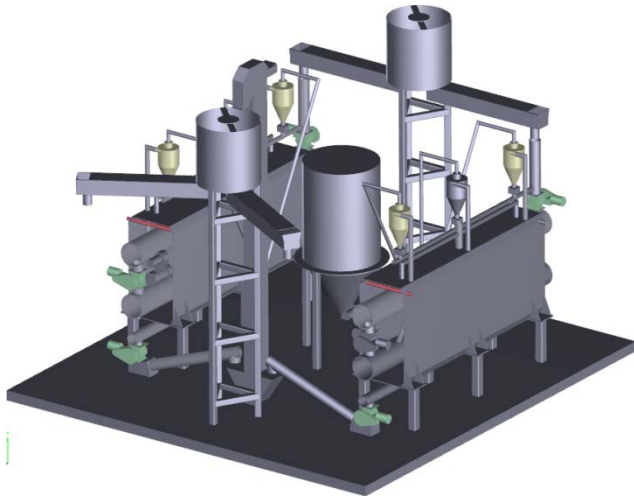




Biochar Products and Applications



Tom Miles
Karr Group of Companies
Onalaska Wood Energy LLC
Western Regional Boiler Association
Pasco, Wa
March 11, 2015



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



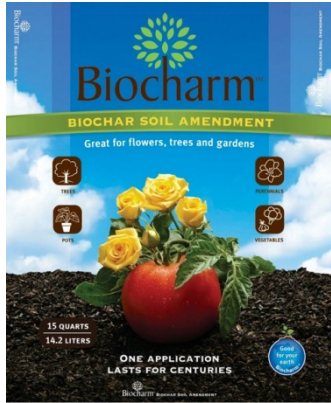
- $\geq 10\%$ Carbon
- H:C ratio < 0.7 (longevity)
- Non toxic
- Sustainable

International Biochar Initiative Std. Ver 2.0
Biochar-international.org

Material*	Ash %	Organic Carbon %	H:C	Toxic e.g. As mg/kg	pH
BBQ Charcoal	$\leq 6\%$				
IBI Biochar Standard		10% Min Class 1: $\geq 60\%$ Class 2: $\geq 30\%$ Class 3: $\geq 10\%$	< 0.7	< 13	
KARR Pyrolysis (Hardwood)	5.2 %	83.8%	0.68	1.2	7.5
Gasification (Softwood tops)	18.3%	74.3	0.41	0.7	12.0
Boiler Flyash (Softwood hog fuel)	98.5	1.6	8.68	5.7	12.8
Boiler – High Carbon Fly Ash (Softwood hg fuel)	8.4	75.8	0.48	9.8	9.5

*Source: T R Miles Technical Consultants Inc.

