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HTW™ Gasification of High Volatile Bituminous Coal

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Structure of Presentation

- Introduction of the HTW™ Process
- Brief description of the test setup
- Feedstock
- Test results
  - Continuous operation
  - Compact results
- Optimization
- Summary and Outlook

Introduction of the HTW™ Process

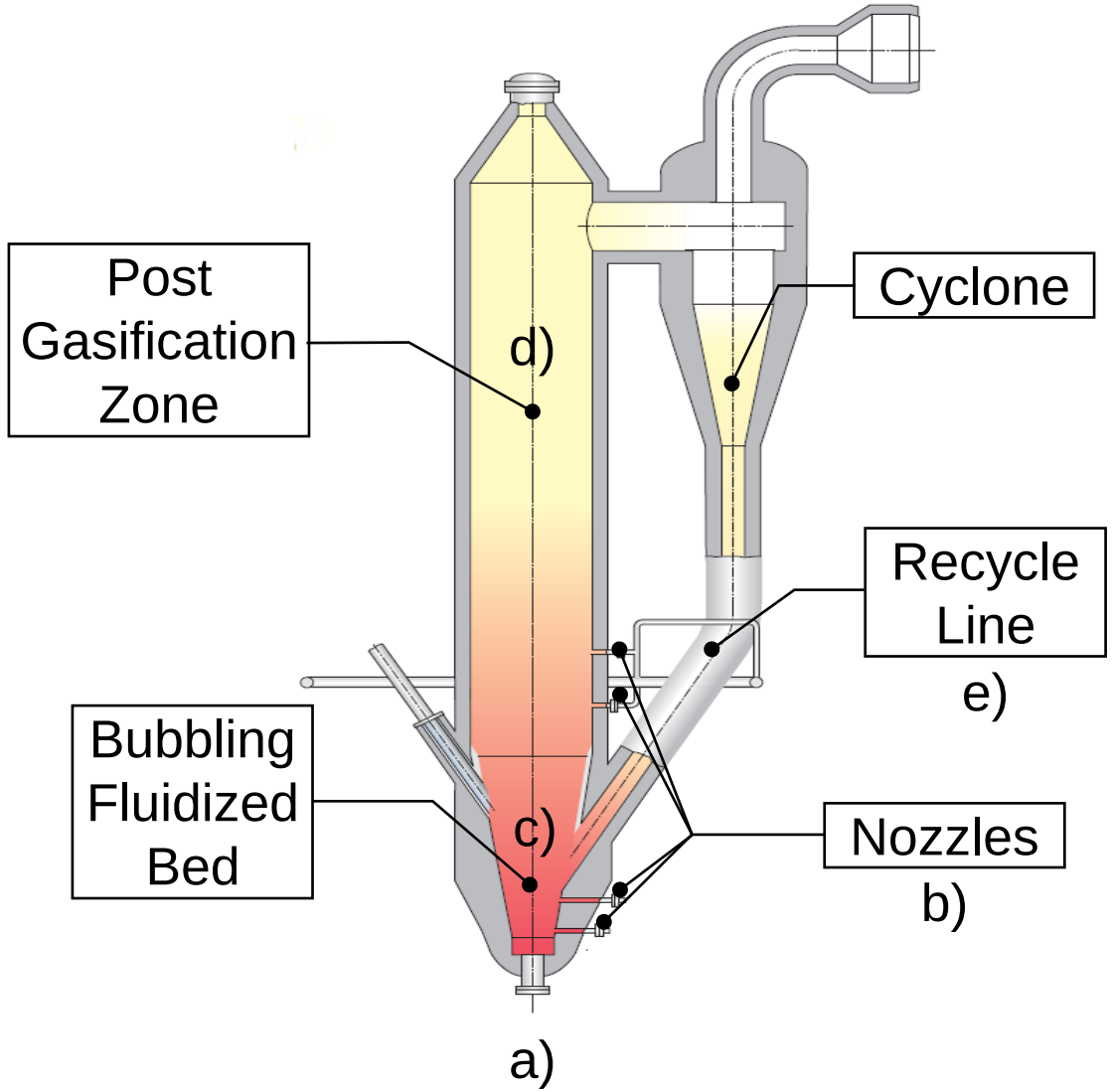
a) Continuous extraction of bed material

b) Injection of gasification agents (O_2, Steam, CO_2)

c) T below ash softening point (850 – 950 °C)

