Production of Biochar from Biomass

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Introduction

- Biomass is a renewable source of energy that comes from animal and plant materials. [1]
- Biochar is a kind of charcoal that is produced from biomass using pyrolysis technology.
- There are multiple environmental and agronomic benefits when biochar is used as a soil amendment. [2]
- Reports on the impact of biochar on soil indicate that biochar quality is important for crop yields.
- The objective of this research is to produce biochar from biomass and to study its properties.

Methods

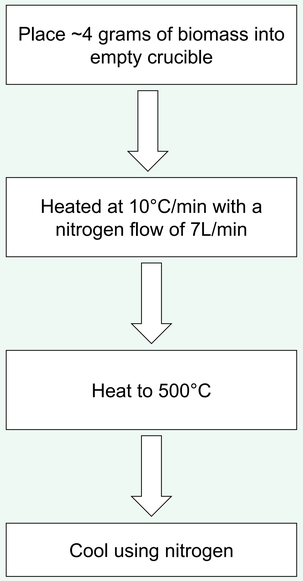

Figure 2: Char preparation method in TGA

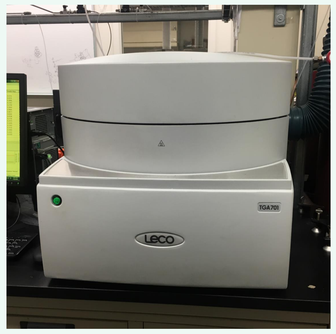

Figure 1: TGA Leco

Thermogravimetric Analysis (TGA) was used to measure the weight loss behaviour of the biomass as temperature increases.

Figure 3: Wood is shredded to 1-2mm samples and then charred in the TGA

Results

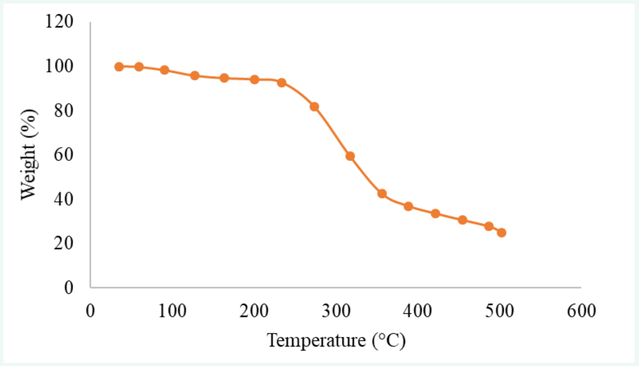

Figure 4: TGA curve to show weight loss at different temperatures

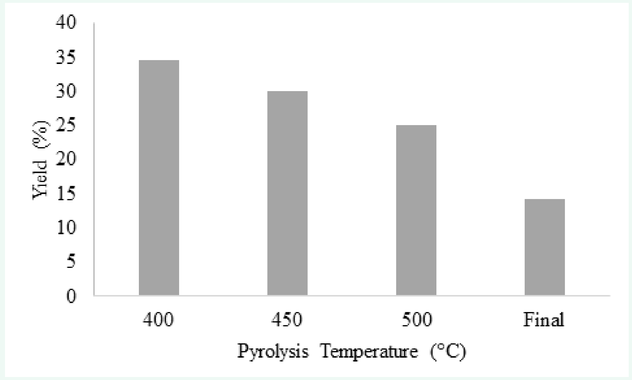

Figure 5: Char yield at different temperatures. Particle size of the biomass used was 425micron to 2mm

Table 1: Proximate Analysis (weight percentage)

Sample	Moisture	Volatile	Ash	Fixed Carbon
Wood	6.5	76	1.5	16

Table 2: Elemental Analysis (weight percentage)

Sample	Carbon	Hydrogen	Nitrogen	Sulfur	Oxygen*
Wood	46	6.2	0.2	0	47.6

*Calculated from difference

Table 3: Surface Area & Pore Volume

Sample	Surface Area m^2/g	Total pore volume cc/g
Wood Char 500	305	2.00E-01

Figure 6: Biomass after shredding (425micron to 2mm)

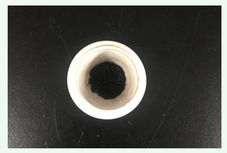

Figure 7: Biochar obtained at 500°C

Conclusions

- Biochar was prepared in laboratory using TGA.
- The biomass weight loss was approximately 80%. Final biochar yield was about 15%.
- Proximate analysis of biomass shows that the sample contains 6.5% moisture, 76% volatile, 16% fixed carbon, and 1.5% ash.
- Elemental analysis of biomass shows the composition of the sample to be mostly carbon and oxygen with less amounts of hydrogen and nitrogen.
- Surface area of the prepared biochar was 305 m^2/g, which is approximately 100 times the surface area of raw biomass.

Applications

- Biochar has been shown to improve water holding capacity as it effectively absorbs both nutrients.
- Biochar can be used as a replacement for the activated carbon that is prepared from coal (non-renewable resource)

Acknowledgements

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Literature Cited

1. Laird, D. A., Brown, R. C., Amonette, J. E. and Lehmann, J. (2009), Review of the pyrolysis platform for coproducing bio-oil and biochar. Biofuels, Bioprod. Bioref., 3: 547-562. doi:10.1002/bbb.169

2. Gurwick NP, Moore LA, Kelly C, Elias P (2013) A Systematic Review of Biochar Research, with a Focus on Its Stability in situ and Its Promise as a Climate Mitigation Strategy. PLoS ONE 8(9): e75932. https://doi.org/10.1371/journal.pone.0075932