An integrated network on thermal biomass conversion for power, heat and transport fuels

ThermalNet Final Report

Work Package: 2.E

WP Title: Gas treatment

WP Leader: TPS Termiska Processer AB

WP 2.E Objectives

- Co-ordination of an exchange of high quality information and experiences between experts on gas treatment, and in particular between experts working in different technology areas.
- Transfer of information and experiences on gas treatment from invited guests to participants in ThermalNet.

WP 2.E Achievements / Deliverables

- Participation in workshops and meetings and
  Organisation of two Gas treatment workshops
- Documentation of workshops:
  - Lille 2006-04: Low-temperature gas treatment
  - Vicenza 2007-10: High-temperature gas treatment

  $\rightarrow$ Report on both workshops available
- Reports on particular items
  - Gas cleaning in flue gas from combustion of biomass
    Kurt Carlsson (Firma EcoExpert) $\rightarrow$ Report available
  - Gas Cleaning for Synthesis Applications
    Hermann Hofbauer, Reinhard Rauch, Karl Ripfel-Nitsche
    (Vienna, University of Technology)

WP 2.E State of the Art

- Gas treatment for COMBUSTION
  - What?
    Particles, SO2, HCl, NOx, ammonia, dioxins, mercury
  - How?
    Cyclones, bag-house filters, ESP, scrubbers, dry absorption, SCR, SNCR and more

Report by K. Carlsson

- Gas treatment for PYROLYSIS
  Example: Particles:
  - Liquid filtration
  - Hot gas filtration

Presentation by Univ. Twente

- Gas treatment for GASIFICATION
  Different needs for gas firing, engine, gas turbine, syngas (for automotive fuels) and fuel cells
  --->

WP 2.E State of the Art

- Gas treatment for GASIFICATION
  - What?
    Cleaning: Particles, tar, ammonia, H2S and other S compounds, HCl, alkali, mercury
    Conditioning: H2/CO ratio, CO2 removal
  - How?
    Cyclones, bag-house filters, high-temp. filters for particles
    In-bed catalyst, tar cracker/reformer, oil-scrubber, WESP, precoat bag-house filter for tar --->
    Water-scrubber for ammonia, HCl and HF
    Physical/chemical absorption, dry absorption for H2S, HCl and CO2 removal
    Shift for H2/CO removal and S compounds
    Hydrolysis for S compounds

Presentation by Bologna Univ.

Report by TU Vienna

WP 2.E State of the Art

- Tar and methane cleaning
  - High temp. gasification
  - High temp. after gasification (Partial oxidation)
  - Physical cleaning: oil scrubbing
  - In-bed catalyst
  - Catalyst after gasifier:
    tar cracker bed (non-metal catalyst like dolomite, Ni-based catalyst)
    reformer (steam reforming, autothermal reforming)
    monolith catalyst

OLGA Presentation by ECN

RME in Güssing Pres. by H. Hofbauer

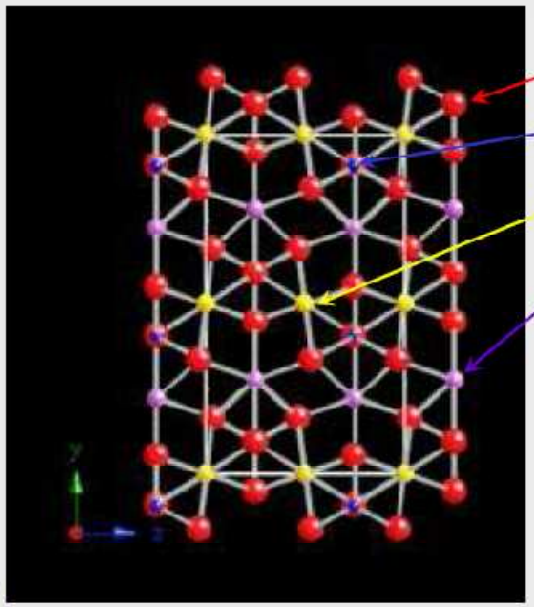
Presentation by GTI

WP 2.E

GTI work:
Thermal Impregnation
Ni-olivine catalyst

When catalysts based on the olivine structure attrit, they would expose fresh, catalytically-active surfaces.

