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Intermediate pyrolysis for power generation from biomass and the utilization of biochar as a fertlizier

Kebelmann, K[a]*; Hornung, A[a]

[a]European Bioenergy Research Institute, School of Engineering and Applied Science, Aston University Birmingham, B4 7ET, UK
*E-mail: prisqua@gmail.com

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Abstract

The use of biomass as energetic as well as chemical resource is of high economic and ecologic impact for the future development of Europe. Beside the classical use of wood and straw, agricultural biogenic wastes are of high interest because of low costs and high availability [1]. The use of these material as an energy or chemical resource is challenging because of their special processing demands. Usually those materials have high ash content sometimes with ashes melting at very low temperature. One solution to process these materials is via intermediate pyrolysis/gasification to generate high quality and highly energetic, dust and tar free synthesis gases for direct CHP use. As a by-product biochar of high quality is realised, which contains almost all ash fractions of the biomass used. The process is called Biothermal Valorisation of Biomass (BtVB) [2]. It is a process proven in lab scale and ready for pilot and industrial application. Core technologies are the Pyroformer [3], a gasification unit and a (gas or dual fuel) engine. Within this BtVB process the products of the intermediate pyrolysis pyrolysis char and pyrolysis vapours are treated separately. The described process will offer new options for the usage of the pyrolysis char, acting as a real source for carbon sequestration and in addition closing the fertiliser loop for new biomass growth.

The pyrolysis char, containing all the ash of the biomass is brought back to agricultural sites. This so called black earth is not only a real carbon sequestration (not CO_2 sequestration) as the pyrolysis char consists of non bioconvertable carbon being stable for at least several thousand years. The second big advantage of the BtVB process is the re-fertilisation aspect. In bringing the pyrolysis char including all the minerals, back to the soil, the agricultural sites are re-fertilised, saving not only money but energy and CO_2.

Important is to realise a biochar suitable for this purpose. Intermediate pyrolysis turns biomass in a dry and brittle char without remaining smell. The char is very stable and can be pelletised easily.

To evaluate biochar as a fertilizer first investigations have been made concerning the water solubility of plant required nutrients from biochar to gain water based fertilizers for algae cultivations. Especially for the fast growing biomass microalgae the fertiliser topic is a key point in terms of the economy and of the ecology of the process. Fertilisers and their production are expensive and causes considerable GHG emission [4]. As microalgae have a high fertiliser demand they are expensive and CO_2 intensive to produce [5]. To avoid this dilemma, a cheap and CO_2 neutral way to recycle fertiliser is the extraction of the minerals out of biochar- the residue of biomass pyrolysis- as this char contains all the minerals of the pyrolysed biomass. Studies investigates the water solubility of mineral compounds from Chlorella vulgaris Beijerinck biochar in dependency of the different particle size fractions and different extraction times.

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