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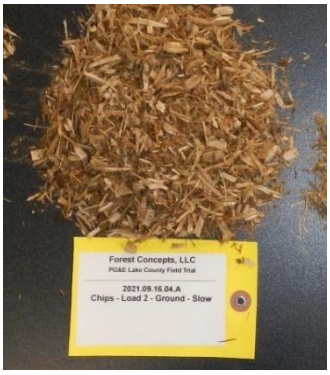
Processing Powerline Vegetation Management Biomass for Use in Distributed-Scale Gasifiers

Forest Concepts / PG&E Woody Biomass Baling Pilot Project

December 6, 2021



Abstract

Pacific Gas and Electric (PG&E) sponsored a project to explore methods to gather powerline vegetation management woody biomass and process it into feedstocks optimized for delivery to distributed-scale gasifiers. A pilot study was conducted in Lake County, California where powerline trimmings were either chipped or baled, then ground at a central biomass processing facility, and finally milled / screened to achieve particle size distributions specified by a gasifier manufacturer. The vegetation included oak, pine, walnut, and other hardwoods. All materials were successfully processed into feedstocks.

Keywords

woody biomass, vegetation management, bale, chips, grinding, milling, crumbling, screening, gasification, gasifier, microgrid, syngas, biochar, crumbler

About Forest Concepts

Forest Concepts, LLC is a technology developer based in Auburn, Washington that works at the intersection of plant biology, engineering, and enterprise. The company has invented, patented, and developed a woody biomass baling method that has proven effective in other locales to increase the transportation density of woody biomass from vegetation management, wildfire protection projects, and forest management activities. Additionally, Forest Concepts has developed woody biomass size reduction, screening, and drying technologies that enable value-added utilization of chipped and baled PG&E vegetation management trimmings.

This document includes activities and results of work conducted by Forest Concepts, LLC for PG&E under Purchase Order: 2700627647 issued to Forest Concepts on June 29, 2021.

Overview of Project

This project is the result of a proposal submitted by **Forest Concepts, LLC** to **The Pacific Gas & Electric Company (PG&E)**, through the PG&E / ADL Ventures *ProblemSpace* competition. The proposal addressed **Category 2: Next-generation woody biomass densification and transportation technology.**

The competition was sponsored by the gas technology research unit within PG&E. The objectives included processing and production of feedstocks to be used by distributed-scale gasifiers. Secondary processing could be conducted anywhere between the source and the gasification site.

ADL, PG&E, and a network of expert industry stakeholders assembled by PG&E, jointly evaluated over 100 technologies, choosing eight finalists for a detailed in-person review session on November 14, 2019. Following that session, ADL, PG&E, and other stakeholders chose to move forward with Forest Concepts and its baling technology.

The crux of the proposed solution was to substitute woody biomass baling for chipping where applicable across PG&E's vegetation management program. Implementation of results optimized for this application will entail design and manufacture of a fleet of purpose-specific balers, bale gathering and handling equipment. Production of gasifier feedstocks as a new product for central grinding yards will entail developing guidelines for grinding and post-grinding processing of baled woody vegetation into feedstocks appropriate for use in distributed-scale gasifiers.

PG&E Pilot Project Objectives

The primary objective of the pilot project was a demonstration and confirmation of the conceptual fit of baling as an alternative or compliment to chipping of vegetation management woody biomass. Of particular interest was to evaluate methods that reduce the cost of collection, transportation, and processing of woody vegetation management debris into feedstocks for use in distributed-scale gasifiers. A secondary objective added in recognition of Forest Concepts' precision feedstocks processing capabilities was to demonstrate processing methods that result in reactor-ready feedstocks acceptable for use in a gasifier.

Specifically, the field pilot addressed the following objectives:

1. Demonstrate how the baling technology will work for operators (i.e. vegetation management contractors).
2. Demonstrate baling's value for transportation (i.e. cost from source to gasifier).
3. Demonstrate management of woody biomass at centralized processing site (i.e. making feedstocks from bales and chips, etc.).
4. Demonstrate logistically the delivery of the final feedstock product to the gasifier.

This report focuses on the third objective.

