Clean Air Tech Has Ancient Roots

By John Gartner John Gartner | Also by this reporter
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Researchers in the southeastern United States are experimenting with a procedure they believe could reduce greenhouse-gas pollution using a discovery pioneered thousands of years ago by farmers in the Brazilian Amazon.

The technique, which uses a charcoal-based fertilizer to absorb gases, is one of several experiments under way as scientists concerned about global warming are looking for someplace -- any place -- to hide excess carbon dioxide. While some say hiding greenhouse gases deep under the Earth's surface is the solution, others believe incorporating them into fertilizer products can solve two problems at once.

Although people may argue about the causes and effects of global warming, scientists agree on two things: We are increasing the production of greenhouse gases by burning more fossil fuels, and the planet is heating up.

According to the Intergovernmental Panel on Climate Change, the average temperature in the Northern Hemisphere rose 0.6 degrees Celsius during the past century. The group also said that during the last 250 years, the amount of carbon dioxide in the air increased from 280 parts per million to 367 ppm.

These facts have prompted researchers to look for new technologies to siphon off the amount of greenhouse gases that are produced by burning fossil fuels like petroleum products and coal.

Scientists have looked at injecting greenhouse gases deep under the sea or using previously drilled underground wells.

Meanwhile, one entrepreneur is working with a team of government scientists who believe that the answer to the carbon question was discovered by South American natives centuries before Columbus set sail. Danny Day,

the president of Eprida, a developer of clean technology, believes that greenhouse gases from burning coal and fossil fuels can be captured and injected into charcoal, which is then combined with ammonia to create a powerful fertilizer.

Day said his company was developing a method for turning biomass materials into hydrogen, a process known as pyrolysis, when the new idea was born. Researchers working on the biomass experiment discovered that turnip plants were growing in a pile of charcoal produced during the pyrolysis process.

Later, Day stumbled upon research stating that charcoal had been used thousands of years ago by farmers in the Brazilian Amazon to create rich, dark soil known as *Terra Preta de Indio*.

Day said all the pieces then came together for reducing the amount of carbon in the atmosphere.

"We have to build a 'carbon reef'" to store the excess carbon, Day said. "And I realized that it had to be in the ground."

Day, along with researchers at the National Renewable Energy Laboratory, Oak Ridge National Laboratory and the Georgia Institute of Technology, is developing technology based on the carbon-rich *Terra Preta* concept that uses charcoal to absorb greenhouse gases at facilities that burn fossil fuels. The charcoal is then mixed with other nutrients to create a super fertilizer, according to Day.

Day said that to create the charcoal that could be used as fertilizer, the biomass must be burned at temperatures somewhat lower than usual (say, 250 to 300 degrees Celsius).

"It's not the stuff you use in your barbecue," he said, noting that microbes in the nutrients bind the carbon to the mixture, preventing it from being released into the air or leeched into the ground for up to 5,000 years.

The charcoal fertilizer could be used to restore the nutrients in areas around the globe where soil has been depleted, according to Day. He believes charcoal-enhanced soil could increase crop yields by 200 percent to 300 percent.

Eprida has performed a demonstration of the scrubbing process, and Day said the next step is to develop a biomass processing plant adjacent to a coal power plant to test the technology on a large scale.

But Galen Suppes, associate professor of chemical engineering at the University of Missouri-Columbia, said he has "low regard" for technologies that claim to reduce greenhouse gases by turning them into solids.

"I don't believe that the product you are turning into carbon is going to stay in the ground. Five years down the line, it's back in the atmosphere," he said. "In a lot of this technology you are just playing games with the carbon.... Sometimes it breaks down very quickly, and sometimes not."

Johannes Lehmann, assistant professor in the Department of Soil Fertility Management and Soil Biogeochemistry at Cornell University, however, said the carbon has been retained in the soil at the *Terra Preta* sites in South America for up to 3,000 years.

Lehmann, who spent three years researching in the Amazon, said that possibly as long as 4,000 years ago, indigenous people discovered that partially burning wood materials at lower temperatures (250 to 350 degrees Celsius) to create charcoal and then combining it with nutrients such as fish bones or animal products made for a very effective fertilizer.

Researchers found that agricultural communities created nutrient-rich oases of fertile black soil in areas that were otherwise nearly barren of calcium and nitrogen. Tribes who treated their soil were able to stay in a single location for hundreds of years, according to Lehmann.

"The charcoal is quite stable in retaining carbon in soil," said Lehmann, who is familiar with Eprida's research.