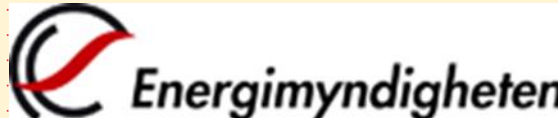


High temperature corrosion during gasification of biomass and waste

Rikard Norling

12.03.2019

High temperature corrosion during gasification of biomass and waste



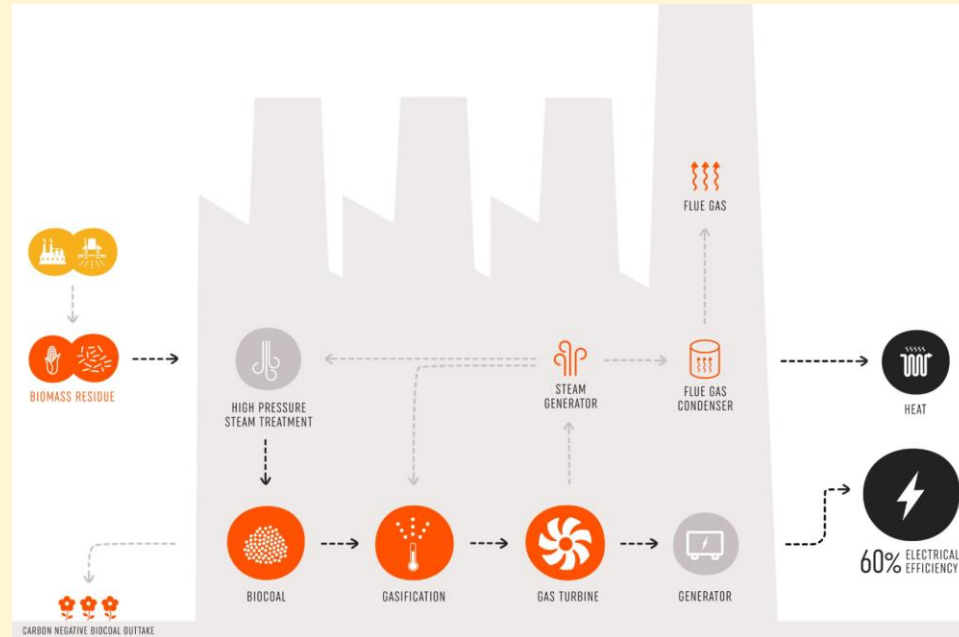
Background - Gasification

- Use for heat and power production
- Use for producing synthesis gas (CO/H_2)



The technology by Phoenix Biopower

- Use for heat and power production
- High-pressure steam treatment and gasification of biomass
- Combustion in a gas turbine for power generation
- Optimised heat integration





BIOMASS RESIDUE



CARBON NEGATIVE BIOCOAL OUTTAKE



HIGH PRESSURE
STEAM TREATMENT



BIOCOAL



GASIFICATION



GAS TURBINE



GENERATOR



STEAM
GENERATOR



FLUE GAS



FLUE GAS
CONDENSER



HEAT



60% ELECTRICAL
EFFICIENCY

The technology by Cortus Energy

- Use for producing synthesis gas (CO/H₂)
- Pyrolysis converts biomass into pyrolysis gas and char
- Pyrolysis gas is combusted to generate heat for the gasification
- Gasification of char with steam



WoodRoll® – Versatile green Energy gas

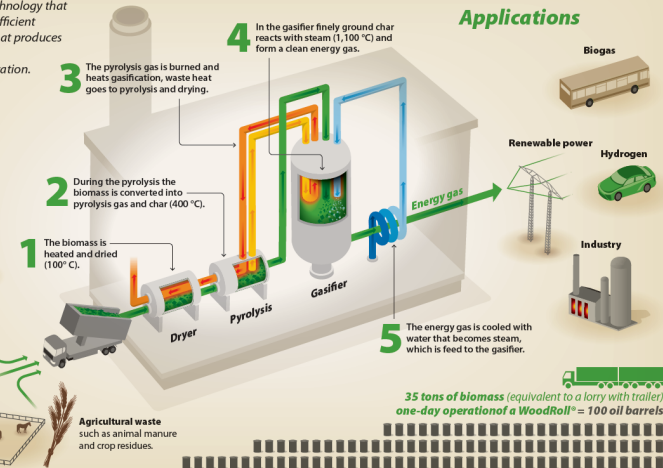
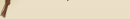
WoodRoll® is a unique technology that replaces fossil energy by efficient gasification of biomass that produces green energy for vehicles, industry and power generation.

Feedstock

Forest-based feedstock such as forest residues and energy crops.



Agricultural waste such as animal manure and crop residues.



WoodRoll® – Versatile green Energy gas

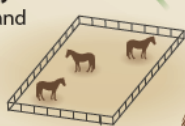
WoodRoll® is a unique technology that replaces fossil energy by efficient gasification of biomass that produces green energy for vehicles, industry and power generation.

Feedstock

Forest-based feedstock
such as forest residues and energy crops.



