BIOCHAR PRODUCTION AND JOB PROMOTION FOR CIVILIAN CORPS INTEGRATION



Presented on April 28, 2022 - US Forest Service Biochar Webinar Series, Southern Regional Extension Forestry, Forest Service Research and Development Division

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- Biochar consultant since 2012 – technology assessment, market analysis, biochar kiln development, workshops and training, biochar kiln manufacturing and sales
- 2008-2012 -- International Biochar Initiative working in communications and project development
- 2004 -2008 – freelance journalist covering environment, energy and climate change
- 1990 -- 2003 forest protection advocate in SW Oregon working for Siskiyou Regional Education Project
- BS in Mechanical Engineering, CSU, Chico, 1987

Outline

- What is the Problem?
- How Can Biochar in the Woods Help?
- Technology and Techniques
- Carbon and Climate Impact
- Opportunities for Jobs and Training
- Project Descriptions
- What's Next?

What is the problem?

- **Wildfire Crisis:** In the western US, climate change, drought, and a century of fire suppression have created a wildfire crisis that threatens ecosystems and communities.
- **Loss of Carbon Storage:** As forests go up in smoke, we are also experiencing the loss of one of our most important natural carbon sinks, at a time when we must rely more and more on natural climate solutions to drawdown carbon.
- **Forest Health:** Fire adapted forests need frequent fire for nutrient cycling and optimum health. Biochar is a natural component of forest soils.

Fire adapted forest soils need biochar

- Activities that exclude fire … eliminate the contribution of this stable, yet biochemically important form of C to the soil ecosystem.

- *DeLuca, T. H., & Aplet, G. H. (2008). Charcoal and carbon storage in forest soils of the Rocky Mountain West. Frontiers in Ecology and the Environment, 6(1), 18–24. http://doi.org/10.1890/070070*

Natural Biochar from Wildfires

The amount of charcoal generated by wildfire depends on fire intensity, fire return interval, vegetation type, fuel loading and fire behavior. **From 10-50% of the carbon found in forest soils is charcoal** (Pingree 2012).

Pingree, M. R. A., Homann, P. S., Morrissette, B., & Darbyshire, R. (2012). Long and Short-Term Effects of Fire on Soil Charcoal of a Conifer Forest in Southwest Oregon. Forests, 3(4), 353–369. http://doi.org/10.3390/f3020353

High Severity Fire – Slater Fire 2020

How are we addressing the fire problem?

- Pre-fire Vegetation Management:
  - Fuels reduction projects taking place across the landscape remove thick undergrowth and either burn in place, or chip and transport it.
- Post-fire Management:
  - Fire leaves behind massive amounts of dead trees that are a safety hazard. This biomass must also be removed.
- ***How can we leverage these mandatory activities to improve forest soil?***

We have no choice – we must deal with fuels

Butte Fire Safe Council and Butte Community College Students
Paradise, California
January 2020

Goal: Return forest to frequent, low-intensity fire regime

Brimmer (2006) found that sites that experience multiple fires contained 3x more char than sites where fire was excluded

- *Brimmer, R.J. 2006. Sorption potential of naturally occurring char- coal in ponderosa pine forests of western Montana (MS thesis). Missoula, MT: University of Montana.*

Management options to increase char in forest soils and prepare for return of frequent fire:

1. Forest thinning followed by prescribed fire
2. Forest thinning followed by biochar production in the woods

US Rake-Force
Veteran-owned
forestry contractors
October 30, 2021
Toledo, WA

Biochar in the Woods Goals & Strategies

Four Goals:

1. Avoid burn pile impacts while reducing fuels
2. Sequester carbon and get paid for it
3. Improve forest soils and forest health
4. Provide jobs with economic and social benefits

Strategies:

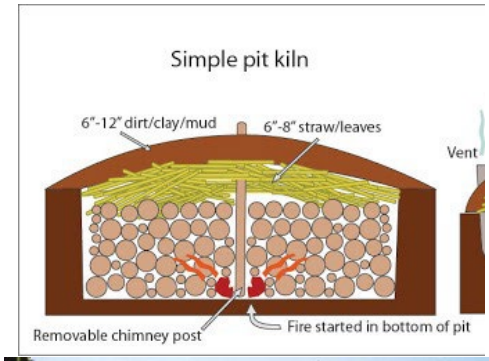
1. Use biochar burn techniques that
   - reduce smoke emissions
   - avoid burn pile scars – loss of organic soil from burn scar
2. Make biochar onsite for easily measurable C sequestration (easy to do LCA – no transport of biomass)
3. Leave biochar onsite to improve rain infiltration, increase soil moisture retention, promote soil health
4. Making biochar provides jobs for youth crews, forestry contractors, arborists, and off-season firefighters

