

**Harney County Fuels Utilization & Byproduct
Feasibility Study
ONFP-02-007**

*"Produced in cooperation with the USDA Forest Service and the Harney
Soil & Water Conservation District"*

Accomplishment Report

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Background

The communities of Burns-Hines, Harney County, are one of approximately 355 Oregon locations listed in the Federal Register as “urban wildland interface communities within the vicinity of Federal lands that are high risk from wildfire” (Federal Register, Vol. 66, No. 160 [August 17, 2001]). Burns and Hines, which adjoin each other, are the only incorporated cities in Harney County, with a combined population of about 3,560. Total Harney County population is about 7,600 (1998-census data). Excessive fuel loadings and hazardous conditions in Harney County occur across a variety of vegetation types, ranging from mixed conifer stands to big sagebrush-western juniper woodlands.

Over 70% of Harney County is managed by Federal agencies. This places the county among the top three in Oregon for percent of total land area managed by Federal agencies (the other two are Deschutes and Malheur counties). The U.S. Department of Interior, Bureau of Land Management (BLM), manages by far the most, with 62% (about 4.1 million acres) out of a total land area of approximately 6.6 million acres. U.S. Department of Agriculture (USDA), Forest Service, manages 8% (about 508,000 acres), the State of Oregon manages 3% (about 192,000 acres), with the majority of the remainder private (14%, or about 1.5 million acres). There is also about 3% (223,000 acres) classified as “other” ownership (Oregon CD-ROM atlas, 2002). BLM staff estimate the agency will be treating fuels or otherwise manipulating vegetation on an average 2,000 acres per year in woodlands and rangelands (per Jon Reponen, Natural Resource Specialist, Burns BLM). Less than half the acreage is accessible with existing roads.

In 2003, Harney County Court, Harney Soil & Water Conservation District and various project partners collaborated to compile a fuels and byproduct utilization study for the region. The project partners included: Burns District Bureau of Land Management, Oregon Economic Development Department, Malheur National Forest, Louisiana Pacific Corporation, West Oregon Wood Products, Oregon State University, and Columbia Basin Community College.

The primary factor for Harney County to undertake this project was Louisiana Pacific’s management interest in exploring options to better utilize boiler and manufacturing capacity to improve return on investment, operating efficiencies, and retain higher-skilled workers. The secondary factor driving the assessment was part of Harney County’s economic development strategy to partner with Federal, state, and tribal land managers, private landowners, and private business to reduce fuels, improve forest and range health, and retain and/or create jobs in the forest products sector.

Goals & Objectives

The Harney County Fuels Utilization and Byproduct Feasibility Study identified three key components within the original scope of work: **biomass inventory assessment, biomass utilization potential and value-added utilization options.**

The goal of the study was to promote cost-effective sustainable use of biomass energy in Harney County and identify value-added markets for biomass.

Harney County advertised the request for proposals and received three responses. With the assistance of an ad hoc resource advisory committee, Harney County voted to retain

Mater Engineering, Ltd. Recent benchmark biomass inventory studies conducted by Mater Engineering for other regions in Oregon and the US had documented this lack of inter-regional resource coordination and the need to create a new *coordinated resource offering protocol* (CROP) for government agencies (BLM, USFS, State Forestry Divisions, State Department of Transportation, etc.). Using CROP and Resource Offering Maps (ROMS), Mater was able to identify the amount, nature, suitability, availability, and economics for raw material resulting from government and private land management activity surrounding Burns and Hines in terms of both biomass and other value-added options.



The biomass inventory assessment was centered on residual biomass that may be available from the Louisiana Pacific LVL plant and biomass volumes projected to become available from public and private forestlands. (See Mater Engineering Final Report)

The Soil & Water Conservation District was charged with implementation of three small value-added utilization field trials for dairy calf bedding, fire pellet manufacturing, and western juniper essential oil distillation.

Sustainable healthy ecosystems & community benefits

The linkage between forest health and watershed health is often overlooked in discussions of appropriate forest management and community benefit. In particular, reducing the risk of catastrophic wildfire not only protects human lives and property; it also prevents long-term impacts on water quality in the riparian areas associated with increased sedimentation into water bodies. Wildfire removes vegetation and exposes mineral soils, decreasing soil's ability to absorb water. This contributes to the potential for excessive soil movements and mudslides following wildfires, and it also affects soil productivity years later. Wildfire prevention is only one watershed benefit that can be attributed to appropriate forest management.

