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Anaerobic stability of biochars from pyrolysis and hydrothermal carbonization

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Biochar is suggested for a broad variety of different applications, ranging from soil amendment to supplement for animal feeding and biocatalyst. This includes the exposure to various bio-active environments such as soils, animal digestion systems and bio-reactors. For optimal design and usage of the biochars not only the physicochemical properties matter, but also bio-stability and interaction with the specific micro flora.

With the aim to get further insights on how different biochars behave under anaerobic fermentative conditions, according digestion experiments were carried out. This included two types of chars – from pyrolysis and from hydrothermal carbonization. The experiment was conducted in 100 ml syringes incubated with digestate for 63 days at 42°C. This data was also compared with experiments carried out in other studies, specifically with biochar derived from pyrolysis, where the experiment was conducted in 1L batch reactors, with 30 days of retention time at 37°C. During this time gas production and gas composition were monitored. Afterwards the chemical properties were determined. From the measurement results a simplified kinetic model was derived and, by means of curve fitting, the degradation kinetic parameters were obtained. In addition, also the impact on the anaerobic micro flora was investigated by DNA based technique.

The results show that under anaerobic conditions pyrolysis chars are highly inert, whereas HTC chars are subjected to degradation in the order of magnitude of 10 % (carbon basis). The results from anaerobic treatment correlate to a certain extent with data from aerobic stability tests in soils. Thus, the anaerobic technique may provide valuable data for distinguishing different forms of carbon in biochar and contribute to a better understanding of biochar degradation in different environments.