Cornelius' Biochar Machine

Continuous-Feed Greenhouse Heat

David Yarrow

Cornelius du Plessis, a civil engineer, built industrial pyrolysis equipment to make activated charcoal for South African gold mining industry. His equipment processed peach pits—high density farm waste—to carbon filters in gold refining.

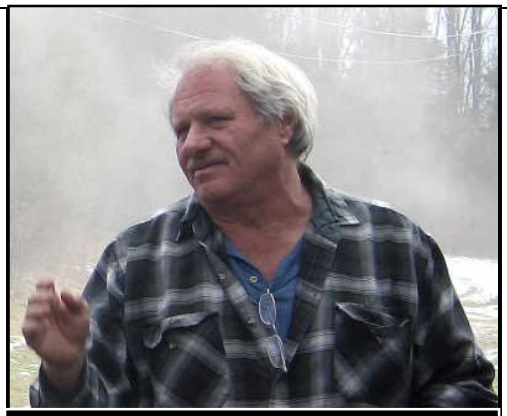
Later, in tropical Mexico, Cornelius worked with farmer coops to turn coconut shells—another high density farm waste—into activated carbon. With patent royalties from designs, he retired to Pawling, New York in the Hudson Valley, happily running Rainbow's End Butterfly Farm, an hour from New York City.

In 2008, BNE Board member Doug Clayton met this retired South African engineer with a long career and extensive experience building pyrolysis equipment to make activated charcoal. From Doug, Cornelius learned something new and fascinating about charcoal:

you can put it in soil.

Intrigued, Cornelius had one of his char-making units shipped to his farm in the US, and began to think and tinker to modify the burner to process woodchips.

Wednesday, January 20, Saratoga Apple's Nate Darrow took me to see Cornelius' new biochar burner. It's continuous-feed woodchips, not a simpler batch mode. Woodchips are challenging to handle, due to size diversity, irregular shapes, sharp ragged edges. Thus, chips stick, clump and clog. Compressed pellets—round, smooth, uniform—have better flow character than ragged chips.



Sustainable biochar is a powerfully simple tool to mitigate global warming

This 6,000-year-old practice converts farm waste into soil enhancers to hold carbon, improve food quality, boost food security, reduce emissions, discourage deforestation.

This method is inexpensive, widely applicable, easily scalable, quickly implemented.

Cornelius has greenhouses to grow special food plants to feed his caterpillars, so he needs a biochar burner scaled to heat his greenhouses. His industrial-scale equipment was far too large and heavy to work with, especially a unit scaled for a greenhouse. So, he scaled down his 6-foot burner to a 55-gallon barrel, and redesigned his apparatus to automatically deliver feedstock to the burner.

The triangle on top delivers measured units of feedstock to the retort, which is inside the round 55-gallon barrel below. This burner operates much like a TLUD (top-lit up-draft), with sophistications. Damper-style airports around the barrel's lower end of regulate air flow into the burn chamber. Periodically a gate opens, and a measure of feedstock drops into the top of the retort. Feedstock moves down through the retort by gravity, heated as it descends, eventually to gasify, then carbonize, and exit out the bottom. Finished biochar is ejected at intervals out a gated port into a half-barrel underneath. Each dump is sprayed with water to stop oxidation to ash and prevent flare-ups.

Cornelius also built a water-jacket heat exchanger around the retort to heat water for space heat and storage. A steady half-inch stream of steaming hot water squirted into a blue barrel. This small, hot volume will run through pipes buried under growing beds to heat greenhouse soil. I didn't do hard number calculations, but I'm impressed by the heat generated by this 55-gallon burner & retort. Perhaps this unit is scaled to heat a modest greenhouse. I assumed a larger burner is needed, but didn't consider continuous feed operating 24/7.

Cornelius hasn't just created a burner, but multi-function machine that operates automatically with minimal management. Cornelius' years of experience as designer & inventor taught him the steps to convert a plan into a working commercial unit. He is thinking ahead to refine this initial "proof-of-concept" into a prototype, made of durable stainless steel. This refined unit can be tested next winter, and evolve into a reliable, functional system to manufacture and market to greenhouse owners. A biochar-making burner can replace current propane and fuel oil burners, and shift us to carbon-negative.

Biochar is Alive!

My special delight was watching Cornelius describe char's effects on soil and growth of his butterfly food plants. He understands thoroughly that char isn't food or fertilizer. Rather, biochar is a substrate to be inhabited by beneficial soil microbes. Thus, it's imperative char is "impregnated" by a diversity of microbial life. His eyes light up in joy talking about microbes, radiating infectious enthusiasm.