How to Make Biochar in the Woods

- The Technique:
  - How Flame Carbonization works
- The Methods:
  - Conservation Burns
  - Flame Cap Kilns

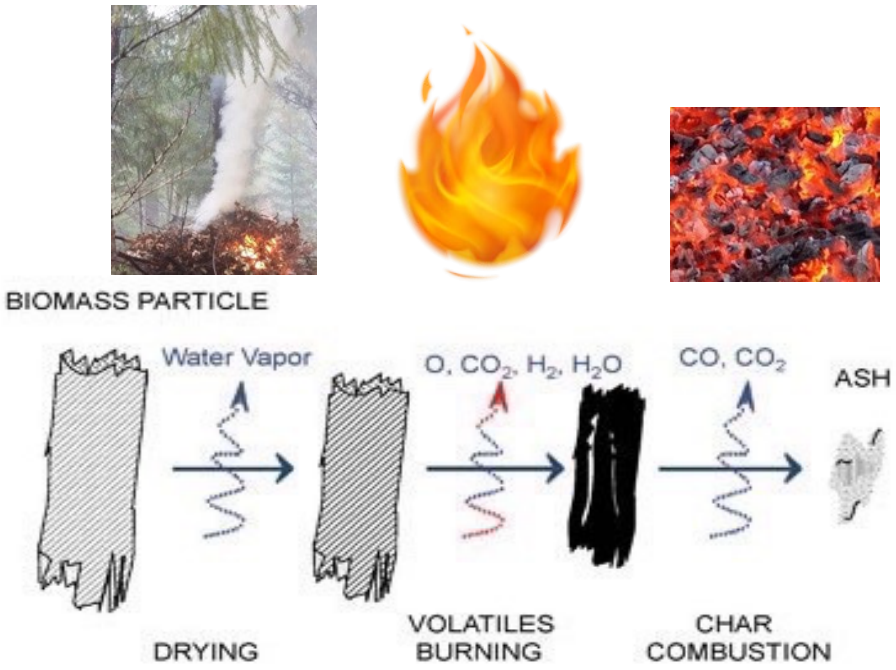
Traditional Kilns: How NOT to make biochar

- Traditional kilns – low temperature smoldering combustion – no flame, lots of smoke
- Fuel charcoal is high in condensed volatiles – makes good fuel, not so good biochar



Flame Carbonization - A form of Pyrolysis

Making biochar in an open flame



- Biomass burns in 3 stages.
- To make char, stop the process before it goes to ash
- Small pieces char more efficiently than large pieces

Method #1 - Conservation Burn

- **Light** piles **on top** to reduce smoke emissions
- **Quench** piles with **water** to save the biochar and avoid scorching soil

Bottom Lit vs. Top Lit Burn Pile

- Conventional: Flame under cold biomass makes smoke
- Top Lit: Light on top – heat transfers to pile by radiation
- Flame on top burns smoke

Jackpot Burn Pile

- Designed so that piles burn completely to ash
- Generate smoke
- Destroy forest soil
- Increase soil erosion, invasive species

Rake and Quench a Burn Pile

Raked and quenched:

- Unburned fir needles under char
- Organic soil is fine

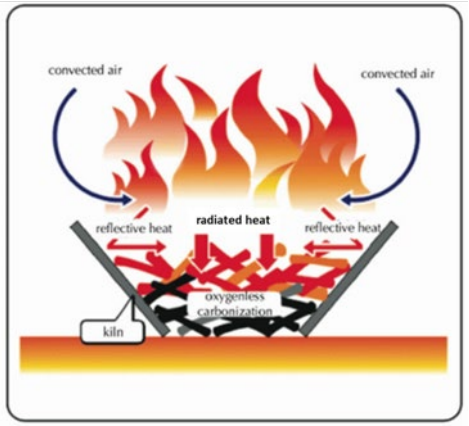
Not quenched:

- More ash
- Organic soil all gone

Styles of Piles for Conservation Burn

Conservation Burns Finish Faster

Method #2 - Flame Cap Kiln
Burn Pile in a Bin



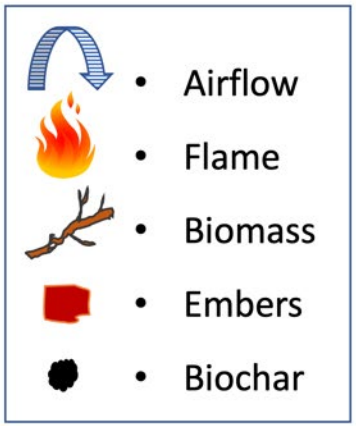
Smokeless Carbonizing Kiln Charring Schematic
MOKI Manufacturing Co. Ltd.
Nagano, Japan

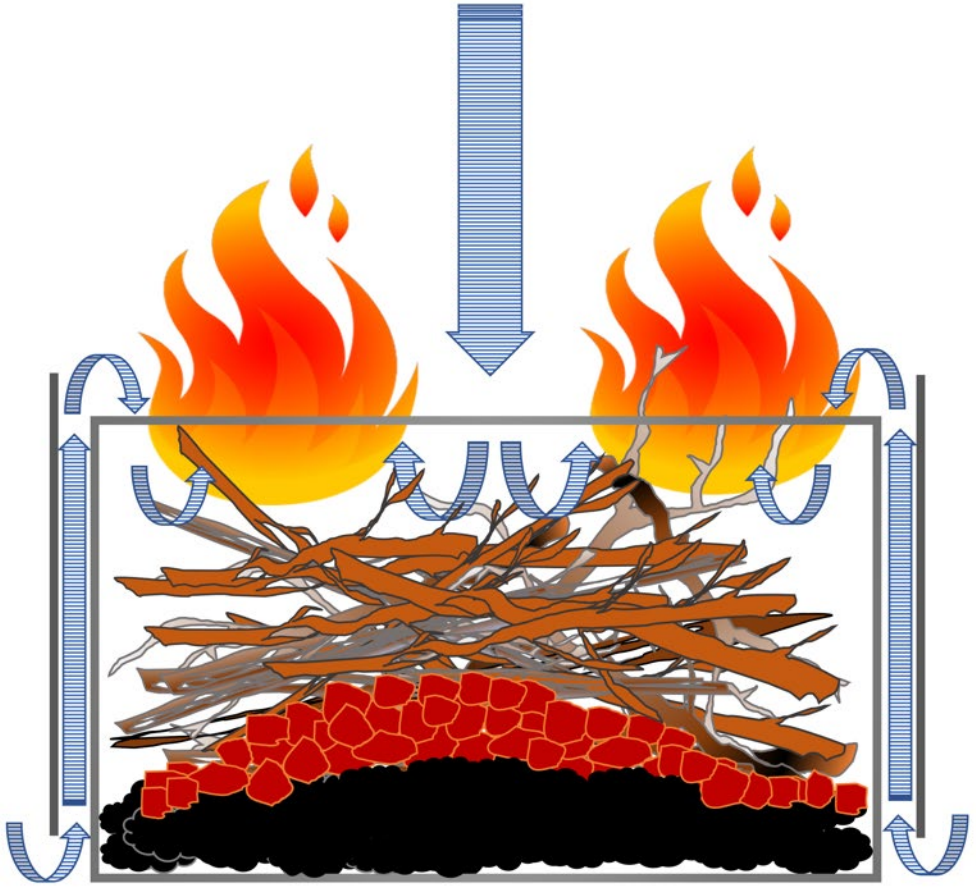
- Pan excludes air from side and bottom
- Flame on top uses up all the oxygen
- Char is protected from air and does not burn
- Keep loading until it is full of biochar
- Quench with water at the end

The Ring of Fire Kiln

Easily mobile. Heat shield improves carbonization efficiency and reduces emissions. Makes 1- 2 cubic yards in about 4 hours.

