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Thermochemical pre-treatments for the hydrothermal liquefaction of sewage sludge

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Hydrothermal liquefaction (HTL) is a thermochemical process for converting directly wet biomass and organic residues into bio-crude. This product can be applied as a drop-in transportation fuel or substitute petroleum in refi neries. Advantages of the process are high conversion rates, the catalytic effect of the reaction medium water and, consequently, the previously mentioned ability to utilize a wet feedstock like sewage sludge. Nevertheless, the production of biofuels by HTL of sewage sludge involves several problems, especially in regard to the inorganic components and the formation of heteroatomic compounds. Sewage sludge has a relatively high content of inorganics, mostly alkali and alkaline earth metallic species, which were used upstream in the wastewater treatment process. This high ash content in the feedstock is refl ected in the bio-crude yield and quality and challenges the catalytic upgrading to fuels e.g. by a decrease in catalyst activity due to poisoning and depositions. Additionally, sewage sludge is a biogenic material rich in proteins and contains, in particular, high amounts of nitrogen and sulphur. These heteroatoms can reduce the heating value, lead to un-desirable emissions and thus increase the costs for downstream processing. In this study, we investigate the infl uence of different pre-treatment methods prior to sewage sludge conversion. Different leaching-agents and temperatures are applied to transfer inorganics and organic nitrogen into the liquid supernatant. In a next step, the resulting solids will be dewatered and converted into bio-crude by HTL. Research work focuses on how the sludge changes in its physical–chemical composition by the pre-treatment, the impact on the HTL product yields as well as on the bio-crude quality.

Therefore, the bio-crude is being separated into different fractions to determine the elemental composition and, consequently, their species. The overall goal of this work is to develop an effi cient pre-treatment method for HTL of sludge. It is expected that an acid pre-treatment at ambient temperature remove inorganic constituents from the sewage sludge matrix and with rising temperature proteins start to hydrolyse and deamination reactions occur. The tretment will lower the nitro-gen, but also the carbon content in the sludge the subsequent HTL bio-crudes will have a higher quality. Additionaly the carbon recovery is investigated and correlated with the bio-crude.

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