GasBio

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# Newsletter 1-2013

This issue highlights the project workshop arranged in Trondheim in March.

## GasBio project workshop

The fifth Gasbio project meeting was arranged 6-7 March in Trondheim. The first day started with a site visit at the Statoil laboratories at the research centre at Rotvoll, followed by the steering committee meeting. The second day was devoted to a project seminar which included presentations to update the project members with the latest research results as well as presentations from the industry partners on their up to date activities. The presentations are summarized below.

### Bioenergy in Statkraft

Marianne Holmen presented the bioenergy activities in Statkraft. They are a major European player within renewable energy, developing and generating hydropower, wind power, gas power and district heating. Within bioenergy their ambition is to strengthen their position as one of the two largest district heating players in Norway and develop existing assets in Sweden. They aim to increase the renewal share of feedstock to 90% at their plants. Statkraft has activities throughout the bioenergy value chain supported by the Statkraft "Energy from biomass R&D programme" with the focus areas: energy conversion technologies, market mechanisms for different bio products, and system solutions.

### Aviation biofuels

The status of the Avinor sustainable jet biofuel project was presented by Olav M. Larsen. This feasibility study was initiated by Avinor, SAS, Norwegian and NHO Luftfart in the fall 2011, to study the potential for "Sustainable and commercially profitable production of sustainable bio jetfuel in Norway". The main research question was: What is the cost of one litre of sustainable bio jetfuel in Norway in 2020 and 2025, and what is the effect on carbon emissions (in the whole value chain)? The report is based on 6 sub projects, and the main results were published in April 2013 (www.avinor.no). SINTEF Energy Research was selected to perform the sub project "Benchmark of conversion- and production technologies for synthetic biofuel for aviation".

### Scale-up and demonstration of Fischer-Tropsch technology

Statoil started development of GTL technology in the mid 1980's, focusing mainly on Fischer-Tropsch catalyst and reactor development, and their competence is highly appreciated in the GasBio consortium. Dag Schanke presented their Fischer-Tropsch (FT) activities, from a small FT- pilot plant that was built and successfully operated from 1987 – 1994 to demonstrate the viability of the slurry reactor/cobalt catalyst concept, to the the challenges related to scale-up and demonstration.

### Laboratory experiments and modeling for scale-up

Liang Wang presented the most recent results on $CO_2$ gasification and alkali release studies: two tasks within work package 3. The char-$CO_2$ reaction plays an essential role during the biomass gasification process for governing the overall conversion rate of gasified materials. In SINTEF Energy Research, the gasification kinetics of two charcoals produced from wood chips and forest residues were studied using thermogravimetric analysis (TGA) with novel heating programs. Cooperating with Professor Gábor Várhegyi in Hungarian Academy of Sciences, a leading scientist, all TGA experiment results were evaluated and kinetic parameters for char-$CO_2$ were obtained. It was found that decomposition kinetics of biomass chars are considerably influenced by feedstock properties and $CO_2$ concentration.

On the other hand, release and transformation of alkali metals may cause considerable influences on the biomass gasification process and operation of a gasifier. Release of alkali metals during devolatilization of two woody biomasses, pine and bark, were investigated by using a combination of several analytical techniques (TGA, chemical fractionation, ICP, SEM-EDX and XRD analysis). The preliminary ash chemical composition analysis results showed that, compared to the pine, the bark contains higher contents of alkali metals (K and Na), Cl, S and Ca. The differences in ash compositions suggests different release tendencies of alkali metals during devolatilization of the two fuels, which may affect gasification behaviors of the two fuels in a gasifier consequently.

### Ash-forming elements chemistry during gasification

Michael Becidan presented the assessment of the severity of ash-related challenges such as corrosion, slagging, fouling and deposition and their practical implications for the plant based on thermodynamic equilibrium calculations. The database used was specially developed in collaboration with Daniel Lindberg at Åbo Akademi, a leading institution in the field. More specifically two case studies (airblown CFB gasifier) proposed by Metso were investigated:

- **Case 1:** a pulp mill (limekiln gasifier) that wants to displace fossil fuel in lime kiln with syngas from pine and eucalyptus bark – main challenge: "non-process elements" fate, i.e. Si, P, Al, Mg, K, Cl, Mn and Fe
- **Case 2:** Pulverized coal gasifier producing electricity. The objective is to displace fossil fuel with syngas from Finnish peat and logging residues (spruce) – main challenge: hot corrosion (caused by alkali chlorides)

The main parameter of interest was temperature. The calculations gave an interesting insight into chemistry of the target elements; a knowledge that hopefully can be used to optimize the operation. This activity will continue in 2013 in dialogue with the industry partners to define the next case(s) of interest.

