Strategic Programms in 6 Research Fields

Energy

Earth and Environment

Health

Aeronautics, Space and Transport

Key Technologies

Structure of Matter

18 scientific-technical and biological-medical research centres
High Pressure Entrained Flow Gasification

→ Fuel/ Load / Product – Flexibility

- Coal
- Residues
- Biomass
- Waste

heterogeneous
high ash content
flexibility

Fuel

Oxygen

Cooling screen

Slag

Syngas

Flexibility
Load / Product
Efficiency

- Fuels, BtL
- Chemicals
- Hydrogen, H₂
- Electricity / Heat, IGCC
EFG for biomass based slurry at high pressure

- Slurry: atomization, gasification
- Slag: controlling, recycle
- Process: control, efficiency

Overall process simulation / control

Fuel / Slurry

Oxygen

Cooling screen

Quench water

Raw syngas

Quench water

Slag
Objective

Knowledge based simulation tool for design and scale-up of technical EFG for a wide range of feedstock.
Scientific Approach and Work Packages

WP1 Data Evaluation
- Particle kinetics
- Slag
- Heat transfer

WP2 Simulation
- LES / RANS
- EF-Gasifier

WP3 Validation
- Gasification, atmo.
- Gasification, pressure
- Diagnostics

Model of reacting multi-phase flow at high pressure

Quelle: M. Müller FZJ
Quelle: B. Noll DLR
WP1 Data Evaluation

**Coke particle / Gas phase**

- fast heat-up rate / RWTH
- Pressure influence / KIT

**Heterogeneous reaction kinetics**

- Pulverized char reaction
- FTIR exhaust-gas analysis
- \( \text{N}_2, \text{CO}_2, \text{O}_2 \) environment
- Influences on heat up rate

**Quantitative determination of heterogeneous intrinsic reaction kinetics**

- \( \text{p} \): vacuum to 40 bar
- \( T_{\text{max}} \): 1200 °C
- Gasification agents: steam, \( \text{O}_2, \text{CO}_2 \)
WP1 Data Evaluation

**Slag Characteristics / FZJ**

TP and TC data base

- CALPHAD method
- HT-HP-Viscosimeter (1800 °C, 20 bar)

**Radiation/Convection at high pressure**

- Models for calculating absorption coefficient and/or emissivity of CO₂/H₂O/CO/H₂ mixtures at pressures up to 80 bars
- Scattering coefficient for droplets and particles
- Boundary layer models for convective heat transfer at high fluid density

**Heat Transfer / TUC**

Gas – Particle – Wall
WP2 Simulation

**CFD RANS / TUC**
- Reactor design and scale-up
- Radiation at high pressure
- Sub-stoichio. combustion
- Particle and droplet
- Slag movement

**LES / DLR**
- Multiphase LES
- Detailed data
- Vaporization of emulsions and suspensions
- Chemistry under fuel rich conditions

**Droplet / Coke Conversion**
- main flow field / TUC
- burner near field / DLR
WP3 Validation

REGA

- Atmospheric, REGA
- High pressure, bioliq®

- Atmo EFgasifier
- Local temperature and concentration profiles
- Heat and mass balance
- Data for model validation
- Test for diagnostics tools
- Slag production

bioliq®

- bioliq® Gasifier
- Biomass based slurry
- EFG 5 MW, 80 bar
- Cooling screen
- Access optical / probe
- Data for model validation
WP3 Validation

Development

Optical measurement
- Species concentration
- Soot volume fraction
- Mixture fraction
- Heat release

Application

- Detailed measurements at atmospheric pressure
- Application for pressurized conditions at the bioliq® gasifier
- Data for validation

Development of optical measurement techniques for gasification processes
overall Objectives HVIGasTech

- Holistic approach
- Fundamentals up to technical application
- Scientific network
- Interdisciplinary training
- Exchange of knowledge
- Experimental Results
- Numerical Simulation
- Durable HGF Cooperation
- Core for EU Projects
- Partners
- Transfer of knowledge
- Annual Seminars
- Student Exchange

Young Scientists