Structure of Olivine



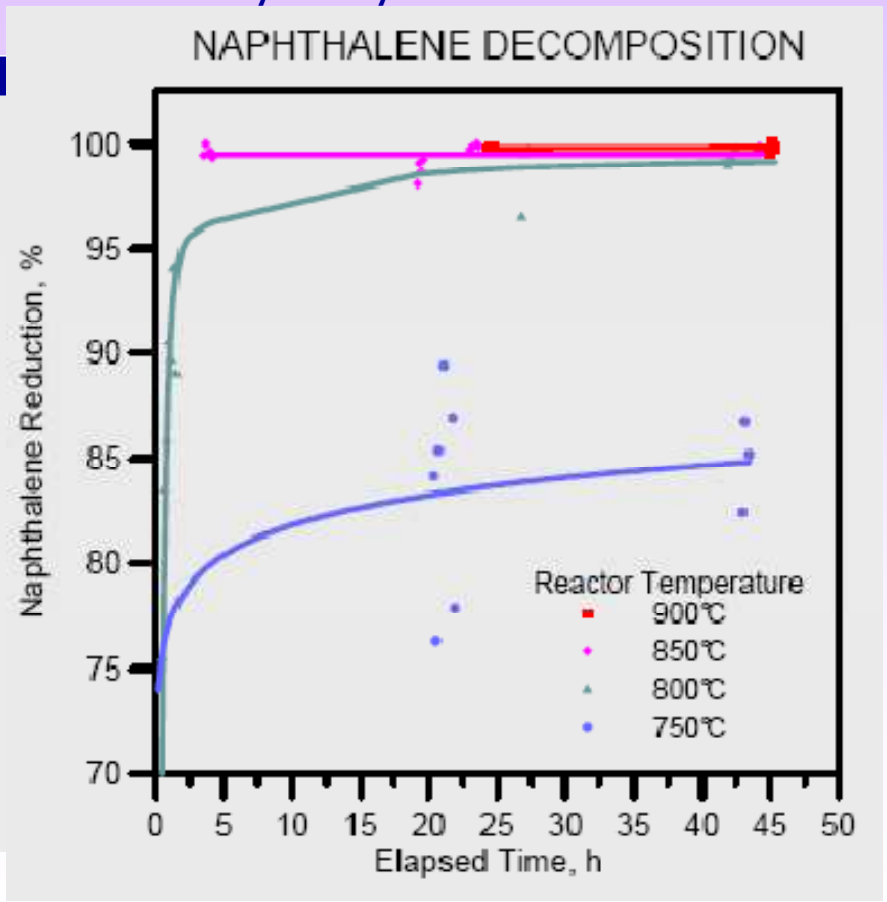
Oxygen in RED

Silicon in BLUE

M1 in YELLOW

M2 in PURPLE

The M1 and M2 sites readily accommodate Mg, Fe, Ni, and Co

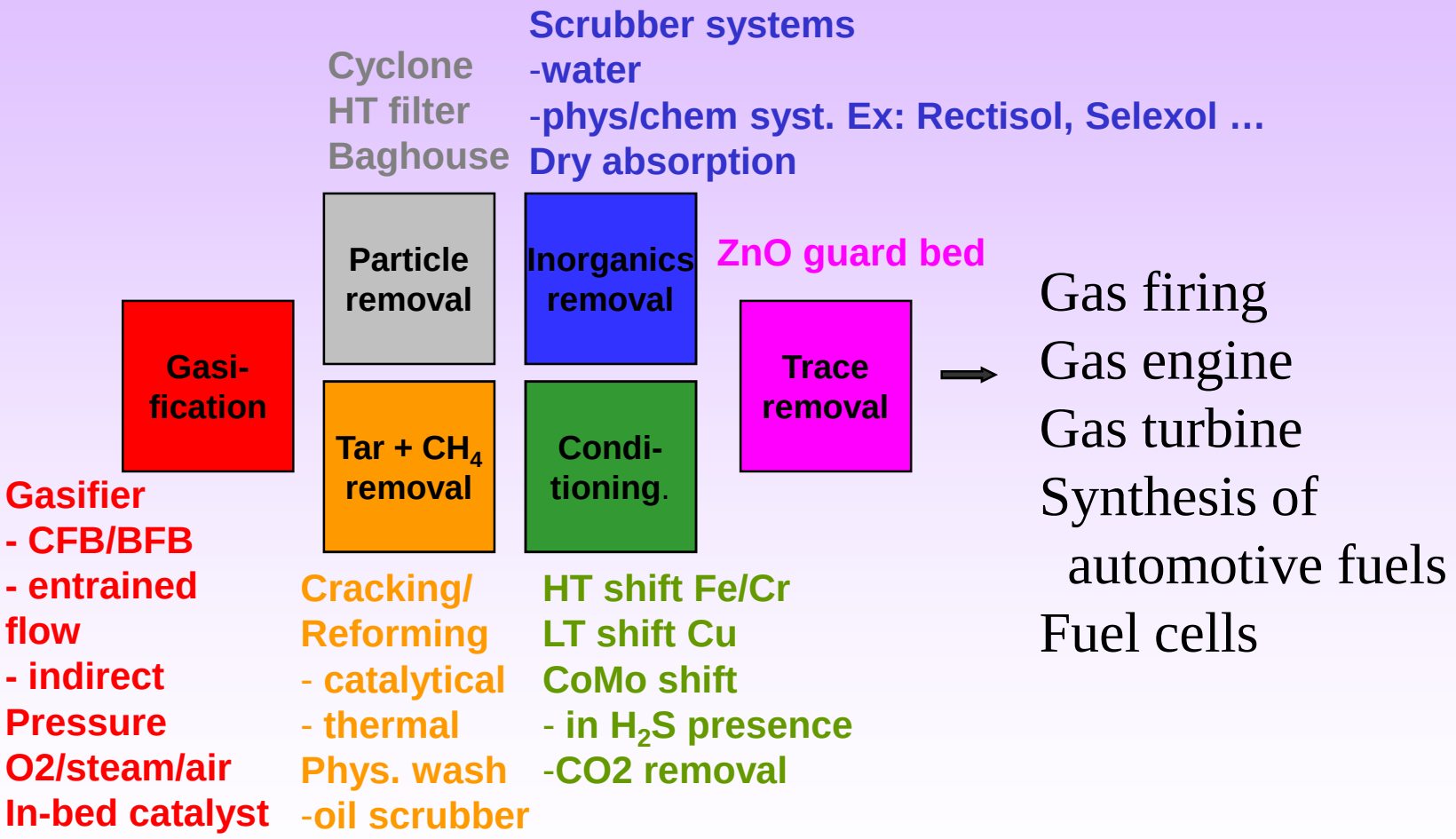


WP 2.E

Fraunhofer UMSICHT monolithic catalyst

Catalyst for tar oxidation at high temperature after gasifier.
Nickel surface based on an alumina catalyst support.
Monolith to cope with a high dust load.

WP 2.E Gas treatment map



WP 2.E Conclusions

- Wide range of technologies. For gasification: should fulfil the needs between different gasifiers and different end use demands.
- Lots of promising developments going on:
  Hot gas filters, reforming, tar cleaning by monolithic catalysts, tar cleaning by scrubbing, dry absorption for syngas applications …
- Valuable exchange of information within ThermalNet.

Thank you for your attention