Modeling of a pressurised entrained flow biomass gasifier in Aspen Plus

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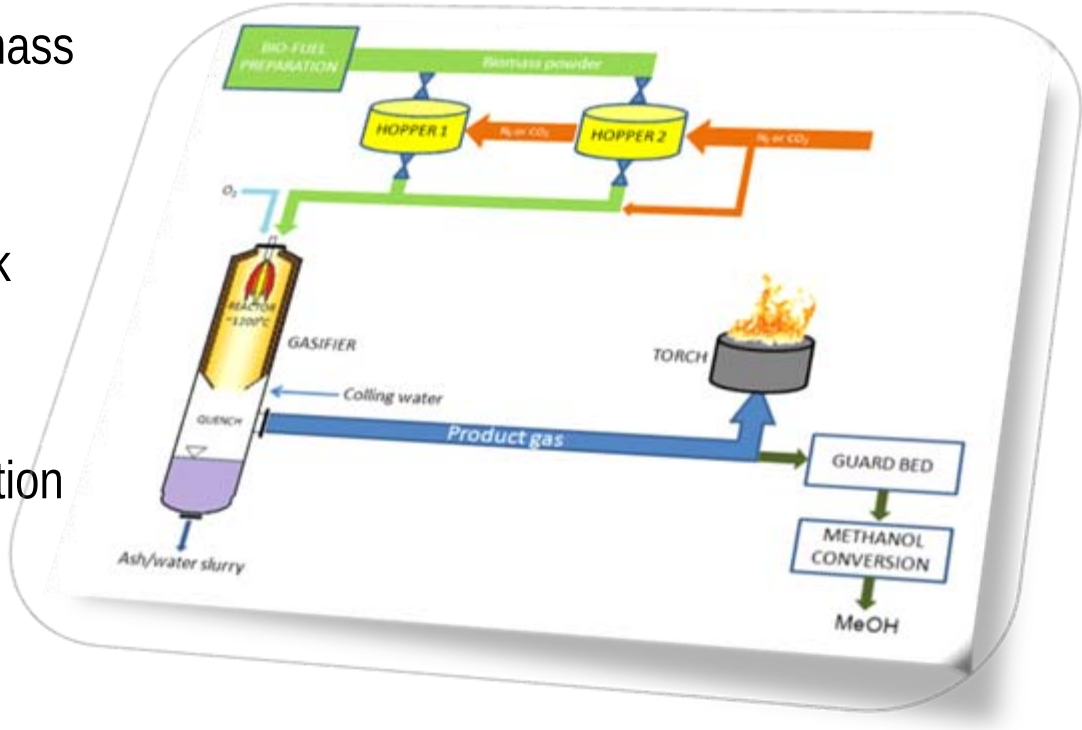
Introduction

- Pressurised Entrained flow Biomass Gasifier
- Low grade biomass as feedstock (Twigs, roots, stumps)
- 1 MW Pilot plant under construction at ETC



