Welcome to the GREENSYNGAS workshop in Güssing, Austria: Experimental and Theoretical Investigation in Biomass Conversion routes to Biofuels “http://www.eat.lth.se/greensyngas/”

This Workshop comprises of the GREENSYNGAS consortium members (FP7 project (contract n°213628) funded by EU) and guests from industry and European energy organization; coordinated by Lund University, Sweden. Its aim is to improve the technology in biomass-based process, above all; the hot gas cleaning system and synthesis step in biofuels. At workshop in February the challenging results from the project will be presented. The consortium members in this RTD programme combines European expertise in the field of gasification, different proficiencies in cleaning technologies, high ranking catalyst expertise, a catalyst and specialty chemicals company, and a research company with R&D activities in the field of energy. The outcomes of this RTD programme will be presented on February 23, 2011 at Güssing, in Austria, and the location can be found at this website (http://www.eee-info.net/cms/EN/). The Workshop will provide the opportunity for all attendees to network and be a forum for exchange of experiences, both from industry and academia.

Registration: The workshop is free of charge

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Workshop “Advanced Cleaning Devices for Production of Green Syngas” (GREENSYNGAS) Work Programme, Cooperation, Theme 5- “Energy”, FP7-ENERGY-2007-1-RTD”

Workshop Programme:

9.00 – 9.30: Registration; each speaker has 30 minutes including the audience with Question and answer sessions

9.30-10.00: General presentation of FP7 EC funded Project GreenSyngas; Coordinator Professor Mehri Sanati

10.00-10.30: Optical online measurement techniques for analysis of gas phase tars and alkali during biomass gasification; Technischen Universität München (TUM), Germany; Professor Hartmut Spliethoff

10.30-11.00: Steam-oxygen blown biomass gasification using a 100kWth circulating fluidized bed gasifier: the fate of sulphur species and tar formation; Delft University of Technology; The Netherlands; Associate Professor Wiebren de Jong

11.00-11.30: Filtration of hot char using an integrated cyclone and pulsejet cleaned metallic filter system; PORVAIR, Special Projects Manager Porvair Filtration Group; United Kingdom; Andy Bevis

11.30-12.00: Removal of inorganic trace elements from hot syngas by solid sorbents; Forschungszentrum Jülich GmbH, Institut of Energy and Climate Research, Germany; Dr Michael Müller

12.00–13.00: Lunch

13.00-13.30: The conditioning of the gasification product gas by catalytic steam reforming and WGS; Norwegian University of Science and Technology; Norway; Professor Edd Blekkan

13:30-14.00: Experimental approach for a reliable sampling and characterization of fine particle formed during biomass gasification using organic and inorganic model compounds; Lund University, Sweden; Professor Mehri Sanati

14:00-14:30: New Process for Thermal Reforming’ Lund University, Sweden; Associated Professor Jan Brandin

14.30-15.00: Catalysis for gas upgrading: a possible solution in real gas from biomass gasification; Bologna University; Italy, Assistant professor Francesco Basile

15.00-15.30: Preliminary Flowsheeting: Producer Gas Clean-up and Conditioning for Chemical Synthesis; Johnson Matthey; United Kingdom; Gareth Williams

15.30-16.00: Development of the biomass CHP Güssing to a biosyngas platform; Kraftwerk Güssing GmbH & Co KG; Austria, Dipl.-Ing. Dr Reinhard Rauch

16.00-17.00: Plant visit with focus to the GREENSYNGAS demonstration on the slipstream of Güssing Gasifier; Markus Kock and Andy Bevis
Appendix 1


Project acronym: GreenSyngas

General presentation of FP7 EC funded Project GreenSyngas; Coordinator
Professor Mehri Sanati “Mehri-sanati@design.lth.se”

ABSTRACT

The transport sector represents a growing share of the total fossil fuel usage in the world. In order to fulfil the commitment to the Kyoto Protocol, the world usage of fossil oil in transport sectors must be reduced. One important approach to achieving this goal is to increase the share of renewable sources as feedstocks in conversion routes. These biomass conversion routes involve a number of difficulties that should be attended to first by a suitable process configuration to avoid catalyst poisoning in production of syngas. Second, a major problem in the production of syngas derived fuel from renewable sources is the presence of contaminates in the product gas from a biomass gasifier. These impurities that cause catalytic poisoning should be completely removed prior to the entry in catalytic systems that utilize in upgrading steps. With the evolution of these advanced uses of biomass derived syngas, it becomes necessary to develop progressively more stringent gas cleaning systems. Therefore, the project's key goal is development of a novel gas cleanup in order to reduce impurities from gasifier’s product gas to limits required for upgrading to syngas using as a feedstock in production of vehicle fuels. To accomplish this target that biomass conversion should preserve high energy efficiency in the subsequent synthesis steps and preventing catalytic poisoning, an alternative product route and more efficient gas cleaning systems are required. Nevertheless, biomass conversion processes offer many economical and environmental benefits, but it is clear that conversion technology should be able to compete with other conversion routes, for example via methane. Therefore, this RTD programme combines European expertise in the field of gasification, different proficiencies in cleaning technologies, high ranking catalyst expertise, Catalyst Company, and one research companies with R&D activities in the fields to expedite the development and commercialization of research outcomes.
GreenSyngas

