

What Is Biochar?



Nicholas Rich-Vetsch,
PE, TRUE Advisor



*“What we today call **biochar** is in fact a recently-invented term for a very old material – **charcoal**. ...*

the new name has perhaps caused researchers to overlook previous research into the properties of charcoal.

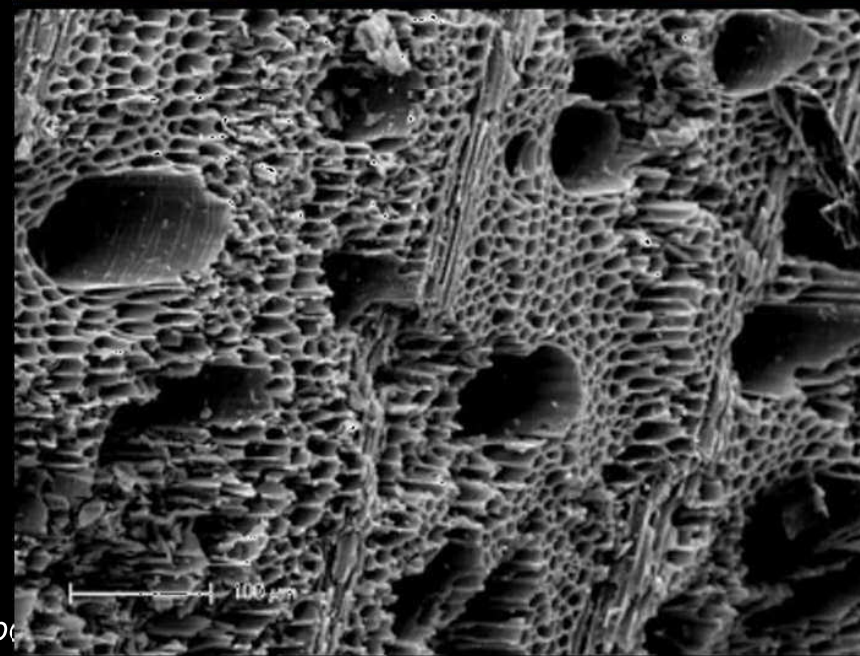
Are we in danger of reinventing the wheel?”



*Unearthing the Past:
The Forgotten History of Biochar
Guy Shrubsole, November 2010*

<https://guyshrubsole.files.wordpress.com/2010/11/unearthing-the-past-gshrubsole-nov-2010.p>

Charcoal vs. Biochar vs. Activated Carbon



vs. Carbon Black

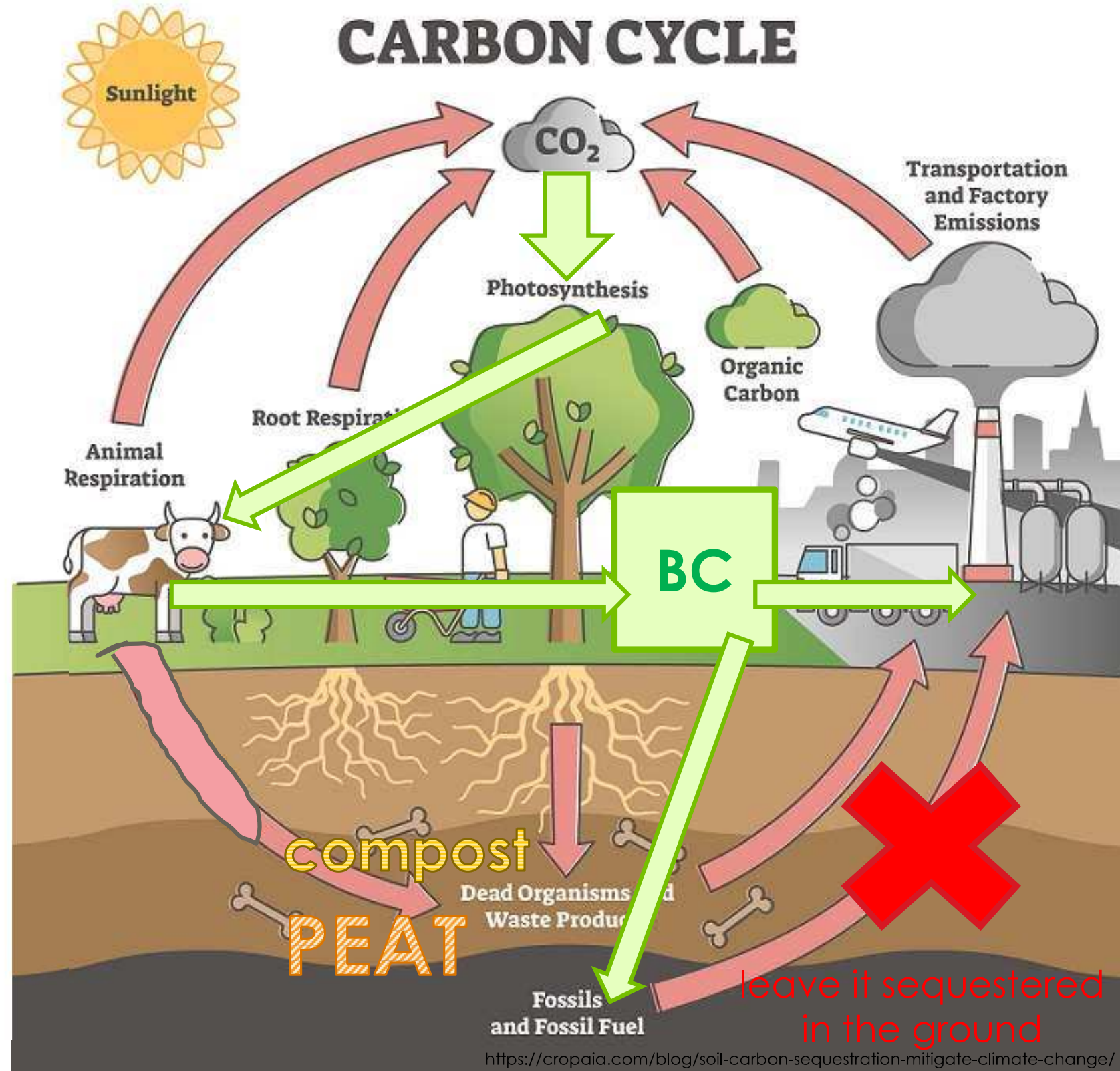


Photo Credit: (left) <https://www.bar.inz/bamboo-charcoal-new-has-its-own-ecological-attributes/> (middle) <https://www.wide.com/charcoal/> (right) <https://www.biochemicals.com/news/activated-carbon/> (bottom left) <https://www.researchgate.net/publication/261048486-Activated-Carbon-Black-Production-From-Peri-21753326> (bottom right) <https://www.oceanic.com/what-is-carbon-black>

Why Biochar ?



