

LIFE CYCLE ASSESSMENT OF BIOCHAR PRODUCTION FROM SOUTHERN PINE

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Biochar, a major co-product from the pyrolysis of lignocellulosic biomass is rich in carbon and is often used as a soil amendment to promote crop production and as a soil carbon sequestration medium to maintain long-term soil health of marginal lands. Pyrolysis is the thermal decomposition of biomass in the absence of oxygen to primarily produce bio-oil with biochar being a co-product. Biochar is also primarily produced from wood logs using conventional carbonization methods (eg. Missouri kilns). For sustainable production of biochar, the most sustainable production route is important for large-scale production of biochar for soil carbon sequestration applications. The main objectives of this study were to conduct the life cycle analysis of producing biochar using three major production routes (fast pyrolysis, slow pyrolysis and Missouri kiln) and to evaluate the life cycle energy and environmental impacts of biochar production from southern pinewood. A cradle to gate approach was used from pine seedling to biochar production with a functional unit to produce one metric tonne of biochar. A detailed mass and energy balance analysis was carried out for each production route to develop emission inventory data. Then, the environmental impact assessment was conducted to evaluate total energy consumption, natural resources use and major environmental impacts using TRACI and BEES methods. Both

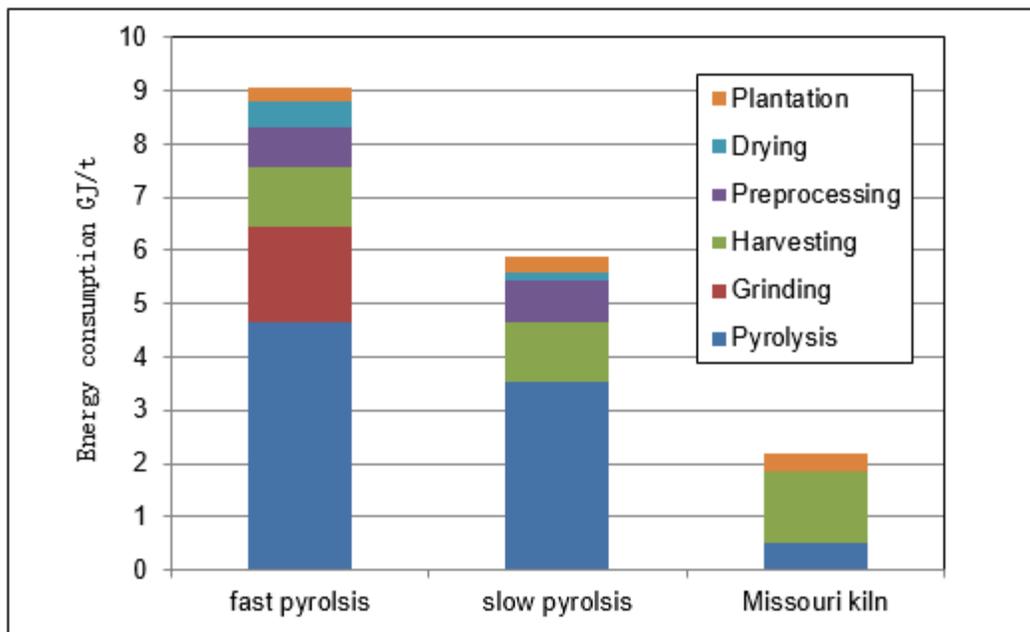


Figure 1 –The breakdown energy consumption of producing biochar from three production routes

mass and energy based allocation approaches were used to assess environmental impacts and compared among production routes. In addition, the sensitivity of major process parameters, fugitive emissions, biomass yield, and biochar yield on the energy use, major environmental impacts such as greenhouse gas (GHG)

emissions, acid formation, eutrophication, smog formation potentials. It was found that the conventional carbonization method using Missouri kiln system used the least among of total energy to produce biochar due to limited unit operations required to produce wood logs compared to those of fast and slow pyrolysis technologies (Fig. 1). On the other hand, the GHG emissions were the highest for the Missouri kiln system and the least for the slow pyrolysis system among the three production routes. The study also compared the energy and environmental impacts of biochar production from forest residues over clean wood chips derived from wood logs to assess the environmental implications of forest residues for biochar production.