d) High T → conversion of heavy hydrocarbons up to 1,200 °C

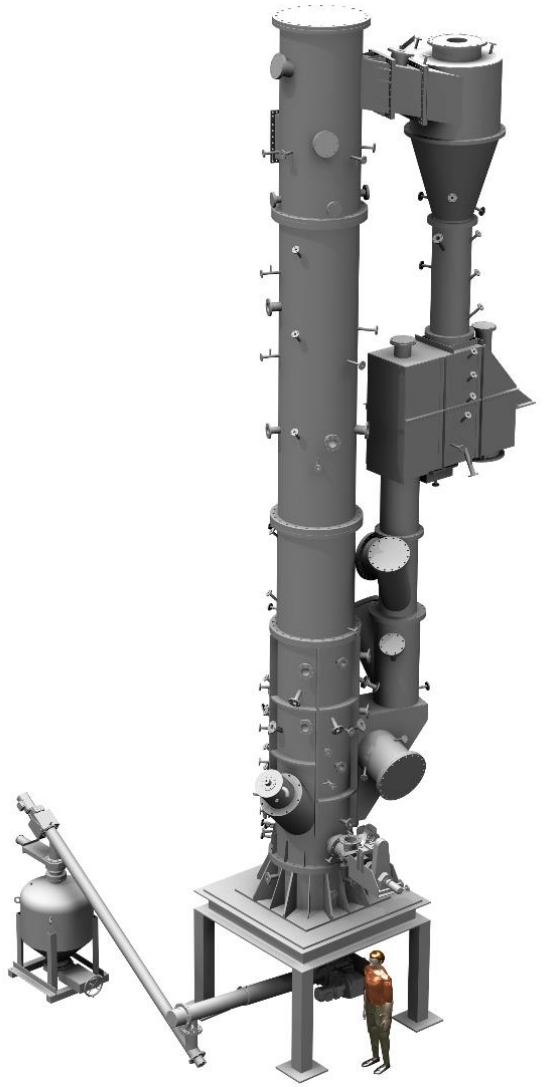
e) Recirculation of particles separated in cyclone to the fluidized bed