Appropriate use of forest management tools including thinning, pruning, and prescribed burning in currently resilient stands helps prevent catastrophic wildfires and helps create and maintain resilient watersheds, which support communities, wildlife and recreational opportunities and improve forest aesthetics. These environmental effects create socioeconomic issues for communities, including water availability, sustained timber production and recreational opportunities. Forest density and fuels management in strategic areas, such as the identified 100-mile radius, can help reverse these negative impacts.

Local capacity building

The use of participatory approaches to plan and manage land and conservation-based interventions is now well established. Few projects in natural resource management today, from whatever agency are funded unless they contain substantial components of community involvement in planning, design and implementation.

Harney SWCD contributed **\$11,618.50** into the Harney County economy by contracting with local vendors. These approaches strengthen and enhance the application of methods to promote participation in natural resource management projects and contribute to preserving quality of life.

Table 1.

Date	Contractor	Still Operator	Raw Materials	TOTAL
4/28/2003	Essential Oil		\$1,350.00	\$1,350.00
5/2/2003	Essential Oil	\$750.00		\$750.00
5/7/2003	Essential Oil		\$900.00	\$900.00
5/8/2003	Essential Oil	\$637.50		\$637.50
8/11/2003	Essential Oil		\$2,250.00	\$2,250.00
8/14/2003	Essential Oil	\$1,012.50		\$1,012.50
9/30/2003	Dairy Calf Bedding		\$130.00	\$130.00
10/20/2003	Wood Pellets		\$2,600.00	\$2,600.00
10/23/2003	Wood Pellets		\$604.40	\$604.40
10/23/2003	Dairy Calf Bedding		\$875.60	\$875.60
3/29/2004	Dairy Calf Bedding		\$208.50	\$208.50
4/14/2004	Dairy Calf Bedding		\$300.00	\$300.00
TOTALS		\$2,400.00	\$9,218.50	\$11,618.50

Measurement and accounting for progress

Having systems in place to measure and communicate progress was a critical part of this project. Appropriate measures not only keep watershed issues on the radar screen, but, as they are met, allow stakeholders to share successes and to highlight new challenges facing the watershed.

Western Juniper Essential Oil Distillation Trials

The purpose of this project was to confirm wholesale & retail markets for western juniper leaf (*Juniperus occidentalis*) or needle oil using the baseline information developed by The Confederated Tribes of Warm Springs (Joe Yesenofski, Western Juniper Oil Distillation & Marketing Project, 1997.) The manufacturing and market trials were designed based on the most feasible options available to Harney County residents.

Western juniper leaf oil samples were sent to Professor Karen Grant, Columbia Basin College for scientific analysis to identify the key elements in the essential oil for marketing of the product samples to potential niche market users. Ten oil samples were distributed to small business niche market users.

Collection, Distillation, and Essential Oil Analysis

A local western juniper entrepreneur was hired by the Soil & Water Conservation District to both harvest, transport, and distill western juniper as cost effective as possible.

Two manufacturing trials were scheduled to produce western juniper leaf essential oil from raw juniper boughs.



Batch 1 (left) vs. Batch 2 (right)

Collection #1 conducted April 26 to May 8, 2004

Western Juniper boughs were collected at 5000' elevation northwest of Burns, Oregon. Boughs were cut lengths of 10-12" & 14-16" and baled in 50-pound bales. Trees contained no berries and ranged in age from 60-100 years old.

Boughs were cooked from two days to six days old. Boughs were stored in a cool shaded area waiting to be processed.

Harvest weather for cutting ranged from 6" fresh snow to rain to heavy wind 32-45 degree temperature.

Distillation

LP Hines provided a boiler maker to assist and supervise instillation of the still to the existing underutilized plant boiler. Raw material was distilled utilizing a EOS-100

Newhouse Mini Still & High Performance TP separating can pre heated before all first cooks with warm water ran from 120 –140 degrees. Each cook utilized approximately 120-125 lbs of western juniper bough.



There were 35 cooks in this trial @ four cooks per day for 8 days and there was one day that only three cooks were able to take place. The bough cook time averaged 2.5 hours- 2 hours. Steam pressure fluctuated from .5 pound – 2 pounds in the course of each cook. Increased pressure depended upon blow by and outside temperature rise and fall.

