PYROLYSIS OF RESIDUES FROM WELL-ESTABLISHED BIOCHEMICAL PROCESSES FOR THE PRODUCTION OF BIOCHAR

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The main objective of this work is to use pyrolysis for the production of biochar from the residues of well-established biochemical processes. The residues that were selected come from two major conversion processes: biogas digesters, and wastewater treatment facilities. These processes produce unconverted lignin-rich residues, made of biomass components that are refractory to biochemical conversion. Pyrolysis is an aggressive thermochemical conversion process that is ideally suited to such residues. The desired biochar characteristics were determined by the specific needs of each industrial partner. The desired traits for the biochar obtained from sewage sludge were the capture, and stabilization of heavy metals contained in the sludge, to reduce the release of heavy metals into the environment. The desired traits for the biochar obtained from anaerobic digestate were the release of nutrients (Nitrogen, Phosphorous, and Potassium) for use as a soil amendment in greenhouses. Carbon sequestration, as well as the thermal sustainability and process economics of pyrolysis were also considered as vital evaluation criteria. Soxhlet extraction provided reproducible, standardized measurement of the release of char components to water. ICP was used to determine the concentration of various metals in the char.Three types of pyrolysis were examined: slow pyrolysis with a heating rate of 10^{o}C/minute in a mechanically fluidized reactor, fast pyrolysis in a fluidized bed reactor, and fast autothermal pyrolysis with partial oxidation in a fluidized bed reactor. The effects of pyrolysis conditions on the desired product characteristics were evaluated. A new method for the determination of the enthalpy of pyrolysis was also developed, allowing for an accurate energy balance to be performed. It was found that high water contents in the feedstock could be accommodated without requiring any additional energy other than that found in the bio-oil and gaseous products. The production of biochar through pyrolysis is an effective and efficient method for the valorization of the solid residues from biogas digesters and wastewater treatment plants while addressing the specific concerns of each industry.