Karlsruhe Institute of Technology

HELMHOLTZ RESEARCH FOR GRAND CHALLENGES

EMR / RU4 Feedstocks and Processes of the Future Carbon Cycle

Modeling / Balancing for Entrained Flow Gasification

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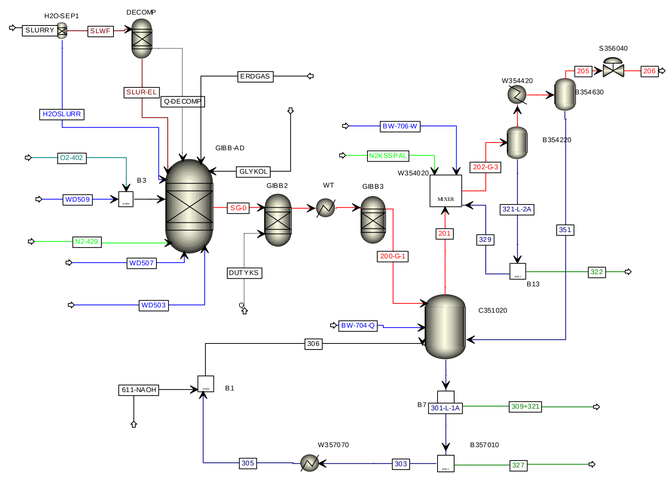
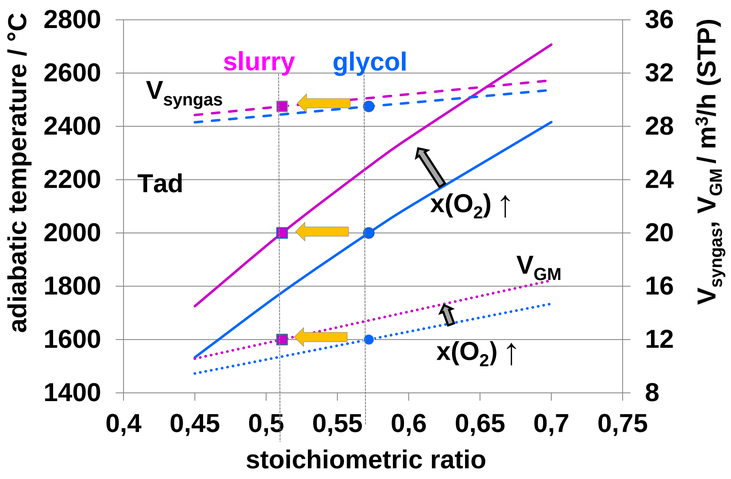
Flowsheet Simulation

Reactor / process models of REGA and bioliq®



- Automated data transfer PCS-Excel-simulation
- Design and validation of experiments for REGA and bioliq® EFG



Fuel variation with constant temperature, residence time and flow field at REGA

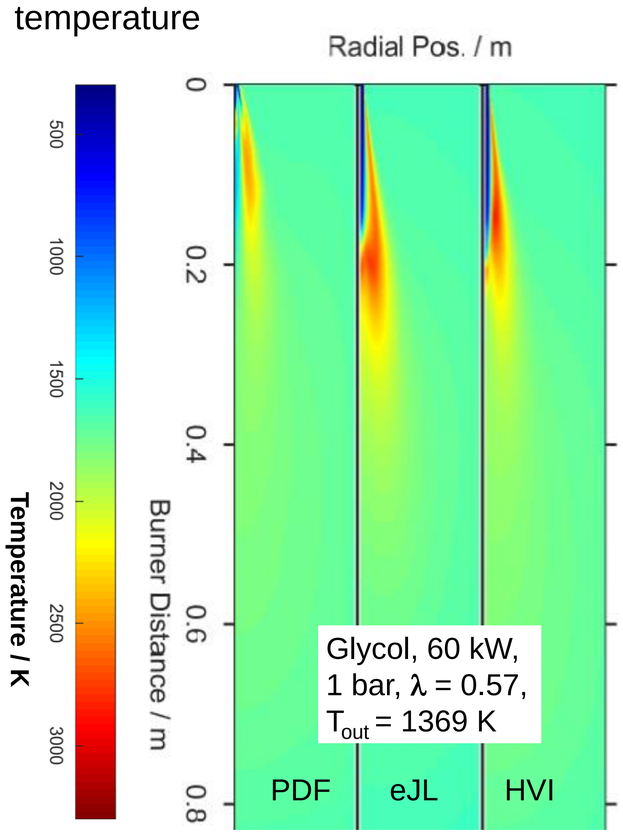
Numerical Simulation

CFD Simulation of EFG using RANS

- Gas phase reaction kinetics: EDC + global reaction mechanism
- Heterogeneous kinetics of char
- Slag: wall film model