Within these 35 cooks the start pressure was .5-pound, increased to 1-pound after one hour, and 1.5 to 2-pounds until done at two hours. The cooker was drained every 20 minutes. The condenser had an automatic temperature control set at 110 degrees for cooling. The condenser ran at approximately 120 degrees. Oil collection jars were typical clear Kerr canning jars. The trial netted a total of 385 ounces or approximately 8-11 ounces per batch cooked of oil.

Eight samples provided by the SWCD were analyzed at Columbia Basin College by GC-MS (gas chromatography – mass spectrometry) techniques for chemical composition and purity. The college was asked to provide a breakdown of components found in the western juniper essential oil for marketing literature. There appears to be no market interest at this time for the distillate or flora waters.

Test Method

0.10 mL of each oil sample was pipetted into a 10.00-mL volumetric flask and diluted to the mark with dichloromethane. 1.00-microliter of this solution was then injected into the gas chromatograph. In addition, the darkest oil sample obtained on 4/21 was also injected neat (no solvent) to ensure better identification without solvent interference.

0.10 mL of each water sample was extracted with 1.00 mL of dichloromethane. The extract was put in a 10.00-mL volumetric flask and diluted to the mark with dichloromethane. 1.00 microliter of this solution was then injected into the gas chromatograph. In addition, the remaining cooker water sample (8.90 mL) was also extracted twice, each time with 1.00 mL of dichloromethane. The 2.00 mL of extract was combined and 1.00 microliter of this extract was injected into the gas chromatograph. The purpose of this was to look at the relative amount and purity of the organic residue in the entire cooker water sample.

Analysis

The instrumental separation and analysis was carried out on a Hewlett Packard (HP) GC-MS system, consisting of an HP 5890 Gas Chromatograph and an HP 5971A Mass Selective Quadrupole Detector. The gas chromatograph was operated in split injection mode with a split ratio of 50:1. The column was an HP DB-5 silica glass 0.32-millibore capillary column, 25 meters long, with methyl, 5% phenyl, C-18 liquid phase. The GC was programmed to start at an initial temperature of 40°C and an initial time of 2.00 min. The ramp rate was 6.0°/min. The final temperature was 270°C and the final time was 2.00 min. The injector temp. was 265°C and the detector temp. was 280°C. An equilibration time of 0.50 min. was used.

The mass spectrometer was programmed to scan from 40 – 500 mass units. A solvent delay of 6.00 min. was set to eliminate the dichloromethane solvent effect. The run time for each sample was 42.33 min. The mass spectrum of each peak observed on the total ion chromatogram (TIC) was obtained and submitted to search through the DATABASE/NBS75K.L (National Bureau of Standards Search Library).

Results

The darkest oil sample (4/21) run neat was used for identification of components and gave results consistent with the chemical composition of western juniper oil. A comparison was made to the components listed in the following reference: “The Leaf Oil Terpene Composition of *Juniperus Occidentalis*”, Ernst von Rudloff, Lawrence Hodge, and Michael Granat, in Phytochemistry, 1980, Vol.19 pp.1701-1703. While there are other references available, this one used leaf samples from two different populations of western juniper near Redmond and Prineville in Oregon, areas somewhat closer to the Harney District. The authors make the point that there are junipers with serrated (teeth-like) leaf margins and junipers with non-serrated leaf margins. The distribution of terpenes is significantly different in the two cases. The western juniper has the serrated leaves and key components are camphene, p-cymene, terpinen-4-ol, bornyl acetate and camphor. All of these are observed in the samples submitted by the Harney District, indicating that the oil comes from the serrated leaf western juniper. See Fig. 1. Other typical components, like α -pinene, myrcene, 3-carene, phellandrene isomers and cadinene (naphthalene-type) and cadinol isomers are also present. The largest component is bornyl acetate, sometimes called “borneol acetate”. In addition, there are no significant impurities evident in Fig. 1.

The other four oil samples, 4-28, #1; 4-30 1-4 batch; 5/6 1-4 batch oil; and 5-8 batch #3 give almost identical results. The 4-28, #1 sample shows the most variation. See Fig. 2. The peaks out around 34.8 min. and 40.2 min. are impurities of the polysiloxane variety. These come from exposure of the sample to stopcock grease or plasticizers, such as those found in plastic caps, etc.