Image credit: https://www.canr.msu.edu/news/the_biochar_boon



<https://www.jfbrennan.com/environmental/wetland-remediation>



https://news.minnesota.publicradio.org/features/2004/01/14_robertsont_peat/



THE OCCURRENCE AND USES OF PEAT IN THE UNITED STATES

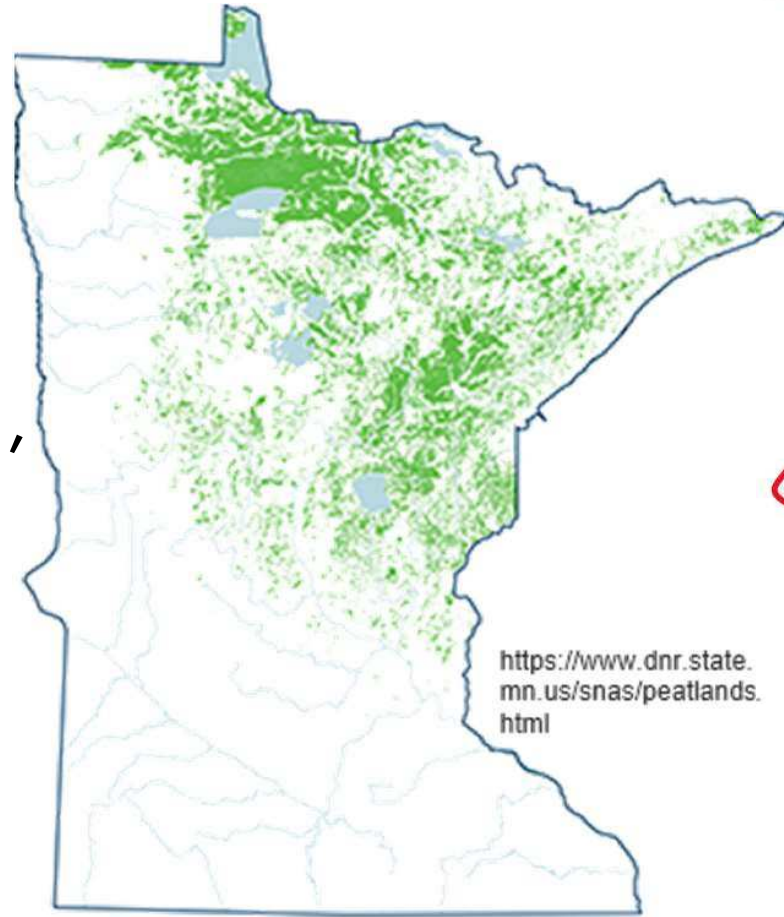
E. K. SOPER AND C. C. OSBON 1922

<https://pubs.usgs.gov/bul/0728/report.pdf>

DEFINITIONS.

The terms "peat" and "muck" are often used interchangeably to designate either of those materials—a practice that is confusing and that should be discouraged. Peat is the partly carbonized organic residuum produced by an arrest in the decomposition of roots, trunks of trees, twigs, seeds, shrubs, mosses, and other vegetation covered or saturated with water. It contains a large proportion of the carbon of the original vegetable matter, and its vegetal structure is generally visible without the microscope. It is usually acidic, and it contains much less inorganic than organic matter. In fact, some pure peats contain less than 4 per cent of inorganic material. Muck is soil that contains a high percentage of uncarbonized organic matter; but, as the name is commonly applied to drained and oxidized areas of peat under cultivation, it is difficult to draw the line between peat and muck; peat may grade into muck and muck into peat. If the material will ignite and burn freely when dry it is usually considered peat.

Peat
Replacement
Biochar,
Charcoal, et al.,
meet official
definitions of
Peat





<https://hal.science/hal-01665385/document>

Cold Climate Peat Soils

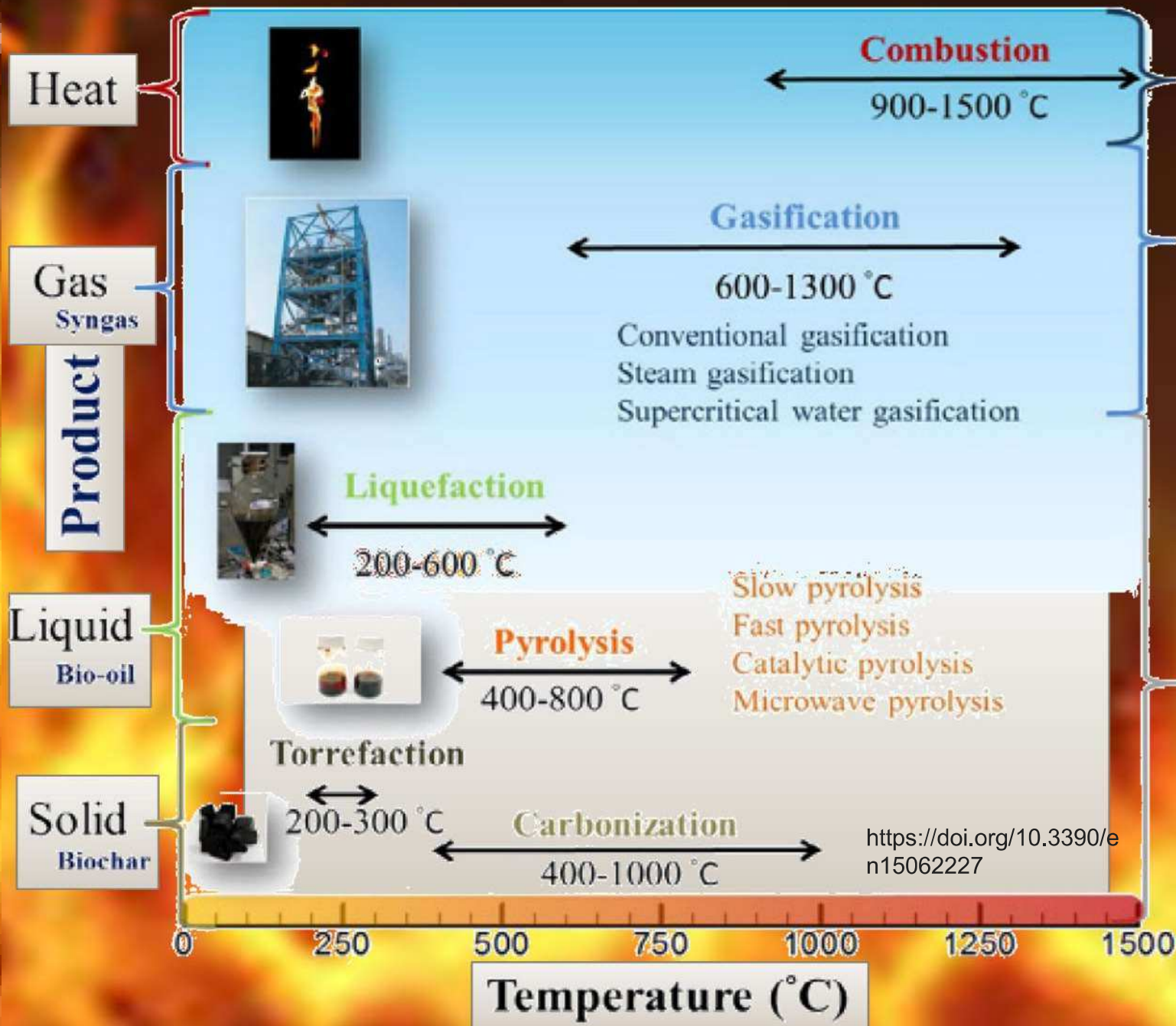
A - Fibric
B - Hemic
C - Hemic
D - Sapric
nominal sand, silt,
or clay content