### Gasification of torrefied biomass for biofuels purposes

The main results and conclusions from an experimental study, addressing $O_2$/steam fluidized bed gasification of two different types of Norwegian biomass, namely spruce and the corresponding forest residues, were presented by Berta Matas Güell. Besides the effect of the feedstock nature, the study focused on the influence of torrefaction level and pressure on the product yields and composition. The results show an increase on gas yield with pressure and torrefaction level for both types of biomass considered. Increasing pressure caused the produced gas composition to shift towards higher $CH_4$ and $CO_2$ content, while $H_2$ and CO levels decreased. The effect of the type of original biomass on gas composition was limited, and became less relevant as pressure and torrefaction level increased. The analysis of the tars produced during gasification also revealed that higher pressures led to the increase of tar yields. On the other hand, torrefaction level presented the opposite effect, with lower tar yields and lighter molecular weight distribution of tars as torrefaction level increased. Since torrefaction is being considered as a promising pre-treatment technique for upgrading biomass to a higher quality solid fuel more suitable for the integration of gasification into biofuels production, the results from this study are relevant for evaluating the influence of the level of torrefaction on the performance of gasification under typical operating conditions in practical applications.

### Influence of wet and dry torrefaction on BtL production

The progress by March 2013 of "Gasification Process plant analysis and synthesis of Second Generation Biofuels under Norwegian conditions" (SP4) was presented by Rajesh Kempegowda. Detailed techno-economic analysis were made recently on the influence of pretreatment through wet and dry torrefaction on the production of gasification/FT-derived biofuel. Preliminary results shows that the net financial value (NPV) for BTL processes configured with raw, dry and wet torrefied materials will be 61 US $/GJ, 51 US $/GJ and 48 US $/GJ, respectively. The decrease in produstion cost for wet and dry torrefied materials is related to the FT product yield improvement and improved overall efficiency of the process. The results show that torrefaction reduces the cost of producing FT fuels. There were suggestions from Statoil to consider the hydrocracking as an upgrading process in the viability studies. Further work is going on studying the influence of gasification technology under simular conditions as these applied up to now.

### Research plans at SANDIA National Labs

A series of experiments on biomass gasification are beeing carried out by Tian Li and Berta Matas Güell in Sandia National Laboratories which is one of the most prestigious research institutions in the US. Their unique experimental facilities, the pressurized entrained flow reactor and the optical entrained flow reactor, are made available for the GasBio work. The objective of this work is to better understand the thermochemical biomass conversion process by comparing the gasification rates and the products from different biomass sources and thermochemical conditions. The valuable first hand results will also be used to validate our CFD model. Several high level publications are expected from this work.

## Other news

### Biorefinery: priority research area within SINTEF

SINTEF Energy Research in cooperation with SINTEF Materials and Chemistry and SINTEF Fisheries and Aquaculture has been recently granted with internal SINTEF funding for a three years project addressing competitive processes and technologies for sustainable economic production of bio-based products from Norwegian renewable biomass resources. SINTEF Energy Research's main focus will be on the conversion of seaweed through hydrothermal liquefaction for the production of biofuels and biochemicals.

### New industry partner in GasBio

The Gasbio consortium has, since January 2013, been extended with the incorporation of Statkraft. This industrial partner is strategically important for the project, particularly with regards to electricity as end product in the biomass-to-liquid value chain.

### European Biofuels Technology Platform (EBTP)

SINTEF Energy Research through Judit Sandquist and Bellona through Jonas Helseth have been accepted to be part of the EBTP Steering Committee since April 2013. This step is highly relevant to Norway for achieving a central position in the development and deployment of biofuels in Europe.

**GasBio** is a Knowledge-building Project with User Involvement (KMB) co-funded by the Norwegian Research Council in the RENERGI-programme. The budget is 25 MNOK, and the duration is 4 years (2010-2014).

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