Development of an Experimental Procedure to Determine Volatile Matter Content in Biochar

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I. Problem

- The hazard of Global Climate Change due to the industrial emissions of greenhouse gases demands research on ways to mitigate its effects.
- The dual use of biomass to produce biochar as a soil amendment and as an energy source could sequester carbon from the atmosphere into the ground and so mitigate climate change.
- The components of biochar represented by the "volatile matter content" have been shown to have a negative effect on plant growth when it is mixed with soil. This is a potential pitfall of sequestering carbon in soil by adding biochar.

II. What is Biochar?

- The heating of biomass in an oxygen limited environment – a process called pyrolysis, produces biochar.
- The properties of biochar are being researched because of possible carbon sequestration.
- The key factors in biochar production are the kind of biomass, the temperature of pyrolysis, and the time the biomass is heated. Different biochars have different properties. One biochar may be beneficial to soil while another may be detrimental

III. Importance of Volatile Matter.

The volatile matter content of biochars is the portion lost after a moisture-free sample has been heated at 950° C for six minutes. The volatile matter content of biochars has been shown to affect plant growth by immobilizing nitrogen otherwise used by plants and providing assessable carbon to microorganisms in the soil (Deenik et al. 2009). Because of this, the volatile matter content of different biochars needs to be determined as a step to ensure biochar does not lower plant growth when added to soils.

Below: Grass and wood biochar Images taken with a microscope

Grass -100 Grass -200 Grass-300 Grass-400 Grass-500 Grass-600 Grass-700

Wood -100 Wood-200 Wood-300 Wood-400 Wood-500 Wood-600 Wood-700

IV. Experimental Procedure Modifications

A key step of the experimental procedure for collecting volatile matter determinations is transporting crucibles in and out of an oven that has been heated to 950° C. We began by transferring crucibles with metal tongs while wearing protective gloves. There were several problems with this approach, these are:

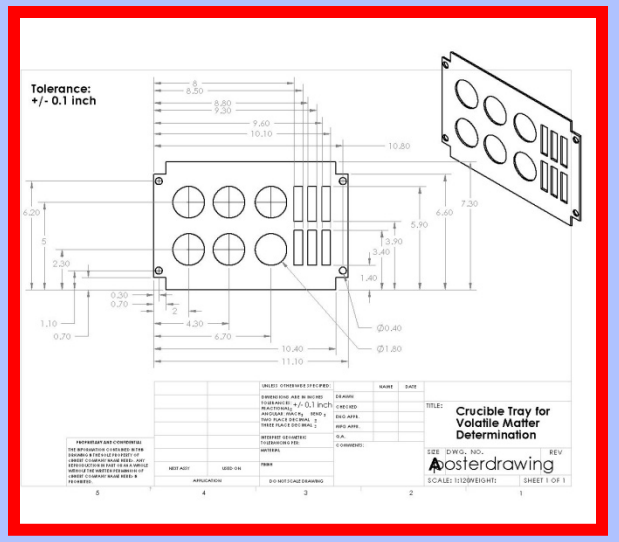
- The oven is so hot that it will burn you if you even get close.
- The the radius of the tongs did not match the needed radius for the crucibles.
- The oven is small and does not easily fit many crucibles

It was determined that the crucibles needed to be moved in and out of the oven by means of an receptacle or tray Some problems that came up during the design were:

- The material needed to withstand 950° C and maintain its strength for reuse.
- The tray needed have removable handles which extend away from the hot oven.
- The tray needed to hold six crucibles

V. Results

To meet all of these requirements, I designed a crucible tray to be made out of Stainless 330 Steel. This grade of steel retains its strength to temperatures of up to 1200° C. The steel was ordered by the OSU Machine Shop but they could not punch holes in the metal because it was too strong and bent the equipment. This metal had to be laser-cut and bent. To do this we hired the company Lasercutting Services, Inc. in Tualatin, OR. To specify dimensions, each measurement is shown in respect to an edge so that the tolerable error of a tenth of an inch is in respect to a fixed point. This way the tolerances are not inadvertently exceeded.



VI. Reference

Deenick, Jonathon L., McClellen, A.T., Uehara, G.. "Biochar Volatile Matter Content Effects on Plant Growth and Nitrogen Transformations in a Tropical Soil." Western Nutrient Management Conference. Salt Lake City, UT. Vol.9. 2009.