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## A New Climate Change Mitigation Tool

The buzz about biochar is getting louder. Many companies have recently unveiled biochar production systems, and advocates are campaigning to include the soil enhancer in global carbon emission reduction policies.

By Anna Austin

Biochar, also called Agrichar or "terra preta" (meaning dark earth in Portuguese), is being lauded as the key to balancing carbon emissions and restoring soil fertility. The fine-grained, highly porous charcoal can be produced by heating biomass in an oxygen-starved environment. Many companies—some working quietly for years—have focused their efforts on developing and commercializing pyrolysis or gasification biochar production systems, and are now displaying them to the public.



Biochar Engineering's Biochar 1000 can process 1,000 pounds of wood chips per hour. PHOTO: BIOCHAR ENGINEERING CORP.

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Whether they are at the commercialization stage or still a few years away, as in any industry, these companies can only go so far if the market for their product isn't there. That's where the umbrella of biochar lobbying groups, the International Biochar Initiative comes in. The group has been pushing for biochar's acceptance into the United Nations Framework Convention on Climate Change as a vital tool for climate change mitigation and adaptation technology, and is making headway. If achieved, the IBI is confident that most nations will consider biochar as a credible climate change mitigation option, which could help put a floor under the market.

According to the IBI, biochar can improve the Earth's soils, reduce greenhouse gas (GHG) emissions and sequester atmospheric carbon in a stable soil carbon pool, and improve water quality by retaining agricultural chemicals.

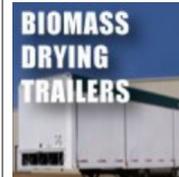
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Meanwhile, the biochar buzz is getting louder among farmers, scientists and government officials, and those already in the business might find themselves way ahead of the pack if they are able to maintain their viability while the biochar market framework is being constructed.

### What's Cooking?

There are two main ways to produce biochar—pyrolysis and gasification. Pyrolysis systems use kilns, retorts



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and other specialized equipment to contain the baking biomass while excluding oxygen. Gasification systems produce smaller quantities of biochar in a directly heated reaction vessel with introduced air.

There are two types of pyrolysis systems—fast and slow. Fast pyrolysis produces more oils and liquids, such as bio-oil, while slow pyrolysis produces more synthesis gas and is used to make a solid fuel.

Colorado-based Biochar Engineering Corp. recently unveiled a mobile pyrolysis biochar production unit at the 2009 International Biochar Conference in Boulder, Colo. The system didn't come to fruition overnight, according to Doug Guyer, company spokesman, as it has been in development for the past four years.

The 5-foot wide, 12-foot long, 7-foot tall system, dubbed the Biochar 1000 is capable of handling 1,000 pounds of input per hour, in this case wood chips, and achieves biochar yields of roughly 25 percent, according to Guyer.

"Whether it's a farm co-op sharing the unit, or the forest service, it's mobile and can be brought to where slash piles are being handled and used to make biochar instead of burning the slash," he says. "The biochar can then be incorporated right back into the forest soil or sold locally."

Guyer says the company sold the first two Biochar 1000s, which cost about \$100,000 each, to the U.S. Bureau of Land Management to research biochar's benefits in mine reclamation, and to the North Carolina Farm Center for Innovation & Sustainability, which recently received a \$1.2 million, three-year grant for biochar research, and will feature the system in a biochar demonstration center under their management.

Mantria Industries LLC recently opened a biochar production facility in Sequatchie County, Tenn. The operation, which utilizes a flash carbonization technology, was developed at the University of Hawaii. A typical system consists of two 3.5-ton reactor units, which are pressurized and sealed once the feedstock is loaded into canisters and placed inside. Electric heaters are turned on to ignite the feedstock then turned off, and the autoclave temperature is controlled by a dual-draft process. Under elevated pressure and heat—temperatures ranging from 400 to 800 degrees Celsius (750 to 1,470 degrees Fahrenheit)—the biomass carbonizes. During carbonization, gases from the process are pumped through catalysts, broken down into simpler compounds and sent through filters for scrubbing. When the 25-to-40-minute process is complete, the biochar is set in a cooling pool for 24 hours.

Mantria CEO Troy Wragg said the company has also contracted 30,000 square feet at a distribution center in Atlanta, Ga. "We have an advanced bagging system in place so we can quickly get the product into the market," he says. "Material handling is one of the biggest costs in any type of fertilizer or soil amendment market, so that's one of the things we've stepped up on—providing the same type of standards the pot ash or fertilizer industry has, but creating the actual logistical distribution and shipping capabilities that other companies don't have."

