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Production of Food Waste-Based Biochar Using Double-Barrel Carbonization Technique.

Deshan Vidusanka
Department of Applied Computing
Faculty of Computing and Technology
University of Kelaniya
Kelaniya, Sri Lanka
deshan.vidusanka@gmail.com

Chanaka Udayanga
Department of Applied Computing
Faculty of Computing and Technology
University of Kelaniya
Kelaniya, Sri Lanka
Chanakau@kln.ac.lk

ABSTRACT

The high amount of solid waste generation is a critical challenge in Sri Lanka to maintain an effective waste management strategy. Among them, the first largest percentage of waste generated which is food waste generation has become a challenging task for food management due to the high consumption of food waste, and the lack of waste-collecting methods. The major aim of this project was to perform the effective pyrolysis of food waste generated in the household, using the double-barrel carbonization technique to achieve biochar yields that meet the specifications of the final applications. A review of the literature was carried out to identify an acceptable design for the double-barrel working module and dimensions that would fit that design[1]. The mild steel double barrel experimental unit is shown in Figure 1.

Figure I- Working module of manufactured double-barrel.

Dimensions of the outer barrel were 280 mm ×190 mm (height × diameter) and the inner barrel consisted of 90 mm × 250 mm (height × diameter). The household's disposable food waste, including banana peels, rice, and peanut shells, was collected. For the first and second experiments, 60 g of each trash was collected. Then, 25 g of each waste (Banana peels 25 g, rice 25 g, peanut shells 25 g) was measured for each experiment on an electronic scale. A thermocouple was placed in the inner barrel and filled with 25 g of each food waste (banana peels, rice, and peanut shells). Then, charcoal was filled in the outer barrel and burnt to get the desired temperature (400 °C) and dwelled for 30 more minutes to ensure complete conversion of food waste. Finally, a preliminary experiment was done to evaluate the behavior of biochar during the absorption process. The rising temperature of the thermometer is influenced by the height of the thermocouple placed inside the inner barrel. Hence, measured the height of 4 inches of the thermocouple that was placed inside the inner barrel and observed data of the temperature rising over time for both the first and second experiments. The inability to move the thermocouple to monitor the temperatures at different points inside the inner barrel is one of the challenges in doing this experiment. In order to be able to measure the temperature at each location on the inside of the barrel, it is crucial to improve the modification of the thermocouple in future investigations. The temperature fluctuation overtime during the production of the food waste-biochar was separately demonstrated for two experiments as shown in Figure 2.

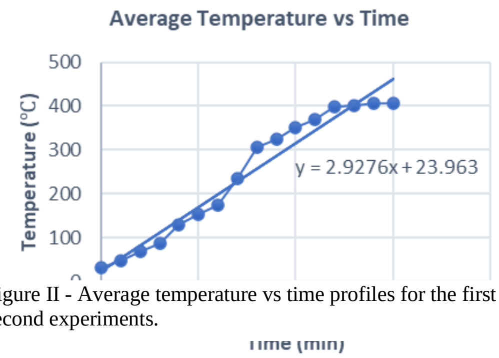

Figure II - Average temperature vs time profiles for the first and second experiments.

Throughout the experiment, linear behavior is visible in the graph of the rising average temperature with time. A temperature range of 398–406 °C was used to obtain biochar yield, and an approximate heating rate of 2.9 °C/min was used to ensure slow pyrolysis. The production rate of pyrolytic biochar decreased with rising temperatures and the impact of the heating rate for the pyrolysis of food waste, which continuously reduced the yield of the biochar with increasing the heating rate. Therefore, the persistence of a high-temperature range for an extended period of time may be the cause of the lower biochar output in the second experiment than the first.

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Keywords— Biochar, Double-barrel technic, Pyrolysis, Slow Pyrolysis, food waste.

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