Biomass Gathering Methods

Roadside Baling with Tree Trimming Crew

The baling pilot test was conducted along Bachelor Valley Road approximately five miles northwest of Upper Lake in Lake County, CA. The neighborhood was comprised of open woodland grazing lands, mature walnut orchards, and pastures. The tree-trimming objective for the crew was described as "routine vegetation work" to establish or maintain the line clearance shown in the PG&E graphic below.

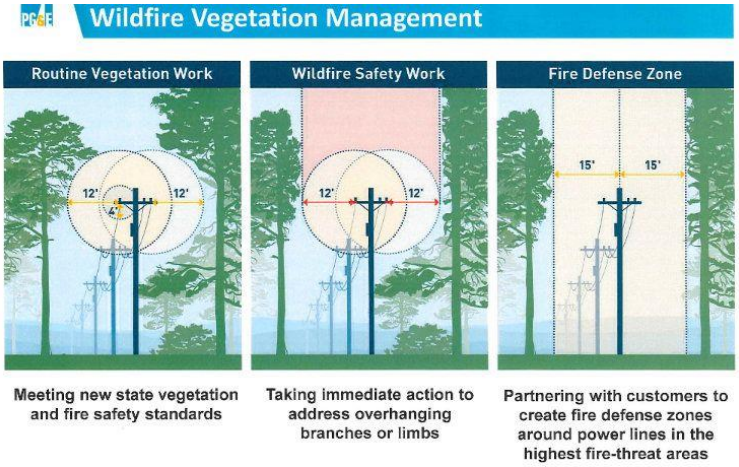


Figure 1. Vegetation management criteria for different levels of clearance.

The vegetation types along the roads were primarily mature oak trees with some walnut and other deciduous trees. Since this distribution line was only being trimmed for line clearance, low brush and vegetation against the lower telephone, cable tv, etc. lines were not trimmed.

The Loggers Unlimited tree trimming crew was comprised of two bucket trucks working together along the road trimming designated trees to establish line clearance. Each truck was staffed by two people – a trimmer and a ground person. The ground personnel from the two trucks also moved traffic cones and performed traffic control when needed. Since the baling was close to the bucket trucks, the trimming crews assisted with traffic control for the baling activity. The trimming ground personnel piled trimmings into organized piles for baling. They used poles to pull down trimmed branches hung up in the trees being trimmed. They occasionally used a leaf blower to clean small vegetation debris and leaves off the roadway. The methods being used were the same as when the trimmings were to be chipped instead of baled.

During the two partial days of work with the bucket crew, Forest Concepts produced four bales having an average weight of 765 pounds. The bale weights were measured in pairs by scaling deliveries to the Donahoo, Inc. biomass processing yard by a Loggers Unlimited flatbed trailer. The lower-than-expected bale weights may be explained in-part by the fact that the baled material was only 23% moisture content (wet basis). We calculated that the same material at a typical winter/spring moisture content of 48% would weigh an average of 1,030 pounds. The oven dry mass of the bales averaged 536 pounds per bale.

Transporting Bales to Central Grinding Site

Bales were picked up from the roadside by a two-person crew from Loggers Unlimited using a flatbed grapple trailer typically used to haul logs too big for their chipper. The trailer configuration was only able to haul two bales at a time due to a mismatch of bed dimensions with the bale footprint. The trailer was used to deliver finished bales to the Donahoo, Inc. grinding site where the trailer was scaled to determine average bale weights for the two bales in each load.

Chipping Crew Comparison

A Loggers Unlimited chipper crew normally assigned to work with the trimming crews was tasked with "catching up" with a backlog of accumulated trimmings from recent climbing and other work within about 10 miles of where the baler trial was being conducted. They produced two loads of chips for use in the grinding trials. The first chip load was produced by the chipper crew along Scotts Valley Road where the vegetation was mostly oak and pine that was previously staged in groups and piles by trimming crews. One load of that material was delivered to Donahoo, Inc. for use in the grinding trials (Chipper load 1). A second load was produced along Bottle Rock Road where the material was a mix of boxwood, beech, and other shrubby hardwoods (Chipper load 2). The two chipper loads had a green weight of 4,620 and 6,200 pounds for loads one and two respectively.

The chipper tow vehicle was a Dodge Ram 5500 Crew Cab truck with a chip box on the bed. The chipper was a Morbark Eeger Beever Model 1821 with a CAT 170hp engine and a winch package.

Grinding Chips and Bales at Donahoo, Inc.