Biochar Products in Different Packages



www.biocharm.com



www.permamatrix.com



walkingpointfarms.com



www.ecotracorganics.net



www.biocharsupreme.com



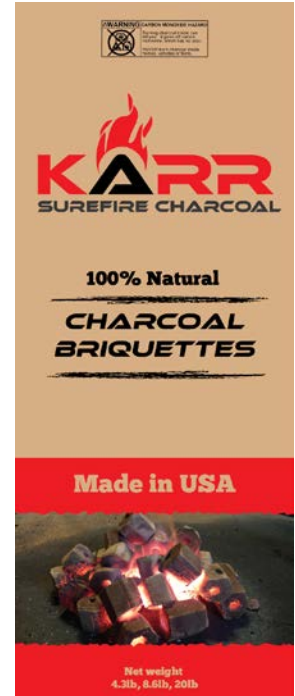
www.confluenceenergy.com



www.soilreef.com

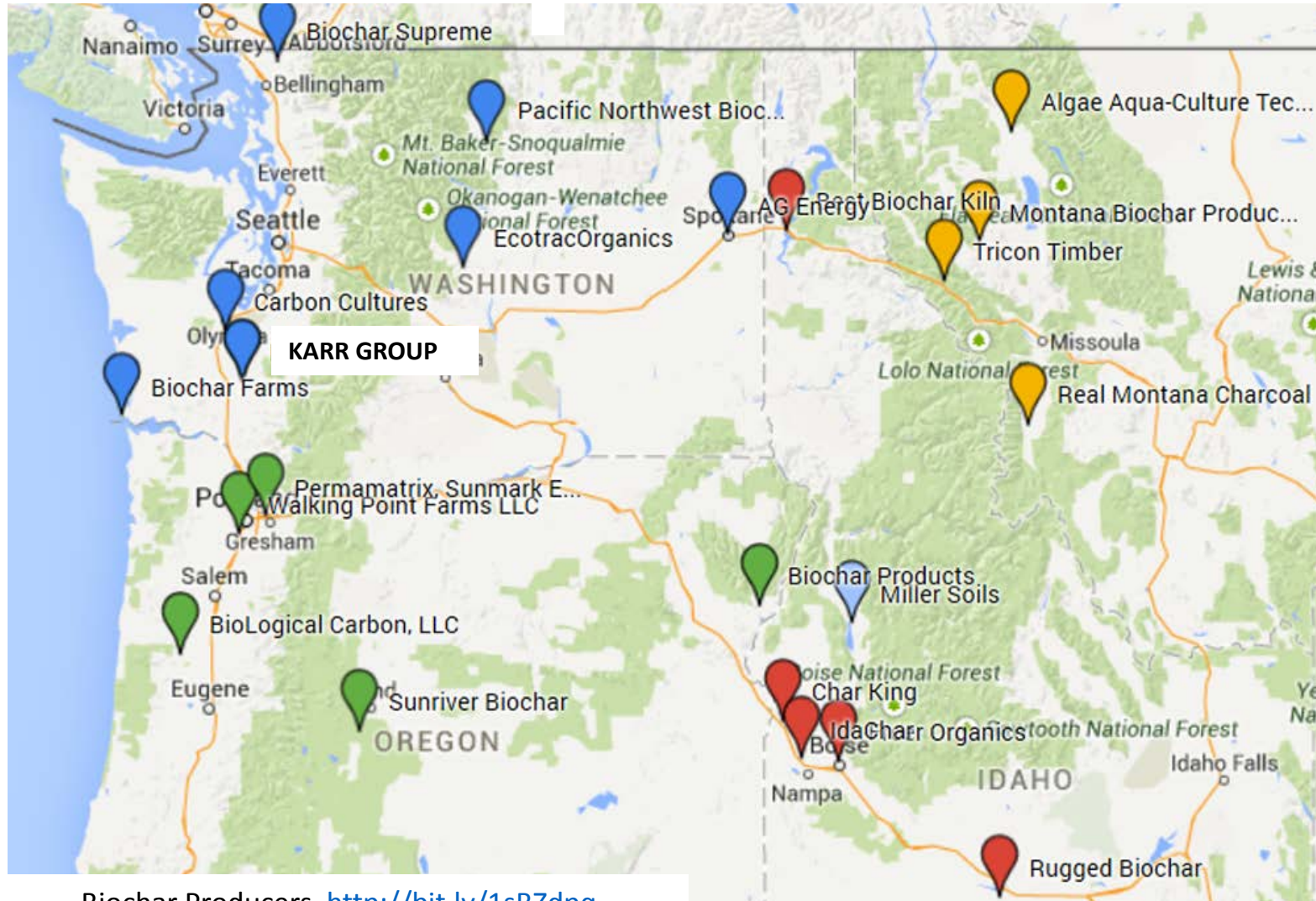


www.coolplanet.com



karrgroupco.com

Biochar Producers and Distributors in PNW Cooperate to Develop New Markets and Uses



NW Biochar Working Group
nwbiochar.org

- Email list
- Web site
- Meetings
- Projects

Biochar Producers <http://bit.ly/1sBZdpq>

Who Buys Biochar? Emerging Markets.

- **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



City of Redmond: Biochar in Bioretention Filter Media for Stormwater



The bioretention soil mix included **15% Black Owl Biochar's Environmental Ultra** in addition to compost and sand. Biochar Supreme offers custom [Stormwater Mix](#)