How the Ring of Fire Works





Ring of Fire Biochar Kiln

Airflow and Flames

www.wilsonbiochar.com

Ring of Fire Kiln Burns Smoke

Flame Cap Kiln – Ring of Fire

Production Process:

1. Initial Loading
2. Lighting
3. Continual Loading
4. Unloading and Quenching

WILSON BIOCHAR
WilsonBiochar.com

RING OF FIRE™
BIOCHAR KILN

Made in the USA. Manufactured in Jackson County, Oregon

Ring of Fire Biochar Kiln Specifications

Kiln diameter (with heat shield)	77 inches
Kiln height (with heat shield)	44 inches
Kiln total volume:	3 cubic yards
Kiln weight (fully assembled)	240 pounds
Number of kiln body sections	3
Weight of one kiln body section	40 pounds
Burn time to make 1 cubic yard biochar	4 hours

April 2022 price: $1,295

CALL for shipping quote:
541-218-9890

Expandable up to 5 panels

Simple Metrics for Estimating GHG Impact

- One foot of biochar in the 6 foot diameter Ring of Fire Kiln equals one cubic yard of biochar.
- Assume one cubic yard of biochar weighs 250 pounds, then eight cubic yards of biochar weigh 2000 pounds = one ton
- Rule of thumb: one ton of biochar = 2.5 tons of sequestered CO_2
- Important data for funding the work with carbon sequestration credits

Costs and Outputs – BIW Methods

	Costs and Outputs	Conventional Pile Burn	Conservation Burn	Flame Cap Kiln
COSTS	Extra equipment Cost	none	low (need water tender)	medium (need water tender, kilns)
	Mobilization cost	low	medium	medium
	Labor cost	low	medium	high
OUTPUTS	Soil Impacts	harmful	beneficial	maximum benefit
	Emissions	high	medium	low
	Biochar production efficiency*	negligible	low	high
	Carbon sequestration	negligible	low	high

* Biochar production efficiency = biomass input/biochar output

Civilian Conservation Corps

- President Franklin Delano Roosevelt proposed the CCC program to Congress on March 21, 1933:

"I propose to create [the CCC] to be used in complex work… [in] … forestry, the prevention of soil erosion, flood control, and similar projects."

Carbon Conservation Corps

- A service year for young people
- Improve forest health and protect communities from wildfire
- Pay them to sequester carbon and create ecosystem infrastructure

  - PHYSICAL FITNESS
  - A SENSE OF PURPOSE
  - HOPE FOR THE FUTURE

Planting trees in biochar – Lomakatsi Restoration Project, Ashland, Oregon

Biochar in the Woods Job Opportunities

Who can benefit?

- Forestry contractors
- Wildland firefighters
- Arborists
- Workforce development programs
- Environmental NGOs
- Natural resource agencies
- Forest land owners
- Residents of the WUI (Wildland Urban Interface)
- Urban greenwaste managers and urban agriculture

Training and Learning Opportunities

- USBI Biochar in the Woods
  - Recordings available for online seminar on January 27
  - USBI YouTube channel:
  - https://www.youtube.com/c/USBiocharInitiative/videos

- Wilson Biochar Associates and other practitioners and consultants are available for field demos and webinars – we have a training network and a list of qualified trainers

- Join our Biochar in the Woods Discussion Forum
  - send email to: Biocharinthewoods+subscribe@Biochar.groups.io.

Project Youth Plus Natural Resources On-Ramp Camp

On Ramp Camp is for students, high school age and older, who are interested in careers in forestry, natural resource protection and wildland firefighting.

We used biochar made the year before in planting holes for willow

We learned how to make biochar in kilns and in “swamper” burns

Partners: Table Rock Foundation, Lomakatsi Restoration Project, Wilson Biochar Associates

Redwood Forest Foundation and California Conservation Corps

Karen Youngblood, Forest Conservation Specialist

Summary of Work Conducted on Usal Redwood Forest							
	Stand Thinning (ac)	Piling Biomass (ac)	Making Biochar (days)	Biochar Made (cy)	Biomass Burned (cy)***	Biochar to Soils (ac)	Established Soil Monitoring Plots
Millbank	5	2.5	7	81	567	10,000 sq ft	1 - 100x100 ft
5100 Rd	0	5	8	46	322	20,000 sq ft	2 - 50 x 50 ft
Duggan's	3	3	3	16	112	10,000 sq ft	1 - 100 x 100 ft
TOTAL	8	10.5	18	143	1001	0.9 acre	4 plots