Objectives for Wp 4

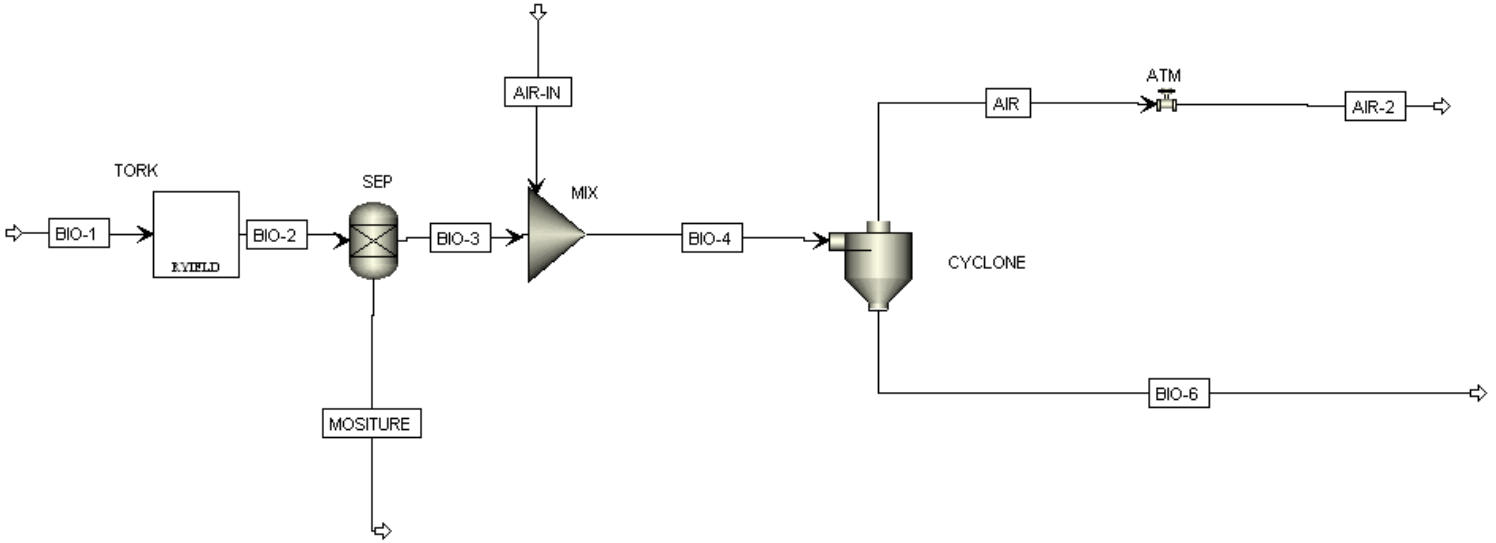
- Complete techno-economic evaluation of the process, from required fuel pre-treatment to the final product

Plan

1) Gasifier plant in Aspen Plus
2) Techno-economic analysis

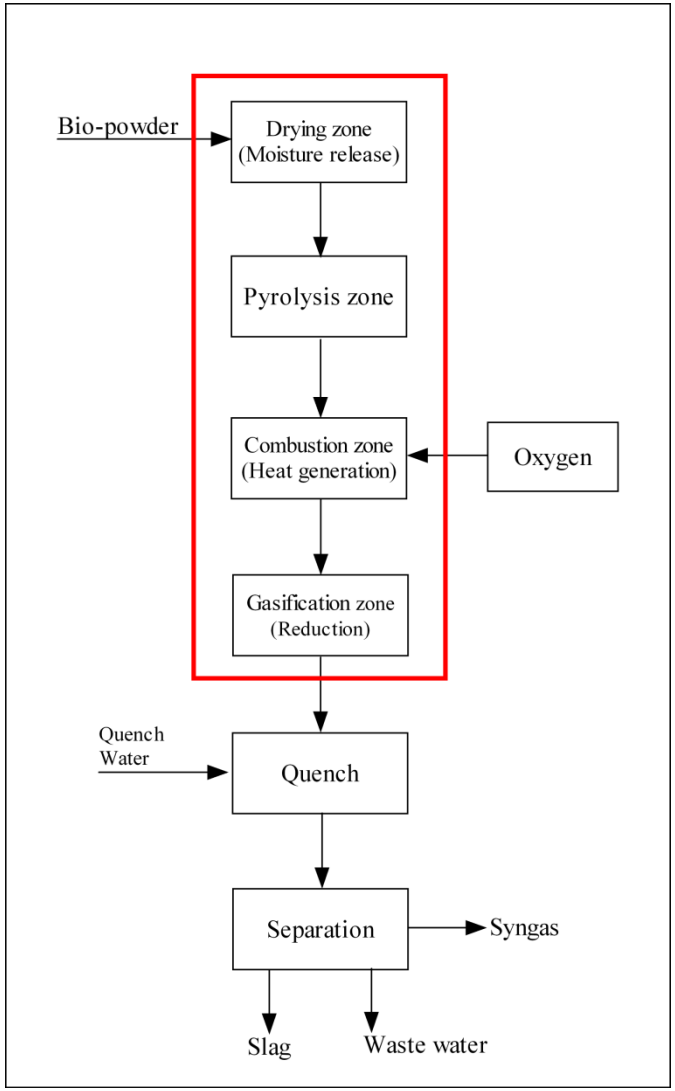
Pre-treatment and feeding system

- Grinding/Milling the biomass into powder
- Dryer for lowering the moisture content
- Pneumatic feeding system for powder
- Cyclones separates air and biomass