Atmospheric REGA simulation

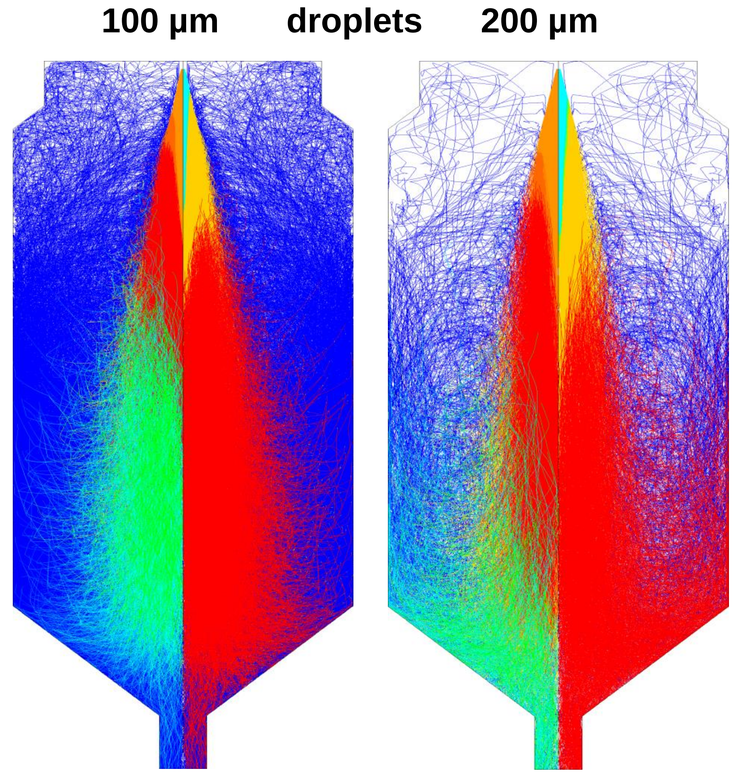
Influence of gas phase kinetics on temperature



M. Mancini et al. **Fuel (2018),** submitted

Pressurized bioliq® simulation

Influence of particle size on conversion



Left: Carbon in coke

- High carbon content
- Low carbon content

Right: Particle law

- Gasification
- Devolatilization
- Evaporation
- Inert Heating/Cooling

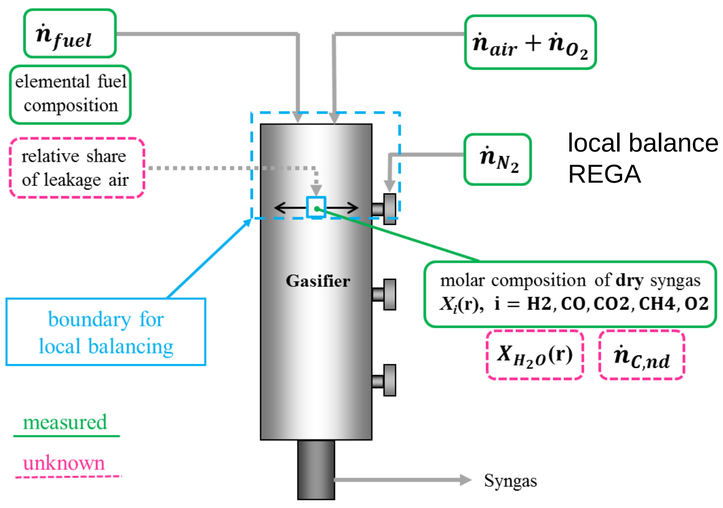
Droplet diameter	Solid diameter	C-Conversion
100 µm	63 µm	100 %
200 µm	125 µm	92 %

Slurry (30% solids), 5 MW, 40 bar, λ = 0.56, T_{ad} = 2381 K

Local / Global Balancing

Global and local balancing of gasification experiments at REGA, bioliq®

- calculation of missing data (leakage air, X_{H2O},..)
- calculation of characteristic parameters CC, λ, T_{WGS},…

