A CARBON CONSERVATION CORPS (CCC) FOR MOBILE BIOCHAR PRODUCTION

Kelpie Wilson
Wilson Biochar Associates
Aug 1, the view from my deck…
View from my deck: October 2009. Smoke fills the air from hundreds of burning slash piles – fuels reduction project.
Jackpot piles burn hot & complete

- Tight piles don’t fall apart
- Burn hot in the center
- Burn completely to ash
- Generate smoke
- Burn forest soil
Burn pile scars are long-lasting

Is there another way to treat problem fuels?
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
1. Light it on top
2. Quench with water to save char
Flame Carbonization
Making biochar in an open flame

- Biomass burns in 3 stages.
- To make char, stop the process before it goes to ash
For greater efficiency: Flame Cap Kiln

- Pan excludes air from the bottom
- Flame on top uses up all the oxygen and burns the smoke
- Char is protected from air and does not burn
Can be any shape – pit, pyramid, cone, ring, trench, box
Design Parameters - the Oregon Kiln

- Sized for feedstock
  - Logs 4 to 5 feet long
  - Up to 6” diameter
- Portable but durable
  - Less than 200 lbs
  - 14 gauge steel
- Ergonomic for loading
  - Only 2 feet high
- Capacity
  - Makes > 1 cy of biochar in about 4 hours
We made 70 cubic yards of biochar during the two year project.

NRCS Conservation Innovation Grant 2015 - 2017
How to operate a Flame Cap Kiln

- Pile loosely
- Light on top
Once the first pile burns down, add more

- Add new material, one layer at a time
- Make sure each layer has the same size material
Keep a Strong Flame on Top

- Especially important in wet conditions
- If you let the flame die down it can be hard to restart
Quenching Time

Quench when kiln is full and flame is gone
Quenching: Flood or Snuff

- Flood till you see standing water
- Stir till cool
- 50 – 100 gallons

- Thin sheet metal lid
- Place on top of hot coals
- Seal with dirt
Drew Biochar Project – Umpqua Biochar Education Team

- 17 acres of thinning
- Removal of small trees
- Umpqua National Forest

Stewardship Contract awarded to South Umpqua Rural Community Partnership – [www.surcp.org](http://www.surcp.org)
Three days, 166 cubic yards of forest slash, 28 cubic yards of biochar
## Project Planning

Based on Drew Veg Biochar Project

<table>
<thead>
<tr>
<th>Project size and volumes</th>
</tr>
</thead>
<tbody>
<tr>
<td>project size, ac</td>
</tr>
<tr>
<td>tree/ac</td>
</tr>
<tr>
<td>volume of piled slash, cy</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Labor crew size</th>
</tr>
</thead>
<tbody>
<tr>
<td>crew size, # of kiln tenders (each tender operates 2 kilns)</td>
</tr>
<tr>
<td>crew size, # of machine operators</td>
</tr>
</tbody>
</table>

**Total crew size: 7 people**
## Labor Time and Machine Hours

### Machines and machine hours

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hours/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loader to place kilns and move slash</td>
<td>6</td>
</tr>
<tr>
<td>Water tender for quenching</td>
<td>2</td>
</tr>
</tbody>
</table>

### Labor hours

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crew set up time</td>
<td>1</td>
</tr>
<tr>
<td>Biochar burning time per kiln batch</td>
<td>4</td>
</tr>
<tr>
<td>Quenching and unloading</td>
<td>2</td>
</tr>
</tbody>
</table>

**Total daily job time, including setup and quench, 7 hours**
## Outputs

<table>
<thead>
<tr>
<th>Production volumes</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>assumed conversion efficiency, biomass to biochar, by volume</td>
<td>16.70%</td>
</tr>
<tr>
<td>volume slash consumed per kiln batch, cy</td>
<td>6</td>
</tr>
<tr>
<td>biochar output per kiln batch, cy</td>
<td>1</td>
</tr>
<tr>
<td>number of kilns</td>
<td>12</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Daily output</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>total biochar output per day, cy</td>
<td>12</td>
</tr>
<tr>
<td>total slash processed per day, cy</td>
<td>72</td>
</tr>
</tbody>
</table>

- 5.5 days to process all slash
- 66 cy of biochar produced
Climate Impact

- Assume one cubic yard of biochar weighs 200 pounds
- $66 \text{ cy} \times 200 \text{ pounds} = 6.6 \text{ tons of biochar}$
- $6.6 \text{ tons} \times 80\% \text{ fixed carbon fraction} \times \frac{44}{12} = 19.4 \text{ tons of CO}_2 \text{ sequestered from one 17 ac thinning project.}$

Average American emits approx. 20 tons CO$_2$ per year

We need to scale this up!
GO BIG – Boots on the Ground
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 … forestry, the prevention of soil erosion, flood control, and similar projects.*

*I call your attention to the fact that this type of work is of definite, practical value, not only through the prevention of great present financial loss but also as a means of creating future national wealth.*
Carbon Conservation Corps

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

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

Planting trees in biochar – Ashland Forest Resiliency Project
Cut, Pile & Burn vs Cut, Char & Quench

- Currently, most of the labor dollars are spent on making piles
- **Do not pile**, just lop and leave on the ground to dry for a season
- Come back and gather the fine fuels to char in kilns
- Burning green is also an option for fine fuels
- We are burning bigger stuff than we need to and making a lot of unnecessary smoke

<table>
<thead>
<tr>
<th>Item</th>
<th>CP&amp;B</th>
<th>CC&amp;Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cut (chainsaw work)</td>
<td>$350</td>
<td>$350</td>
</tr>
<tr>
<td>Pile (5-8 piles/hour per worker)</td>
<td>$600</td>
<td></td>
</tr>
<tr>
<td>Burn (20 piles/acre, using drip torch)</td>
<td>$150</td>
<td></td>
</tr>
<tr>
<td>Biochar Kilns (3 - 4 kilns per acre, 1 person feeds 2 kilns)</td>
<td></td>
<td>$600</td>
</tr>
<tr>
<td>Quenchanting water (water truck &amp; operator)</td>
<td></td>
<td>$150</td>
</tr>
<tr>
<td><strong>Total cost/acre</strong></td>
<td>$1100</td>
<td>$1100</td>
</tr>
</tbody>
</table>
Growing Number of Projects and Partners

- NRCS
- USFS
- USDA-ARS
- Oregon Department of Forestry
- North Dakota Forest Service
- Nebraska Forest Service
- Kansas Forest Service
- Utah State University Extension
- Oregon State University Extension
- South Umpqua Rural Community Partnership
- Long Tom Restoration Council
- Illinois Valley Community Development Organization
- Two Rivers SWCD
- Ridge to Reefs
- Sustainable Community Development Institute
- Institute for Sustainable Forestry

Charring Pinyon-Juniper in Utah
Wilson Biochar Associates specializes in biochar technology and market development. We provide strategic advice and services to businesses and organizations.

- Technology Assessment
- Research and Analysis
- Project Development

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Questions?