Time-Dependent Catalytic Activitation of Layered K-feldspar in Fluidized Bed Conversion

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thermal gasification

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Introduction

Previous studies have shown that an ash layer forms on the bed material during dual fluidized bed steam gasification which increases the catalytic activity towards gasification reactions. Similar layer formation has been observed during combustion, enabling the use of bed materials from combustion when studying gasification enhancing behaviour of bed materials.

Materials and Methods

K-feldspar bed material samples were periodically taken from fluifized bed combustion. The fuels used were bark, chicken manure, and a mixture of 0.7 mass fraction bark and 0.3 mass fraction chicken manure on a dry basis. Scanning electron microscopy (SEM) analysis was performed for all collected bed material samples to study the time-dependent layer formation on the bed materials.
The samples were additionally studied regarding their catalytic activity towards the water-gas-shift (WGS) reaction in a micro-scale test-rig focusing on the time-dependent activation of K-feldspar. CO and H_2O are fed into a fixed bed reacting to CO_2 and H_2. A higher catalytic activity will result in more products.

Results and Discussion

Figure 1 displays SEM images obtained for the combustion of the bark-chicken manure mixture. A layer is forming on K-feldspar, with its thickness increasing over bed material age.

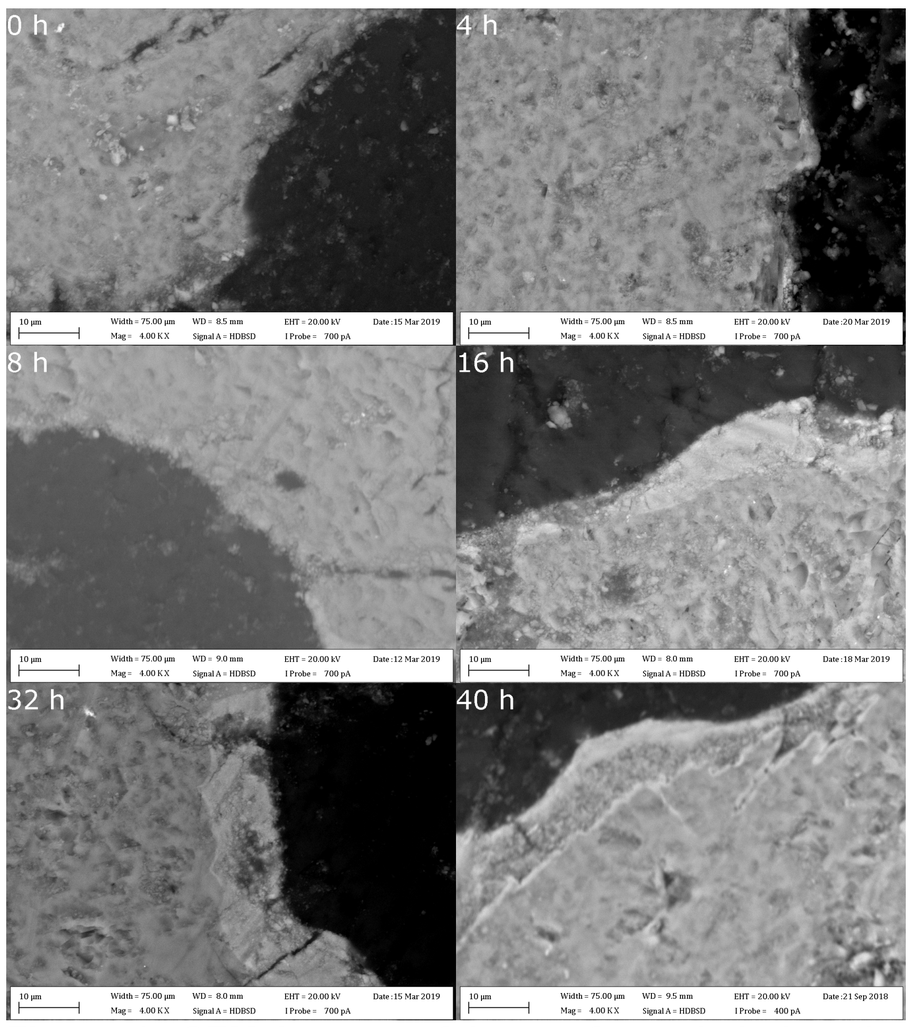

Figure 1: SEM images of layers formed during the combustion of the mixture.

Figure 2 displays the H_2 content measured for the bed material samples over particle age. As for the layer thickness, the catalytic activity clearly increased with bed material age. The samples from chicken manure combustion displayed the highest H_2 concentrations in the first hours until the combustion experiment had to be terminated. The samples from bark combustion display the lowest H_2 contents. This corresponds to the fuel ash content, with the highest ash contents leading to the fastest activation.

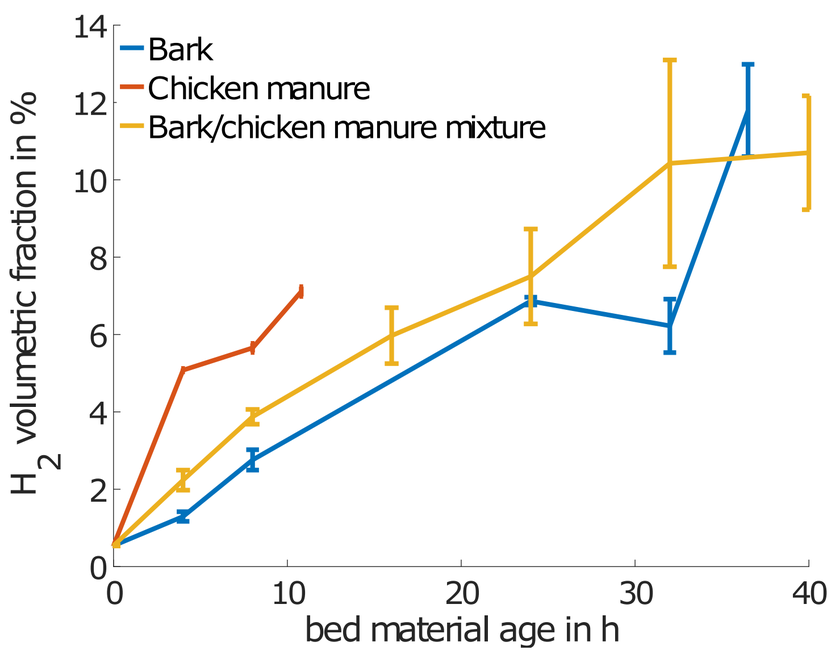

Figure 2: Catalytic activity of K-feldspar regarding the WGS reaction over bed material age

Conclusion and Outlook

The layer thickness, as well as the catalytic activity regarding the WGS reaction clearly increased during the interaction with biomass ash. The amount of ash in the fuel sped up the activation of the bed material. Longer combustion experiments are necessary to determine the final achievable catalytic activity and its dependency on the fuel used. Additional investigations are also necessary to determine whether the catalytic activity is dependant on layer thickness and composition.

Acknowledgment

BIOENERGY 2020+ GmbH is funded within the Austrian COMET program, which is managed by the Austrian Research Promotion Agency (FFG) and promoted by the federal government of Austria as well as the federal states of Wien, Niederösterreich, and Steiermark. We are grateful for the facilities and technical support (Cheng Choo Lee) of the Umeå Core Facility for Electron Microscopy (UCEM) at the Chemical Biological Centre (KBC), Umeå University.

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