Transnational Access at Åbo Akademi University

Daniel Bernhardt of the Technical University of Dresden, Germany, outlines his experience of BRISK Transnational Access at Åbo Akademi University in Finland

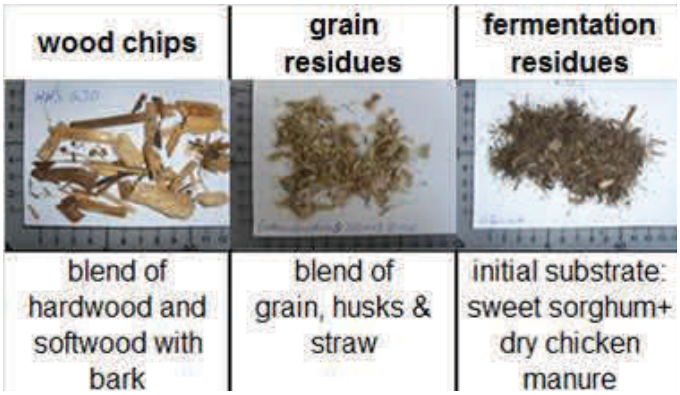

Figure 2: Biomass fuels used for experiments.

At the end of October 2014 I visited the Process Chemistry Centre of Åbo Akademi University in Turku, Finland, for ten days. The purpose of my visit was to investigate the combustion and ignition behaviour of coarse biomass particles with the Single Particle Reactor (SPR). The results of the experiments should help to interpret results of combustion tests with wood chips, grain residues and fermentation residues, which were determined in a 300kW Circulating Fluidised Bed reactor (CFB) (specifically NO formation) and an ignition furnace. These experiments were conducted at the Centre for Energy Technology (CET) in Dresden before my visit to Åbo Akademi University. The SPR was very suitable for that task, since similar reaction conditions (e.g. heating rate, reaction temperature, reaction gas composition) could be realised with the experimental setup.

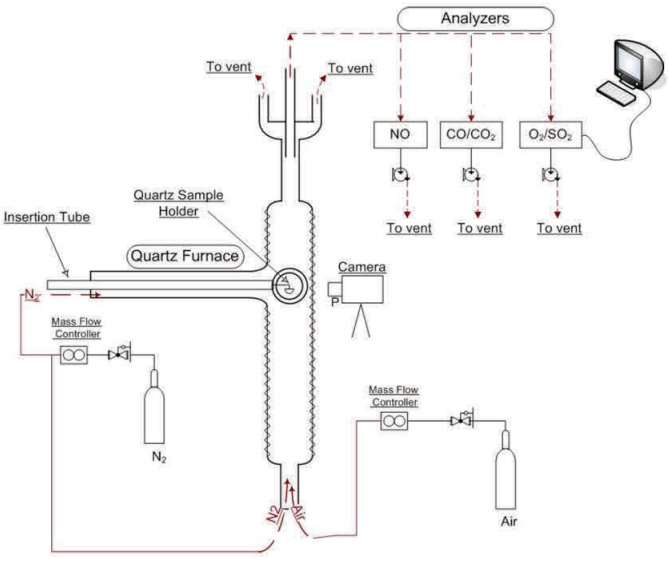

Figure 1: Schematic of the Single Particle Reactor (SPR) and gas analysis.

The SPR consists of a quartz tube which is inserted into an electrically heated ceramic furnace. For the experiments the reactor was heated to a constant temperature (800°C; 900°C) and continuously purged by a gas mixture of synthetic air and nitrogen (3vol.-% and 10vol.-%. O_2). To have similar mass and heat transfer conditions for all the fuels 70±2 mg of each biomass was compacted to a pellet. The sample was placed on a thin net in a nitrogen purged insertion tube. The sample holder was manually inserted from the cold nitrogen purged environment into the reactor and immediately exposed to the hot environment. For the measurement of CO, CO_2, and NO, the outlet gas of the reactor system was analysed with commercial analysers. To take into account the residence time distribution of the reactor system, the measured signals were deconvolved. Based on the release profiles of the measured gases (e.g. NO), the total amount of fuel-N released as NO was calculated for the complete combustion time and for the single conversion stages (volatile combustion and char oxidation). In addition to the gas analysis, the fuel conversion process of the pellet was recorded with a camera. After the experiment the ignition delay was determined by video analysis as the time difference between flame appearance and sample insertion.