Source: thyssenkrupp Industrial Solutions AG

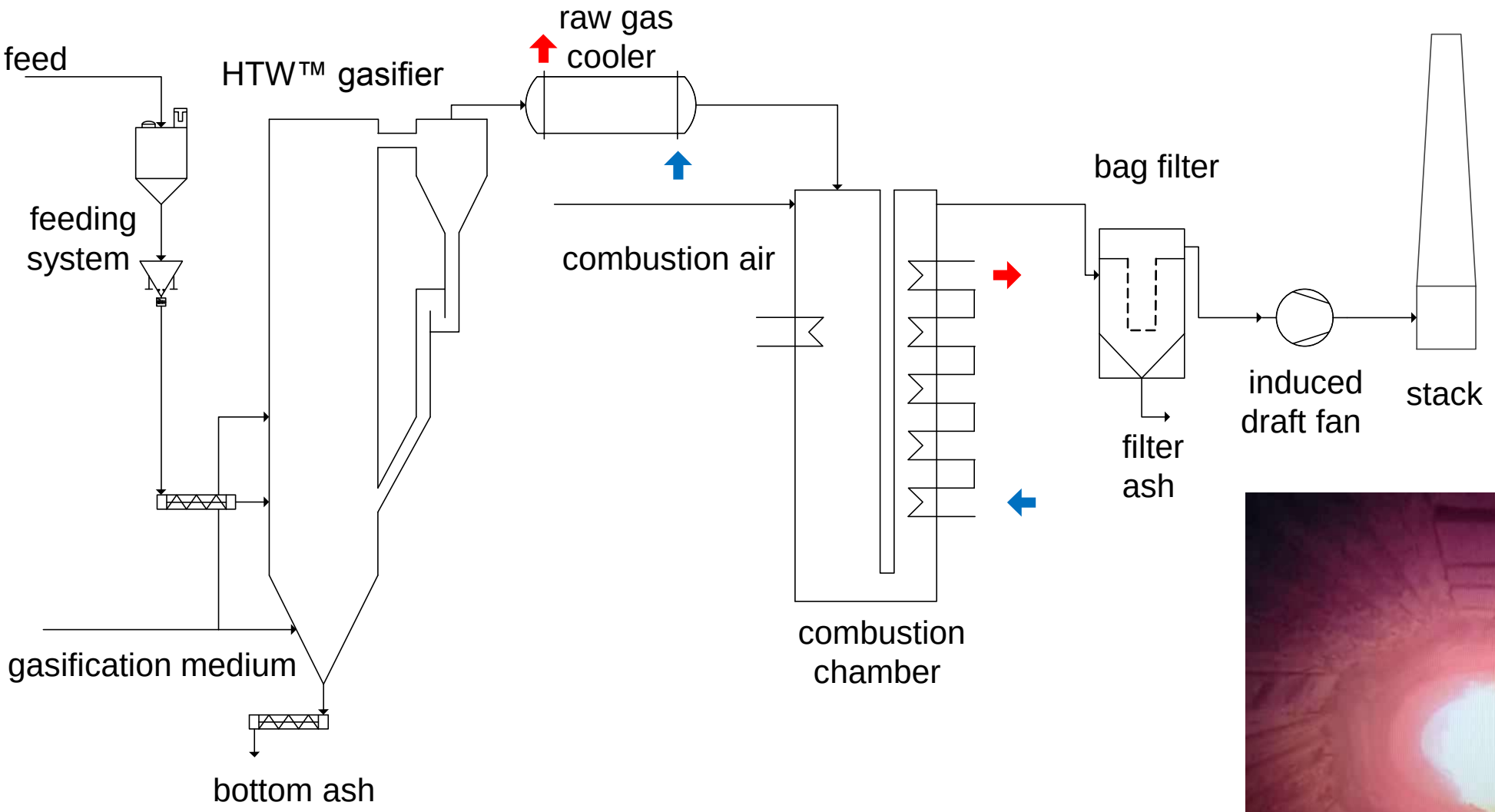
Pilot Plant

- 2015 retrofitting of a fluidized bed reactor into a HTW™ gasifier
- Investigation of
  - Feedstock suitability
  - Equipment for large-scale plant usage
- Gasifier
  - Inner diameter of 400 mm
  - Height of 11 m
  - Temperatures up to 1,200 °C
  - Operating at atmospheric pressure level



Source: EST TU Darmstadt

Pilot Plant

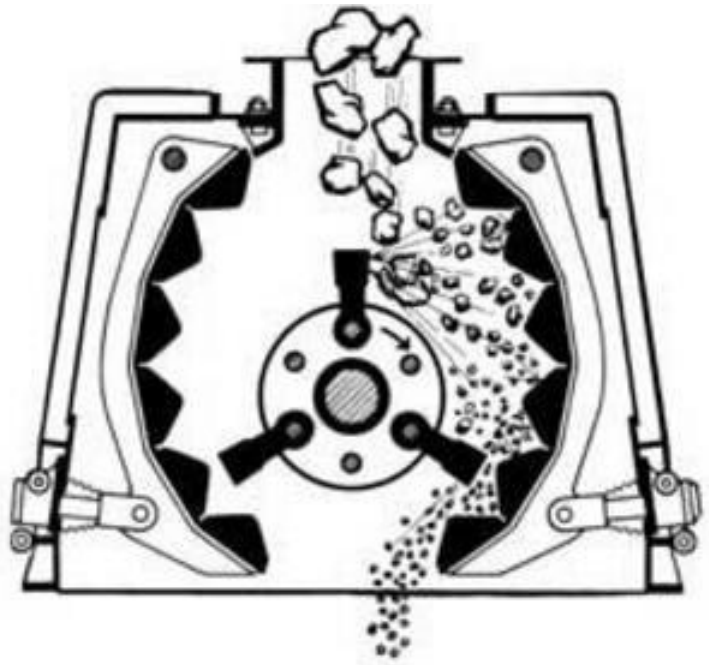


Source: EST TU Darmstadt

Feedstock

- High Volatile Bituminous Coal (HVBC) prepared by grinding
- Continious operation for 5 days (7.4 tons)

		HVBC
Lower Heating Value	MJ/kg	29.1
Ash Softening Point	°C	1,100
Water Content	wt.-%	5.7
Ash Content	wt.-%	7.0
C-fix	wt.-%	52.6
Volatile Content	wt.-%	34.7
D50	µm	402



