Biochar Pilot Project 2024
Glorieta Camps, NM

Biochar Treatment and Forest Restoration Projects

Introduction

The value of converting slash piles from forest thinning projects into onsite Biochar is becoming recognized as an important component of forest soil improvement as well as a valuable forest product.

Many forest areas in New Mexico have become severely degraded and unable to regenerate after many high-severity wildfires and escaped prescribed burns in the past 15 years. To mitigate this condition, the development of **pilot onsite Biochar projects is needed** to accomplish the following:

- Use small diameter trees and branches to burn “down” into biochar rather than be ignited from the base of the slash pile to burn “up” and create smoke emissions
- Convert low value slash into high value on-site biochar as well as off-site “exported” biochar for sale
- Utilize new approaches to slash pile and broadcast burning for use in place to help restore forest soil carbon
- Introduce “Flame Cap Pyrolysis”[1] – well suited for in-forest production of biochar

Historic charcoal levels & conversion rate of biomass to charcoal from fire events

Some of the most productive and resilient soils in the world contain significant quantities of soil charcoal, or "natural" biochar. Nature makes megatonnes (40-240 Mt per year) of black carbon during wildfires or prescribed fires in forests and other vegetation types (Preston & Schmidt, 2006). This kind of natural charcoal is present in large quantities in some of the most valuable agricultural soils in the world, like the carbon-rich Mollisols of the US Midwestern prairie states (Skjemstad et al. 2002, Glaser & Amelung 2003).

Several studies have estimated that the conversion rate of biomass to charcoal during a forest fire event ranges from 1-10% of the biomass consumed in a fire, or 1-2% of the biomass available in the forest (DeLuca & Aplet 2008). Based on biomass inventories, DeLuca & Aplet estimated that a single fire event in a mature lodgepole pine forest might deposit 3.25 tonnes per hectare of carbon in the form of charcoal. They concluded: "Thus, wildland fire need not be viewed only as a cause of C loss to the atmosphere, demanding suppression, but rather, as a driver of long-term C sequestration."

[1] Biochar for Forest Restoration in the Western United States-9-18-15 (res. 3-35-16)

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). Application of biochar is expected to mimic many soil properties associated with wildfire-generated charcoal (Harvey et al. 1979).

In-woods pyrolysis

Other than chipping for biomass energy, the main alternative for biomass disposal is the current practice of incinerating it in onsite burn piles, which is costly, can alter soil productivity, increase CO_2 emissions, and produce particulates. Slash pile burning may alter soil microbial populations, destroy seeds, and result in bare soil, which is vulnerable to colonization by invasive species (Korb et al. 2004). Smoke and particulate production from slash pile burning limits the burning window especially in air-quality limited watersheds, making it more difficult to accomplish the work.

A sensitivity analysis pinned economic performance most strongly on capital costs, labor and feedstock costs, and projected bio-oil and biochar prices. However, methods to optimize harvesting, transportation, and **centrally located pyrolysis equipment** are now being developed (Harrill and Han 2014). This change in how forests are harvested and residues are treated may help make future efforts at in-woods processing more cost-effective. [2]

Below is a detailed description of the operational steps needed with some projected numbers for production volumes and labor requirements:

Operational Plan for Roadside Biochar Production with Forestry Kilns

- Goal: Approximately 1/4 mile of roadside treatment per day
- Crew: 12 people in teams of 2
- Kilns: 48 kilns delivered on a truck or trailer and dropped off one every 50’ along each side of the road. Each crew of 2 is responsible for 8 kilns
- Ancillary Equipment: 2000 gal water tender, loader, flatbed and totes for removing biochar
- Total daily production volume: 48 cy of biochar (4.8 tons if biochar is 200 lb/cy)
- Daily production per worker: 800 lbs
- Total value of daily production at $150/cy: $7,200

[2] *Biochar for Forest Restoration in the Western United States – 9-18-15 (rev. 3-15-16)* 7

Description of operation steps:

1. Team builds a rick inside kiln about 4' tall and lights it
2. Move to next kiln and build another rick
3. Light that rick and move on until all kilns are ablaze
4. Return to first kiln which should have collapsed into hot coals 5. Build another rick on top of glowing coals - rick will self-ignite Build another rick on top of glowing coals - rick will self-ignite 6. Return and build more ricks in each kiln until kiln is full
7. Bring 2000 gal water tender to first kiln that is finished
8. Each kiln gets 40 gal of water
9. Place thin sheet steel lid on kiln and leave overnight
10. Return to site next morning and unload biochar into totes

11. Pick up kilns and move to next site

Hand crews will begin by constructing and lighting a rick in each kiln and then continue to feed the material into the kilns until they are full of char. A water tank truck will dispense quenching water into the kilns. If limited water is available, a smaller amount (40 gallons) of water can be used with a loose fitting metal cover that will complete the quenching step. The cover will exclude air while the char cools overnight.

If water is abundant, kilns can be quickly quenched with 100 or more gallons of water. Once the water is drained, workers can immediately load the biochar into cubic yard size tote bags for transport to market.

Advantages of Forestry kilns

There are several significant operational and economic advantages of the Forestry Kiln over mechanized mobile pyrolysis systems:

- **Low Capital Cost** - The Forestry Kiln has low capital cost. In our scenario, a full complement of 48 kilns capable of producing 48 cy of biochar a day would cost no more than $50,000 - far less than any mechanized system with similar capacity.
- **Always Ready** - Mechanized pyrolysis kilns and gasifiers are subject to equipment downtime and maintenance needs. The Forestry Kiln is always ready for work.
- **Highly Mobile** - The Forestry Kiln can be placed on a roadside berm or in the woods near a road or skid trail.
- **Scalable** - Adding or deleting capacity is simple and cheap.
- **Potentially Cheaper than Pile & Burn** - The Forestry Kiln system uses a large amount of labor and labor will be the most significant cost by far. However, it may not use a great deal more labor than current labor-intensive pile and burn methods that do not produce a useful product to offset costs.
- **Work Force Training** - Working with fire to produce biochar would be valuable training for the thousands of young people who are recruited to fight wildland fires every year.

The Forestry Flame Cap Kiln

The Forestry Flame Cap Kiln is a very simple, low cost device based on the Japanese Cone Kiln described above. WBA designed this version of the Flame Cap Kiln to be optimized for low cost manufacturing and for efficient logistical deployment and use along forest roads as an alternative to pile burning or chipping. Basically, it is a method of improving the efficiency and char recovery of the Rick Pile Burn by placing it inside a container.

Designed by **Wilson Biochar Associates** for use in forestry to convert burn piles to biochar.

<u>Glorieta Pilot Project</u>

1. Instruct thinning crews to pile appropriate slash along access roads and pump water lines so kilns can be easily filled with fuel for ignition – and extinguished when burned down into biochar.
2. Size of operation and crew(s), number of kilns and materials for biochar removal are yet to be decided.
   Contact: Teresa Seamster: 505-466-8964 or ctc.seamster@gmail.com