INFLUENCE OF GAS CARRIER AND TEMPERATURE ON THE PYROLYSIS OF CONTAMINATED BIOMASS

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Abstract
Pyrolysis is considered as a suitable thermochemical treatment when the biomass sources are contaminated by potentially toxic elements (PTEs). More than the type of the feedstock, the pyrolysis operating conditions are the key parameters affecting the transformation of PTEs during the thermal treatment and the migration and distribution to the pyrolysis end-products. By a proper choice of the pyrolysis conditions allow to concentrate the PTEs in the solid product (biochar) leaving the vapor phase (bio-oil) free of heavy metals thus enabling its use as a fuel[1]. Pyrolysis temperature is the main variable affecting PTEs concentration and recovery in the biochar in a more thermally stable form than those found in the original biomass. At lower temperature PTEs are confined in the biochar, and their concentration increases with the temperature, whereas 550-700°C is the optimal range for producing biochar with both high porosity but less PTEs concentration. Moreover, high porosity and surface area are the most relevant properties for biochar application involving solid–fluid interface phenomena in different application fields [2] (fertilizer, activated carbons precursor, filler in wood and polymer composites, contaminants adsorbent in wastewater and soil, floating cover). A key aspect for the enriched PTEs biochar application is the assessment of its toxicity related to the PTEs mobility and bioavailability. To the best of our knowledge, temperature and heating rate are already faced out for the PTEs behavior, but there is still a knowledge gap concerning their fate under different pyrolysis reaction environments. To this aim, in the present study lignocellulosic biomass (populus nigra) contaminated by Pb is tested under slow pyrolysis conditions (HR=5 °C/min), and the effect of temperature (465, 550, 700 °C) and gas carrier (N_2, CO_2, H_2O and mixture of them) are investigated on biochar properties and PTEs behavior. The risk assessment of the biochar is also performed based on the sequential extraction procedure defined by the European Community Bureau of Reference (BCR) that allows for the classification of metals in the biochar in different chemical categories.

[1] Grottola, C. M., Giudicianni, P., Pindozzi, S., Stanzione, F., Faugno, S., Fagnano, M., Ragucci, R. Steam assisted slow pyrolysis of contaminated biomasses: Effect of plant parts and process temperature on heavy metals fate. Waste Management; 2019; 85, 232-241.
[2] Qian K., Kumar A., Zhang H., Bellmer D., Huhnke R., Recent advances in utilization of biochar. Renewable and Sustainable Energy Reviews; 2015, 42, 1055–1064.