www.biocharsupreme.com

Many Toxics & Organics are Filtered by Biochar

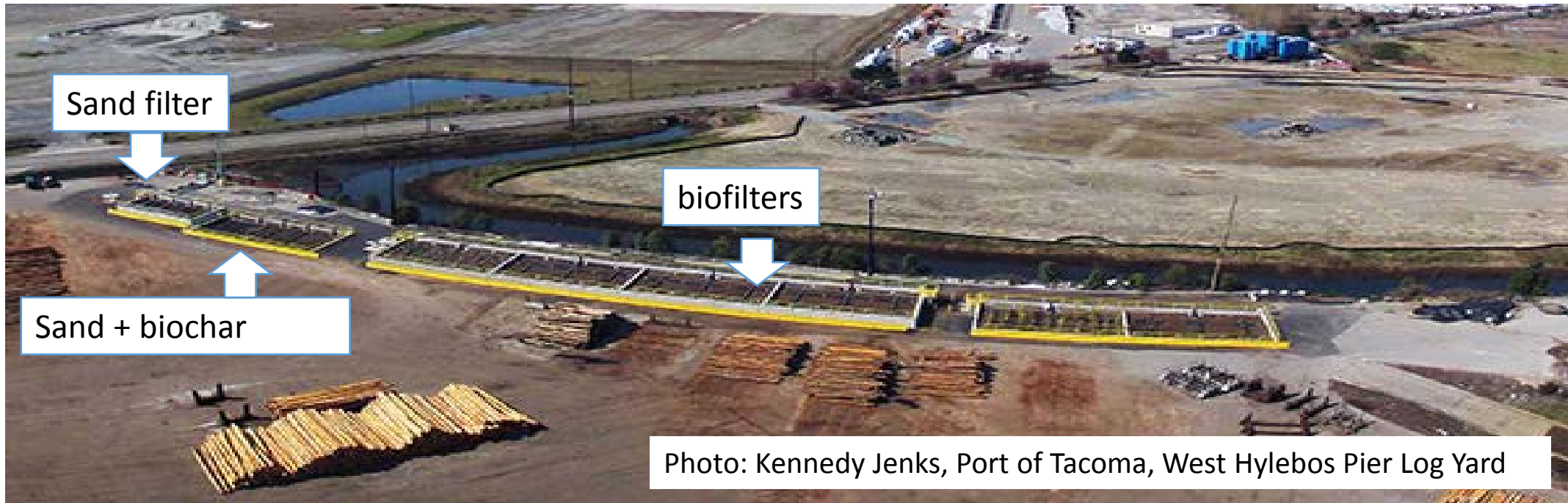
Peer reviewed research shows the following toxic organics are sorbed by biochar.

- **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**
- **Poly chlorinated biphenyls (PCB)**
- **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



ROOF DRAINS



BIOCHAR IN COMPOST ROLLS AND BIO BAG FILTERS FOR SURFACE RUNOFF

Biochar in Structural Soil



Loading or Compaction Effort

Parking forest PCC
(Maria Cahill)