Due to the excellent support provided by the team at Åbo Akademi University (Anders Brink, Oskar Karlström and Luiz Bezerra) and their extensive experience with the SPR, it was possible to carry out all planned tests (about 100 experiments). In order to prepare the experiments before the visit, Anders Brink and I had a continuous discussion about the planned

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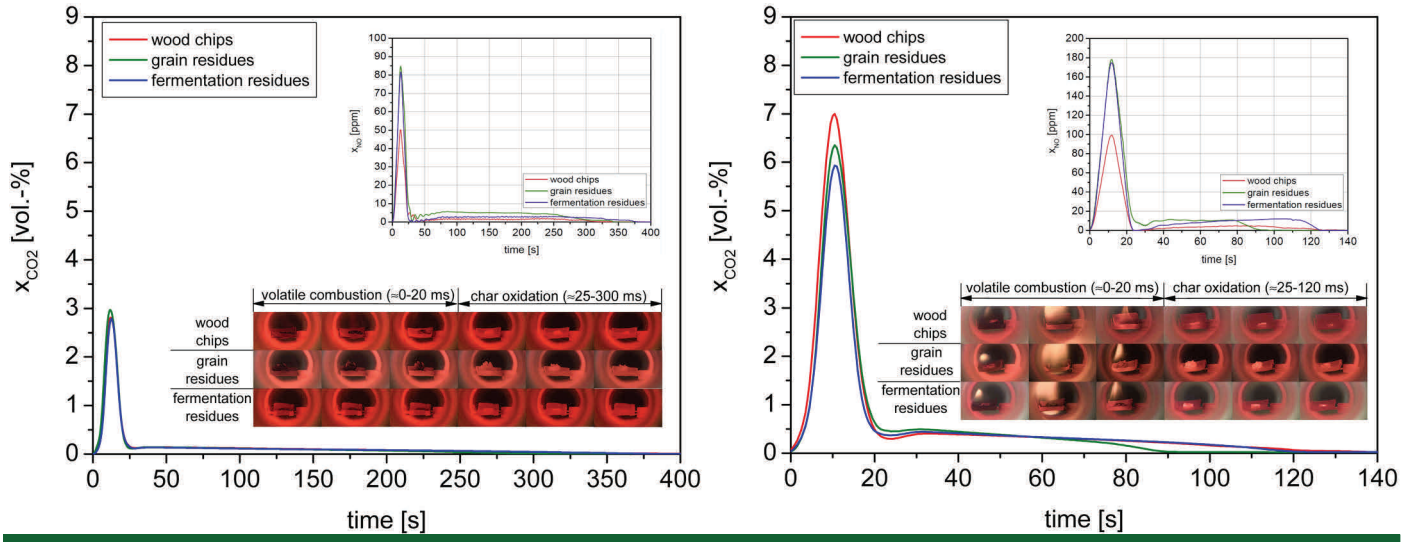

Figure 3: *Left*: Deconvolved release profiles of CO_2 and NO at 900°C for 3vol.-%. *Right:* Deconvolved release profiles of CO_2 and NO at 900°C for 10vol.-%.

tests and how to realize them. At Åbo Akademi University, Luiz Bezerra trained me in handling the SPR setup. Two days into my visit I was able to carry out my investigations independently. I was able to have discussions about the ongoing experiments and results with Oskar Karlström almost every day, and he also helped me with the evaluation of the measuring results.

The application process was very simple. Before sending off the application for my BRISK project, I contacted the host organisation and we planned the experiments and the visit. Then I completed the short application form, which received approval within three months, and I was offered the opportunity to stay in Turku for two weeks. In addition the User Selection Panel (USP) provided some valuable comments concerning my planned experiments.

From the SPR experiments at Åbo Akademi University I gained a deeper understanding of biomass conversion. The results of the experiments are a part of my PhD thesis and will be part published during the 22nd International Conference on Fluidised Bed Conversion in June 2015. Furthermore, with the help of my hosts at Åbo Akademi University, I had the opportunity to further develop my experimental skills. Many thanks to Anders Brink, Oskar Karlström and Luiz Bezerra for all of their assistance.

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Figure 4: Handling of the Single Particle Reactor (SPR).

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