An objective for the PG&E woody biomass baling pilot study was to determine the feasibility of processing powerline vegetation debris into functional feedstocks for small scale and distributed-scale gasification. The pilot included **Omni BioEnergy** as a distributed-scale gasifier company and their customer **Scotts Valley Energy Company** (SVEC) located in Kelseyville, California. Omni BioEnergy's Artis gasification systems are fixed bed co-current gasifiers that are most often directly coupled to internal combustion engine/generators to produce 200-1,000kw of distributed power. The SVEC business plan includes:

1) a set of clustered regional bioenergy projects using modular Omni Bioenergy (www.omnibioenergy.com) gasification and electricity generation technology systems,

2) a biochar processing facility to collect and distribute biochar produced as co-products of gasification, and

3) a wood processing campus to aggregate woody biomass, produce feedstocks for the gasifiers, and produce other value-added biomass-based materials.

The initial specification for gasifier feedstocks in this pilot study were for the biomass to pass a 3/8-inch screen deck and not pass a 3/32-inch screen deck. Small-scale gasifiers require feedstock that is uniform, flowable, and has a particle size distribution appropriate for feeders, augers, and the gasifier reactor. Gasifiers such as produced by Omni are sensitive to excessively large and lengthy particles that can cause jamming. It is generally accepted that "arborist chips" have unacceptable size and shape for use in small gasifiers. Bulk vegetation management debris, chipped debris, and baled debris all need to be further milled and screened to produce gasifier feedstocks.

To that end, **Donahoo, Inc.** was enlisted as a central grinding yard cooperator for the pilot study. The company routinely processes woody biomass, including PG&E vegetation management debris, into hog fuel for large-scale biomass boilers using a horizontal grinder and grate with large openings. With support from PG&E, Donahoo replaced the grinding bits with cutter bits and replaced the large grate with a fine grate having 5/8-inch openings. These choices are commonly used in the southeastern U.S. to convert logging slash in to "micro-chips" for use in fluidized bed power boilers and in wood pellet mills. The Donahoo grinder was used to process Forest Concepts' biomass bales, chipped vegetation management debris, and non-merchantable roundwood logs gathered from vegetation management and burned sites.

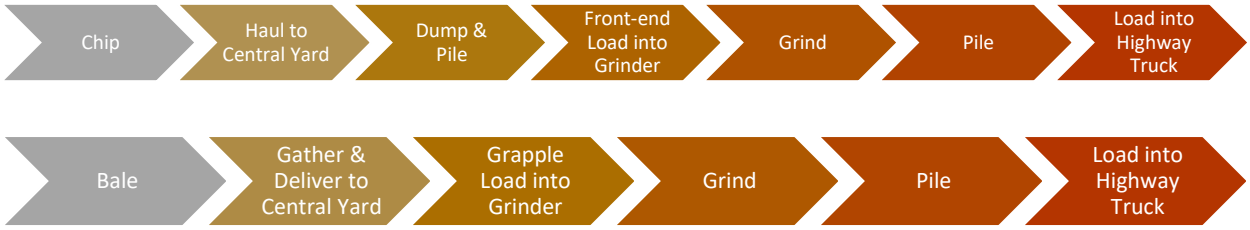


Figure 2: Delivery and processing operations for chips vs bales using a central grinding yard such as Donahoo, Inc.

The Figure above shows the sequence of unit operations for a central aggregation and processing yard beginning with chips or bales at a vegetation management site and ending with loading highway trucks for delivery of ground biomass to a gasifier site. This is one of many potential schemes for organizing a supply chain that ends with finished gasifier feedstocks. In this scheme, both raw chips (that contain many long sticks) and bales are ground into a bulk material for transport and subsequent processing at the destination into reactor-ready and user-specific feedstocks. [Note that this conventional system had to be modified by adding post-grinding screening and rotary-shear second-stage milling at Forest Concepts to meet the Omni BioEnergy gasifier specifications.]

Processing Chipped and Ground Materials at Forest Concepts

Since Donahoo, Inc. did not have a screening system, samples of ground biomass from each material were brought to Forest Concepts' processing plant in Auburn, Washington for screening through a two-deck orbital screen. The Forest Concepts Model 2448 orbital screen system was used to determine the mass yield of on-spec particles that passed a 3/8-inch top screen and were retained on a 3/32-inch lower deck fines screen.

