Surprise: less oxygen could be just the trick

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It was used by the people of the Amazon for thousands of years. Now Australian researchers say biochar could reduce atmospheric carbon dioxide - while providing a new source of energy, and boosting farm productivity.

For almost 7000 years Amazonian farmers kept their soils fertile by setting organic waste alight and letting it smoulder under mud or earth, reducing it to a black carbon-rich material.

" Biochar is not unlike charcoal," says Lukas Van Zwieten, a senior research scientist with NSW's Department of Primary Industries.

When organic material is burnt with air it is often reduced to white ash. Trapped carbon goes up into the air as carbon dioxide, hence the greenhouse emission problem at coal-fired power stations.

But if heated while starved of oxygen "it just goes black, like a pizza left too long in the oven", says Van Zwieten. Called pyrolysis, the process leaves up to half the carbon trapped in the char.

At Somersby, on the Central Coast, BEST Energies Australia, a company researching clean energy technology, has built a demonstration pyrolysis plant with the capacity to process 300 kilograms of dry green waste, wood waste, rice hulls, cow and poultry manure or paper mill waste every hour.

The material, says Adriana Downie, the company's technical manager, is heated at up to 550 degrees for 40 minutes.

During processing gases are released from the material which are cleaned and burned to produce energy. This gaseous biofuel is called syngas. "Syngas can be used as a replacement for natural gas or LPG in gas-fired boilers or dryers, or to produce electricity," says Downie.

The remaining black carbon-rich biochar can be used on farms.

Van Zwieten says early Department of Primary Industries experiments with biochar have been "extremely encouraging". They show that using 10 tonnes per hectare raises the soil's carbon content by half a percentage point. "That's a huge amount - 75 per cent of Australia's soil has less than 1 per cent."

Soybeans grown with biochar in glasshouses doubled their green bulk. Field trials are now under way to see if it can do the same for crops. There is also evidence biochar boosts the soil's ability to retain water.

"We are also hoping we might be able to reduce nitrogen fertiliser rates," says Van Zwieten. "It's one of the few technologies that can drive power generation and improve agricultural soil. It's a win-win situation."

US research has shown that the majority of carbon in conventional mulch and timber waste could be returned to the atmosphere by bacterial activity in as little as 10 years.

Since 30 to 50 per cent of the original carbon remains bound up in biochar, it is unable to quickly escape and add to greenhouse emissions.

"It is very stable in the soil," says Van Zwieten. "It could last thousands of years", which explains why the ancient Amazon farm soils are still so rich today.

And as plants growing in biochar put on more bulk, they should absorb extra atmospheric carbon dioxide.

Further, biochar should slow the soil's natural release of nitrous oxide, a greenhouse gas 310 times more potent than carbon dioxide.

Overall, says Downie, "there is more carbon dioxide removed from the atmosphere than is returned, even after the syngas has been utilised as a biofuel".

If biochar is so efficient, why has it taken 7000 years to be appreciated? The problem, says Downie, is that coal-fired electricity and oil have been so cheap. However, as energy costs soar, and greenhouse emissions are factored into prices, biochar may again become as important as it was to the ancient Amazonians.

This month the technology won the United Nations Association of Australia's World Environment Day award for "meeting the greenhouse challenge".

Richard Macey