No defined parameters for an acceptable peat material are present in current MnDOT spec. Relevant spec sections include:

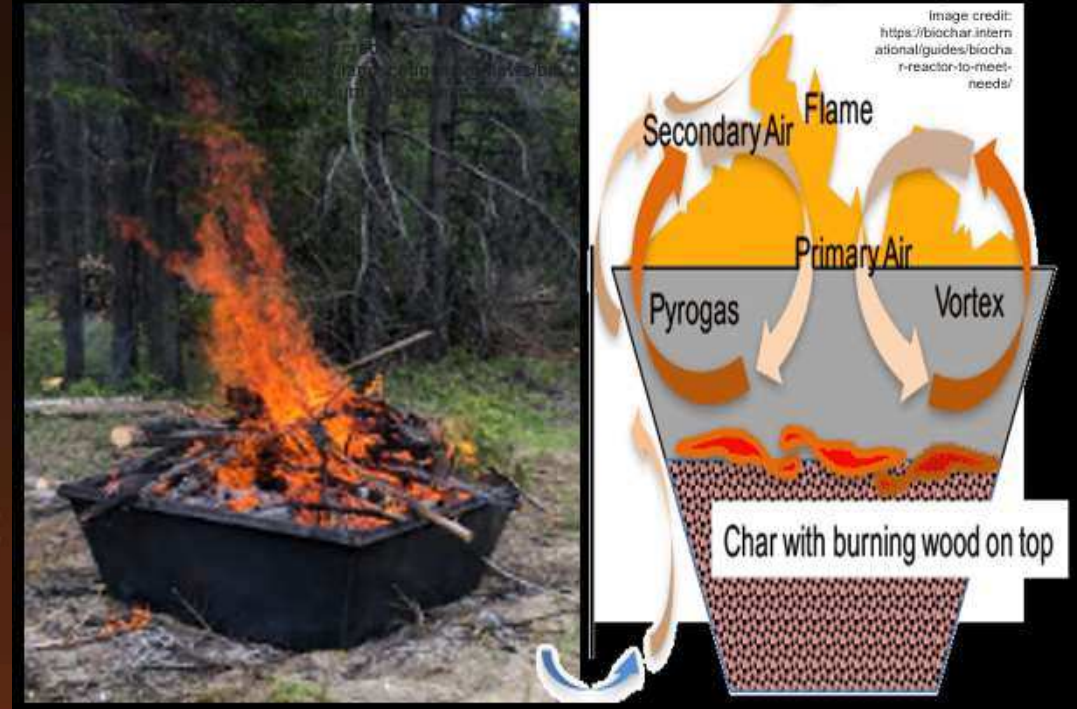
- **2106.2 B.7 Topsoil** ... Peat and other Organic Soils may be used to supplement the existing topsoil, ...
- **3896.2 SOIL AND ROOT ADDITIVES** ...
 - **E Activated Charcoal** Provide **activated charcoal** to neutralize or deactivate residual organic pesticide or chemical contaminants in the soil ...
 - **F Rhizobium Inoculum** ...
 - **(1) Sterilized carbon-based carrier** (lignite/**charcoal**, peat, or compost) ...
- **3896.3 SAMPLING AND TESTING — BLANK**

The US Mulch Soil Council defines peat as “Naturally occurring material formed chiefly from the partial decomposition of moss plants and organic matter in a water-saturated environment.”