Optical online measurement techniques for analysis of gas phase tars and alkali during biomass gasification; Technischen Universität München (TUM), Germany;
Professor Hartmut Spliethoff “spliethoff@es.mw.tum.de”

ABSTRACT:

Within the GreenSyngas project the Institute for Energy systems developed and tested optical measurement techniques for impurities in the producer gas of biomass gasifiers. With laser induced fluorescence (LIF) the fluorescence signal of gas phase tars was measured, for the analysis of gas phase alkali excimer laser induced fluorescence (ELIF) was applied. Measurements were performed at two fluidized bed gasifiers and the influence of parameters like temperature, pressure, steam to biomass ratio, biomass, on the tar and alkali formation was investigated.

Steam-oxygen blown biomass gasification using a 100kWth circulating fluidized bed gasifier: the fate of sulphur species and tar formation; Delft University of Technology; The Netherlands;
Associate Professor Wiebren de Jong “Wiebren.dejong@tudelft.nl”

ABSTRACT

Gasification of renewable biomass provides good perspectives for production of transportation fuels as well as combined heat and power generation. Experiments have been carried out using a 100 kWth CFB gasifier for converting two woody biomass fuels Agrol and willow and an agriculture residue, Dry Distiller’s Grains with Solubles (DDGS). Effects of operational conditions and bed materials on the composition distribution of the product gas, including sulphur and tar species formation from these fuels were investigated. The results show that there are significant deviations in the composition of the gases produced.

Filtration of hot char using an integrated cyclone and pulsejet cleaned metallic filter system; PORVAIR, Special Projects Manager; Porvair Filtration Group; United Kingdom;
Andy Bevis “andy.bevis@porvairfiltration.com”

ABSTRACT

The separation equipment for the pilot scale system that is to be supplied to Biomasse Kraftwerk Gussing GmbH in Austria includes a pre-separation cyclone and a pulsejet filtration unit. To provide supportive evidence of the design that will be provided for the pilot plant a cyclone and filter unit were tested in the PFG Fluidics Laboratory.
• Differential pressure with flow,
• Filtration efficiency of the separate stages with solids challenge,
• Differential pressure development over time with solids ingression
• Efficacy of pulsejet blow down in solids recovery and
• Recovery of filter elements over time/pulsejet operation
GreenSyngas

Removal of inorganic trace elements from hot syngas by solid sorbents; Forschungszentrum Jülich GmbH, Institut of Energy and Climate Research, Germany; Dr Michael Müller “mic.mueller@fz-juelich.de”

ABSTRACT:

The aim of the “GreenSyngas” project was to develop and demonstrate advanced synthesis gas cleaning technologies based on both chemical conversion and physical separation. In order to develop a chemical hot gas cleaning concept for the biomass derived syngas, suitable sorbents had to be determined. The main focus was laid on alkali removal and sour gas control. The presentation will outline results of thermodynamic model calculations and lab-scale experiments with different sorbents.

The conditioning of the gasification product gas by catalytic steam reforming and WGS; Norwegian University of Science and Technology; Norway; Professor Edd Blekkan “edd.blekkan@chemeng.ntnu.no”

ABSTRACT

The tasks of NTNU are related to the catalytic reforming of hydrocarbons in the gasification product gas, and the subsequent water gas shift (WGS) reaction for the tuning of the H2/CO ratio in the final syngas. Several reforming catalysts have been evaluated in terms of activity, stability, and the effect of tars, salts, and soot on the activity. A HT-WGS catalyst was found suitable for the WGS step. Steam reforming combined with WGS has been carried out in lab scale. The main deactivation mechanism appears to be carbon deposition on the catalyst.