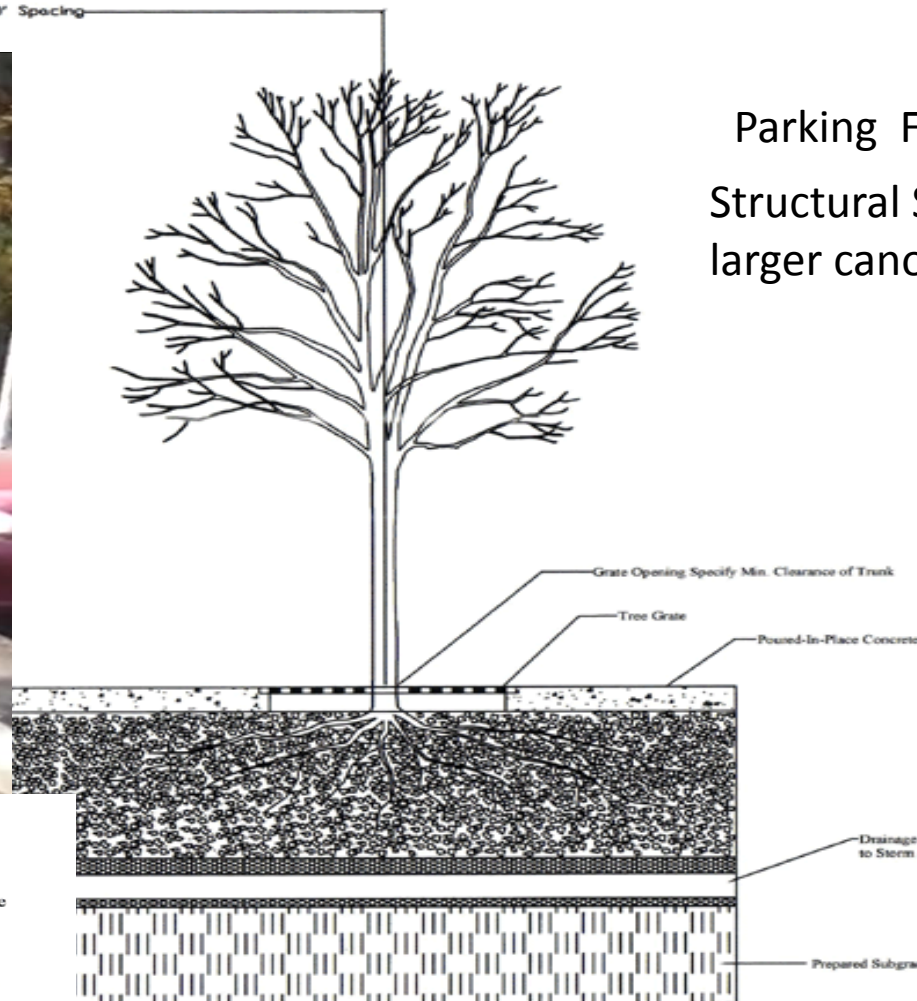


Stone particle

Soil particle

Air or water pore

Stone contact points
where load is
transferred



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.

Structural Soil, Cornell University
www.hort.cornell.edu

Biochar Helps Re-vegetation, Environmental Remediation.



www.permamatrix.com

BIOCHAR IN HYDROSEEDING AND FILTERS

Biochar Improves Remediation With Mulch



PermaMatrix 10% Biochar



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

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




**Calforest
Nurseries**



**Ponderosa Pine in Soilless Media with Vermiculite (Left)
and Biochar (Right)**

Biochar Improves Green Roof Media



Using 30% biochar in scoria roof media increased plant water availability by 16% .

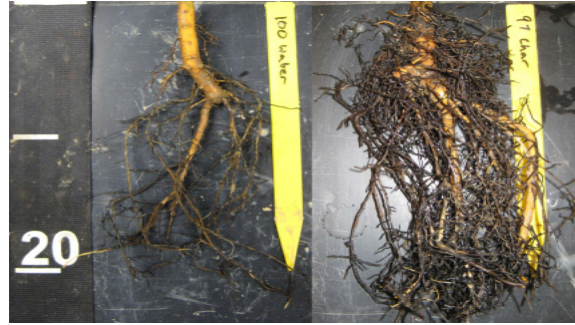
Cao, C.T.N., C. Farrell, P.E. Kristiansenn, J.P. Rayner. 2014. [Ecological Engineering 71: 368-374.](#)

Photo: Ladybird Johnson Wildflower Center

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.

Beck, D.A., G.R. Johnson and G.A. Spolek. 2011. [Environmental Pollution 159: 2111-2118.](#)

Biochar Improves Tree Health



No Treatment (right) 5% biochar + compost top dressing
Tree roots at 18 months in compacted soils.
Photo: Morton Arboretum Soil Science Laboratory



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

(Dr. Makoto Ogawa)

- 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

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



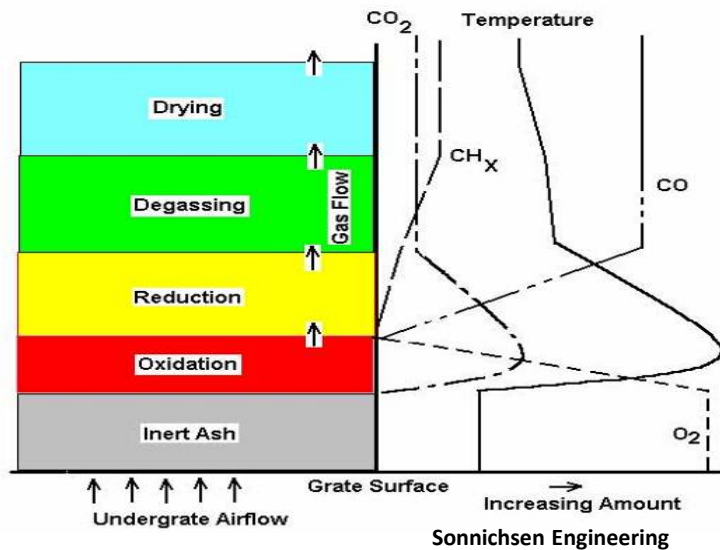
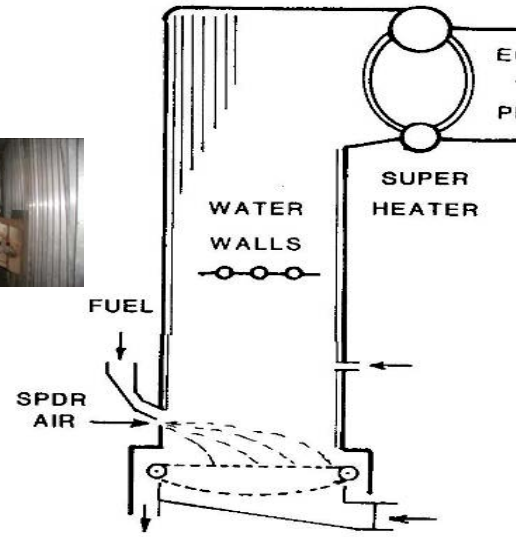
Inspecting Seedlings Grown with Biochar
Soils and Use Determine Properties Required

