Biochar Products and Applications

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Western Regional Boiler Association
Pasco, Wa
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What is biochar?

Who buys it?

How can biochar help a boiler owner/operator?
Biochar and Charcoal: Different Forms and Qualities For Different Applications

- Charred Branches
- Char in Soil – Terra Preta 3,500 yrs
- Charred Chips
- 6 mm Chips
- Biochar Pellets
- Biochar+ Fiber+Micro Biotic Soil Amendment
- Prills
- Extruded Charcoal
Biochar is charcoal made for use in the soil

- Carbon enriched (for lost C)
- Carbon smart (C Credits)
- Safe for use in soil
- ≥10% Carbon
- H:C ratio <0.7 (longevity)
- Non toxic
- Sustainable

<table>
<thead>
<tr>
<th>Material*</th>
<th>Ash %</th>
<th>Organic Carbon %</th>
<th>H:C</th>
<th>Toxic e.g. As mg/kg</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>BBQ Charcoal</td>
<td>≤6%</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>IBI Biochar Standard</td>
<td></td>
<td>10% Min</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Class 1: ≥60%</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Class 2: ≥30%</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Class 3: ≥10%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KARR Pyrolysis (Hardwood)</td>
<td>5.2 %</td>
<td>83.8%</td>
<td>0.68</td>
<td>1.2</td>
<td>7.5</td>
</tr>
<tr>
<td>Gasification (Softwood tops)</td>
<td>18.3%</td>
<td>74.3%</td>
<td>0.41</td>
<td>0.7</td>
<td>12.0</td>
</tr>
<tr>
<td>Boiler Flyash (Softwood hog fuel)</td>
<td>98.5</td>
<td>1.6</td>
<td>8.68</td>
<td>5.7</td>
<td>12.8</td>
</tr>
<tr>
<td>Boiler – High Carbon Fly Ash (Softwood hg fuel)</td>
<td>8.4</td>
<td>75.8</td>
<td>0.48</td>
<td>9.8</td>
<td>9.5</td>
</tr>
</tbody>
</table>

*Source: T R Miles Technical Consultants Inc.
Biochar Products in Different Packages

www.biocharm.com
www.permamatrix.com
www.walkingpointfarms.com
www.ecotracorganics.net
www.bicharsupreme.com
www.confluenceenergy.com
www.soilreef.com
www.coolplanet.com
www.karrgroupco.com
Biochar Producers and Distributors in PNW Cooperate to Develop New Markets and Uses


NW Biochar Working Group [nwbiochar.org](http://nwbiochar.org)

- Email list
- Web site
- Meetings
- Projects

- Retail Garden and Landscaping
  - Packaged consumer products
    - Biochar, Compost and biochar
    - Biotic Soil Amendments (biochar + organics, minerals and biologicals)

- Wholesale to
  - Landscape services – tree service
  - Specialty Crops, Horticulture, and Turf

- Bulk Char to Remediation, Erosion Control
  - Stormwater filtration
  - Granulated products for hydro-seeding
  - Oilfield remediation, Filtration
  - Mine reclamation
The bioretention soil mix included **15% Black Owl Biochar's Environmental Ultra** in addition to compost and sand. Biochar Supreme offers custom [Stormwater Mix](http://www.biocharsupreme.com)
Many Toxics & Organics are Filtered by Biochar

Peer reviewed research shows the following toxic organics are sorbed by biochar.

- **Heavy Metals**: Copper, Zinc, Lead, Cadmium, Chromium, Mercury
- **Explosives**: DNT, TNT, RDX
- **Herbicides**: Atrazine, Acetochlor, Clopyralid, Fipronil, Glyphosate, Simazine, 2,4D, Trifluralin, Diuron (DCMU)
- Benzonitrile, Phenathrene, trichloroethylene, Triazine
- **Hydrocarbons**
- **Pesticides & Fungicides**: Pyrimethanil, Hexachlorobenzene, Pentachlorophenol, Lindane, Isoproturon, Endosulfan, Chlorantraniliprole, Chlorpyrifos, Carbofuran
- **Polycyclic Aromatic Hydrocarbons (PAH)** >50% of 4- & 5- ring PAH, >40% of 2- & 3- PAH

Literature Search: sciencedirect.com
Biochar in Industrial Stormwater Filters

Port of Tacoma, West Hylebos Pier Log Yard

Up to 80% - 90% reduction in ISGP parameters: pH, Zinc, Copper, Turbidity, TSS & COD

Small Scale tests: 70% Sand + 30% Biochar to capture Copper and reduce Chemical Oxygen Demand (COD)
Biochar Improves Water Quality in Many Applications

LOW IMPACT DESIGN: RAIN GARDENS/STORM DRAINS

DEMOS: 8 Cities
RESEARCH:
• OSU
• EPA Corvallis
• WSU
• Gonzaga
• Stanford - CSM

BIOCHAR IN COMPOST ROLLS AND BIO BAG FILTERS FOR SURFACE RUNOFF
Biochar in Structural Soil

Parking Forest  ParkingForest.org

Structural Soil under Permeable Pavement for larger canopy trees.

Biochar in Structural Soil
- Improves tree health, helps them resist disease
- Adsorbs oils/metals from the parking lot
- Filters rain water, keeps nutrients close to trees.
- Increases water available to street trees.

Parking forest PCC
(Maria Cahill)

Structural Soil, Cornell University
www.hort.cornell.edu
Biochar Helps Re-vegetation, Environmental Remediation.

