PHYSICAL AND MECHANICAL PROPERTIES OF PYROLYZED PELLETS

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Pellets have higher densities than the raw materials they are composed of and are convenient feedstocks for continuously operated pyrolysis reactors. They allow the possibility of co-pyrolyzing different types of feedstocks in the form of semi-homogeneous particles. Further use of pyrolyzed pellets (i.e. biochar) is highly dependent on their physical and mechanical properties, as these are the indicators of feasibility for transportation, storage, and automation. In the current study, slow pyrolysis of 11 types of pellets was performed in a screw reactor (i.e. Stage II – The UK Biochar Research Centre) operating at 550 °C and 700 °C. The pellets were prepared from buckwheat husks, hemp shives, giant miscanthus stalks, and hazelnut shells as main components and 10 wt.% of coffee grounds or potato pulp as binders in selected cases. Before and after slow pyrolysis, the physical and mechanical properties, i.e. diameters, bulk and particle densities, and drop resistances of pellets and biochars were measured. The results indicate a strong correlation between the bulk density of pellets utilized in pyrolysis and the bulk density of biochar produced, and due to the decrease of particle diameter at higher process temperatures the biochar bulk density remained at similar levels for products obtained at 550 and 700 °C. Moreover, the correlation between the particle and bulk densities of produced biochars has been defined (Figure 1). By measuring the change in particle densities of pellets fed to the reactor and the pellet-biochar produced it is possible to estimate the bulk density of the latter with high precision (0.91 and 0.83 for biochar produced at 550 °C and 700 °C, respectively). These findings, which led to the processing and estimation of the transportation and storage costs of pyrolyzed pellets (biochar) in the case of a limited amount of data (samples), have a high potential in industrial and scientific applications. The addition of binders in the form of potato pulp or coffee grounds may lead to an increase in the bulk density of biochar and improve its drop resistance, however, this effect is dependent on the main biomass used for pelletization.

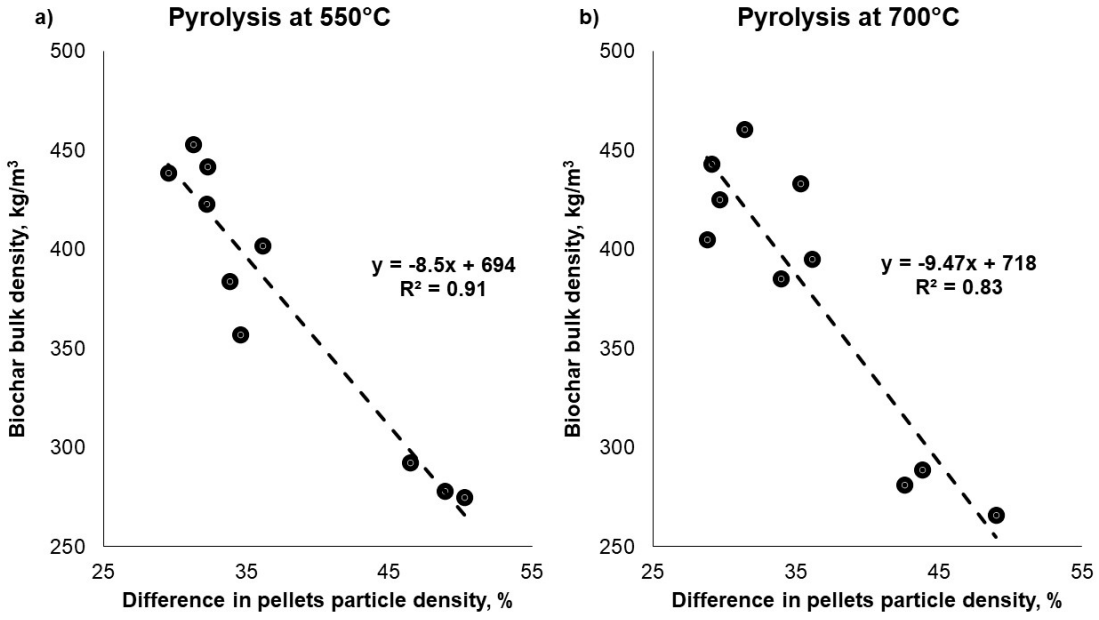

Figure 1. Correlation between the difference of pellets particle density before and after pyrolysis and biochar bulk density at a) 550 °C and b) 700 °C