Source: Wuhan Erun technology co.,ltd

Operation with high volatile bituminous coal

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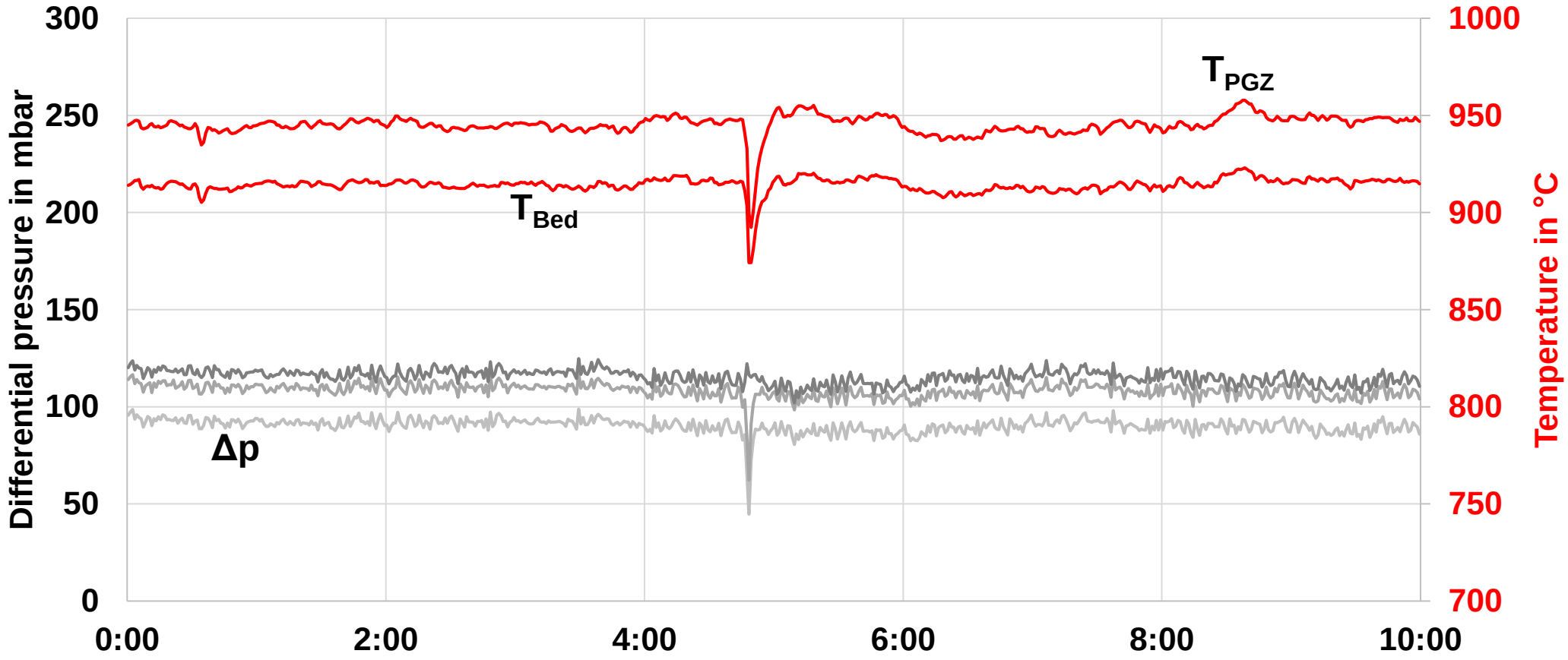
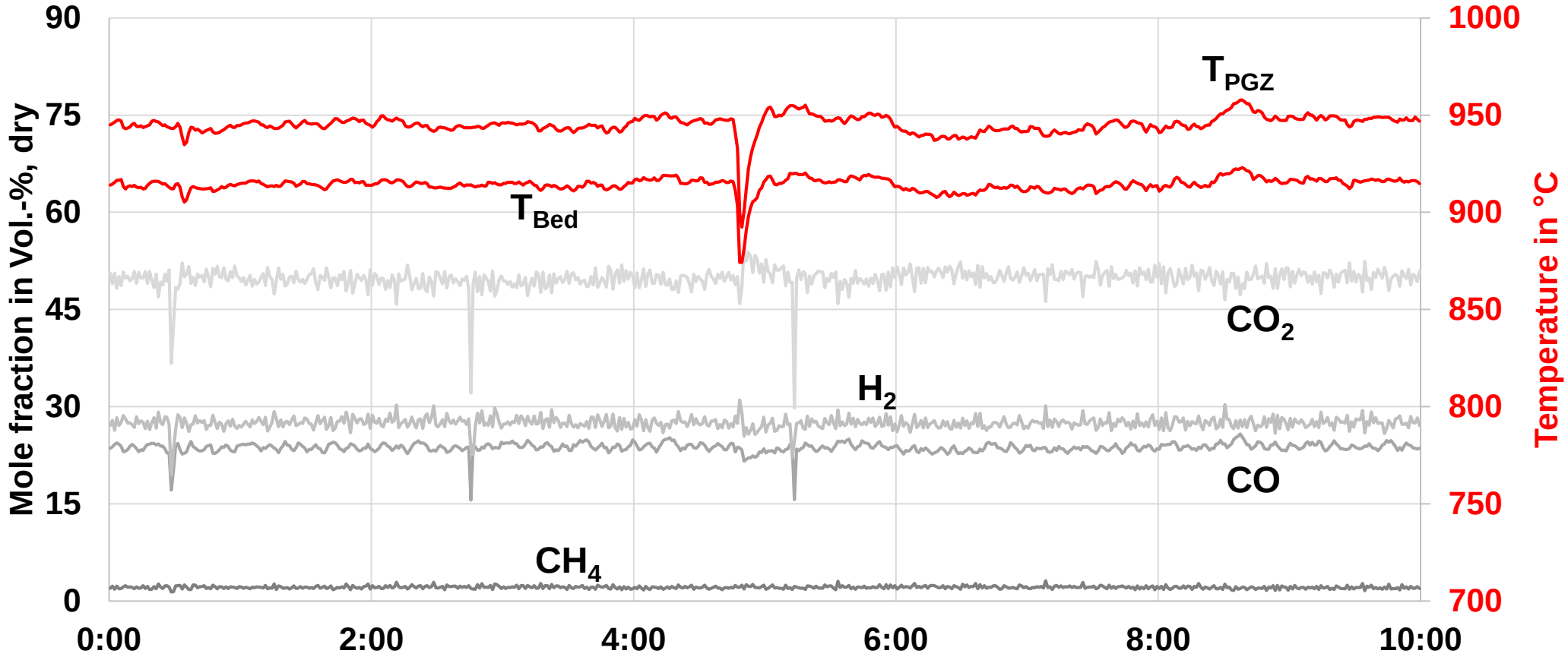
- Continuous operation



