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Upgrading of Fast Pyrolysis Byproducts for Material Use with High Value

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Motivation and Aims

Fast pyrolysis is a thermochemical conversion process for the production of liquid substances from solid organic fuels, be it a blend for energetic use (liquid fuel) or more specific chemical substances for material use. However, complete liquefaction of the biomass cannot be achieved and there is always a solid byproduct, i.e. char. The amount of this byproduct increases inevitably when feedstocks with high ash content are used (see Figure 1).

In this study, activation of fast pyrolysis char was investigated. One focus was on suitable ways to deal with the high ash content of the char (~40 %) which results from using wheat straw as feed material. The aim is to produce a marketable pulverized activated carbon (PAC). After the use for adsorption, spent material can still be used within the bioliq® concept for the production of chemicals and/or drop-in fuels.

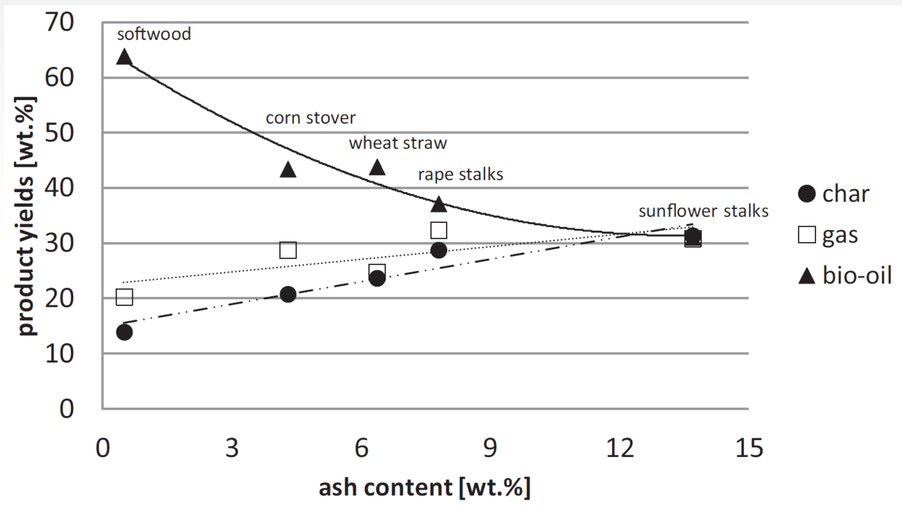
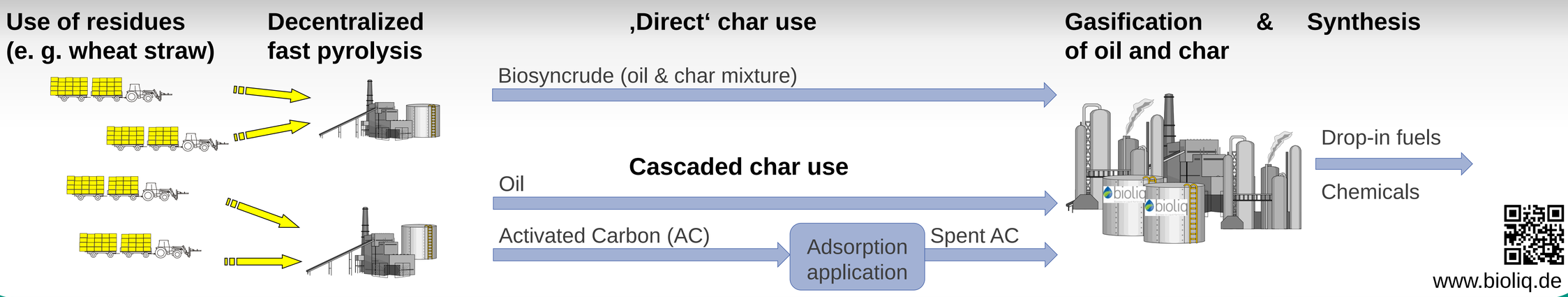


Figure 1: Fast pyrolysis product distribution with varying ash content of the feedstocks [1]



Experimental Section and Results

The experimental procedure of activation started with a demineralization yielding a demineralized char. With this demineralized char, chemical activation at 700 °C (method described in Figure 3) and steam activation at 750 °C were conducted.

Steam activation produced an activated carbon with much higher ash content due to the carbon burn off, which results in an enrichment of minerals. In consequence, the BET surface area of the steam activated carbon is comparably low (Figure 2). Activation with KOH leads to a near complete removal of inorganic compounds and a suspiciously high BET surface area. Iodine number (ASTM D 4607) has been determined for the chemically activated carbon to be 2400 mg g^{-1}. It is concluded that the fast pyrolysis char has been activated successfully [2].

