

# BioCarb+ Enabling the biocarbon value chain for energy



## Newsletter 1-2015

### BioCarb+ at Energiforskningskonferansen

BioCarb+ was invited as one of four projects to present itself at Energiforskningskonferansen, the annual energy research conference arranged by the Research Council of Norway, May 21 in Oslo. Øyvind Skreiberg briefly presented the project in the session "Grenseprengende forskning" (Boundary breaking research) to the audience of more than 300 people. Outside the conference hall, BioCarb+ also had a presentation stand, including two large roll-up posters. The conference was also transmitted live at the internet, and both slide presentations as well as live presentations are available [here](#), while the content of the BioCarb+ roll-up posters are attached to this newsletter.

### BioCarb+ meeting at Elkem in Kristiansand

Arranging project meetings at industry partner locations is both wished for and interesting, and the most recent project meeting was arranged in Kristiansand May 27-28, and was hosted by Elkem. A tour of the Elkem labs was included in the program, and Elkem could show an extensive and impressive lab infrastructure connected to materials testing and characterisation. The meeting participants are pictured below.



Figure 1 BioCarb+ meeting participants.

### BioCarb+ at the 23<sup>rd</sup> European Biomass Conference & Exhibition

Three BioCarb+ papers were presented as posters at the 23<sup>rd</sup> European Biomass Conference & Exhibition in Vienna June 1-4. The abstracts of the papers are given below:

#### EFFECT OF STORAGE TIME AND CONDITIONS ON BIOMASS CHARCOAL PROPERTIES

In this work, effects of storage time and conditions on the properties of one woody charcoal were studied. Analyses results showed that the volatile matter content of the charcoal samples collected from the bottom section of containers changed significantly more than those collected from the top section. Compared to small size charcoal samples, a higher increase in volatile matter content was detected in large size charcoal samples, and increasing with increasing storage time. The fixed carbon content of all charcoal samples changed along the storage time. Results from this work suggest that long storage/transportation time at unfavorable conditions should be avoided, in order to maintain the as loaded charcoal properties during long-term transport and storage.

Keywords: charcoal, wood, pyrolysis, storage.

#### CHARCOAL PRODUCTION FROM FOREST RESIDUES

The carbonization behaviors of spruce wood and its forest residue at different conditions were studied in this work. A standard proximate analysis procedure delivered the lowest charcoal and fixed-carbon yields. Sample size considerably affected the charcoal and fixed-carbon yields. In this work, for spruce wood and its forest residue, an increase in sample size from 10 mg to 130 mg increased the charcoal yield at 950°C from 18.60 to 21.49 wt% and 26.78 to 28.12 wt%, respectively. For all TGA measurements, both charcoal and fixed-carbon yields are significantly enhanced when a closed crucible is employed, in comparison to an open crucible. The highest charcoal and fixed-carbon yields obtained in this work were offered by a high pressure TGA at 8 bar. These findings show the influential role of secondary char forming reactions. Conditions that improve or prolong contact of pyrolytic vapors with the charcoal matrix enhance the fixed-carbon yield.

Keywords: Charcoal, forest residues, wood, pyrolysis.

## COMBUSTION CHARACTERISTICS OF BIOMASS CHARCOAL PRODUCED AT DIFFERENT CARBONIZATION CONDITIONS

The combustion properties of spruce chars and spruce forest residue chars were studied in the kinetic regime by a series of TGA experiments. The work aimed at establishing how the pressure of the char preparation affects the reactivity with oxygen. In the present phase of the work the pressure during char preparation was employed on a thin layer of biomass with ample ventilation. In this way only negligible pressure effects were observed during char combustion. The kinetics of the char burn-off was described by assuming a main reaction and a side reaction. 12 experiments at three different temperature programs were evaluated by the method of least squares to obtain a dependable kinetic model. A common activation energy of 137kJ/mol gave a reasonable description of both reactions in all the 12 experiments.

Keywords: char, forest residues, wood, combustion, model.

## Stretching the terms carbonization and biocoal

The terms carbonization and biocoal are sometimes stretched quite far, also taking into account a rather mild degree of carbonization. However, the quality and area of use of the product will in practice be very different compared to charcoal. Examples are e.g. terming steam explosion based pellets as biocoal, or calling mild hydrothermal treatment conditions as hydrothermal carbonization (HTC) and the product as biocoal, even though the product in practice has only gone through a wet torrefaction. A clear distinction must be made between mild thermal treatment conditions giving torrefied fuel qualities and carbonization producing charcoal, i.e. biocarbon or biochar. The difference between these two product groups can be visualized by the figure below.