While this was not a quantitative analysis (That would require standards to correct for different response factors.), the darkest oil sample and the 5-8 batch #3 oil sample showed the most abundance for the same size sample. The 4-30 1-4 batch cook oil sample showed a little less abundance. See Fig. 3. The other two oil samples were somewhere in between.

The distilled water (no date) showed no oil of any significance. See Fig. 4. The 4-30 distillate water and the cooker water showed very minor amounts of the larger

components of the western juniper oil in terms of abundance, when compared to the oil samples.

When all 8.90 mL of the cooker water (the entire sample provided) was analyzed, somewhat larger amounts of the oil components were present, together with some significant impurities. The peaks at 26.6 min. and 30.0 min. are impurities not present in western juniper oil and are comparable in size to some of the larger constituents in the oil. See Fig. 5. This suggests that attempting to recover or collect the western juniper oil from the cooker water may prove difficult because of the organic impurities present.

In summary, the oil samples submitted appear to be western juniper oil in quite pure form. If further analysis is desired, chiral separations for optical isomers or quantitative determinations of components against standards could be performed.

Collection #2 conducted August 6-August 12, 2003

The basis for the test collection #2 was to document whether or not season and a variance in processing would produce significant changes in oil production.

Western Juniper boughs were collected at 5000' elevation northwest of Burns, Oregon. Boughs were cut in lengths of 12-14" and baled in 50-pound bales. Trees contained no berries and ranged in age from 25-100 years old. Boughs were cooked from one day to four days old. Boughs were stored in a cool shaded area waiting to be processed.

Harvest weather for cutting averaged 60-80 degree temperature.

Distillation

Raw material was distilled utilizing the same EOS-100 Newhouse Mini Still & High Performance TP separating can was pre heated before all first cooks with warm water ran from 120 –140 degrees. The condenser was set at 110 degrees for cooling. Each cook utilized approximately 150 lbs of western juniper boughs due to dryness of the boughs.

There were 33 cooks in this trial @ six cooks per day for 4 days, 5 cooks for one day and 4 cooks for one day. The bough cook time averaged 2.5 hours- 2 hours. Steam pressure fluctuated from .5 pound – 2 pounds in the course of each cook. Increased pressure depended upon blow by and outside temperature rise and fall.

Within these 33 cooks the start pressure was .5-pound, increased to 1.5-pounds after twenty minutes, and 2+ pounds until done at one hour. The cooker was drained once per cook. The condenser had an automatic temperature control set at 110 degrees for cooling. The condenser ran at approximately 120 degrees. Based upon the recommendation of the laboratory, amber Wheaton Science TM oil collection jars with Teflon enforced lids were purchased to avoid oil contamination and light penetration. The trial netted 99 ounces or approximately 3-3.5 oz bottles per batch cooked of oil.

Five samples provided by the Harney Soil and Water Conservation District were analyzed by GC-MS (gas chromatography-mass spectrometry) techniques for chemical composition and purity. As requested feedback from a wholesale buyer, the oil flash point was also determined for bulk shipment to overseas buyers.

Test Method

The method used was the same as the first test.

Analysis

The analysis used was the same as the first test.

The flashpoint sample was a mixture of oil samples 1, 2, and 3, and was run three times.

Results

The flashpoint result is 55°C (131°), indicating that it is a flammable mixture. It is considered flammable if the flashpoint is < 140°F. The results were reproducible.