BIOCHAR IN HYDROSEEDING AND FILTERS

www.permamatrix.com
Recycled soil from a steel mill. There is a line where PermaMatrix was sprayed and where it was not applied. The other vegetation died. [www.permamatrix.com](http://www.permamatrix.com)
Biochar Can Improve Turf and Landscape Management for Parks and Recreation

- Use normal practices
- Use stable soil amendment
- Retain more water
- Replace non-sustainable materials
- Reduce chemical leaching and runoff
- Reduce chemical and fertilizer use
- Decrease saturated hydraulic conductivity
- Promote growth of microorganisms
- Sequester CO₂

(Permamatrix)
(Sand-based turfgrass root-zone modification with biochar, Shane R. Brockhoff, Iowa State University)

Biochar + compost may resist Pythium blight
(Photo LP Tredway)
Biochar in Urban Farms and Gardens

Ghost Peppers and Hot Chilis
Black Stuff Biochar

URBAN FARMING
GREEN ANCHORS
www.facebook.com/greenanchorspdx
Biochar in Nurseries With Bark, Peat, or Peat Substitutes

Agronomic Benefits

SOIL STRUCTURE-
  Vermiculite substitute

COMPOST AID -
  Peat substitute = Compost + Biochar

PLANT HEALTH -
  Inhibits root disease
  Nutrient (P) carrier for poor soils

Ponderosa Pine in Soilless Media with Vermiculite (Left) and Biochar (Right)
Adding 7% Biochar to Scoria based media improved the effluent with 70% reduction in Nitrates, 40% reduction in Phosphates and 70% reduction of Organics than un-amended control.

Biochar Improves Tree Health

Biochar + Compost
Biochar + Mycorrhiza, Composted

• Increases disease & insect resistance
• Improves microbial activity and soil fertility
• Increases soil water retention, and available water to tree roots
• Stimulates tree growth
• Improves tree survival

Trenches with Biochar + Mycorrhiza can be used to rehabilitate diseased trees, like these examples from Japan

(Dr. Makoto Ogawa)

Bartlett Tree Service
www.bartlett.com/tips/Biochar.cfm
Biomass Sources and Biochar Markets

Sources
• Urban wood waste
• Agricultural and Forest Industry process residues
• Forest residues – slash, fuel reduction, restoration
• Crop residues

Markets
• Horticulture, nursery and urban landscaping, community gardens
• Turf establishment and maintenance, parks, golf courses
• Soil remediation and storm water (green streets) nutrient management
• Crops and soil amendment, e.g. biochar + digested solids, composting
Opportunities for Boiler Owners

• Make high carbon flyash in existing boiler
• Install large industrial pyrolyzer to make biochar and heat/power
• Install a modular carbonizer to make biochar, BBQ charcoal, and heat.
Make High Carbon Ash in a Spreader Stoker - Moving Grate

- High under grate air + poor OFA/Low under grate air
- Insufficient or poor over fire air
- Poor fuel distribution or deep fuel bed
- High concentration of wet sawdust and bark

3/11/2015

KARR GROUP
Build Industrial Gasifier to Convert Wood to Heat, Power and Biochar

Makes 40 TPD 400 CY/Day BIOCHAR

4-8 TPH Biomass 2-5 MWe
10-15,000 t/y biochar
Convert Wet Fuel to Heat and Char Through “Fractional Hydro Pyrolysis” (Karr)

- Wet Sawdust
  - 6 t/h
  - 50% M C

- Bark
  - 1.4 t/h

- Log yard Waste
- BBQ Briquettes
- Biochar

- Process Gas to the burner
- Gas Knockout Drum
- Excess Producer Gas
- Bumner
- Electric Output 1.77 mw @ 10,000 btu/kw-hr heat rate

17 MM Btuh Heat to Boiler or Dryer

karrgroupco.com
Install Modular Karrbonizer to make BBQ charcoal and biochar

- Capacity 6 t/hr wet biomass 50% MC
- Feed wet fuel, no external dryer
- High Karrchar™ output 40%
- High KarrGas™ production for heat or power
  400 Btu/scf, H2 rich, quick light
- Low foot print – 25 ft x 40 ft, can be placed next to boiler or kilns
- IBI Certified Biochar
- Patent (Pending) Karrbonizer-6t™ design
- Prototype operation for over a year
**Low Risk Residue Conversion to Biochar**

**Karr Group:**
Convert all excess fiber at the mill site – hog fuel, sawdust, planer/sander dust, shavings

Net Increase of $25/BDT revenue for fiber: 100,000 bdt/yr fiber = $2.5 million/yr

Free gas for dry kilns

**Low risk –**
- Karr buys the charcoal and mill uses the free gas
- No additional personnel to operate the Karrbonizer
- Lower boiler maintenance costs
- Lease or purchase option
- No administrative infrastructure for managing, selling, collecting A/R, logistics and follow up on the waste.

**Low environmental impact –**
- Zero discharge, only air emissions, which are minimal, Karrbonizer uses 20% of the gas produced for internal purpose –no waste disposal, easy permitting
- Carbon neutral
Summary

• Biochar – carbonized biomass- is becoming an established product to improve soil fertility, increase food production, reduce pollution, improve water quality and sequester carbon.

• Biomass industries with fuels, residues, boilers and dryers can benefit from converting part of their biomass residues to biochar, charcoal and heat. Biochar can be made as a co-product with BBQ charcoal.

• Commercial systems are available that can be operated parallel to boilers in existing mills to convert residues that are not suitable for higher value wood products.
Design and development of energy and environmental processes

Industries
- Biomass energy
- Pollution control
- Materials handling
- Feed, Food and Fuels

TR Miles Technical Consultants, Inc. 503-780-8185 tmiles@trmiles.com www.trmiles.com

International Biochar Initiative Biochar-international.org

NW Biochar Working Group www.nwbiochar.org

Biochar Listserv www.biochar.bioenergylists.org

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818-929-6332 ajayk@karrgroup.com
Plant site: 1674 State Hwy 508, Onalaska, WA 98570

www.trmiles.com