Cornelius flew to Oregon to study with Dr. Elaine Ingham, the Soil Food Web lady. Enthused about compost tea as a universal soil treatment, he bought a $1000 digital microscope to record videos of microbes in compost teas and biochar. We watched hyphae, rotifers, flagellates, nematodes, and micro-fauna—amazing how fast those teeny critters dart about!

Cornelius must focus on Rainbow's End Butterfly Farm, which opens Memorial Day weekend. Cornelius invested much time and money to develop his machine. He wants to collaborate with scientific research on using biochar in soil, and host workshops at Rainbow's End Farm to showcase his invention and tell biochar's critical role in environmental restoration. His farm holds education events with schools, with facilities for talks and meetings. We discussed a modest biochar workshop at Rainbow's End in summer, a larger event in autumn.

Biochar at Solarfest

July 17-18, Tinmouth VT

www.solarfest.org

Solarfest is VT's annual off-the-grid music and education festival. Held the second weekend of July at Forget-me-not Farm in Tinmouth, the 3-day event—in its 16th year—is an eclectic music program, plus over 100 speakers and workshops on renewable energy and sustainable living, plus booths for vendors and non-profits to tell stories and sell products. Education events are well attended by rapt audiences from a diversity of generations.

BNE Board member David Yarrow spoke on biochar at the last two Solarfests to enthusiastic audiences. Last year, David arranged to add to the program burner demos by Peter Hirst and Bob Wells of New England Biochar (NEB). Bob and Pete did two burns with their 100-gallon "Tinman," and added biochar to test plots at Forget-me-not Farm.

This year, biochar will be featured at Solarfest, including booths for BNE and NEB. BNE's booth is being organized by NH Board member Doug Clayton. A "Biochar Theater" will offer continuous biochar burner demos, and test plots will be begun to show effects on soil and plants. A full schedule of talks by experts and innovators will be assembled, some featured in the Solarfest program; others scheduled in the Biochar Theater.

For more information or to volunteer:

Doug Clayton: 603-532-1120

Peter Hirst: 950-804-0498

Field Trials on Small Grains

New England Small Farm Institute

Belchertown MA

Last year, a large supply of charcoal was found in CT at a closed mascara factory. Since NESFI is on state-owned land, three MA agencies imposed extensive, expensive tests to prove char isn't toxic and safe to transport. Patiently, NESFI walked this bureaucratic gauntlet.

This spring, a 30-ton truck char arrived at NESFI, and was blended with compost to inoculate it. NESFI farmer Adam Dole will spread this on a small grain field and plant it with a succession of field crops over three years.

The goal is to test the basic benefits of biochar to soils and field crops.

for more information:

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Biochar Research

at UMass Amherst

by Dr. Touria El-Jaoual Eaton

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Environmental agriculture and plant environmental stress have been the focus of my research for 19 years. *Efficiency in Nitrogen Use to reduce nitrate leaching* was my master's thesis, and plant nutrient stress my doctoral degree focus. Issues that arise repeatedly throughout my professional carrier at UMass are rising costs of farming, nitrogen losses by nitrate leaching and nitrous oxide emissions, and negative impacts on the environment. So, when I heard biochar has anion exchange capacity to enable it to capture nitrogen, this got my attention.

Last year, I attended biochar events at Pony Farm, and the Symposium in Nov. I saw a need for scientific research, and wanted to undertake that effort. In collaboration with UMass faculty Doug Cox and Masoud Hashimi, I began simple investigations to learn about biochar.

Preliminary analysis of physical and chemical properties of five industrial biochars, including Ideal Compost (Peterborough NH) and New Earth (Seattle WA), were done at UMass plant and soil analysis laboratory. Biochars were analyzed for mineral nutrients, pH, Cation Exchange Capacity, and levels of Lead, Cadmium, Nickel, and Chromium.

Biochars were tested for plant survival on two sensitive plants: geraniums and lettuce. If a medium grows these plants, it can safely grow almost any plant.

A greenhouse experiment at UMass, in winter 2010, on marigolds examined the effect of Biochar on plant growth (shoots and roots), quality, nutrient content of the shoots, and nitrate leaching from the growth medium (*bottom photo*). Statistical analysis of the data is still ongoing.

A 2009 growing season experiment at UMass research farm at Nuestras Raices in Holyoke investigated the effect of biochar on growth and yield of peppers (*top photo below*). Four treatments were studied: biochar, biochar+compost (50/50), compost, and control. Statistical analysis of the data is ongoing.

This year, lettuce will be tested on the plot used for last year's pepper trial. No biochar will be added, to examine the effect of time on Biochar performance.

Another field experiment investigates biochar effects on Corn growth, yield and nitrate leaching. This starts May 25 at UMass research farm in South Deerfield. BNE board and members will be invited to our August Field Day to notify others about biochar research.

Once published, research results will be sent to BNE to share with biochar researchers and the industry.