zone in Colombia and right now, this disease is been spreading out in other regions. Carbonization of oil palm trunks has been seen as a method to produce biochar not only to be used at the same field where the next generation of oil palm will be grown up, but also as a way of sanitary control to kill the inoculums of the bud rot disease.
At this moment, there is not a commercial method of carbonization of those huge materials in open field areas. However, the use of batch reactors has been seen as a starting point to deal with the oil palm trunks. The main goal in this paper is to show the methodology that has been used to improve the carbonization process. Records of internal and external temperature of the reactor during the carbonization process, biochar and biomass characterization, yield of biochar, and ways of operation among others issues, will be shown in this paper. A discussion about of using this methodology as a CDM project will be also addressed.

Lessons Learned from a Successful Small-Scale Biochar Production Operation

Hunt, J

Landscape Ecology, United States

E-mail: josiahhunt@me.com

Since late 2009, approximately 2.5 m^3 (>=1ton) of biochar have been produced weekly from sawmill waste. All biochar produced has been sold locally. Community support has enabled funding and fabrication of an increasingly more advanced production facility. Construction has begun on a retort capable of producing 5 m^3 of biochar per batch as well as bio-oil and heat.
Many obstacles have been presented in the growing of this business. Public education, local consumer demand, product consistency, and farming economics have proven to be critical points of interest.
Potential clients are often initially skeptical of the merits of biochar. Although peer-reviewed scientific journal articles and informative websites are referenced, the greatest impact often comes from examples of successful applications in local soils. Many samples of biochar were donated to achieve this goal. Free workshops and lectures offering education on the biochar paradigm and how it may fit local needs both increased public awareness and sales. The initial availability of biochar and resulting usage also seemed crucial in aiding to increase demand by way of satisfied clients telling others of their success.
Biochar product consistency, in particular particle size, is of great concern to most clients. Achieving high levels of adsorbancy and cation exchange capacity (CEC) is ubiquitously desirable yet the desirable particle size consistency may vary depending on specific needs. In this business' local area heavy clay soils benefit from gravel size and finer particles (<=12mm), Orchid growers demand clean particles in the range of 12mm and for blending with fertilizers particle size of 6mm and less has been desired. Achieving these specific sizes required fabrication of specialized grinding machinery.
Initial applications of biochar can be overwhelmingly costly to farmers. Grant funded research into composting biochar as a means of increasing CEC, nutrient value and thus plant growth response has been under way and analysis of product characteristics and plant growth trials will be compiled in June of 2010. Plant growth trials are showing positive results and have sparked much excitement. Biochar inoculated with microorganisms and liquid organic fertilizer shows promise as a novel method of achieving a similar goal in a shorter period of time. After many conversations with local farmers, blending biochar with organic material based fertilizers has come up as an economic way to apply both fertilizer and biochar. Wholesale and retail distribution of such a product is expected to begin by June.

Formation, Structure and Stability of Biochar-Mineral Complexes

Lin, Y[a]*; Munroe, P[b]; Joseph, S[b]; Hook, J[c]; Henderson, R[d]; Thomas, P[e]; Chia, C[b]; Blackwell, P[f]

[a]The University of New South Wales; [b]School of Materials Science and Engineering, University of New South Wales, NSW 2052, Australia; [c] NMR Facility, Analytical Centre, University of New South Wales, NSW 2052, Australia; [d]School of Civil and Environmental Engineering, University of New South Wales, NSW 2052, Australia; [e]Faculty of Science, University of Technology Sydney, NSW 2007, Australia; [f]Department of Agriculture and Food, Geraldton Regional Office, Geraldton WA 6530, Australia

*E-mail: yun.lin@unsw.edu.au

Biochar-mineral complexes (BMC's) have been developed to combine the unique properties of biochar, torrefied high mineral ash biomass, clay and minerals. The reaction of the clay and specific minerals with the heat treated biomass results in carbon-rich phases with relatively high stability, cation exchange capacity and ability to release nutrients when they are needed by plants. The addition of BMC into soils improves both the utilization efficiency of specific nutrients (especially P) in the mixture and also soil microbial growth. This subsequently provides plants access to nutrients through a symbiotic microbial pathway.
In this study, two BMCs were synthesized and applied in an agronomic field trial in Western Australia, where wheat was grown as a crop. The structure was characterized using both SEM and TEM. Elemental composition was analyzed by energy X-ray dispersive spectrometry (EDS) facilities attached to both the SEM and TEM. Solid state ^{13}C NMR was applied to characterize the carbon structure within the BMCs. Thermal Gravity – Mass Spectrometry (TG-MS) was employed to provide data regarding chemical structure and stability. Water extractions from the soil, both with and without BMC, were analyzed by Liquid Chromatography - Organic Carbon Detection (LC-OCD) to indicate the change of dissolved organic carbon (DOC) in the soil and evaluate its bioavailability so to assess its retention in the soil. After the field trials, some BMC particles were isolated from the soil and observed using SEM to identify microbial activity.
Electron microscopy showed that interfacial reactions occurred between biochar and the mineral phases. EDS analysis showed that P, Ca, Mn, Mg, Fe, Al/Si rich phases were present at the interface between the mineral and the biochar. This suggests that cations have a major contribution to the formation of BMC's. Phosphate precipitation, especially at these interfaces, was also observed. Solid state ^{13}C NMR showed that aromatic carbon was the dominant organic phases in BMC. However, there was also a relatively high percentage of labile carbon present. TG-MS showed that organic phase decomposition commenced at temperatures above 300°C, which implies that the labile carbon in the BMC was more stable than that in biochar alone. LC-OCD analysis

showed the decrease of DOC in the water extractions from the soil with BMC. In other words, DOC was greater for the BMC, which indicated more DOC was retained by the BMC. For the aged BMC's, fungi hyphae were observed using SEM, suggesting the BMC promoted microbial activity.

