

Newsletter 2-2013

This issue highlights the project meeting arranged in the Netherlands in November.

GasBio project meeting in the Netherlands

The sixth GasBio project meeting was arranged 20-21 November in the Netherlands. The first day started with the steering committee meeting followed by a project seminar which included presentations to update the project members with the latest research results. The presentations are summarized below. The second day was devoted to a site visit in the Energy research Centre of the Netherlands (ECN) in Petten.

Gasification activities at Sandia National Laboratories, USA.

In order to better understand the effect of torrefaction on the thermochemical conversion of biomass, a collaboration study between SINTEF Energy Research, NTNU and Sandia National Laboratories (USA) was conducted this spring. A high-level experimental campaign focusing on the gasification behavior of torrefied and non-torrefied Norwegian spruce feedstocks was conducted at Sandia by Tian Li and Berta Matas Güell. Over 100 char samples were produced and collected by using Sandia's entrained flow reactor in various pyrolysis, gasification and oxidation conditions. A complete sample analysis of the collected char samples has been carried out in Norway this autumn by SINTEF and NTNU in order to characterize (SEM, BET-analysis) the main properties of the produced chars. A scientific publication on the effect of torrefaction on char reactivity will be submitted to the 35th International Symposium on Combustion in December 2013. One to two additional publications addressing devolatilization and char kinetics are expected in 2014.

Influence of pretreatment and CO₂ capture technology on BTL production

Rajesh Kempegowda and David Berstad presented the work that have been carried out on techno-economic evaluation of biodiesel production from raw and torrefied woody biomass via gasification-FT under Norwegian conditions, including several scenarios. The main process steps considered have been fuel preparation, high temperature entrained flow gasification, syngas cooling and conditioning, FT synthesis for biocrude production and biocrude separation. In addition, integration and optimization of combined heat and power and carbon capture and storage option (CCS) have been incorporated in the analysis. The study evaluates the influence of fuel preparation scenarios such as drying/torrefaction temperature, along with the key operational parameters of the plant on the overall energy efficiency of the process and on the FT biodiesel product.

Ash-forming elements chemistry during gasification

Michaël Becidan presented the thermodynamic calculations addressing ash-related challenges in biomass gasification, based on a Metso case study, employing real life data concerning both operational parameters and fuel composition. The thermal system studied has been constituted of a fluidized-bed gasifier (700-1000°C) with a mixture of sand and limestone as bed material, Finnish peat as feedstock, air excess ratio of 0.3, and with temperature as main parameter of interest. The focus has been on ash-related challenges and includes (1) general chemistry of Cl, P, Si, Na, K and Ca (partitioning and speciation); (2) Cl-induced high temperature corrosion; (3) particles; (4) deposit formation.

The calculations provide an array of insights with the most interesting ones being: (a) when aluminosilicates are available for reaction, they will prevent the formation of corrosive gaseous alkali chlorides (KCl, NaCl) by forming alkali-aluminosilicates compounds; (b) the corrosion risk will increase many fold between 700 and 1000°C and (c) combining thermodynamic and empirical models it is evaluated that, in the case studied, the deposition severity may be high from about 1000°C.

Gasification of torrefied biomass for biofuels purposes

The recent collaboration work between SINTEF and IREC (Catalan Energy Research Institute) addressing the effect of temperature (750 and 850 °C) and bed material (sand vs. dolomite) on gas and tars produced from pressurized (5 bar) gasification of Norwegian torrefied biomass was presented by Berta Matas Güell. Both, the increase in temperature and the presence of catalyst (dolomite) in the bed material proved to be beneficial not only to enhance gas yields but also to reduce tar formation. The catalytic effect of dolomite promoted tar cracking towards gas products and thus higher gas yield. Comparable trends were observed with increasing temperature, which had a positive effect on cracking reactions and tar destruction.



GasBio

Visiting ECN in Petten

A study tour visiting the Energy research Centre of the Netherlands (ECN) in Petten complemented the stay in the Netherlands.

The visit started with a very interesting meeting with exchange of information and experiences as well as discussions of technical issues and possibilities for cooperation. Avinor and Metso presented their activities and interests within gasification and biofuels, while SINTEF presented their research activities within bioenergy. Bert Rietveld gave an overall presentation of ECN, being the largest energy research institute in the Netherlands with 600 employees, and dealing with applied research. ECN has identified six core activities for the coming period; Solar power, wind energy, biomass, energy efficiency, environment & energy engineering, and policy studies. Within biomass, ECN will contribute to the bio-based economy, with focus on thermochemical conversion of biomass, and particularly within pretreatment, gasification, purification and biorefining.