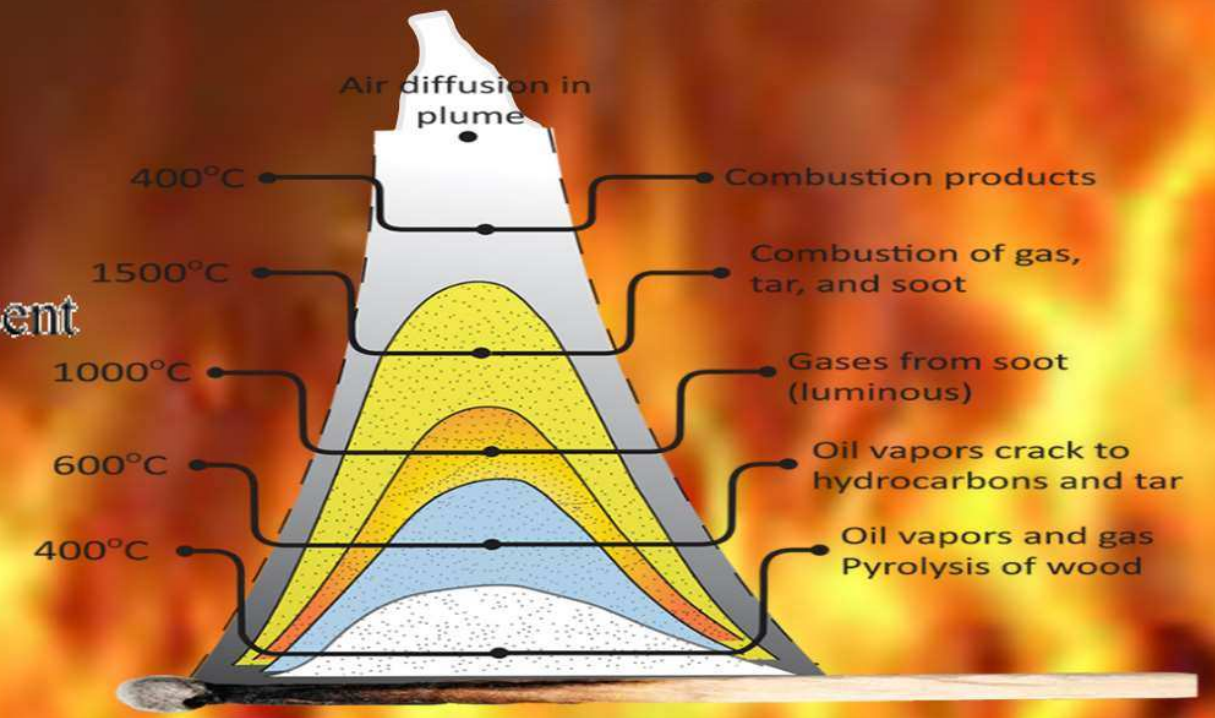
Fire Chemistry

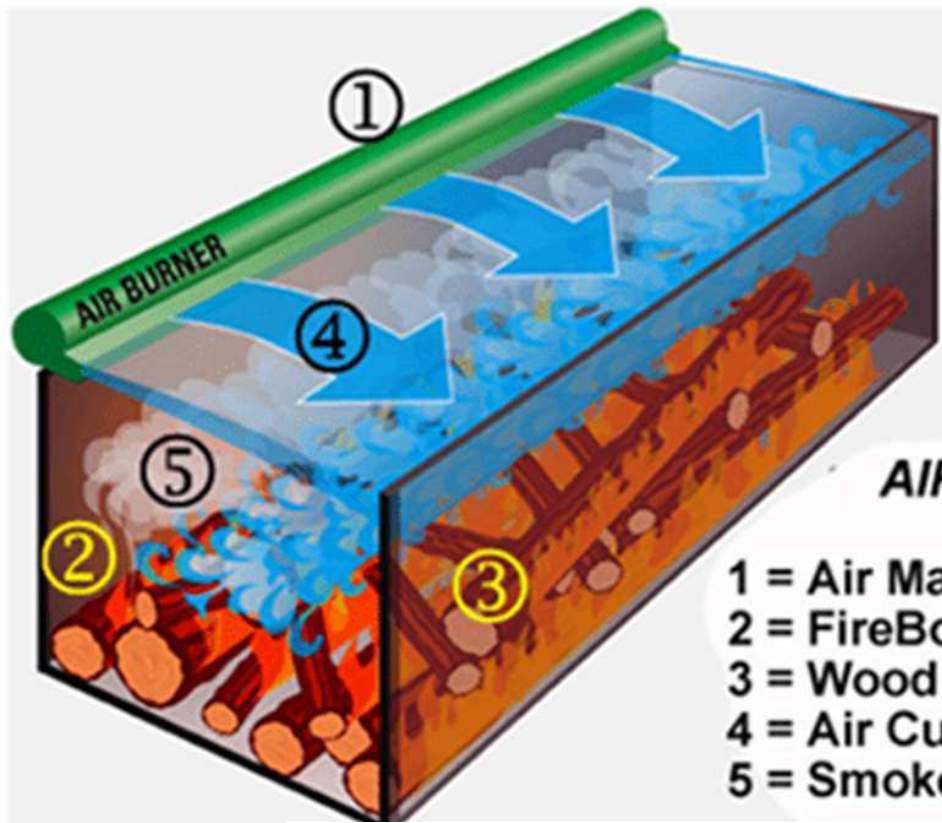


Oregon Kiln – Flame Cap



PYROLYSIS, GASIFICATION and COMBUSTION in a FLAMING MATCH





**AIR BURNERS, INC.
THE PRINCIPLE OF
AIR CURTAIN BURNING**

- 1 = Air Manifold
- 2 = FireBox Refractory Wall
- 3 = Wood Waste or Wood Fuel
- 4 = Air Curtain (left to right)
- 5 = Smoke (PM or Black Carbon)



<https://www.kleensite.com/kleenbox-burnboxservice-method>

**Air Curtain Burners—
Forced Air Flame Cap**

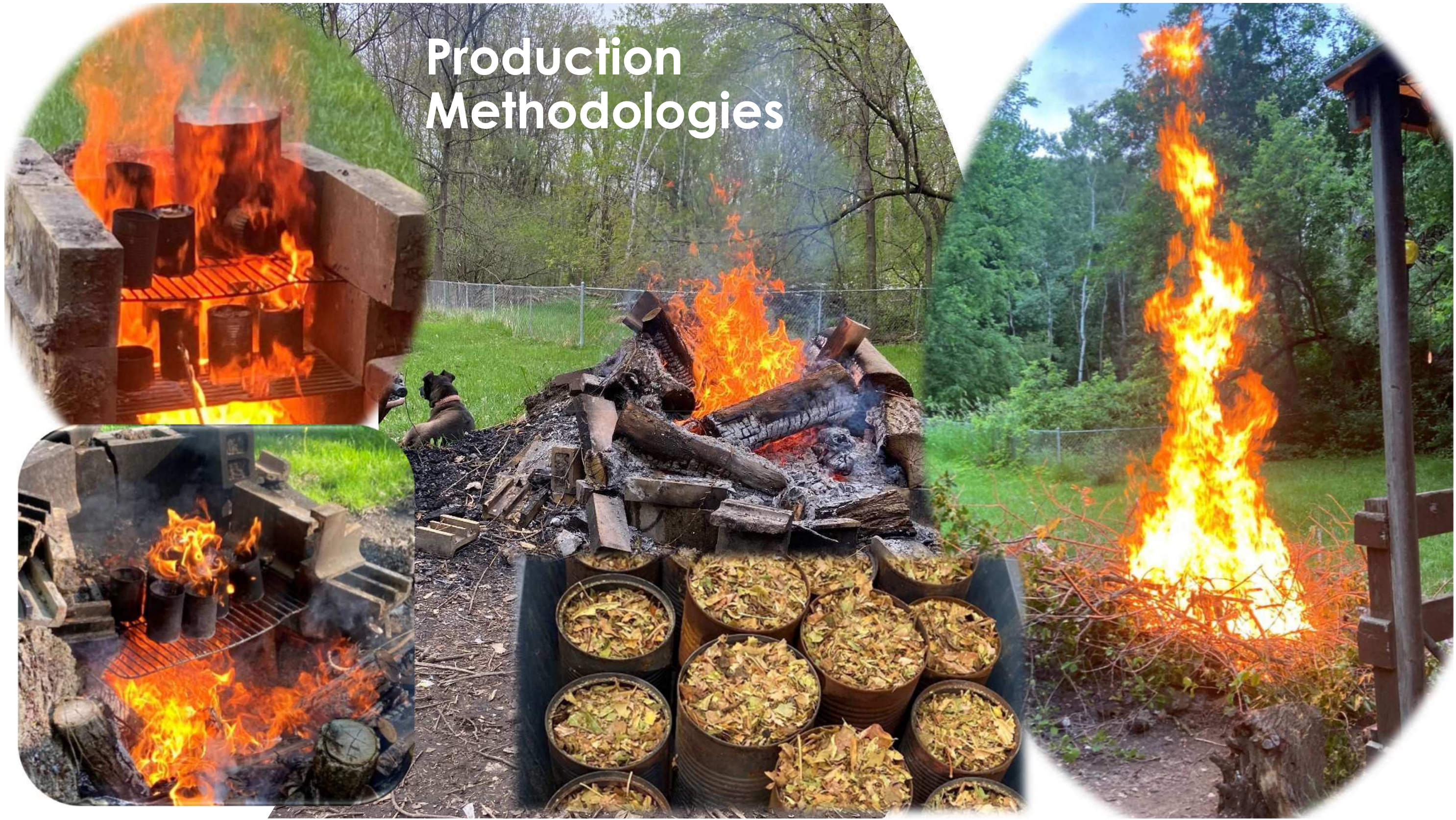


<https://www.eplin.af.mil/News/Article-Display/Article/391840/burn-baby-burnincinerator-clears-range-debris/>



Image credit: <https://www.customcarbonizing.com/>

Production Methodologies



Indirect Pyrolysis

Retort Kiln

Temperature (°C)

550

630

680

740

770

800

850

900

950

1000

1100

1200

1300

https://commons.wikimedia.org/wiki/File:Example_incandescence_colors_%28temperature_range_550_-_1300_C%29.svg



Rob Hietala





**TLUD –
Top Lit Up-Draft**



**Auto-
thermal
Pyrolysis**



Image credit:
<https://biocharinternational.org/biochar-reactor-to-meet-needs/>
<https://warmheartworldwide.org/successful-biochar-program/>