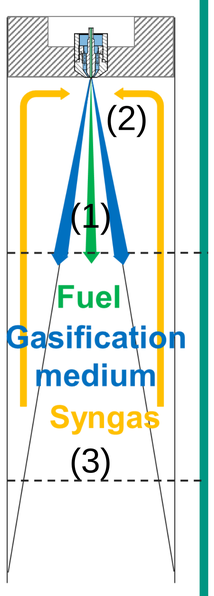


S. Fleck; et al.: **Fuel 217 (2018) 306-319**

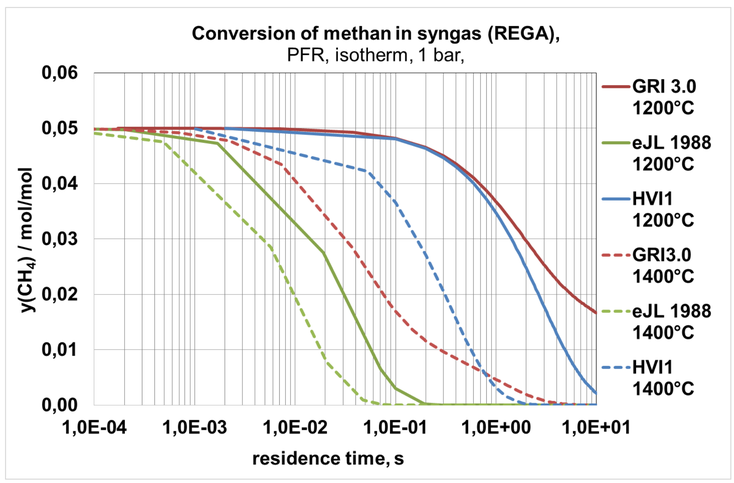
Gas-Phase Kinetics

6 reactions gas phase HVI mechanism derived

(1) decomposition of fuel at high heating rates
(2) syngas oxidation in flame zone
(3) WGS and reforming of hydrocarbons downstream



Validation of HVI mechanism versus detailed mechanisms
- GRI3.0 (2) + (3),
- DLR (1)



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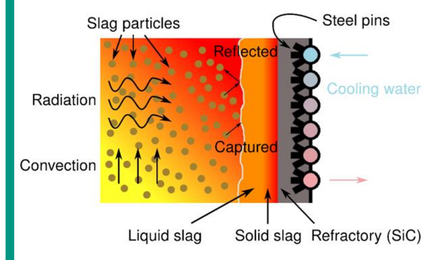
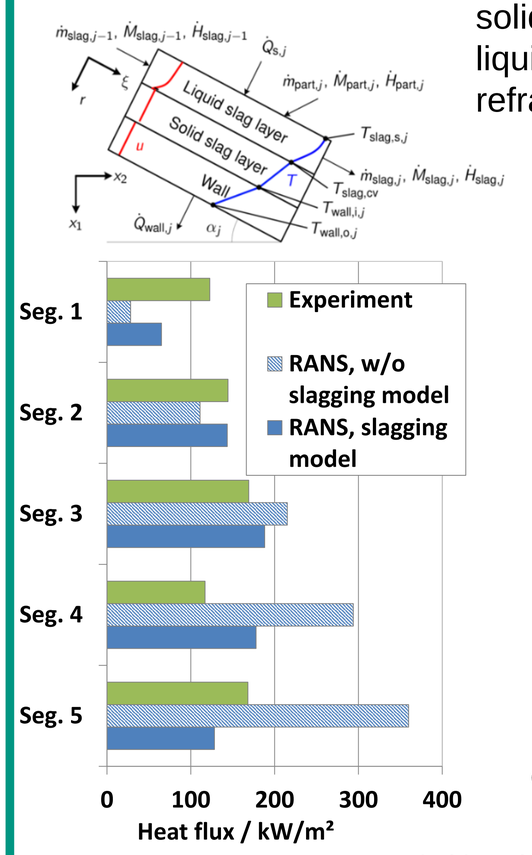
Slagging Model



- based on wall film model and thermal resistance circuit
- assumes linear temperature profiles in solidified slag, liquid slag and refractory



Seebold et al., **Fuel 197 (2017)**

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