All of the oil samples, including the sample containing a mix of batch 1 and batch 2, look extremely pure and appear to contain very little moisture. Also, the batch 1 water sample is extremely clean. See Fig. 5. There are no more than minute traces of the major oil components, along with trace amounts of some other impurities, such as acetic acid. The four oil samples are very similar to both the first set of samples (See prior test) and to each other. However, there are a few differences. The Batch 1 Oil sample analyzed this time (See Fig. 1.) shows considerably more **camphor** content than is seen in the other oil samples, Batch 2, Batch 3, and Batch 1 and 2 (See Figs. 2, 3, and 4) or in the first set of samples analyzed. There is also a higher pinene abundance and a lower abundance of the higher molecular weight compounds out around 20.00 to 25.00 minutes than is observed in the rest of the samples and the previous samples analyzed. Since camphor and α -pinene are highly aromatic compounds, it is likely that these differences could change the odor of the oil in subtle ways that a trained observer might detect. In fact, this analyst could distinguish some slight difference in the odor of the Batch 1 Oil compared to the other three oil samples. All are extremely pleasant and smell like juniper, but there are subtle differences. Camphor sublimates readily and there are differences in volatility among all the components in this kind of an oil; so some differences in relative amounts of components will occur, depending on the age, temperature, and treatment of the sample (exposure to air, etc.). The other three oil samples (Batch 2, 3, 1 and 2 mixed) are remarkably similar. You can lay the three chromatograms on top of each other and get almost a perfect match. For marketing purposes, it would be desirable to strive for as much consistency in the amounts of components (all of which contribute in some way to the overall scent) as possible. Each time an oil sample is opened; there is the potential for some selective evaporation of the components to occur. Temperature changes will also affect this, since each component has a different volatility. Heat, age, and exposure to air and light can also contribute to rearrangement of components to other isomers, some of which are oil components in their own right. This changes the relative amounts of the constituents. Degradation to decomposition products may also occur, although these samples do not show significant impurities.

Again, the oil samples submitted appear to be western juniper oil in very pure form. If further analysis is desired, headspace analysis for the very low-end volatile components, chiral separations and analysis for optical isomers (which can contribute substantially to the nature of the overall odor) or quantitative determinations of components against standards could be performed.

Conclusion

As expected, oil production levels fell off drastically in the summer, however, oil consistency had improved over the spring cook

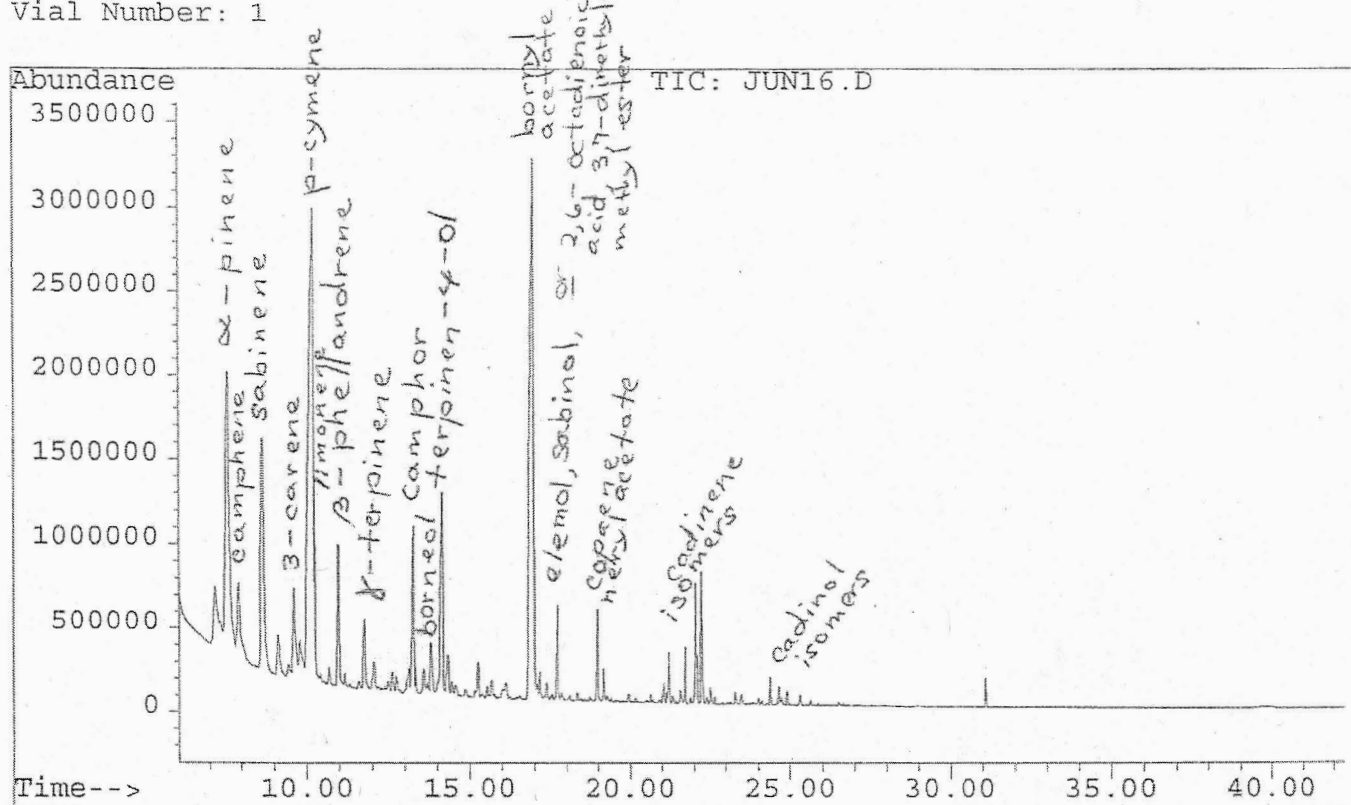
Based upon feedback from distributors of aromatherapy, soaps, candles, and naturopathic distributors there are positive indicators for western juniper oil components in the niche markets. Feedback from potential customers indicates their willingness to pay from \$30-\$60/lb for distilled western juniper leaf oil in small orders and quite possibly up to \$100.00/lb for naturopathic distributors. Our production costs to implement the western juniper oil trial totaled \$6,900.00. The net oil production of the two distillations was 484 ounces or 30.25 lbs of oil. Therefore, the cost of our trial production far exceeded the profits expected in the market place.

