was found to contain approximately 6 x 106 times as many bacteria colonies than the biochar. In addition to the sterility tests, a heavy metal analysis was done on the final biochar sample. A sample of the humanure-based biochar was sent to the North Carolina Department of Agriculture and Consumer Services where it was tested for heavy metal concentrations of the nine heavy metals under regulation by the United States Environmental Protection Agency for biosolids. All nine of the required heavy metal concentrations found in the humanure biochar were below the ceiling concentrations for EPA standards. The results suggest that 1) the humanure-based biochar is more sterile than raw compost, 2) pyrolysis can be used to recycle humanure, and 3) the humanure-based biochar has the potential to be used as a soil amendment.

Affordable Biochar Furnace Producing Heat Energy and Biochar for the Small Farm and Nursery with Inoculation System

Du Plessis, C

Rainbow´s End Biochar, United States

E-mail: katnip827@gmail.com

The author, C.J. du Plessis, holds 8 patents on process and equipment to produce activated carbon from agricultural wastes. I have owned and operated activated carbon producing factories in South Africa, Mexico and the United States. I currently own and operate a butterfly farm and nursery with my wife in New York State. (See article by D.Yarrow at www.RainbowsEndBiochar.com).
I got interested in producing heat energy for nurseries utilizing wood chips as a heat source and at the same time producing high-grade biochar. The research and development to produce this unit was done in the farm workshop. A prototype was built and tested, normal R & D procedures were followed, concentration was on feedstock, particle size range distribution, moisture content and flow properties. Flow obstacles of wood chips were overcome and a continuous flow process was developed. The unit was specifically built and designed to be affordable, supply heat energy and produce a high-grade biochar from a readily available waste product on the northeast and northwest coasts of the US. These goals have been achieved.
The second phase was to produce an active biochar activated with biology! For this a vermicompost and garden compost extract was developed and used to impregnate the biochar produced by the unit. \Test work and verification were done by an outside laboratory, Soilfoodweb, internationally known as the people for biology identification. The produced active biochar is currently being used in the greenhouses of Rainbow’s End Butterfly Farm & Nursery for plant growth evaluation.
This is not a presentation of what “could” be done. This is a presentation of what has been done. As we say in South Africa, “talk is cheap…money buys the whiskey”. Presentation will consist of power point and video clips.
For references, please consult our homepage www.RainbowsEndBiochar.com or contact me at katnip827@gmail.com or (845) 832-6749.

Bamboo Charcoal and Biochar

Fu, J

International Network for Bamboo and Rattan, China

E-mail: jfu@inbar.int

There are 1500 woody bamboo species and 27 mil ha bamboo forest around the world. Bamboo is a widely distributed sustainable natural resource in Asia, America and Africa and has more than 2000 uses in the world. Bamboo is playing more and more important role in the changing world to environment, livelihood and economy. One of the important uses of bamboo is bamboo charcoal. Bamboo charcoal specific area can be up to 300-500 m^2/g compared to less than 30 m^2/g of most wood charcoal. Because of its outstanding absorption capacity, bamboo charcoal is used as deodorants and many other uses.
Bamboo charcoal has a good market in Japan and China due to a felling ban in natural forests and the good character of bamboo charcoal. In addition to bamboo charcoal being used for fuel, there are several other uses:
Agriculture: As a carrier of organic manure and micro-organism in the soil, bamboo charcoal can improve the vigour of the soil, so people use it as a good soil enhancer. Bamboo charcoal is a kind of biochar, it contributes also to carbon sequestration besides as fertilizer.
Chemicals: Bamboo charcoal can be used as the raw materials of bamboo active carbon.
Medicine and health care: Pillows and mats made of bamboo charcoal can soothe the nerves, relax backaches, and control snoring. Bamboo charcoal also has the functions of deodorization, dehumidifier and fungicide.
Environment protection: Bamboo charcoal can be used as a water clarifier, shield off electromagnetic waves and absorber of poisonous gases.
Other fields: Bamboo charcoal can be made into many kinds of compound materials in the material industry. It also can be made into handicrafts, feed additives and high capacity rechargeable storage batteries, textile added with bamboo charcoal etc.
Annually over 100,000 tons bamboo charcoal is been produced. These bamboo charcoal is used as above mentioned purposes and can sequestrate and store almost 400,000 CO_2 annually. The annual production of bamboo charcoal is increasing very fast, hence bamboo charcoal is playing a more and more role to mitigate climate change as well other benefits on economy.
We are implementing an EC bamboo biomass energy project -- Bamboo as sustainable biomass energy: A suitable alternative for firewood and charcoal production in Africa.

Preliminary Evaluation of Biochar Production for Oil Palm Trunks by Using a Batch Reactor

García-Núñez, JA*; Yáñez-Angarita, EE

CENIPALMA, Colombia

*E-mail: jgarcia@cenipalma.org

During oil palm crop renovation around 80 tones /ha of dry biomass are produced, thus oil palm is one of the species that adds more organic matter into the soil where it is grown. In Colombia, there are more than 60.000 hectares of oil palm that are going to be replanted during the next 5 years. Additionally, the bud rot disease has destroyed more than 25.000 ha of oil palm plantations in the western 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