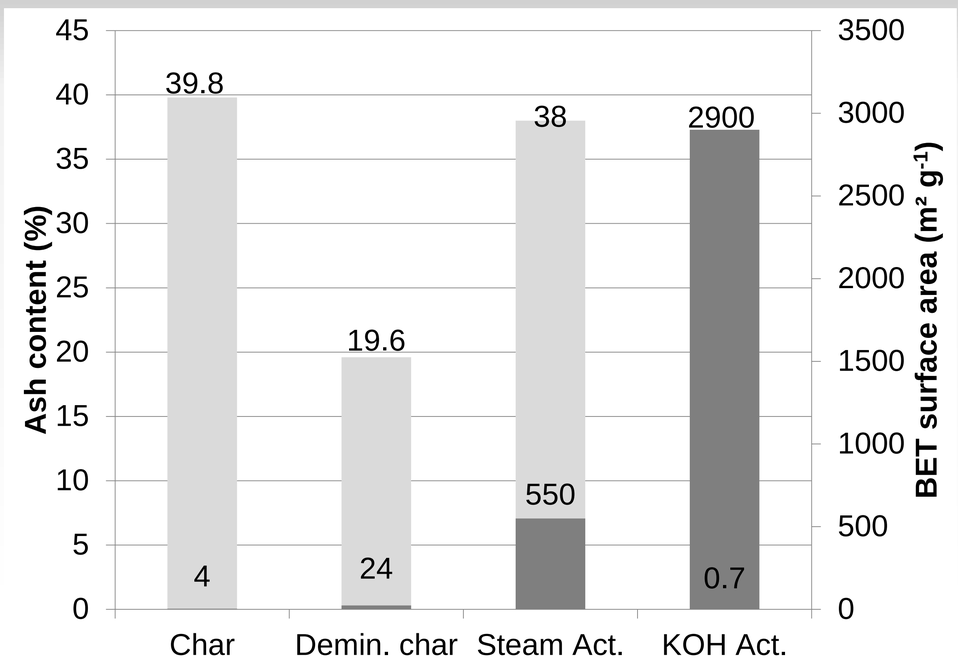


Figure 2: Ash content and BET surface area of char, demineralized char, steam activated carbon, and chemically activated carbon

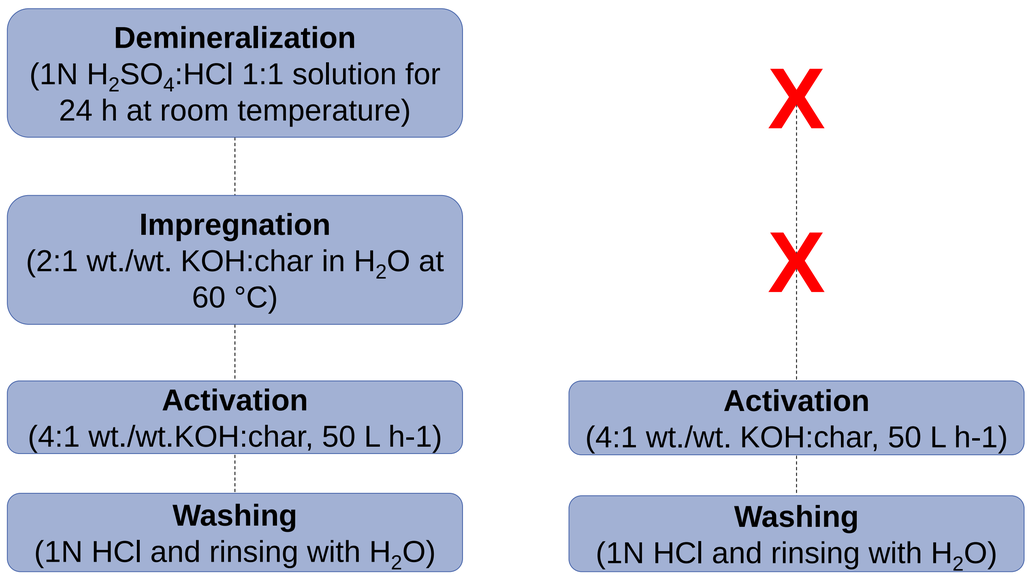


Figure 3: Full and simplified method for chemical activation

Notably, demineralization decreased the ash content only by about 50 % whereas chemical activation lead to a near complete removal of ash. Screening tests were performed to simplify the chemcial activation method (see Figure 3) and it was found that the activation and washing step is sufficient to achieve a near complete removal of ash components.

Further reserach will be conducted to optimize the activation procedure in order to achieve an economically viable solution. Furthermore, process integration will be investigated to assess possible synergies when the activation step is conducted on site of the pyrolysis plant.

[1] Tröger, N., D. Richter, et al. J Anal Appl Pyr 100 (2013) p 158-165.
[2] Funke, A., A. Niebel, et al. Bioresour Technol, *submitted*

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