Christiaan van der Meijden presented the major ECN biomass gasification activities in more detail, including direct CFB gasification and indirect FB gasification (MILENA) combined with the OLGA gas cleaning technology. The MILENA technology is a unique, patented biomass gasification technology, with its until now unparalleled high conversion efficiency. This technology converts biomass to gas, equivalent to natural gas, for use in boilers, engines, turbines or fuel cells. ECN has worked with this technology from research in lab scale facilities (25kW and 0.8MW) combined with extensive gas analysis, and further towards commercialization through a 1MWth pilot plant connected to their OLGA tar removal system running from 2008. The technologies are now licensed to Royal Dohm for certain regions, and a 12MWth is under construction in Alkmær (the Netherlands) with planned start-up in 2015.

Finally, we had a lab tour, looking at the gasification and gas cleaning facilities. It was interesting to see that ECN has a complete and interlinked biomass-to-bioSNG system at lab-scale, covering the main steps in the entire value chain. This facility is used to generate the required knowledge to select the right combinations of technologies, catalysts and operating conditions for a bioSNG-system.

Other news

Activities in IEA task 33 Thermal gasification of biomass

The first meeting of this year was hosted by NREL in Denver, Colorado, where the new laboratory for energy integration was shown. This was built with self-efficient energy consumption in mind and presented interesting solutions for energy utilization. The second meeting was held in Gothenburg where SINTEF's plans for the upgraded bio laboratory infrastructure were presented by Roger Khalil. Details were given for the newly designed entrained flow reactor and for the newly purchased pressurized TGA system.

International seminar on gasification (SGC)

SINTEF was represented by Roger Khalil at the SGC conference in Gothenburg, mainly for network building and for keeping an eye on new developments in biomass gasification technologies. At the last day of the seminar, Roger visited the GoBiGas gasification plant which was still not fully operational at that time. The GoBiGas is a gasification plant of 20 MW capacity built by Metso under a licence from Repotec for the production of bio-methane to be used for transport fuel. Another highlight of the seminar was a presentation given by Siemens detailing plans for the construction of a new methanol production plant based on entrained flow gasification of biomass. A consortium consisting of BioMCN, Siemens, Linde, and Visser & Smit Hanab, has received €199 million in grants for construction of this large-scale biomass refinery. This initiative, also known as the Woodspirit project, will make a significant contribution to the availability of sustainable and advanced biofuels, and to the bio-based economy in the Netherlands. More information about the SGC seminar can be found at <http://sgc-konf.camero.se>

Recent progress in transport biofuels in Norway

SINTEF in collaboration with Borregaard elaborated a comprehensive overview on the recent progress in transport biofuels in Norway as being one of the topics in a newsletter (Issue 34) from IEA Task 39 "Commercializing conventional and advanced liquid biofuels from biomass" (www.task39.org).

Gasification conference in London

Judit Sandquist attended the ACI's 3rd Annual Gasification Summit, which took place 6-7 November in London, UK. The conference had approximately 40 attendees, and dealt with the status, barriers and markets of biomass and coal gasification. Although coal gasification was on the agenda with interesting presentations and case studies, 90% of the participants were interested in biomass gasification, which gave a unique possibility to networking and discussions. Judit Sandquist presented the biomass gasification status and plans in Norway, SINTEF and the biomass gasification research activities as well as the planned entrained flow reactor.

Development of a gasifier

The national infrastructure application for biorefining (NorBioLab) that was submitted for funding to the Norwegian Council in October 2013 and where SINTEF Energy Research is one of the five R&D partners was successfully granted this autumn. The main objective of the Norwegian Biorefinery Laboratory is the development of processes for the sustainable conversion of Norwegian land- and marine-based biomass to novel, environmentally friendly biochemicals, biomaterials and bioenergy products. SINTEF Energy Research will be involved in this infrastructure project by developing a unique entrained flow gasification reactor, pioneer among the few existing installations in the world and the only one in Norway.

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).

For general inquiries regarding the GasBio project, please contact: Berta Matas Güell, Berta.Guell@sintef.no
SINTEF Energi AS, 7465 Trondheim, Phone: + 47 73 59 72 00, www.sintef.no/energi

