UNIVERSITÄT HOHENHEIM

INSTITUTE OF AGRICULTURAL ENGINEERING

Department of Conversion Technologies of Biobased Resources (440f)

Head of Department: Prof. Dr. Andrea Kruse

Production of Activated Carbon via Hydrothermal Carbonization (Thesis/Project)

Motivation

The production of activated carbons from cellulose-rich materials has been investigated in the past few years for the adsorption of micropollutants. For this purpose, several feedstock rich in cellulose content were considered such as, farm crops and, dry biomass. Due to the huge amount of solid residues rich in cellulose produced on the water treatment plants, there is considered as an interesting feedstock for the production of activated carbon.

Moreover, the production of activated carbons consists of two steps. First, the production of a rich carbonaceous material using the initial feedstock. This step is usually done by a thermochemical process (i.e. pyrolysis and/or hydrothermal carbonization). The main different between treatment is the desired amount of water in the initial feedstock. Second, the production of the activated carbon by using a thermal (only temperature) physical (temperature and oxidizing agent) or chemical treatment (temperature and chemical reactant). On the other hand, the necessary treatment of the residues generated from the chemical treatment makes to focus more deeply into thermal and physical treatments.

Thus, the aim of this project is the valorization of rich cellulose feedstock through the production of activated carbons by using physical and/or thermal treatments for the absorption of micropollutants.

Task Description

1. Screening into Hydrothermal Thermal Carbonization (HTC) with three different sewage sludge and pyrolysis.

Production of hydrochar at the hydrothermal carbonization reactor unit (250 mL volume) with three feedstock with two three temperatures (180, 220 and 240 °C) and reaction time (2 and 4 h). The obtained hydrochars will be activated under nitrogen and steam atmospheres. The physicochemical properties will be compared for the understanding of effect of HTC and activation with different operating conditions.

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2. Investigation on scale-up effects in HTC: From Autoclave to mini plant

Production of hydrochar at the hydrothermal carbonization reactor unit (250 mL volume) with one feedstock with two different biomass-to-water ratio, three temperatures (180, 220 and 240 °C) and reaction time (2 and 4 h). The most suitable conditions based into the physicochemical properties of the hydrochar will be scale up at the mini plant (8 L volume).

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3. Investigation on the specific surface area and porous size, chemical elements and the absorption capacity of activated carbon in sewage treatment.

Production of activated carbon at 3 different temperatures (600, 800, and 900 °C) with thermal and physical activation in a fixed-bed pyrolysis reactor. Obtained activated carbon will be studied the micro and mesoporous of obtained activated carbon, chemical elements content and the absorption capacity with different dyes (methylene blue, …).

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