- $T_{Bed} \approx 915$ °C
- $\Delta p_{total} \approx 110$ mbar – 120 mbar
- $T_{PGZ} \approx 945$ °C

Operation with high volatile bituminous coal

- Continuous operation



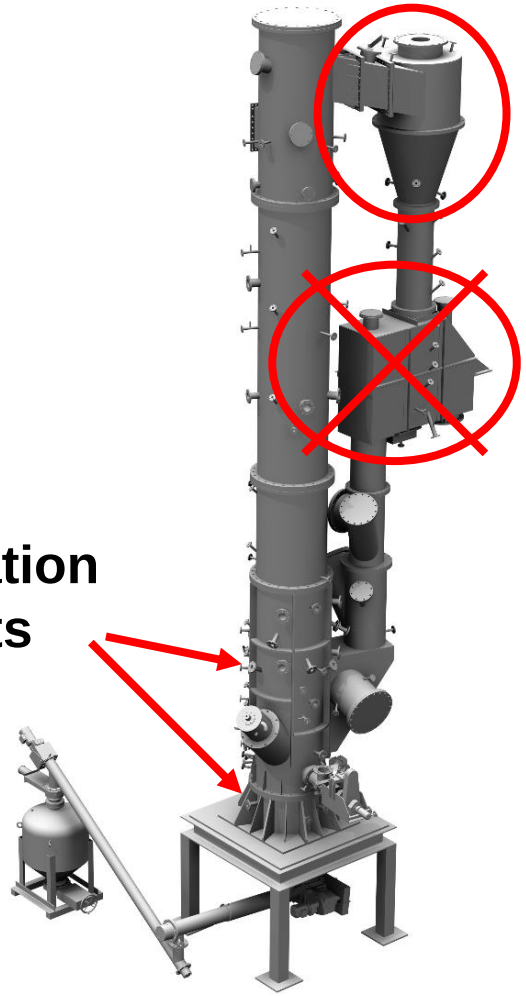
Summary of results

- Comparison of test results with High Volatile Bituminous Coal and Lignite Energy Grained