Wragg says the company already has contracts in place for its EternaGreen biochar, and sees the industry gaining momentum. "I believe over the next two to five years, we'll really start to see a boon for biochar, he says. "From 2011 on, we're going to see biochar become one of the largest commodity products in the world, and I say that only because right now our current policies nationally and internationally are focused on energy playing a role to combat climate change when, in fact, agriculturally, we stand a chance to make a bigger impact."

That impact could be huge, from the perspective of the IBI, the mothership lobbying group for biochar, although there are still some challenges in using biochar.

#### **Biochar and the U.N.**

James Amonette, IBI science advisory panelist and a scientist at the U.S. DOE Pacific Northwest National Laboratory, says during the past couple of years, the IBI's main focus has been on the UNFCCC to be held in Copenhagen, Denmark, in December, to coordinate efforts to get biochar on the official list of mitigation strategies that can be employed to fight climate change.

The IBI is at the top of the biochar community, he says, and is aimed at influencing national and international policies. "National and regional organizations are also springing up under the IBI, but they're all sort of connected," he says.

At PNNL, Amonette says his biochar research involves two aspects, the first being the characterization of biochar to understand its chemical and physical properties. "I've taken a number of samples from whoever will give them to me and run them through a series of tests to try to understand how wide the variability is among properties in different types of biochar," he says. "One of the big issues we have, and this is something the IBI is working on as well, is classifying biochars, as some are good for some purposes, and some are not—it depends on the exact purpose. Biochar A is good for purpose A but not for purpose B, and you'll need to know this to avoid mistakes."

Some biochars may have a high pH, and if applied to a soil that is already high in pH, the plants will likely die. If applied to an acidic-poorer soil in the southeast part of the U.S., that biochar would be perfect as a liming agent, Amonette says. This also involves understanding how much biochar is stable for long periods of time and how much will be relatively available to microorganisms, he says. "This is a volatile matter/fixed carbon ratio question and this is important from a carbon sequestration perspective—how you value biochar for that purpose, and that is based on how much recalcitrant carbon you have in the char. We're developing tests for that," he says.

Amonette and the IBI are also trying to analyze the impact of biochar as a global climate mitigation tool. "We're working on a series of models where we are looking at the implementation of biochar on a large scale—how big should it be, at what level does it become sustainable or unsustainable, and what impact



would it have in terms of mitigating climate change—we're coming up with numbers, calculating how many gigatons of carbon per year the global adoption of biochar can upset," he says.

No matter how this research concludes, until there is a floor in the market for biochar provided by carbon credits or a carbon tax on other forms of energy, it will be difficult to make it economically, Amonette believes. "That's the bottom line, and it prevents a lot of companies from moving forward," he says. "The IBI is trying to get it established as a mitigation strategy at the global level, and then national levels will start to implement cap and trade so it can be bought and sold as a carbon mitigation option. Then I think you'll start to see these new biochar developers become more profitable—it's hard to justify making \$800 per year on an acre of land as a farmer, and having somebody want to sell you biochar at \$500 per ton, or even \$50 per ton—when you could use 50 tons per acre. If you had carbon credits on that, it'd pay for itself."

#### Accepting and Addressing Climate Change

If the IBI is successful in Copenhagen, the group expects that in the next year or so nations will start to adapt to biochar use. Until society in general takes climate change seriously, however, there still isn't going to be a demand for it, Amonette says.

"If you look at the other options for sequestering carbon, like geological sequestration when CO<sub>2</sub> (carbon dioxide) is injected under the ground, that's extremely expensive—we're talking \$300 to \$400 per ton of CO<sub>2</sub>. So in that regard, there's a lot of room for this technology to fit in economically once society says we're going to do something about it."

Amonette suspects it will take a number of years, perhaps even upwards of ten, before efforts to address climate change shift into high gear. "A lot can happen in the next few years, so I think it's a matter of these companies getting established, keeping their heads down and trying to be flexible," he says. "They will be in a very good position a few years out when a massive response to climate change kicks in. A lot of the small-scale biochar people I know do a fast pyrolysis system, where they have bio-oil which they can sell for the energy, but can switch over and make more biochar by going with slow pyrolysis, or just change their parameters a bit so when the price of biochar goes up they have that option as well. There is a market for bio-oil as a replacement for bunker oil and things like that as long as you can control the acidity."

Widespread acceptance of climate change will be key, according to Amonette. "In [the U.S.], 50 [percent] to 60 percent of people don't believe in climate change, and that's a huge barrier to overcome," he says. "I think the only way it'll be overcome is if a huge piece of Greenland slides off into the ocean and disrupts the Gulf Stream; something will have to get people's attention and make them realize we'd better take action."

Amonette and the IBI believe that the next year will be critical in terms of establishing what biochar can do from a climate change mitigation perspective, and if successful at Copenhagen, they believe it will really catch fire. "We could see some good carbon credits a few years down the road," he says. "It's moving extremely fast." BIO

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