Waste from industry
such as fiber sludge and construction waste.



Agricultural waste
such as animal manure and crop residues.

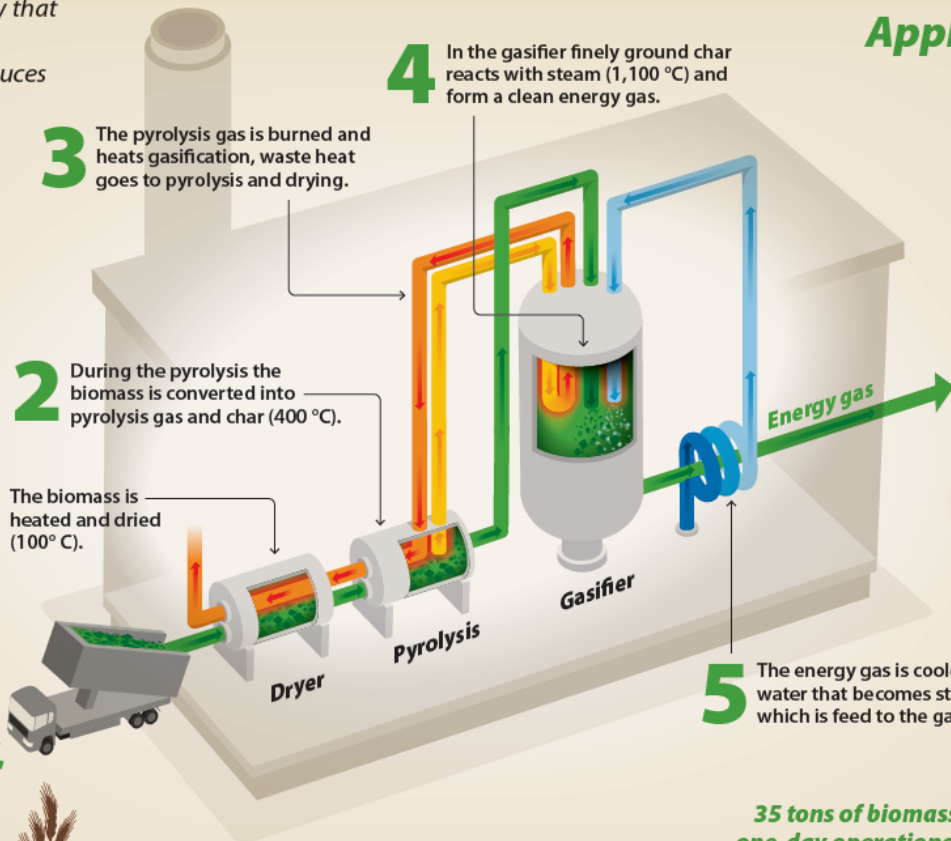
1 The biomass is heated and dried (100° C).

2 During the pyrolysis the biomass is converted into pyrolysis gas and char (400 °C).

3 The pyrolysis gas is burned and heats gasification, waste heat goes to pyrolysis and drying.

4 In the gasifier finely ground char reacts with steam (1,100 °C) and form a clean energy gas.

5 The energy gas is cooled with water that becomes steam, which is feed to the gasifier.

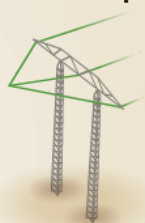


Applications

Biogas



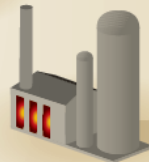
Renewable power



Hydrogen



Industry



35 tons of biomass (equivalent to a lorry with trailer)
one-day operation of a WoodRoll® = 100 oil barrels

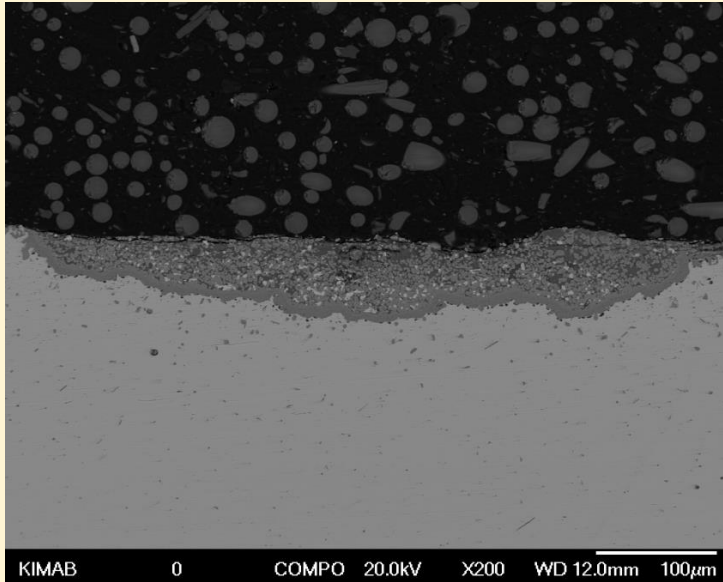


Previous project results

- Material exposures have been made in the Cortus' gasifier in Köping
 - Very high temperature, $\sim 1100\text{ }^{\circ}\text{C}$
- Biomass-based feedstock