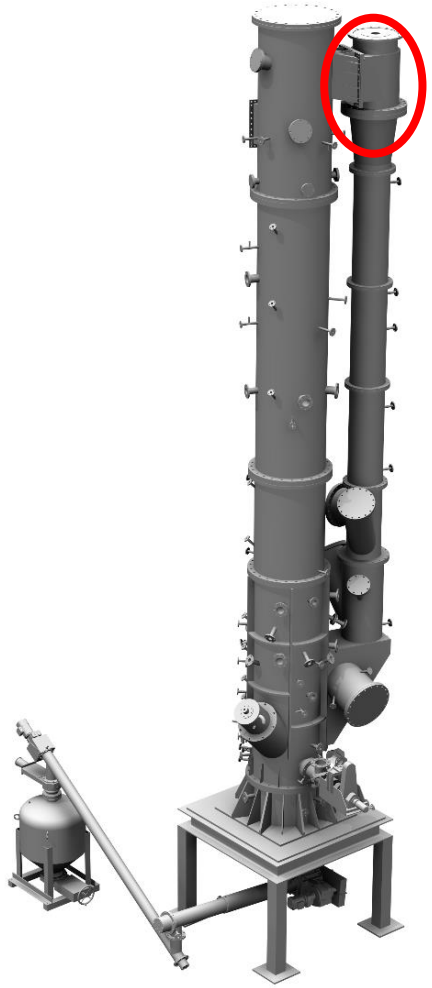
		HVBC		LEG
Coal mass flow	kg/h	61.0		70
Gasifier performance	kW_{th}	493		418
Raw gas quantity	kg/h	221.4		225
Gas composition (dry)				
CO_2	Vol.-%	48.7		30
CO	Vol.-%	23.1		31
CH_4	Vol.-%	1.9		1
H_2	Vol.-%	26.3		30
Lower heating value raw gas (dry)	MJ/m^3	6.4		7.5
Carbon conversion rate	%	75.7		96

Optimization

Original



Optimization

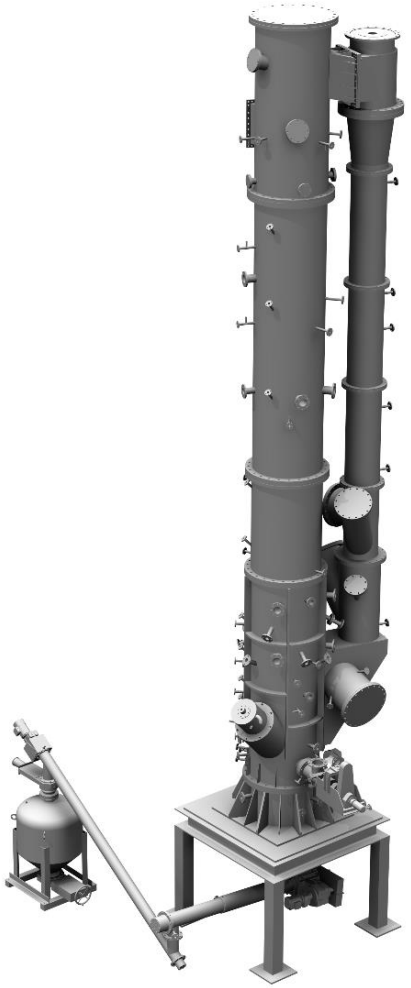


Source: EST TU Darmstadt

Optimization

- Impact of the optimization

		Campaign		Optimization
Gas composition (dry)				
CO_2	Vol.-%	48.7	↘	**36.4**
CO	Vol.-%	23.1	↗	**28.8**
CH_4	Vol.-%	1.9	↗	**2.1**
H_2	Vol.-%	26.3	↗	**32.7**
Lower heating value raw gas (dry)	MJ/m³	6.4	↗	**7.9**
Carbon conversion rate	%	75.7	↗	**94**