Since Scotts Valley Energy plans to develop a wood processing campus to directly serve the feedstock needs of their gasifiers, an additional objective was to evaluate the utility of Forest Concepts' Crumbler® rotary shear equipment for processing chipped and shredded vegetation management debris close to the point of use by the gasifier systems. The Crumbler® systems are better scaled to the needs of a gasifier campus, are quiet, produce little dust, and typically have higher yields of on-spec feedstocks

than grinders or hammermills. To that end, a portion of the materials brought to Forest Concepts was milled and screened using the Crumbler® system.

Processing Methods, Data, Results, and Observations

Materials and Processing Methods

One processing objective was to screen the materials ground by Donahoo, Inc. to produce "accepts" fractions for evaluation by Omni BioEnergy and to determine the mass yield of accepts, fines, and overs from the grinding operation. In a production environment, the overs would be returned to the infeed pile for reprocessing. The fines would most likely be delivered or sold to a compost, mulch, or a soil mix operation.

A second objective was to evaluate whether the raw chipped material could be crumbled using the Forest Concepts rotary shear technology rather than ground, and then screened to quantify accepts, fines, and overs. As in the case of grinding, any overs would be recycled to the infeed for reprocessing and the fines would be sent to other markets.

The Forest Concepts 2448 orbital screen was setup the same for all materials. Thus, any differences in flowability, handling, or feeding of the accepts fractions sent to Omni BioEnergy were due to source and/or milling method.

Chips – Load 1 – (Sample ID: 2021.09.16.01)

This material was collected along Scotts Valley Road and side-streets approximately 10 miles northwest of North Lake. It is comprised primarily of oak and pine, with some woody brush.

Chips – Load 1 – Ground Fast – Screened – Accepts (Sample ID: 2021.09.16.01.A.A)

Chips from Load 1 were ground by Donahoo using the 5/8-inch round hole grate at a high feed rate. That material was subsequently screened by Forest Concepts to pass a 3/8-inch round hole punched plate top deck and be retained on a 3/32-inch wire screen lower deck.

Chips – Load 1 – Crumbled 1/4 – Screened – Accepts (Sample ID: 2021.09.16.01.B.A)

Raw chips from Load 1 were milled with a Forest Concepts Crumbler® M6 rotary shear that had ¼-inch thick cutters. The material was recirculated three times to mimic commercial systems. The Crumbler® machine output was subsequently screened by Forest Concepts to pass a 3/8-inch round hole punched plate top deck and be retained on a 3/32-inch wire screen lower deck.

Chips – Load 2 – (Sample ID: 2021.09.16.04)

This material was collected along Bottle Rock Road and side-streets approximately 3 miles northeast of North Lake. The material was a mix of boxwood, beech, and other shrubby green hardwoods.

Chips – Load 2 – Ground Fast – Screened – Accepts (Sample ID: 2021.09.16.04.A.A)

Chips from Load 2 were ground by Donahoo using the 5/8-inch round hole grate at a high feed rate. That material was subsequently screened by Forest Concepts to

pass a 3/8-inch round hole punched plate top deck and be retained on a 3/32-inch wire screen lower deck.

Chips – Load 2– Crumbled 1/4 – Screened – Accepts (Sample ID: 2021.09.16.04.B.A)

Raw chips from Load 2 were milled with a Forest Concepts Crumbler M6 rotary shear that had ¼-inch thick cutters. The material was recirculated three times to mimic commercial systems. The Crumbler® machine output was subsequently screened by Forest Concepts to pass a 3/8-inch round hole punched plate top deck and be retained on a 3/32-inch wire-screen lower deck.

Bales – 2021.09.16.03

Four bales were produced by the Forest Concepts engineering prototype baler along Bachelor Valley Road approximately five miles northwest of Upper Lake in Lake County, CA. The neighborhood was comprised of open woodland grazing lands, mature walnut orchards, and pastures. The vegetation types along the roads were primarily mature oak trees with some walnut and other deciduous trees. Since this distribution line was only being trimmed for line clearance, low brush and vegetation against the lower telephone, cable tv, etc. lines were not trimmed.