Total tons of CO2 sequestered: 38

***assume a 7:1 ratio**

SAN JUAN ISLANDS CONSERVATION DISTRICT
SAN JUAN COUNTY, WASHINGTON

ISLANDS CONSERVATION CORPS

Kai Hoffman-Krull, Forest Health Manager, San Juan Islands Conservation District: Biochar in the Woods with the Island Conservation Corps

- Western Washington University students get a stipend and college credit for a semester of Biochar in the Woods
- Mostly using Conservation Burn methods

Potter Valley Tribe

- The Potter Valley Tribe held a Forest Biochar Production Demonstration day on April 23, 2021.
- Five Indian Tribes were represented: Potter Valley Tribe, Coyote Valley NSN, Pinoleville Pomo Nation, Round Valley Indian Tribes, and Robinson Rancheria.

The teacher: Cuauhtemoc Villa, a regenerative ag teacher from the Portland, Oregon area and expert in biochar production and use

Sponsored and supported by North Coast Resource Partnership, with assistance from the California Conservation Corps, Ukiah Center and Sonoma Ecology Center

Watershed Consulting, Missoula, Montana
www.watershedconsulting.com

Mark Vander Meer
- Restoration Ecologist
- Forester
- Soil Scientist
- Email: mark@watershedconsulting.com

Pre-Thinning Conditions:
- Study Area: 21 Acres of Mixed Conifer Forest in Western Montana,
- Species Included Ponderosa Pine, Western Larch, Douglas Fir, & Lodgepole Pine
- Tree Density Varied Throughout the Unit, and Averaged about 1500 Stems/ Acre
- Elevation: 4500 feet.
- Topography: 0-10% slopes. Short pitches of 10% to 20% slopes.

Post-Thinning Conditions
- The Stand was Thinned in 2020.
- We Cut 1000 Stems / Acre, Most Stems Under 3" in Basal Diameter.
- Slash Treatment: Lop & Scatter, Allowing for One Year of Drying Time

Slash Treatment:
- Converted Slash to Biochar in the Spring and Fall of 2021
- Methods: Wilson Ring of Fire Biochar Kiln

SUMMARY		
Item	Amount	Units
Area Treated	21.0	Acres
Kilns Burned	85.0	Burns
Average Yield/ Kiln	1.3	Cubic Yards
Cost / Ac	$2,014.38	$/Acre
BioChar Total Yield	112.5	Cubicc Yards
BioChar Yield/Ac	5.4	Cu.Yds./Ac
BioChar Cost/cu.yd.	$376.02	$/Cu. Yd.
Area Treated Per Kiln	20-25%	of an Ac.

Eco-log - Cave Junction, Oregon

Eco-log was started by professional wildland firefighter, Sean Hendrix and his son, Trey Hendrix.

- Eco-Log Forest Products purchased the Ring of Fire Kiln in the fall of 2021.
- There is a want and a need for this service locally.
- The Ring of Fire Kiln is useful on a couple fronts:
  - It teaches people to burn in a safe responsible way. The kiln contains the fire, and you have a hose on site to quench the fire.
  - By using this kiln we are able to capture biochar for use in gardens, carbon sequestration, and to use as an amendment to forest soils.
- We have used the Ring of Fire Kiln approximately 10 days in 2022.
- Looking into the future, what we need to make the business successful is more trained workers to make biochar and to get the word out about the uses of biochar!

Ari Mashiah, Biochar 4 Life - Nevada City, CA

How many days have you made biochar this year?
I have made biochar 56 days this year. Starting from January 9th 2022 to beginning of April 2022.

How much are people paying you now?
Minimum $30 an hour and up to $60 an hour.

What does the future look like for your enterprise- what are your plans for expansion?
My dream is to have people out in our forest clearing brush and making biochar. Work that our neglected, overgrown, and seriously unmanaged fire threat of a forest deserves. With the time and effort I have put in to clearing brush and making char with just a couple of friends, we can clear and treat about an acre in 3 days (about 10 yards of biochar).

So imagine the HUGE DIFFERENCE we can make with more people and more kilns. There's a lot of people out there willing to learn and help with the collective goal of carbon sequestration and managing our forests. We just need to get organized and make it happen. There is no planet B!