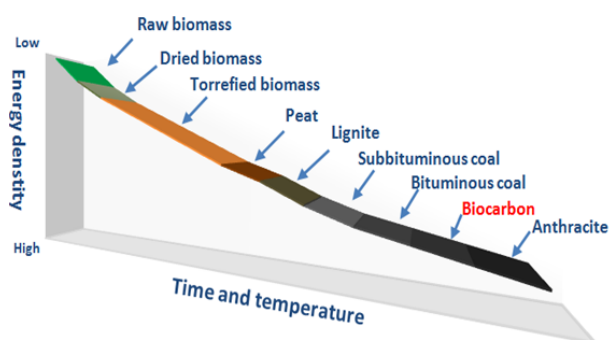


Figure 2 Biocarbon versus torrefied fuel qualities.

## Finansavisen article

The Norwegian financial newspaper "Finansavisen" featured June 19 an article regarding the use of coal in metallurgical industry and the potential of charcoal as a replacement for this. The article left a one-sided and negative impression, not mentioning several recently started projects focusing on the

future expanded utilization of charcoal in the metallurgical industry. Because of this negative impression a rebuttal was quickly formulated and published in the same newspaper a few days later, clearly showing the increased efforts, including BioCarb+, in the metallurgical industry towards increased use of charcoal as a metallurgical reductant.

## BioCarb+ summer student

A summer student financed by BioCarb+ within the SINTEF summer job program is working with aspects connected to biocarbon reactivity. The summer job is carried out partly in the Elkem lab in Kristiansand and partly in the SINTEF/NTNU lab in Trondheim. The goal is to investigate and compare the CO<sub>2</sub> reactivity of biocarbons in two different experimental setups.

## New publications

Øyvind Skreiberg (2015). [BioCarb+](#). Presented in the session "Grensesprengende forskning" at Energiforskningskonferansen, 21 May 2015, Oslo, Norway.

Liang Wang, Gábor Várhegyi, Øyvind Skreiberg, Morten G. Grønli, Michael J. Antal, Jr. (2015). Combustion Characteristics of Biomass Charcoal Produced at Different Carbonization Conditions. Presented at 23rd European Biomass Conference and Exhibition, 1-4 June 2015, Vienna, Austria.

Liang Wang, Charissø Higashi, Øyvind Skreiberg, Morten G. Grønli, Michael J. Antal, Jr. (2015). Charcoal Production from Forest Residues. Presented at 23rd European Biomass Conference and Exhibition, 1-4 June 2015, Vienna, Austria.

Liang Wang, Kathryn Hu, Charissø Higashi, Øyvind Skreiberg, Viktor Myrvågnes, Morten G. Grønli, Michael J. Antal, Jr., Gábor Várhegyi (2015). Effect of Storage Time and Conditions on Biomass Charcoal Properties. Presented at 23rd European Biomass Conference and Exhibition, 1-4 June 2015, Vienna, Austria.

## BioCarb+ in the media

Lars Martin Hjorthol, Øyvind Skreiberg (2014). Lopwood and brushwood make high-grade charcoal. [Gemini](#).

Lars Martin Hjorthol, Øyvind Skreiberg (2014). Kvist og kvas blir edelt kull. [Gemini](#). Reproduced on [forskning.no](#), [Aftenposten nett](#) and [Adresseavisen nett](#).

## Other news

### IEA Task 32 Biomass Combustion and Co-firing

A Task 32 meeting was arranged in UK June 11-12. Planning of activities for the next triennium (2016-18) was on the agenda. The next task meeting is planned in connection with the IEA Bioenergy conference in Berlin October 27-28.

### EERA Bioenergy - Stationary Bioenergy

An EERA Bioenergy - Stationary Bioenergy Sub-Program workshop was arranged at ECN in the Netherlands June 15-16. The goal of this workshop was to align efforts towards joint proposals, to e.g. H2020, within the stationary bioenergy area.

### RHC technology platform

The activity level of the RHC platform is currently limited, as new financing solutions are sought for and the originally planned strategy documents have been delivered. A decision regarding the path forward can be expected in the autumn.

**Links** (click on the links or logos to get there)

[BioCarb+](#)

[SKOG22](#)

[Energi21](#)

[Renewable Heating and Cooling technology platform](#)

[EERA Bioenergy](#)

[IEA Task32 Biomass Combustion and Cofiring](#)

