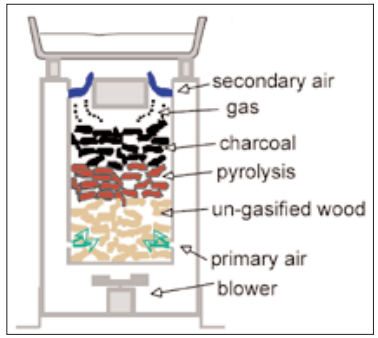
In the cone kiln, air is drawn in over the hot outer wall of the kiln and swirls above the fuel bed, creating a vortex that ensures good mixing of pyrolysis and combustion air and resulting in very low emissions.

www.biochar-journal.org/en/ct/39-Kon-Tiki-the-democratization-of-biochar-production

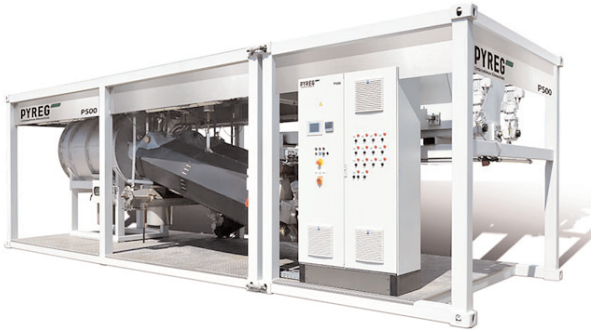
Bottom-quenched char in a tilting Kon-Tiki deep-cone kiln, designed and manufactured in Tasmania for orchard and vineyard prunings.

Image courtesy www.terrapretadevelopments.com.au



A TLUD operates as a gasifier by creating stratified pyrolysis/combustion with four basic zones: raw biomass (un-gasified wood, bottom), then flaming pyrolysis, gas combustion and charcoal combustion.

www.biochar-international.org/technology/stoves



Example of modern pyrolysis equipment, the Pyreg Reactor, a successful commercial installation in Europe.

Courtesy Pyreg GmbH, www.pyreg.de/machinery-en.html

Local networks

Municipal programs are already at work, such as the Kaindorf Ecoregion in Austria, for a whole-of-community ecological approach to sustainable waste management. Could the same happen in your region? The source of this brochure might already know of a local network you could join to develop your own biochar potential—please ask.

Sources and resources

- *Biochar Journal* (articles on multiple uses of biochar, history, soils, stoves, kilns, etc.): www.biochar-journal.org
- International Biochar Initiative (worldwide technology, research, businesses, networks): www.biochar-international.org
- Ireland's "+CHAR" beef and dairy joint venture: www.pluschar.ie
- Ithaka Institute for Carbon Intelligence: www.ithaka-institut.org
- Municipal pyrolysis technology: www.bigchar.com.au; https://pacificbiochar.com
- Sewerage treatment and enriched fertilisers: www.greenlife.co.at; www.pyreg.de/technology-en.html
- *The Biochar Revolution* (information, research and innovation): www.thebiocharrevolution.com
- Water filtration: www.aqsolutions.org

Compiled in 2015 for the **Biochar for Tasmania** network by Karen Enkelaar, Steve Sullings, Christina Giudici and Frank Strie.

BIOCHAR

General information

What is biochar?

BIOCHAR is made from any form of waste biomass using a **PYROLYSIS** process of heating the biomass from the top down and limiting the oxygen, temperature and time so it does not reduce to ash.

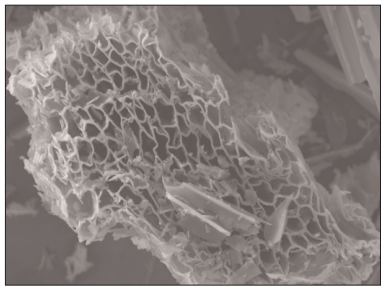
Normally organic matter decomposes over time, releasing gases and leaving little carbon. During pyrolysis, gases from the heated biomass burn but, with limited access to oxygen, the carbon content is left stabilised, potentially for centuries, resulting in less amounts of damaging emissions.

Once quenched with liquid, a large surface area remains in the char, able to house water and nutrients.

Making and using biochar is an easy way for individuals and organisations to manage pollution and harness energy. Biochar is "simple genius" in that it creates something of value from otherwise nuisance waste.

Top-lit fire emissions (left) versus bottom-lit (right).

Images: Kelpie Wilson



Sponge-like surface area of biochar after pyrolysis.