Boulder Biochar Barrel - The Brewmaster

\$2,999 + shipping
2 Barrel kit for running a generator motor \$1,999 + Shipping



<https://www.hpbiochar.com/boulder-biochar-barrel>

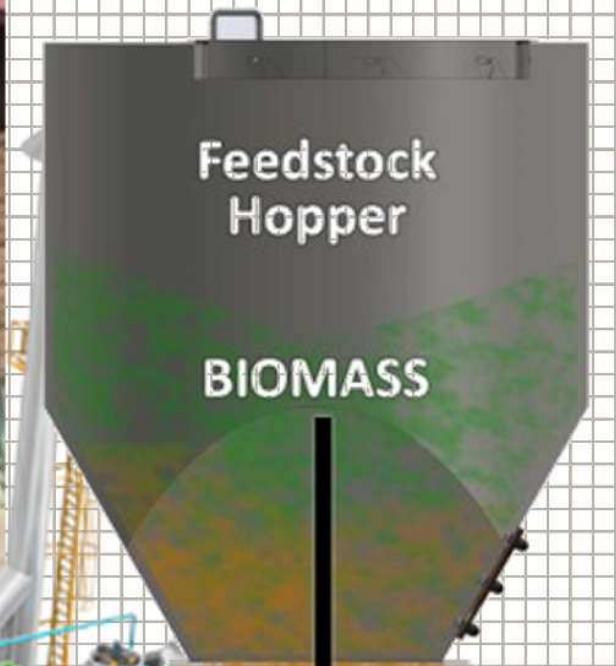
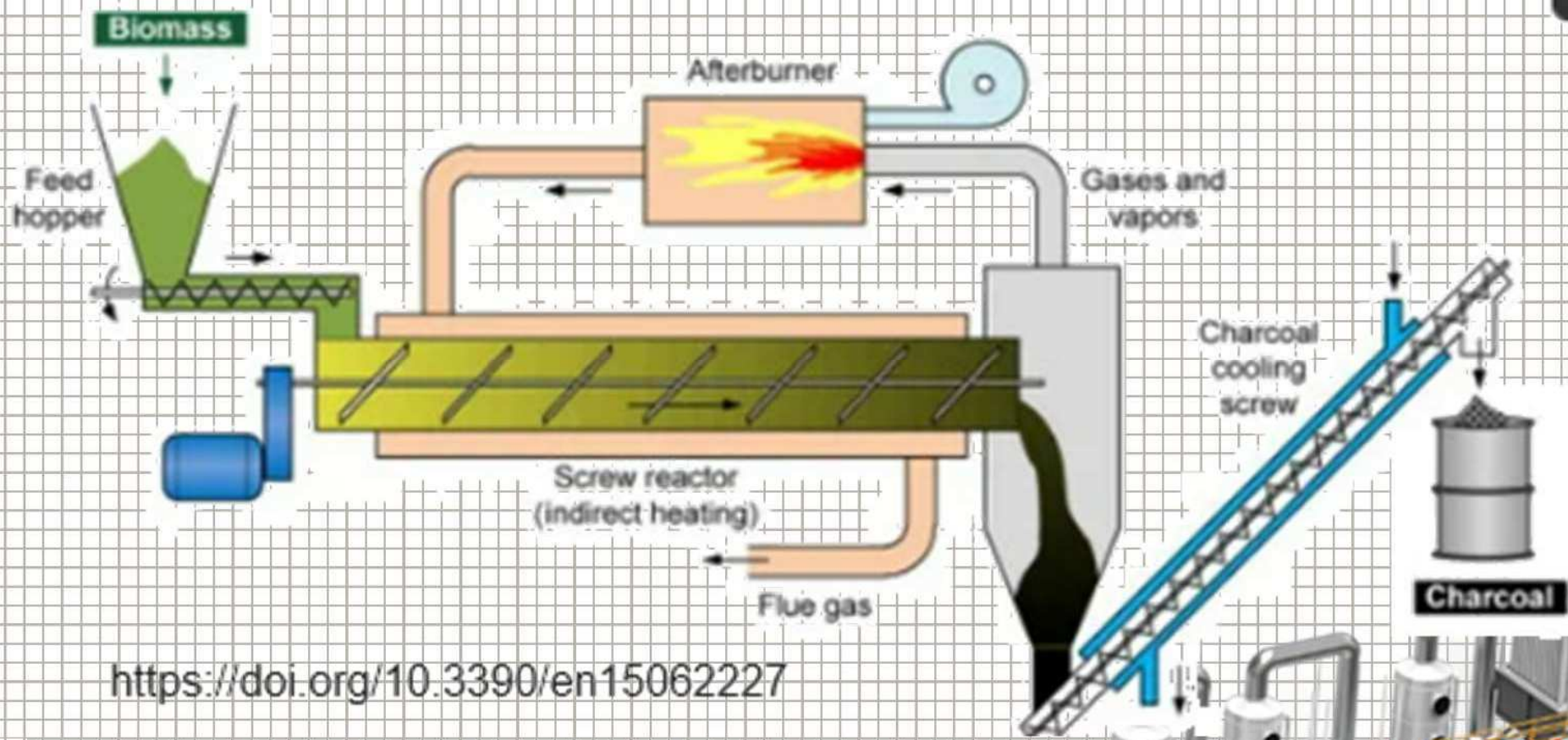