Biochar, the Oldest Technique but Newest Hope

Moktaruzzaman, Md

Forest Range Officer

Forest department of Bangladesh

E-mail: moktaruzzaman@yahoo.com

Biochar is the oldest techniques but newest hope of the planet. Biochar is defined simply as charcoal that is used for agricultural purposes. It is created using a pyrolysis process, heating biomass in a low oxygen environment. Once the pyrolysis reaction has begun, it is self-sustaining, requiring no outside energy input. Byproducts of the process include syngas (H_2 + CO), minor quantities of methane (CH_4), tars, organic acids and excess heat.Evidence shows native peoples in the Amazon used the substance centuries ago to enrich their soil to feed a thriving civilization. New grassroots efforts are aimed at showing biochar is not ancient history. Research shows that the stability of biochar in soil greatly exceeds that of un-charred organic matter, sequestering carbon in stable soil carbon pools for centuries to millennia. Bioenergy coproduction with biochar can displace fossil fuel use. Because biochar retains nitrogen, emissions of nitrous oxide (a potent greenhouse gas) maybe reduced. Turning waste biomass into biochar also reduces methane (another potent greenhouse gas) generated by the natural decomposition of the waste. Biochar systems are integrated systems with multiple, cascading benefits It is very much necessary to broadcast the techniques all over the woirld to save our planet.

Continuous Production of Biochar Through Direct Contact, Aerobic Pyrolysis

Mulqueen, D

Biochar Engineering corp., United States

Email: dan@biocharengineering.com

A process and apparatus for the production of charcoal through direct contact aerobic pyrolysis is described in which a biomass input is pyrolysed in a reaction chamber that is open to atmospheric air. Energy released in the pyrolysis of biomass supplies the heat necessary to cause the pyrolysis of incoming material. There are a number of issues with this method including reduced control over reaction temperature and a need for input biomass to have moisture content below 20%. These issues can be addressed by drying input material and by adjusting reactor conditions such as air flow rates and stirring rates. Using direct contact, aerobic pyrolysis, char can be produced across a range of conditions, specifically between 500-700 ˚C so that the adsorption of a product biochar can be maximized while other properties can be modified through production temperature to produce a biochar that is well suited to a particular application.

Hydrothermal Carbonization of Residues from Anaerobic Digestion

Mumme, J[a]*; Kern, J[a]; Rupp, F[a]; Eckervogt, L[a]; Pielert, J[b]

[a]Leibniz Institute for Agricultural Engineering Potsdam-Bornim, Germany; [b] Department of Soil Science, Technische Universität Berlin, Germany

*E-mail: jmumme@atb-potsdam.de

Fermentation residues from anaerobic digestion are an abundant source of biomass. High concentrations of minerals and water, however, are limiting their use to a few applications. Therefore, the aim of this study was to investigate the feasibility of HTC for converting these wastes to biochar. For comparison purposes, also the microcrystalline cellulose Avicel PH-101 (Fluka) was tested.

The experiments were carried out in a 1 L stirred batch reactor (Parr, USA) using distilled water as process medium. The fermentation residue (TS = 96.9 g/kg; Total-N = 7.9 g/kg; NH_4-N = 735 mg/kg, C in % of TS = 45.4) was obtained from a laboratory digester using maize silage as a sole substrate. Avicel (C in % TS = 43.7) was processed at temperatures of 190, 230 and 270°C whereas the fermentation residue was only treated at 230°C. All experiments were started at pH 5 (after addition of citric acid) and operated with a retention time of 4 h. The reactor's initial TS concentration of Avicel and fermentation residue was 97 g/L and 73 g/L, respectively.

The particulate carbon produced from Avicel at 190, 230 and 270°C was 13.7, 14.2 and 16.0 g corresponding to a C efficiency of 64.7%, 67.2% and 75.6% and a C content of the biochar of 49.9%, 67.7% and 73.1%, respectively. Treated at 230°C, the fermentation residue yielded 8.1 g of particulate C. This corresponds to a C efficiency of 61.2% and a C content of the biochar of 53.6%. When comparing the final liquor pH values from processing Avicel (pH 2.7-3.2) and fermentation residue (pH 6.4) it can be assumed that the HTC of fermentation residue was affected by the puffer capacity deriving from its minerals. In respect to the HTC liquid phase, it appears noticeable that acetate is the dominant volatile fatty acid (VFA) of both carbonized Avicel (0.59-1.77 g/L; 90-97% of total-VFA) and carbonized fermentation residue (1.33 g/L; 81% of total-VFA).

As shown by the experimental results, the HTC of fermentation residues from anaerobic digestion is feasible but could be disturbed by their relative high concentrations of minerals. As acetate is an ideal substrate for anaerobic digestion, recycling the HTC liquor back to the original digester could be a promising option. Topics for future research concerning the HTC of fermentation residues should include the optimal process design and optimal process control as well as a suitable pre- and post-treatment strategy.