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

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



ICM 200 tpd Gasifier
Wood, Straw, Stover
www.icminc.com

Convert Wet Fuel to Heat and Char Through "Fractional Hydro Pyrolysis" (Karr)



Wet Sawdust



Bark



Log yard Waste



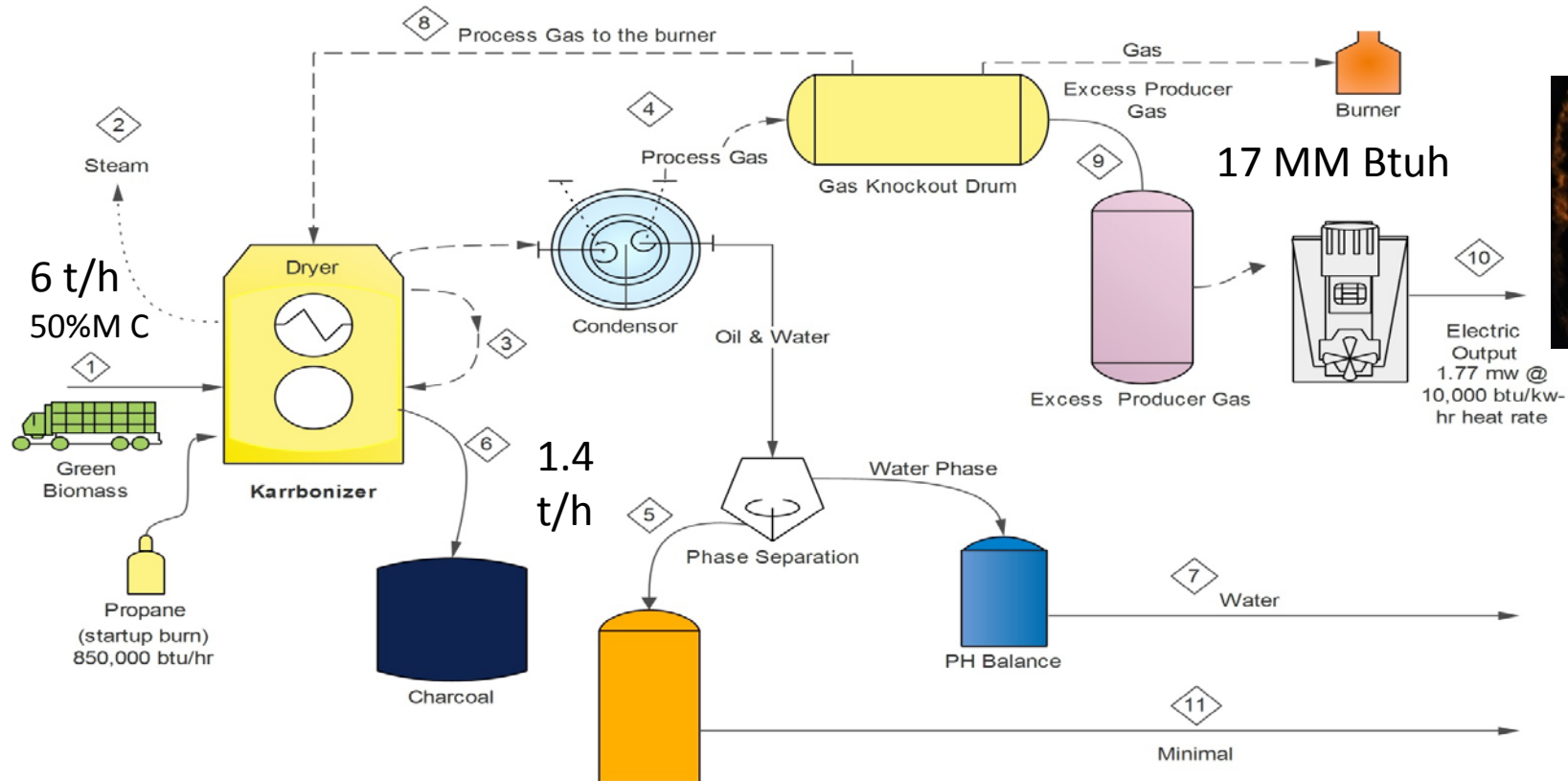
BBQ Briquettes



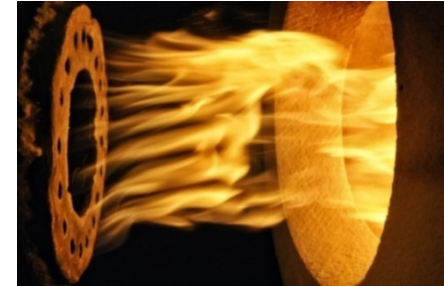
Biochar



karrgroupco.com

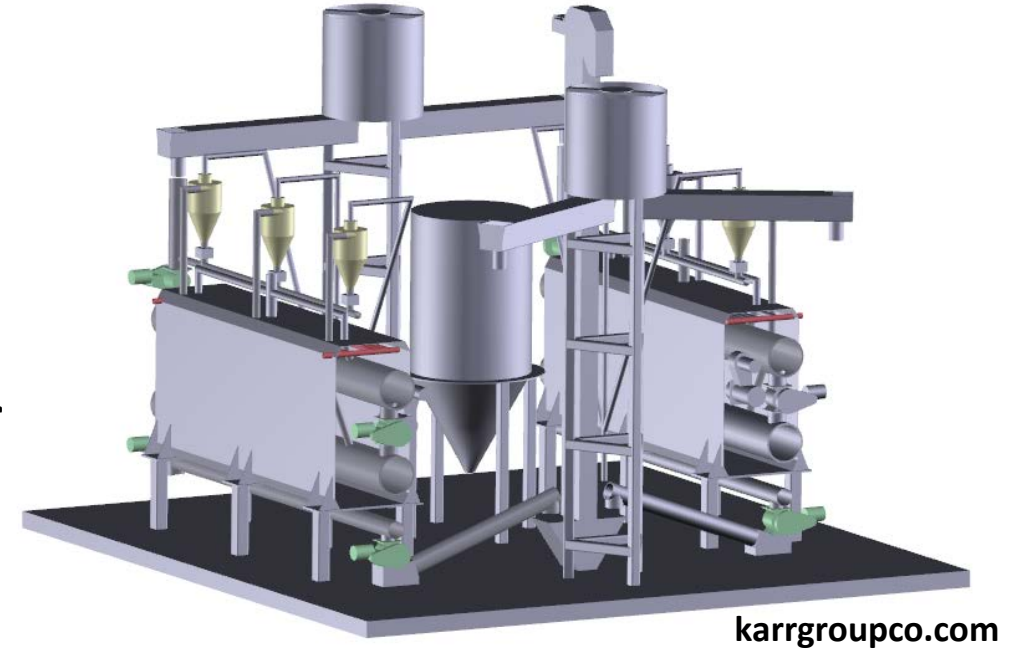


Heat to Boiler or Dryer



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
- Zero discharge. No oil. No waste product.
- 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

