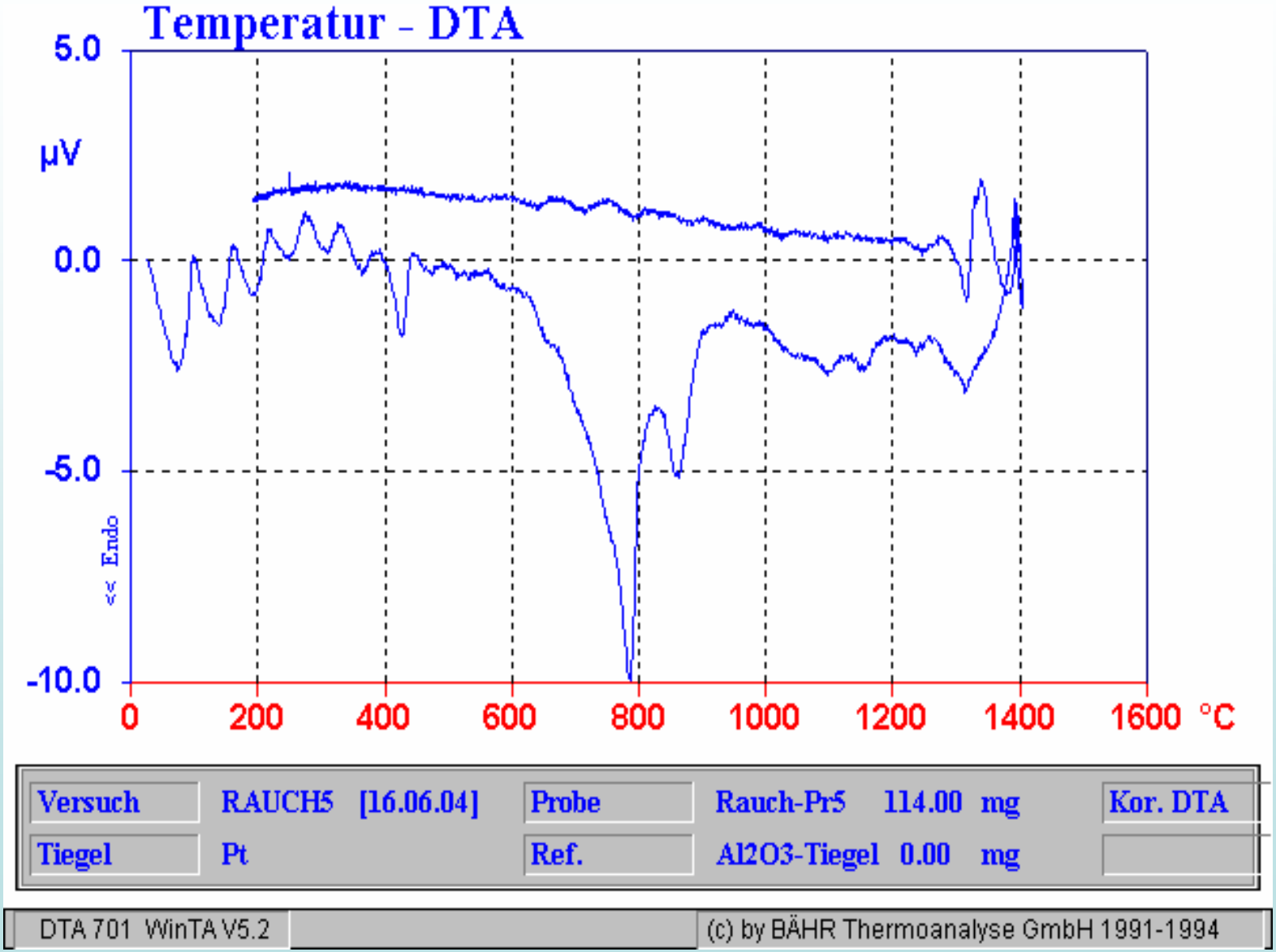
The depositions contain mainly the elements:

- Oxygen
- Calcium
- Carbon
- Magnesium
- Potassium
- Silicium

Traces of the following elements are found:

- Aluminium
- Phosphor
- Sulphur
- Manganese
- Iron

DTA-Measurement



Conclusions

- Likely, the air preheater depositions are because of a chemical reaction rather than because of ash melting
- DTA measurements show an irreversible decomposition of the depositions at 700-900°C (air atmosphere).
- The carbonatisation reaction can be expected to happen at temperatures about 200-300°C lower than the decomposition temperature.
- Carbonatisation of CaO with flue-gas CO2 likely to be the mechanism for deposits
- Next step: avoiding Ca in the process (Mg and Al as substitutes)

Contact and Acknowledgement

www.renet.at

www.ficfb.at

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