RocketChar 301 Biochar Furnace

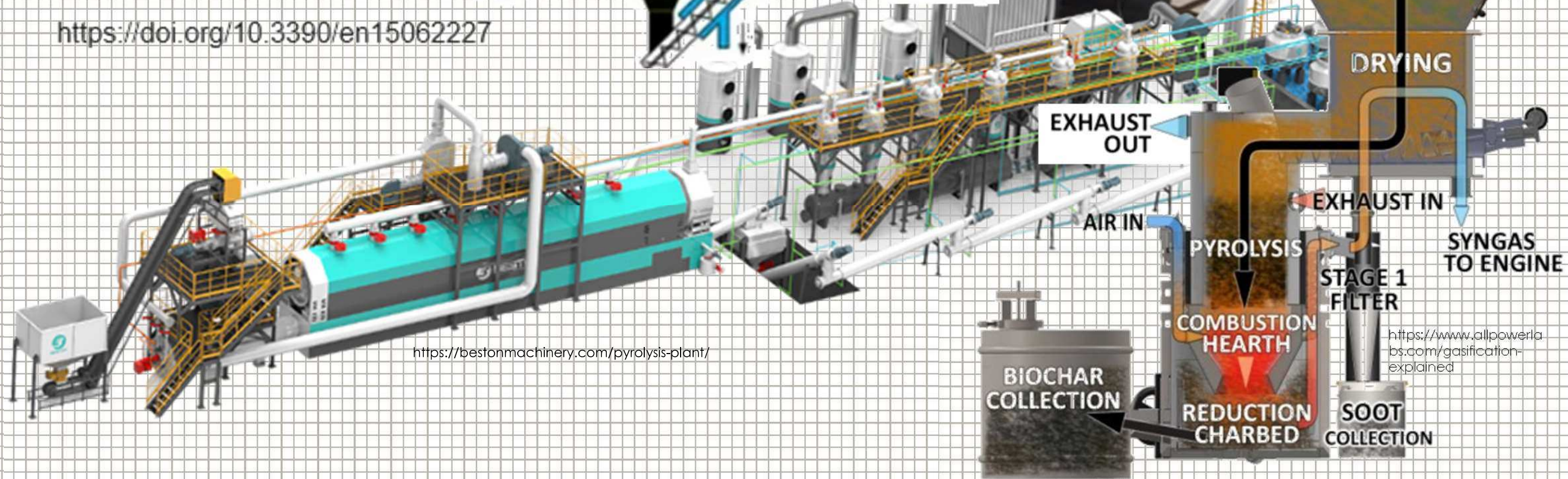
\$40,000 USD

<https://www.hpbiochar.com/rocketchar>





<https://doi.org/10.3390/en15062227>



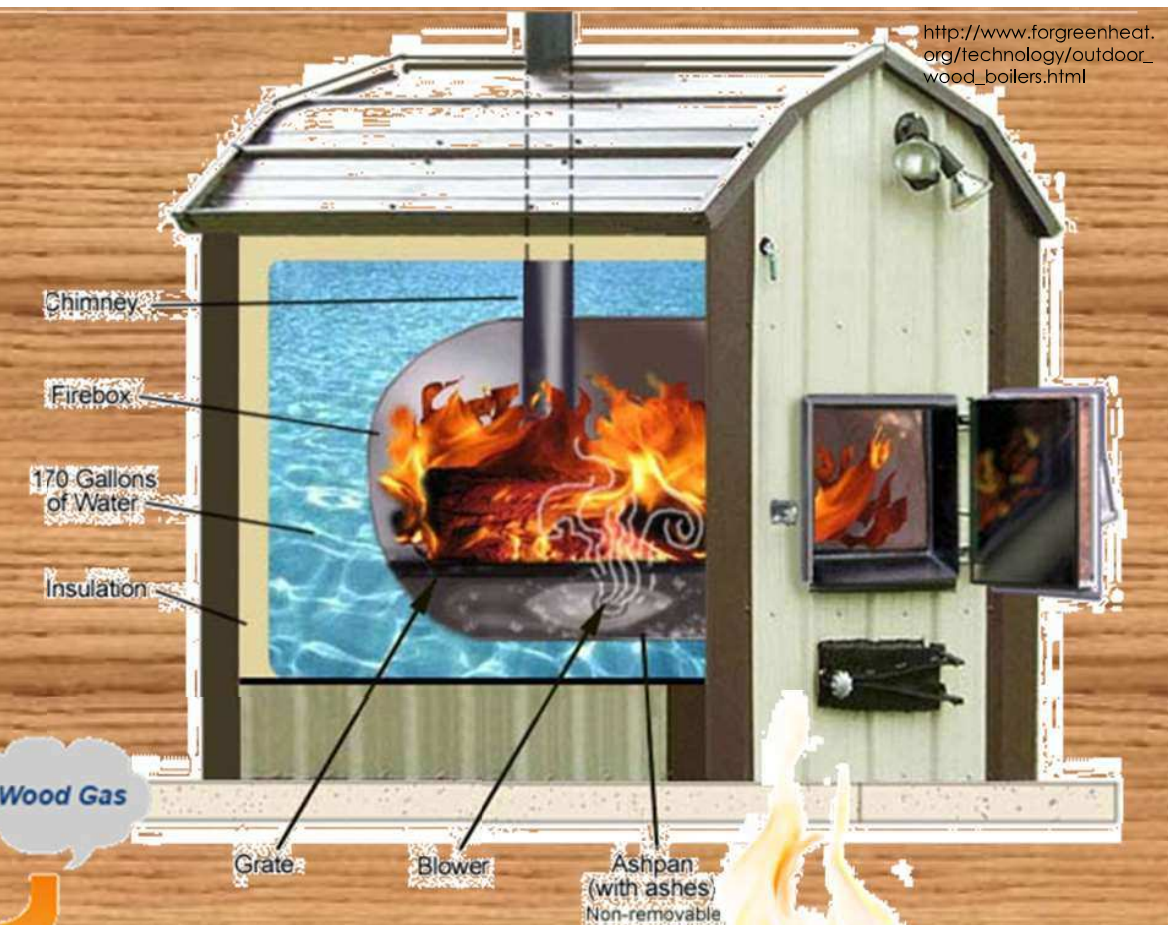
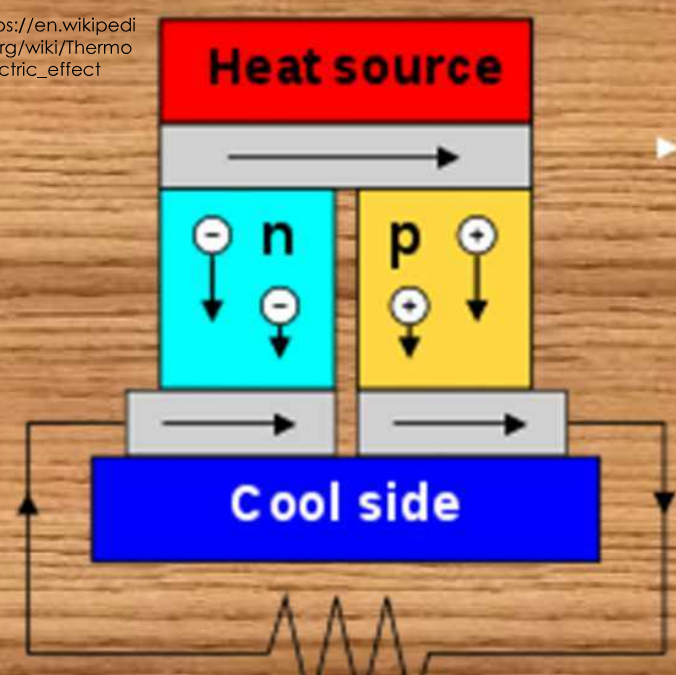
<https://bestonmachinery.com/pyrolysis-plant/>