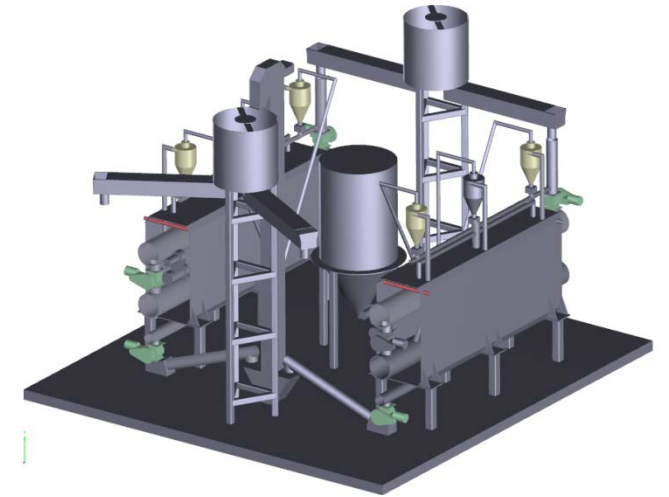
Free gas for dry kilns

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



karrgroupco.com

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.

Onalaska Wood Energy LLC.

Karr Group of Companies

818-929-6332 ajayk@karrgroup.com

Plant site: 1674 State Hwy 508, Onalaska, WA 98570



International Biochar Initiative Biochar-international.org



NW Biochar Working Group www.nwbiochar.org



Biochar Listserv www.biochar.bioenergylists.org

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

Design and development of energy and environmental processes

Industries

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