All bales were 48-inches wide by 32 inches high and approximately 52-54-inches long. The width and height are set by the walls of the baler. The length at the time of compression is 48-inches but expands as the tying material stretches after release from the baling chamber.

The bales were delivered by Loggers Unlimited to Donahoo for grinding. As noted above, the coarse grates in the horizontal grinder were replaced with 5/8 diameter round hole grates for this study. That decision was made as a “best guess” of setups to achieve the Omni particle spec in one pass through the grinder. We immediately discovered that grinding the baled material with such as small grate was almost impossible and resulted in very fine shardy output. We attribute the challenge to at least two factors.

- Firstly, baled material has the branches and twigs oriented across the bale and consequently across the grinder Grinders are engineered to process woody biomass from the end grain and not from the side grain. Essentially, this meant that the grinder had to gnaw its way through the bale. Prior field trials to grind bales were targeted to produce large hog fuel and used 2-1/2 to 4-inch grates. Those trials were much more successful.
- Secondly, the 5/8 grate plugged with stringy bark and greenwood fibers. In the grinder outfeed were many fibrous plugs almost like pellets that were formed within the grinder grate.

Thus, we recommend follow-on bale grinding trials with larger grates and a two-pass grinding scheme for baled material.

Logs – 2021.09.16.02

Donahoo, Inc. had a deck of non-merchantable conifer logs awaiting processing into hog fuel. They proposed that one large log be processed through the grinder with the 5/8 grate to see how well that material might fit the gasifier specification. Since logs represent a portion of the vegetation management debris, it made sense to include ground logs for completeness of the data set.

A log was ground and samples were collected. Forest Concepts conducted the same evaluations as for other materials. Yield of screen fractions of the as-ground materials was measured. Since the majority of the material met the gasifier specification, there was not a perceived value to run the material through Forest Concepts' Crumbler system.

Screening Results and Discussion

The screen yield of milled biomass that is sized appropriately for the Omni BioEnergy Artis gasifier was an important metric for the pilot. The spec we used here was to pass through a 3/8-inch punched plate (P3/8) and be retained on a 3/32-inch wire screen (NoP3/32). The table below shows the yields as a percentage of mass for materials where the yields are relevant.

Table 1. Yield of Ground or Crumbled Feedstocks from Screening with a Two-Deck Orbital Screen.

[NoP 3/8 means the material is retained on (does not pass) a 3/8-inch screen deck. P 3/32 means the material passes through a 3/32-inch screen deck]

[Designators "ground – slow" and "ground – fast" are settings of the Donahoo grinder made by their operators]

9/29/2021				
PG&E Lake County Field Trial		Screen Distribution (%mass)		
Description	**Sample ID**	**NoP 3/8**	**P3/8, NoP3/32**	**P3/32**
Chips - Load 1 - Raw	2021.09.16.01	72%	21%	7%
Chips - Load 1 - Ground - Fast	2021.09.16.01.A			
Chips - Load 1 - Ground - Fast - Screened P3/8, NoP3/32	2021.09.16.01.A.A	28%	49%	23%
Chips - Load 1 - Crumbled 1/4 - Screened P3/8, NoP3/32-Recirc	2021.09.16.01.B.A	30%	52%	19%
Chips - Load 2 - Raw	2021.09.16.04	73%	20%	6%
Chips - Load 2 - Ground - Slow	2021.09.16.04.A			
Chips - Load 2 - Ground - Slow - Screened P3/8, NoP3/32	2021.09.16.04.A.A	26%	55%	19%
Chips - Load 2 - Crumbled 1/4 - Screened P3/8, NoP3/32-Recirc	2021.09.16.04.B.A	25%	58%	18%
Bales - Ground - Slow	2021.09.16.03.A			
Bales - Ground - Slow - Screened P3/8, NoP3/32	2021.09.16.03.A.A	27%	42%	31%
Bales - Ground - Slow - Crumbled 1/4 - Screened P3/8, NoP3/32 -Recirc	2021.09.16.03.B.A	6%	55%	39%
Logs - Ground - Slow	2021.09.16.02.A			
Logs - Ground - Slow - Screened P3/8, NoP3/32	2021.09.16.02.A.A	23%	65%	13%

In the case of Chips – Load 1, you can see that the raw chips directly from the truck are mostly (72%) too big for feeding directly into the gasifier. The fines fraction of the raw chips that may cause packing within the reactor bed is fairly low (7%). The amount of fines is a function of chipper knife sharpness and the amount of leafy and small twig material in the vegetation being chipped. [Note that the Donahoo horizontal grinder had a brand new set of chipping bits and a new 5/8" grate installed for this pilot.] So, if we simply receive truckloads of chips from the chipping crew and only screened them, approximately

21% of the mass from Chipper Load 1 would meet our current gasifier spec. Thus, the need for milling and screening. Surprisingly, even though the vegetation type in Chipper Load 2 is very different from Load 1, the raw chips had a very similar size distribution.