Experimental approach for a reliable sampling and characterization of fine particle formed during biomass gasification using organic and inorganic model compounds; Lund University, Sweden; Professor Mehri Sanati “Mehri.sanati@design.lth.se”

ABSTRACT

In order to utilize biomass gasification for renewable fuels and products, there is a need to understand the formation of fine particles suspended in the produced gas and enhance the economical and technological performance of such conversion systems. The objective of this work was to design an experimental model setup to perform field studies of particle formation in biomass gasification process. The set-up includes an aerosol generation system, a high temperature sampling probe and denuder to separate particles and volatile material. The generation system produces KCl particles in a nebulizer and soot from diffusion flame burner, (both as non-volatile cores). It is followed by condensation of volatile material (Di Octyl Sebacate oil) on the model particles, which are sampled, heated up and diluted by a probe and then passed to a denuder where the volatile fraction is removed from the particles. The system will be used in connection to Porvair cleaning device in order to measure performance of purification based on emitted particulate.
**New Process for Thermal Reforming**

Lund University, Sweden;  
Associated Professor Jan Brandin “Jan.Brandin@chemeng.lth.se”

**ABSTRACT**

Short abstract: A sulphur tolerant regenerative partial oxidation reactor for the reforming of methane in synthesis gas generated from biomass by gasification is modeled. The model was developed as a first stage in the understanding of the regenerative reactor concept at high temperatures. A lab scale reactor (about 2 kW) was built to demonstrate the regenerative reactor concept. The temperature profiles over the reactor coincide well with the simulated profile for the reactor. The risk of soot formation at high temperature in rich fuel-mixtures is evaluated.

**Catalysis for gas upgrading: a possible solution in real gas from biomass gasification;**

Bologna University; Italy,  
Assistant professor Francesco Basile “f.basile@unibo.it”

**ABSTRACT**

The objective of the GreenSyngas project is focused on the catalytic step for the upgrading of the gas downstream of the gasifier after the filter. In this step the reforming of the gas is performed to decrease the methane and light hydrocarbons with a subsequent enrichment of the gas in CO + H2 (syngas). Three different configurations were proposed to achieve this aim: the regenerative partial oxidation, the steam reforming and the autothermal reforming (oxygen assisted reforming). The two latter technologies were selected as processes to study for the catalyst development: the steam reforming being performed at low temperatures, (800-900 ºC), whereas the autothermal reforming was chosen as a high temperature process (950-1000 ºC). In order to investigate these technologies in the GreenSyngas project, the effect of the contaminants and reaction conditions on the efficiency of the process has also been studied in same workpackage as catalytically investigation. In this work a recommendation of operation parameters and the catalysts to be used in the reformer has been explored based on experimental tests The actual demonstration of the reforming catalysts using a real-gas feed has be carried out in a bench scale reformer placed in a slip-stream downstream the air/steam circulating fluidized bed (CFB) gasifier at TUD, to be located after the BWF filter and TUM.
ABSTRACT:

Gasifier producer gas contains several contaminants including tars and sulphur that are detrimental for downstream operations not least for power production, but also for chemical synthesis such as FT fuels and SNG. The GreenSyngas project has addressed, from both a theoretical and an experimental standpoint, the individual processes to both purify and condition the producer gas, with a high temperature of operation being a focus for contaminant removal. A preliminary flowsheeting study using Aspen HYSYS has been undertaken to complement the main project work, putting together an example low pressure flowsheet(s) for generating a biosyngas of quality suitable for further chemical synthesis, using a raw gasifier producer gas similar to that generated at the Güssing CHP plant. The initial results indicate the process benefits of a reforming operation that can remove tars, which itself may require some high temperature sulphur removal if it is catalytic in nature. If non-catalytic tar removal routes such as water scrubbing are selected then this lends itself to more conventional sulphur removal systems operating at lower temperatures, prior to downstream compression and chemical synthesis. A high-level comparison of flowsheeting options with and without a reforming stage is also given.

ABSTRACT

In Güssing, Austria an innovative gasification system is in operation since end of 2001 to produce power and heat from biomass. The gasification technology is based on steam blown dual fluidised bed gasifier, which produces a nitrogen free gas with a high calorific value (12 MJ/Nm³) and only a low amount of tar. A cooling and two stage gas cleaning system makes sure that the gas engine gets a cool and clean gas. Until the end of 2010 about 50,000 hours of operation with the gas engine could be reached, which demonstrates the smooth functionality of the CHP plant. The favorable characteristics of the product gas (low nitrogen content, high hydrogen content) allow also other usages of this gas. Research projects concerning the production of SNG (synthetic natural gas), Fischer-Tropsch Diesel, mixed alcohols, hydrogen and electricity in a SOFC (solid oxid fuel cell) have been done. During the last years, the biomass CHP Güssing has been established as R&D platform, where many different applications of synthesis gas from biomass were investigated.
Plant visit with focus to the GREENSYNGAS demonstration on the slipstream of Güssing Gasifier;
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