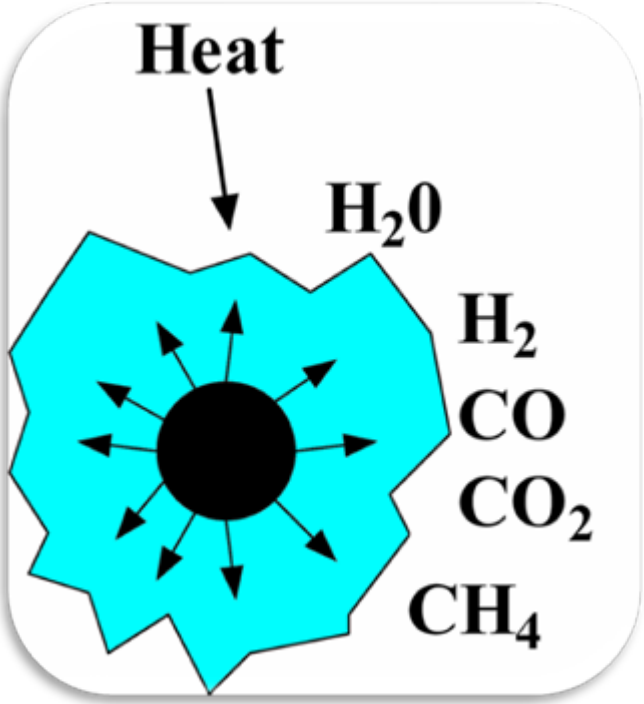
Gasifier model

- Approach to simulate the gasifier with a sub models for each major reaction
- Allows better prediction of the syngas composition
- Moisture content and chemical composition of the felling residues



Gasifier model

- Pyrolysis composition according to literature
- Reaction kinetics of the volatile combustion not considered
- Tar is simulated as lumped hydrocarbon (C_6H_8O)
- Plug-flow reactor simulates the gasification zone

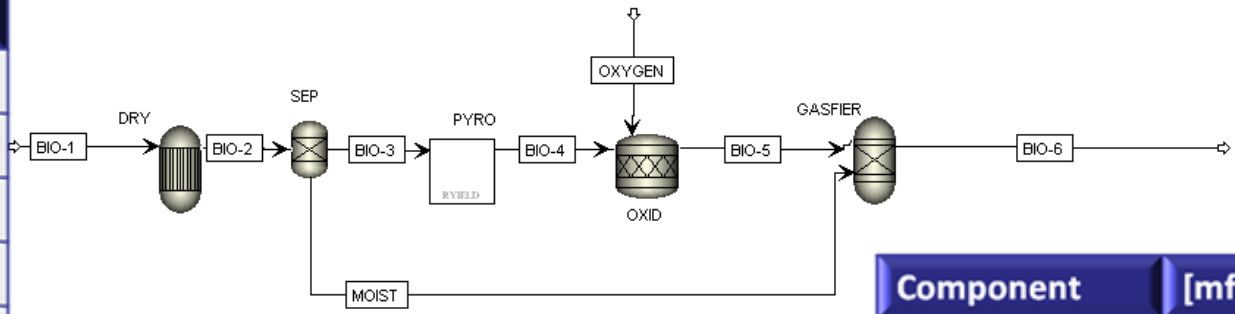


Quench

- Four water inlets
- Syngas and waste water outlets
- Modeled using conventional mixer and heater blocks

Preliminary results

Proximate Analysis	[wt%]
Ash	1
Carbon	51
Hydrogen	7
Nitrogen	1
Oxygen	40



Ultimate Analysis	[wt%]
Moisture	15
FC	18
Volatile matter	81
Ash	1

Operating conditions	
Biomass feed	89 kg
λ kg O_2/fuel kg	0.5
Reactor temp	1200 C
Pressure	6 bar

Component	[mf%]
CO	21%
CO2	7%
H2	27%
CH4	7%
H2O	37%
ASH	1%
CHAR	1%
TAR	4%

Further work

- Establish heat and mass balance
- Include heat losses to surrounding, by adapting into plug-flow reactor
- Contaminations not included
- At least partly validate the model
- Economic analysis

Thanks for your attention!