<https://www.allpowerlab.com/gasification-explained>

Energy Recovery



https://en.wikipedia.org/wiki/Thermoelectric_effect



http://www.forgreenheat.org/technology/outdoor_wood_boilers.html

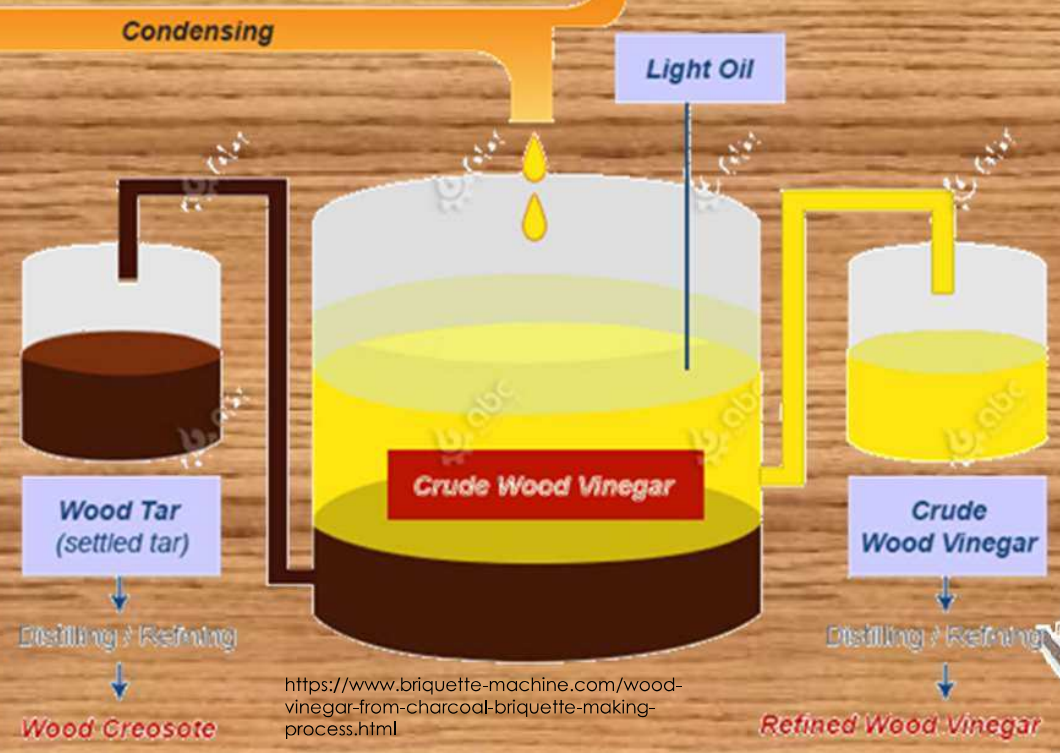


Wood Carbonization

<https://www.tegmart.com/wood-stove-thermoelectric-generators/>



Wood Gas



https://cdn.shopify.com/s/files/1/0666/9741/products/CampStove2_1_d6669270-700b-4685-b756-be3b42ef0f98.jpg?v=1612737235

<https://www.briquette-machine.com/wood-vinegar-from-charcoal-briquette-making-process.html>



<https://www.smilkeo.com/thermoelectric-p>

Water / Snow

Litter / Bedding

Quenching / Charging

Urine / Liquid Manure



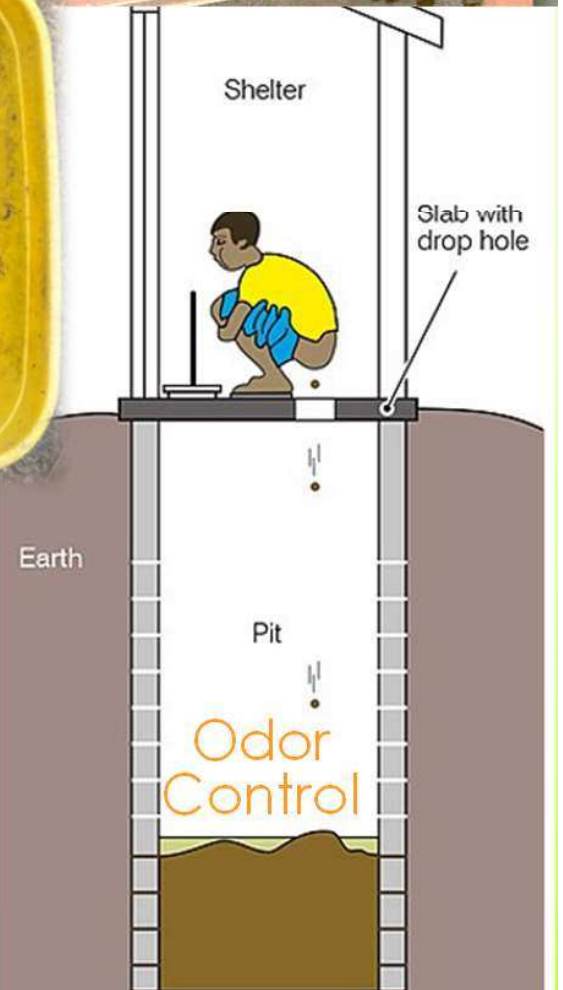
Fertilizer or Inoculant Solutions



[https://www.dairydesign.com/projects/manure-management-flush-systems/#lightbox\[gallery_image_1\]/3](https://www.dairydesign.com/projects/manure-management-flush-systems/#lightbox[gallery_image_1]/3)



<https://www.amazon.com/Natures-Head-Contained-Composting-Quarters/dp/B009Z7EK1C>



https://en.wikipedia.org/wiki/Pit_latrine



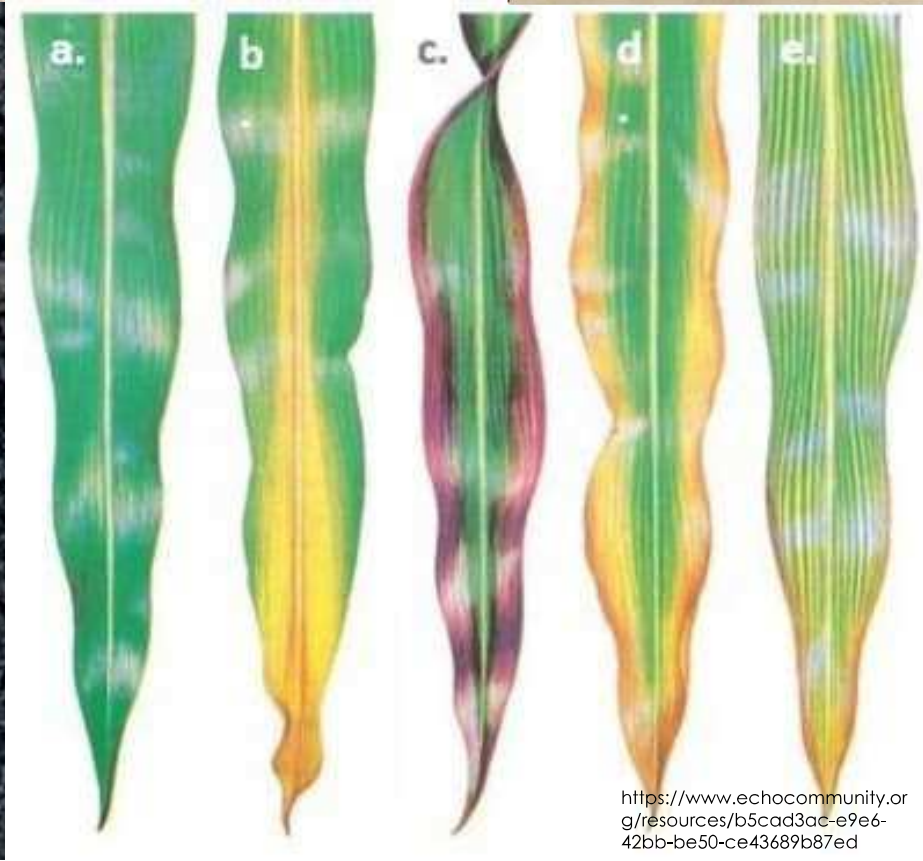
Transport, Transfer, & Storage Considerations