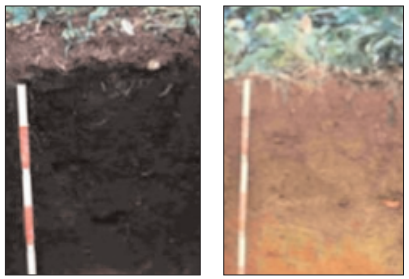
Image: Michael Hayes

Development and history

Global interest in biochar stems from the rediscovery of deep, fertile **TERRA PRETA** (black earth) soils at historical sites in the Amazon basin, where often the topsoils are thin and depleted due to high rainfalls. It is believed the char-rich *terra preta* soils were deliberately created by local communities to grow food and sustain large populations.

From here came the realisation that biochar could improve depleted soils elsewhere in the world, as well as the desire to learn how biochar works in soils as part of a natural system that enhances plant growth.

Now there are multiple international collaborations, such as the International Biochar Initiative, that research and promote biochar (see more in the resources list).



Soil sections comparing *terra preta* (left) with nearby Oxisol (right) normally found in the Amazon basin.

Glaser, B., Haumaier, L., Guggenberger, G. & Zech, W. (2001). The Terra Preta phenomenon: A model for sustainable agriculture in the humid tropics. *Naturwissenschaften*, 88, 37–41.

Benefits and uses

The first-hand benefits of creating biochar can include:

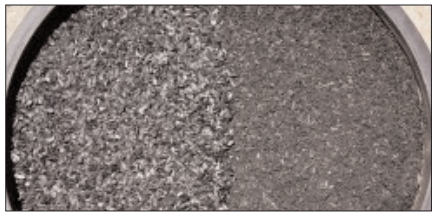
- Stable carbon capture in soils—for carbon farming and horticulture initiatives
- Gas and thermal energy capture—for cooking and heating
- Nutrient run-off capture
- Animal health improvement—digestion and bedding
- Water filtration in disaster zones.

Extended benefits can be created by combining biochar (one form of waste) with:

- Other wastes such as sewerage or manures from dairy, pig, chicken or fish farms, to create enhanced fertilisers and neutralise odour pollution
- Compost wastes to build water, minerals and beneficial micro-organisms such as mycorrhizal fungus in soils
- Other elements to capture heavy metal contaminants
- Other building materials for soundproofing, insulation and fire retardation.

Fungi wrapped around biochar in dung.
Photo Josiah Hunt, Hawaii, https://pacificbiochar.com

Growth from biochar (no fertiliser) compared with plain soil.
Biomass Energy Services and Technology Pty Ltd (BEST) demonstration site, Somersby, Australia, as part of the 2007 International Biochar Initiative Conference, Terrigal, New South Wales.
Viewed www.biochar.info/biochar.biochar-overview.cfml



Clean char (left) and "biologically activated" biochar (right).
Viewed https://pacificbiochar.com

Modern liquid manure spreaders can considerably decrease nutrient losses and greenhouse gas emissions, but the highly concentrated ammonia still remains harmful to the soil. By pre-treating liquid manure and mixing it with biochar, it may increase fertiliser efficiency by around 50%.
Source: www.biochar-journal.org/en/ct/29-Treating-liquid-manure-with-biochar

Backyard waste turned to char.

Materials

Any form of biomass waste, such as dried wood, husks or stubble, can be converted to biochar, even grass clippings mown by councils along roadside verges. Multiple opportunities exist to make use of waste materials that remain after farm, orchard, vineyard or forestry harvests, and weed removal such as gorse and willow.

What possibilities surround you?

- Note that trials and research continue to find the optimum biomass materials and methods for different uses.
- Advice should be sought if biochar is to be applied agriculturally because results can vary depending on soil type, climate, application rates and the method of application (www.selectcarbonchar.com).
- It is possible to analyse and **CERTIFY** various grades of biochar (e.g. European Biochar Certificate www.european-biochar.org).

Making biochar

Currently the simple technologies used to create biochar remain open-sourced, which means knowledge about them is freely shared. Smaller units can be moved to where the waste biomass is situated, saving collection costs. Two technologies capturing innovative attention are:

- **TOP-LIT UPDRAFTS (or TLUDs)**. These include the elegant Bazman Gasifier, as well as recycled backyard tin drums and simple cook-stoves being manufactured for use in global villages
- **CONE KILNS.** The cone-kiln design originates from Japan. Recent developments include the three-legged deep-cone version from Switzerland, and tilting, rimmed, and even trailer versions manufactured in Australia.

Many videos, articles and organisations offer assistance on biochar methods, from ovens, troughs, pits or trenches in the ground, to large-scale industrial systems.

Production of biochar in a 90 cm deep pit with a stone rim.
Images: Ithaka Institute. Viewed www.biochar-journal.org/en/ct/39-Kon-Tiki-the-democratization-of-biochar-production