Summary and Outlook

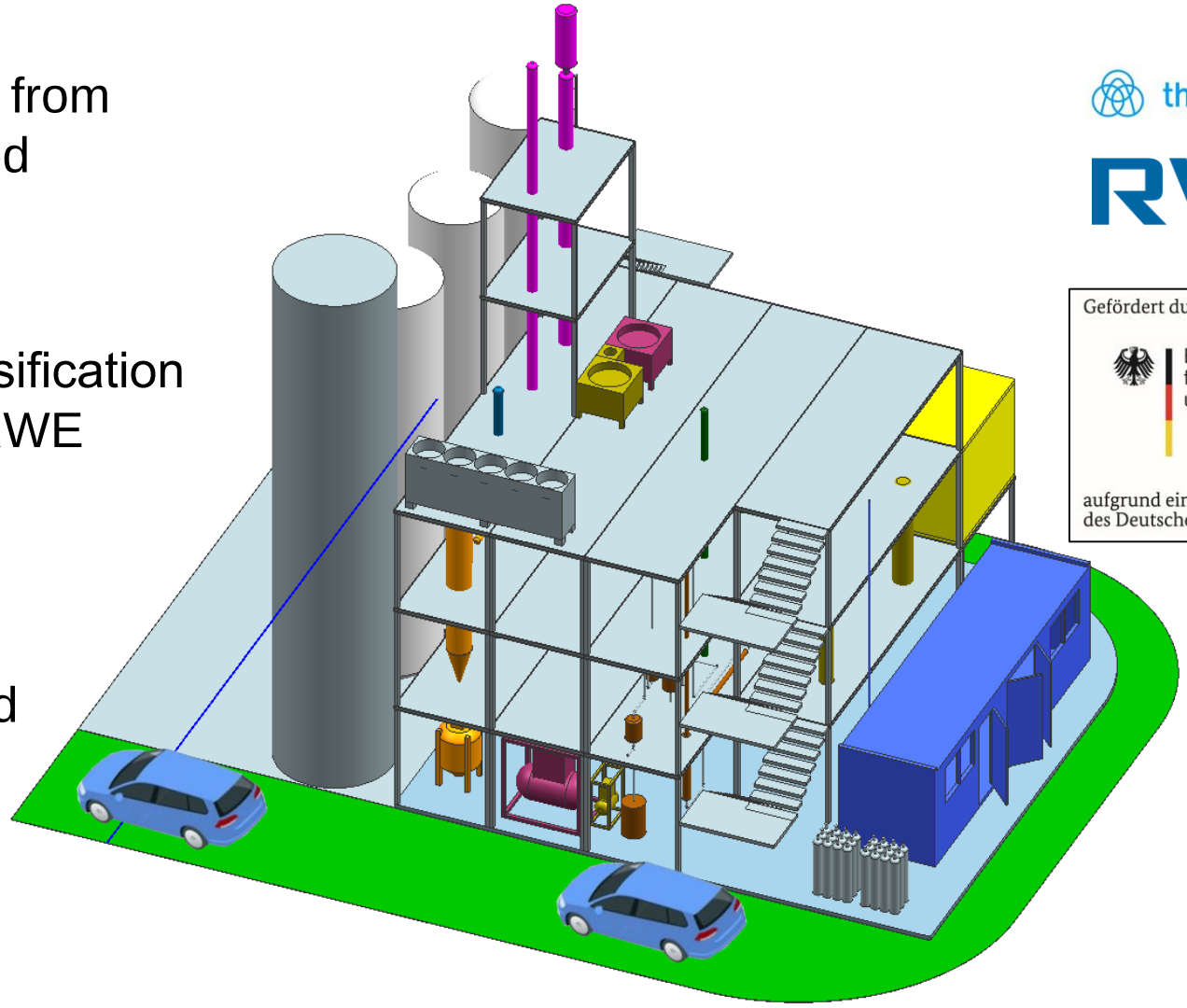
- Gasification test
  - Continuous operation for 5 days with high volatile bituminous coal (gasification of 7.4 tons)
  - Stable process, resilient to disruptions
- Optimization for the pilot plant operation include:
  - New design of cyclone
  - Removal of loop seal
  - Increasing preheating temperature of the gasification agents
- Prove that the HTW™ gasification is applicable to the High Volatile Bituminous Coal

Summary and Outlook

FABIENE:
Flexible Supply of Electricity and Fuels from Gasification of Lignite in a Fluidized Bed

- Erection of a gas purification unit
- Coupling with the existing HTW™ gasification pilot plant and a catalysis test rig of RWE
- 4 two-week test campaigns

- Techno-Economic assessment of polygeneration based on fluidized bed gasification
- Christian Heinze, TU Darmstadt
- 11:50 – 12:10
- Room: Pavillon



thyssenkrupp
RWE

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Thank you for your kind attention!