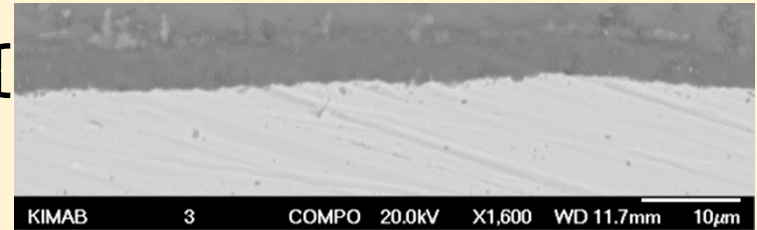
Previous project results



310 S – Deep corrosion attack

} ~50 μm

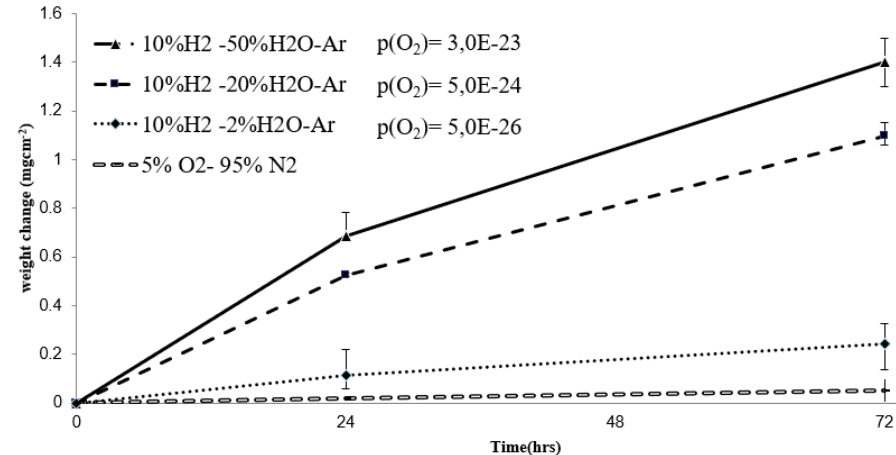
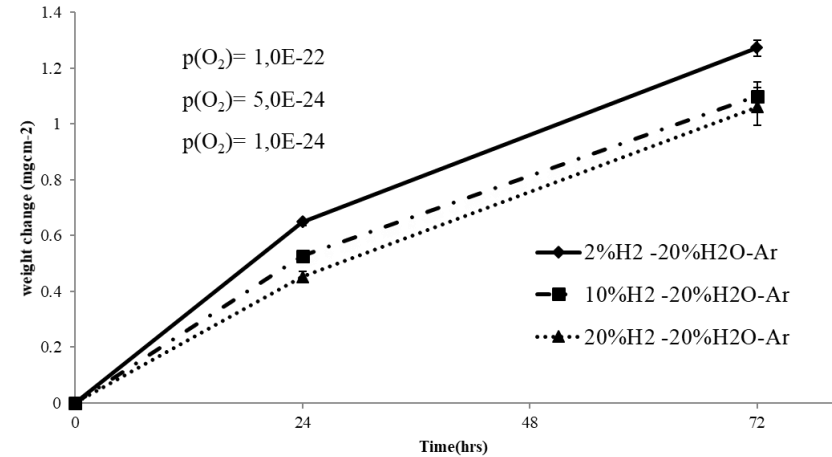
~5 μm {



Kanthal APM – Thin Al oxide layer

Previous project results

- Lab exposures at Chalmers
- The effect of H₂ and H₂O



Previous project results

- Lab exposures at Chalmers
 - The effect of H_2 and H_2O
- Marginal chromia formers, e.g. 304L, can be subject towards accelerated corrosion in low oxygen activity environments.
 - Breakaway may be triggered by a deep chromium depletion of the alloy substrate.
 - The chromium depletion was deeper in H_2 - H_2O environment than it is in, e.g. dry O_2 , because the pure chromia scale formed in H_2 - H_2O environment grew faster than the $(Fe_xCr_{1-x})_2O_3$ scale formed in air and dry O_2 .

The present new project - Contents

Research on high temperature corrosion in plants for gasification of biomass and waste

- Material degradation by oxidation, corrosion and/or carburisation in environments with low oxygen activity
 - Studies of influence of the gas environment and/or of corrosive deposits
 - Studies of the relation of the degradation attack to alloy type (Fe-base or Ni-base), alloying elements, microstructure and/or oxide type (chromia or alumina)

The present new project - Contents

A number of important research topics of particular interest have been identified. These include the following that may be addressed in the project:

- Influence of very high water content in the gas (~ 60 vol.%)
- Influence of very high temperatures (~ 900-1100 °C)
- Influence of KCl at intermediate temperatures (~ 400-500 °C)

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Thank you for listening!