When we look at the effect of grinding using the Donahoo grinder and 5/8-inch grate, the amount of overs drops and the amount of fines increases as expected. Mass yields of "first-pass" grindings are fairly good in the range of 50%. However, in an operational situation the overs would be reprocessed which is likely to increase the yield to closer to 70%. Future pilots should take a structured search for an "economic-optimal" grate size based on yield of gasifier feedstocks and the economic value of larger and smaller coproducts.

We also ran some of the raw chips and ground bales through the Forest Concepts Crumbler® milling system. This may be an alternative to grinding for the chipped material and serve as second-stage milling for the ground bales. Here we see that directly crumbling chips produced about 55% yield of on-spec feedstock without recirculating the overs for recutting. Recirculation of overs is likely to increase the yield close to 80%.

Figure 2: Feedstocks after grinding and screening to pass a 3/8-inch round hole screen and be retained on a 3/32-inch wire screen using Forest Concepts' orbital screen system.

Based on this first-pilot data, it appears that we can process the vegetation management woody biomass into gasifier feedstock with about 70-80% mass yield when we include recutting or regrinding of overs. Much of the fines are produced from leaf fragments, twig bark fragments, etc. so reducing that fraction will be difficult. As discussed earlier the yield from ground bales was low due to grinding with too-small of a grate and the orientation of the bales in the grinder.

Biomass and Feedstock Physical Properties Measurement

Forest Concepts evaluated the physical properties of select materials and feedstocks from this pilot to obtain an initial understanding that can be compared to more than ten years of data from processing of other woody biomass into feedstocks.

Moisture content was very low compared to "green" woody biomass from other studies. The moisture content of raw chips was 29% on a wet basis for the Load 1 and 38% for Load 2. Expected values were in the 48 – 50% range. The difference between the two loads is consistent with the type of vegetation in each load. Load 1 was oak and pine while Load 2 was much greener leafy material. The low numbers should not be surprising since the pilot was conducted at the end of an extremely dry summer in California. On the positive side, low initial moisture will mean that drying of milled feedstocks for

gasification will be much faster and consume less energy for this kind of material. Future studies should quantify moisture content across seasons and across a plausible range of vegetation types.

The moisture content reduced by 5-10% during grinding in the Donahoo grinder. This is consistent with prior data at Forest Concepts and studies by others.

Bulk density data is useful when planning storage facilities, hopper sizes, and feeding systems into reactors. The bulk density is measured at as-tested moisture content and not adjusted to an oven-dry or 10% MC basis. Prior work at Forest Concepts has found that the relationship between bulk density and moisture content is very non-linear so mathematical adjustment is not recommended.

Two values for bulk density were measured. Loose bulk density was measured by carefully pouring the material into a standard cylinder, sweeping off the top to a flat surface, and determining the mass. This density value represents the material in a small pile, on a conveyor belt, etc. Tapped bulk density was measured by first filling a standard cylinder as for the loose measurement, dropping the cylinder onto a hard surface from a standard height (150mm in this case) multiple times, refilling the settled space, and continuing to repeat that cycle until the material no longer settles. This density value represents the material in a truck after hauling, at the bottom of a large pile, etc. For materials like gravel, the difference between loose and tapped density is quite small. However, for biomass the difference can be in the range of 25 – 50 percent.

Nominal particle size is presented at the geometric mean (Xgm) following ASABE Standard 424.1 using a set of stacked oscillating/tapping sieves. The value Sgm is the variance of the mean size measurement. The size information is useful for estimating comminution energy and for comparison with studies conducted by others in the literature.

