RECOVERY OF PHOSPHORUS FROM MUNICIPAL SEWAGE SLUDGE THROUGH DIFFERENT THERMAL TREATMENTS

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Phosphorus (P) is an essential and irreplaceable plant macronutrient, and the main source for P fertilizer, mined rock phosphate, is a critical non-renewable globally demanded resource facing an increasing concern about the commercial availability and cost in the near future. However, with the proper match between thermal process design and operation, fuel characteristics and end-use, it may be feasible to close essential phosphorus-loops and coproduce non-fossil energy and high quality P fertilizers from collection and conversion of organic secondary resources. Some of the secondary organic resources e.g. sewage sludge carry both a substantial energy potential, and a very high content of plant nutrients including P [1]. To fulfill this potential, thermochemical platforms, including pyrolysis and gasification, have been identified as very promising due to flexibility, thermal efficiency and the ability to simultaneously address biochar valorization and energy utilization [2].

During thermochemical treatment of such materials, the organic fraction is converted into heat and combustible gases while the majority of the inorganic compounds (including P) are retained in a solid residue (biochar/ash). In addition to energy production and concentration of the residing nutrients, the thermal process also purifies these by removing/destroying pathogens, organic xenobiotics and certain heavy metals [3].

In this study, sewage sludge is subjected to slow pyrolysis, steam-gasification and incineration to investigate the effect of temperature profiles and processing atmosphere on the phosphorus fertilizer quality in the ash/char residue. To evaluate the fuel quality of sewage sludge in the three processes, wood chips are included as a best-case reference. The wood and sewage sludge samples as well as the resulting pyrolysis biochar, incineration ash and gasification ashes are all tested for proximate analysis, elemental analysis and porosity (BET) as well as P fertilizer quality through soil incubation studies.

These tests are the first steps to assess the feasibility of co-producing non-fossil energy and engineered P rich biochars by thermal processing of secondary biomass resources and evaluate the possibility of combining agricultural residues to obtain materials that improve soil properties. This would result in a step forward on the state of the art of P management technologies and a valuable solution to the challenge of P supply and recovery as well as in a reduction of environmental problems related to the inappropriate management of secondary biomass resources.

References

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