Production of Garden and Wood Waste-Based Biochar Using Double-Barrel Carbonization Technique

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ABSTRACT

Presently, Sri Lankan society is facing a severe challenge in effectively managing the increasing amount of produced wood and garden waste portion of municipal solid wastes. This problem led to serious socio-economic and environmental concerns, which in turn resulted in this project's actions aiming to promote sustainable wood and garden waste management solutions domestically. The main objective of this project is to develop an engineering application for converting Wood and garden-based waste to energy and biochar as a valuable product. Thus, this study guarantees that the double-barrel pyrolysis technique is effective as an urban household application to produce wood and garden waste-based biochar. When selecting a suitable design and dimensions for the double barrel working module, significant considerations included the effectiveness of biochar production (percent conversion), pollution prevention, ease of use, safety, durability, labor, and material expenses. Used discarded wood chips, coconut shells, and husks were carefully cleaned and dried for three days in the scorching sun when preparing the mixed waste samples for experiments. The inner barrel was filled tightly with dry wood and garden waste and placed upside down inside the outer barrel [1]. Therefore, the garden waste will not be exposed to O2 during the heating process. The volume between the containers was filled with wood, which was burnt for heating the inner barrel [1]. After the pyrolysis of garden waste, the solid produced is called biochar. The actual double barrel working model was manufactured using mild steel, which has a high melting point of 1350°C-1530°C [2] and, a thermal conductivity of 42 W/m K at 400 °C [3], with an inner barrel dimension of 0.25 m × 0.09 m × 0.003 m and outer barrel dimensions of 0.28 m × 0.19 m ×0.005 m (height× diameter ×thickness). The selected material, mild steel, was able to withstand without any deformation around 350°C to 450°C+ pyrolysis temperatures, and it was able to cool for the next experiment rapidly. Figure I depicts the finished mild steel double barrel working module. Based on the data obtained during the experiment, the graph of the upward average temperature over time (Figure II) is used to calculate the heating ratio for the wood and garden waste-based biochar product, It is 0.06875ºC/s. The conclusion reached here is that the small-scale double-barrel model can be used to obtain more than 30 wt% of wood and garden waste-based biochar yield from the input sample, through an hour of heating at a temperature range of 390°C to 420°C. Analysis of the produced biochar provided significant data and increased the overall understanding of slow pyrolysis technology. Figure III shows a picture of the yield of wood and garden waste-based biochar produced by using the double barrel working module under zero oxygen conditions. The double barrel pyrolysis experiments in this study indicated that wood and garden waste-based biochar were successfully produced domestically, providing a sustainable solution for municipal solid waste management.

Figure I- Side view of the manufactured actual double barrel working module.

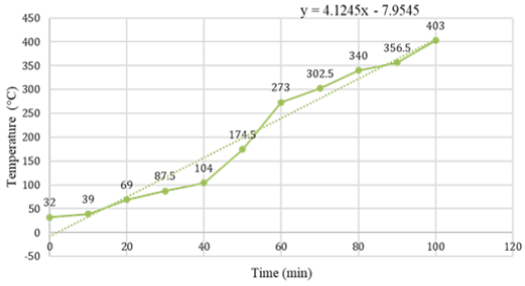

Figure I - Average upward temperature vs time graph of two experiments for production of wood & garden waste-based biochar using double barrel working module.

Figure IIII - yield of wood and garden waste-based biochar.

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Keywords— Biochar, Carbonization, Double-barrel technic, Municipal solid waste (MSW), Pyrolysis, Slow Pyrolysis, Wood, and garden waste.

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