What kind of help do you need to make your business successful?
I hope that by October 2022 we can get funding and get more people paid to clear brush and make biochar. Getting our forest service involved in making biochar can help bring back the forgotten knowledge of fire being a tool to address our ever so present wild fire hazard and depleted soil fertility and erosion.

Urban Biochar

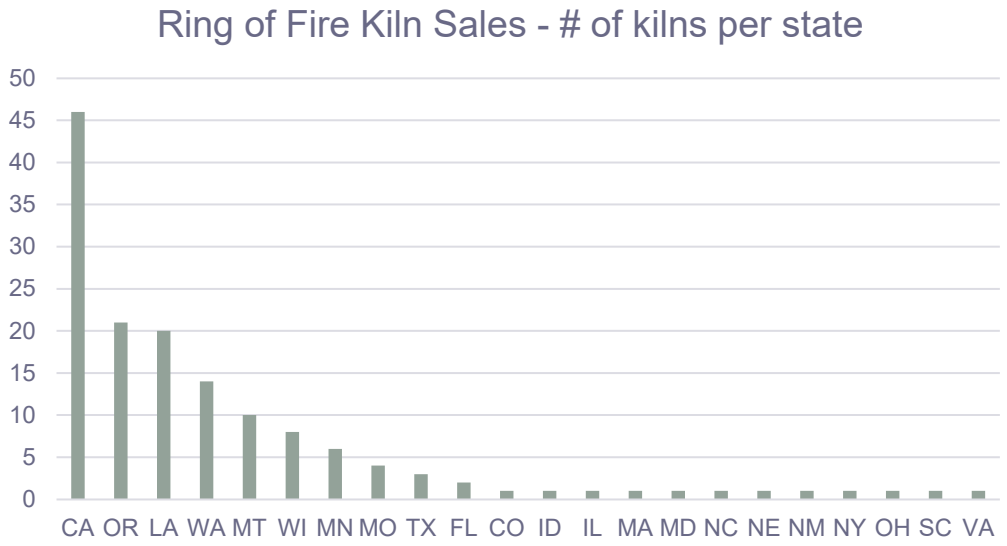
weclean WATER Metropolitan Wastewater MANAGEMENT COMMISSION

- The water treatment plant for the cities of Eugene and Springfield grows poplar plantations as part of their water treatment.
- Poplar is harvested for various uses, and now the slash can also be turned into biochar.

Northwest Youth Corps at work – September 2021

What's next?

- Spread the word about Biochar in the Woods
- Support the agencies, community groups and individuals who want to do the work
- Refine carbon accounting protocols for biochar
- Count all the benefits to:
  - Soils and forest health
  - air quality
  - rural development
  - youth empowerment



Ring of Fire Kiln sales as of 4/26/22

RING OF FIRE™ BIOCHAR KILN

Going Nationwide in 2022!

Acknowledgments

- ***Wilson Biochar Associates would like to thank the many collaborators who have helped develop and sponsor demonstration projects using flame cap kilns and other onsite biochar technologies for forest restoration, including but not limited to:***
- Natural Resources Conservation Service, US Forest Service, USDA-ARS, US Biochar Initiative, Sonoma Biochar Initiative, Sonoma Ecology Center, Grayback Forestry Inc., Lomakatsi Restoration Project, Illinois Valley Community Development Organization, South Umpqua Rural Community Project, Umpqua Biochar Education Team, Umpqua Community College Welding Department, Ithaka Institute, Consortium for Research on Renewable Industrial Materials, Utah State University, North Dakota Forest Service, Nebraska Forest Service, Kansas Forest Service, Oregon State University, Yew Creek Alliance, Butte Community College, Butte Fire Safe Council, Institute for Sustainable Forestry, Northwest Permaculture Convergence, Redwood Forest Foundation, Inc., Long Tom Restoration Council, International Society of Arborists, Table Rock Foundation, Project Youth Plus, Soil and Water Conservation Districts in multiple states…
- ***…and hundreds of small woodland owners, farmers, and biochar enthusiasts who have attended workshops and demonstrations to help pitch slash into kilns and make biochar.***



Thank You!

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Wilson Biochar specializes in biochar technology and market development. We provide strategic advice and services to businesses and organizations.

- Technology Assessment
- Research and Analysis
- Equipment Manufacturing and Sales

More info at: WilsonBiochar.com