In summation, utilizing the information received from this trial indicates the price points for Western Juniper essential oil remains relatively similar to pricing indicated in the 1997 Western Juniper Oil Distillation and Marketing Project report for the US Forest Service. There is enough interest from the candle manufacturing and aromatherapy sector to warrant a small scale western juniper distillation operation in conjunction with a biomass processing

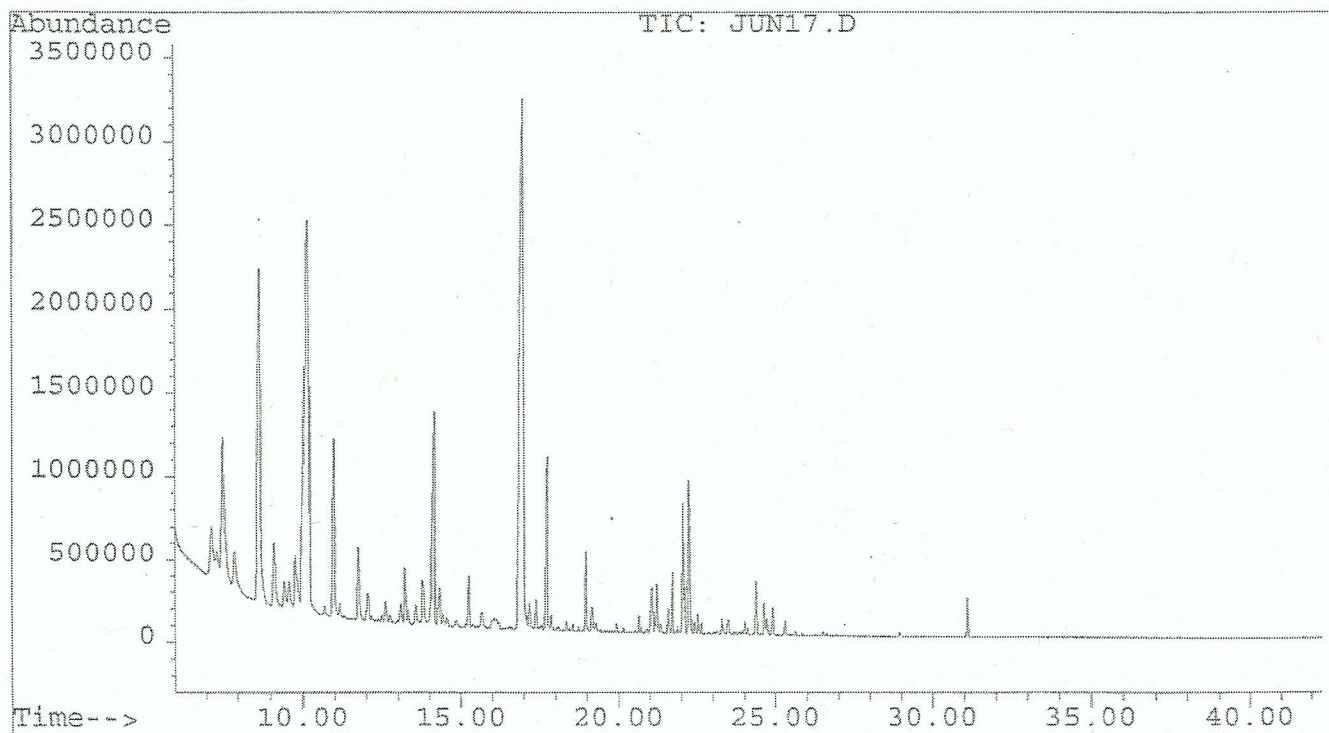
facility. A the next logical step would be to diversify product offerings to include western juniper berry, sagebrush (*Artemisia*), and other local plant material essential oils to offset market fluctuations that may be experienced.