Table 2. Physical Properties Analysis

PG&E Lake County Field Trial		Moisture	Bulk Density		Size	
Description	**Sample ID**	**(%wb)**	**Loose (Lb/ft^3)**	**Tapped(Lb/ft^3)**	**Xgm (mm)**	**Sgm (mm)**
Chips - Load 1 - Raw	2021.09.16.01	29	10	14	16.3	3.1
Chips - Load 1 - Ground - Fast	2021.09.16.01.A	24	12	16	3.6	2.1
Chips - Load 1 - Ground - Fast - Screened P3/8, NoP3/32	2021.09.16.01.A.A				4.5	1.6
Chips - Load 1 - Crumbled 1/4 - Screened P3/8, NoP3/32-Recirc	2021.09.16.01.B.A				4.4	1.6
Chips - Load 2 - Raw	2021.09.16.04	38	8	11	13.6	3.0
Chips - Load 2 - Ground - Slow	2021.09.16.04.A	27	13	17	3.8	2.1
Chips - Load 2 - Ground - Slow - Screened P3/8, NoP3/32	2021.09.16.04.A.A				4.3	1.7
Chips - Load 2 - Crumbled 1/4 - Screened P3/8, NoP3/32-Recirc	2021.09.16.04.B.A				4.7	1.7
Bales - Raw	2021.09.16.03			16		
Bales - Ground - Slow	2021.09.16.03.A	23	9	13	3.0	2.3
Bales - Ground - Slow - Screened P3/8, NoP3/32	2021.09.16.03.A.A				3.0	1.8
Bales - Ground - Slow - Crumbled 1/4 - Screened P3/8, NoP3/32 -Recirc	2021.09.16.03.B.A				3.0	1.8
Logs - Ground - Slow	2021.09.16.02.A	20	13	17	4.4	1.8
Logs - Ground - Slow - Screened P3/8, NoP3/32	2021.09.16.02.A.A				4.5	1.6

Revised Spec and Processing

After review of the milled / screened materials by Omni BioEnergy, the screening specification used in September was revised to shift both the top size and fines designations downward (October spec).

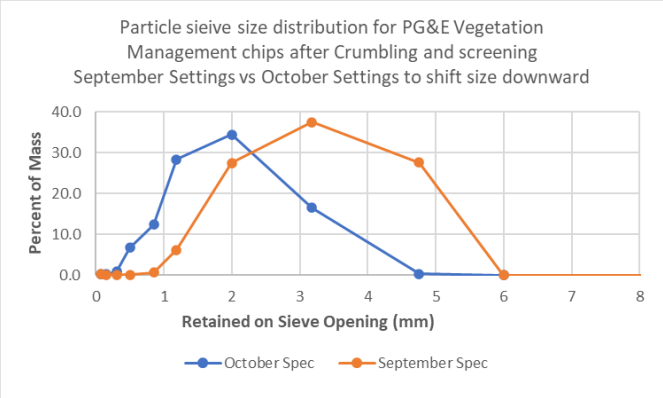


Figure 3. Particle size distribution for gasifier feedstocks produced from the initial (September) specification and the revised (October) specification from combined wood chips.

The particle size distribution graphic above shows that the dominant sieve fraction shifted downward from just over 3mm in the September materials to 2mm to meet the revised October spec. By changing the top deck in the orbital screen, the amount of 5mm particles was reduced from approximately 28% to near zero. Similarly, the portion of the mass that was less than 1mm increased from near zero in September to approximately 15% in October. The important observation from this is that particle size distribution can be modified in relatively subtle amounts at both the top and bottom of the particle population to achieve a particular gasifier system requirement.

Summary and Conclusions

Chipped and baled woody biomass from powerline vegetation management activities in Lake County, California was successfully gathered and processed to meet the feedstock requirements for a distributed-scale gasifier system. Chipped and baled woody biomass was ground by a horizontal grinder containing a 16mm (5/8”) grate. The resulting material needed additional processing to meet the gasifier spec. Logs processed through the grinder did meet the gasifier size specification but needed polish-screening to remove shards.

Today, existing biomass processing centers are unlikely to have all the equipment needed to do primary comminution and final feedstock preparation. At a minimum, milling and screening systems will need to be added that produce narrow size distributions and highly flowable particle shapes in the 1mm to 5mm particle size range. It is also likely that a biomass processing center will need drying capability to ensure final feedstocks meet gasifier users’ moisture requirements.

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