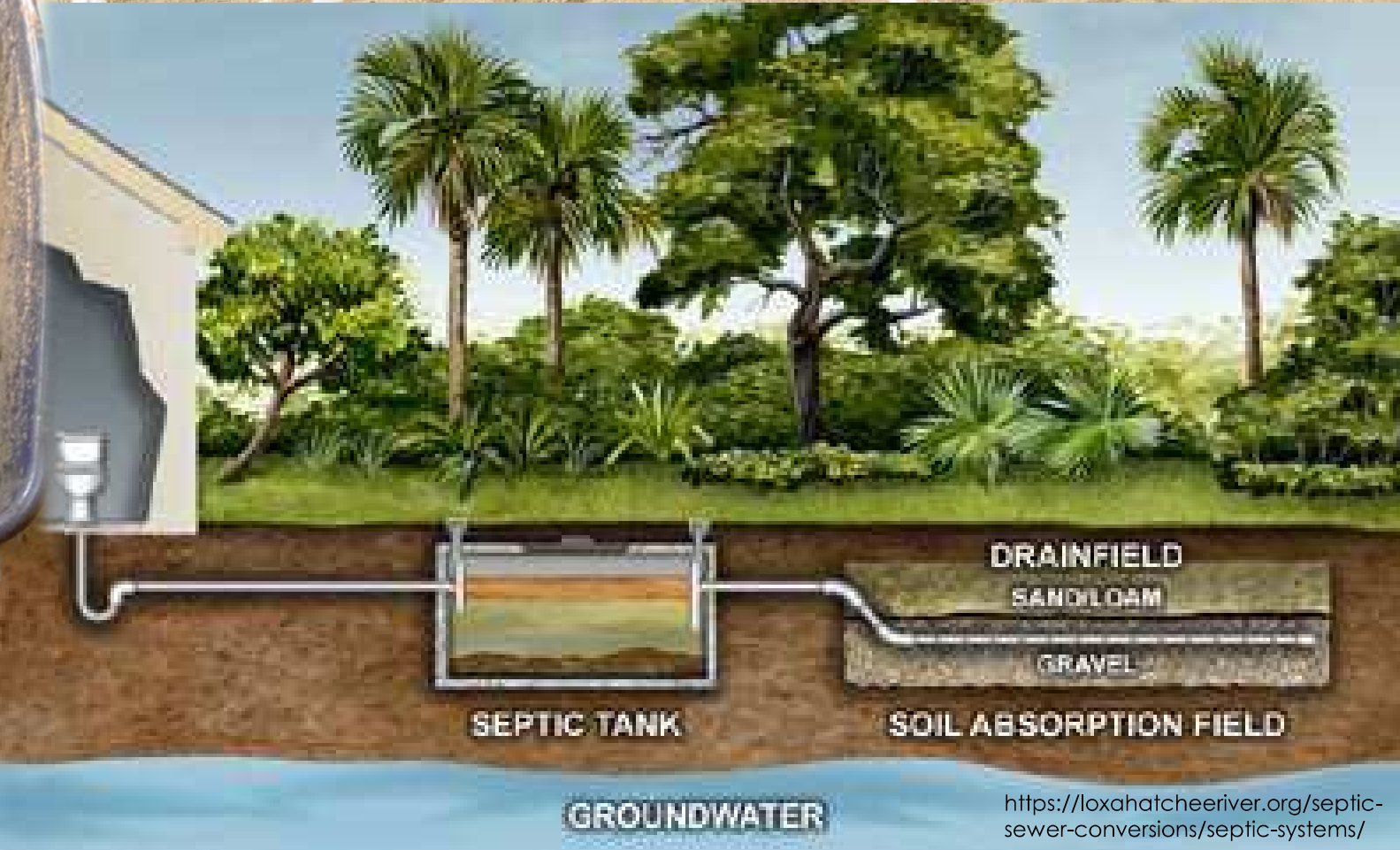
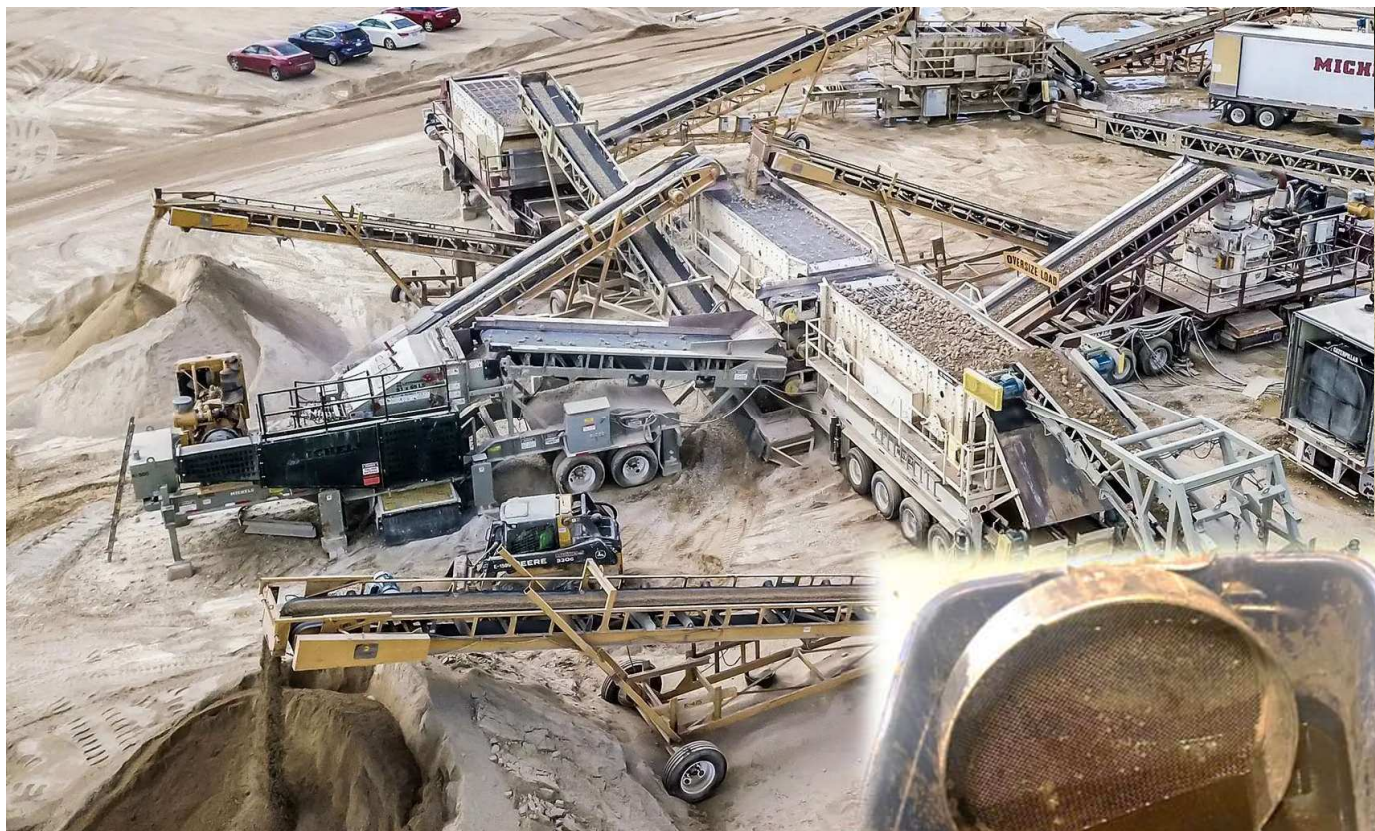


<https://ozturners.com.au/product/ct-compost-turners/>



<https://www.echocommunity.org/resources/b5cad3ac-e9e6-42bb-be50-ce43689b87ed>





MNCC/MNBI



<http://www.mncompostingcouncil.org/biochar.html>

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Up Next:

David Bauer

Ed Matthiesen

Kurt Spokas

Then:

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Q&A

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