File : C:\HPCHEM\1\DATA\JUN16.D
Operator : Amanda Pierson
Acquired : 18 Nov 103 2:43 pm using AcqMethod JUNIPER1
Instrument : 5971-Inst
Sample Name: Batch 1 Oil, Aug. 6, 2003, 2nd
Misc Info : Juniper Oil from the Harney District
Vial Number: 1

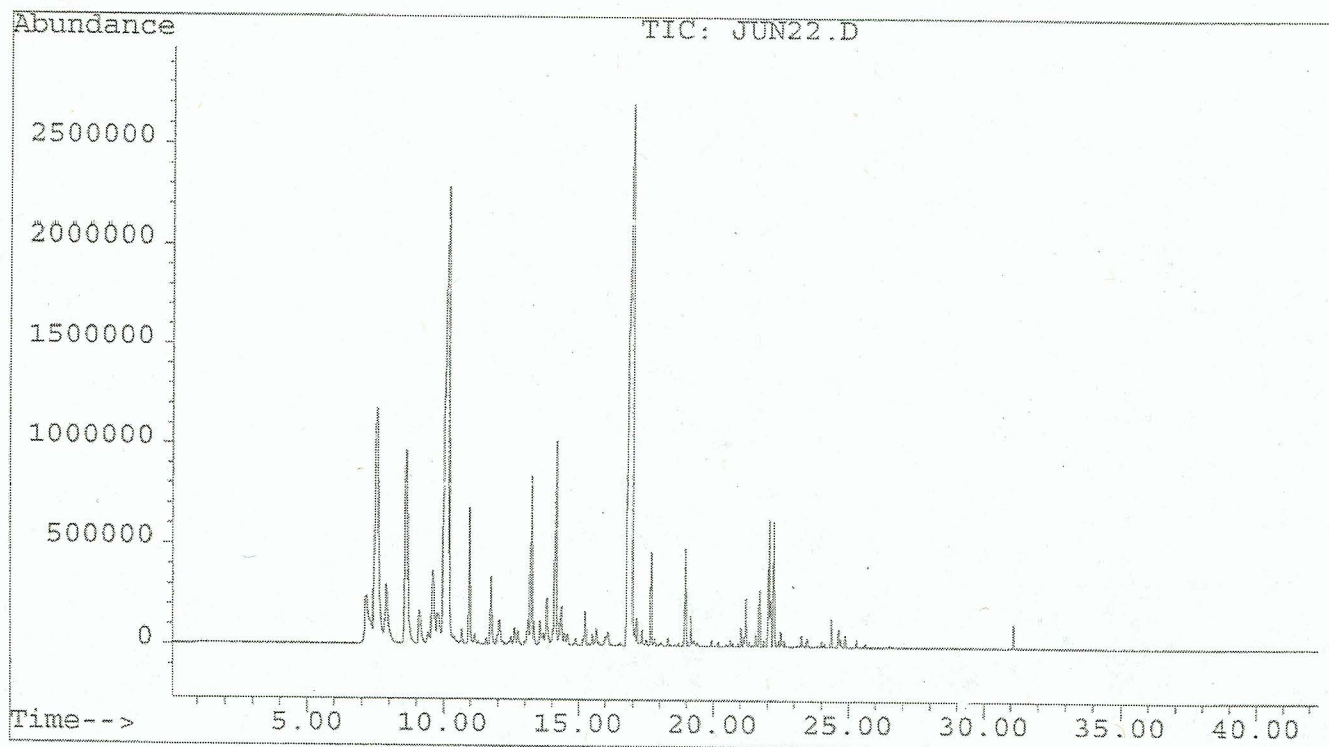
Fig. 1.



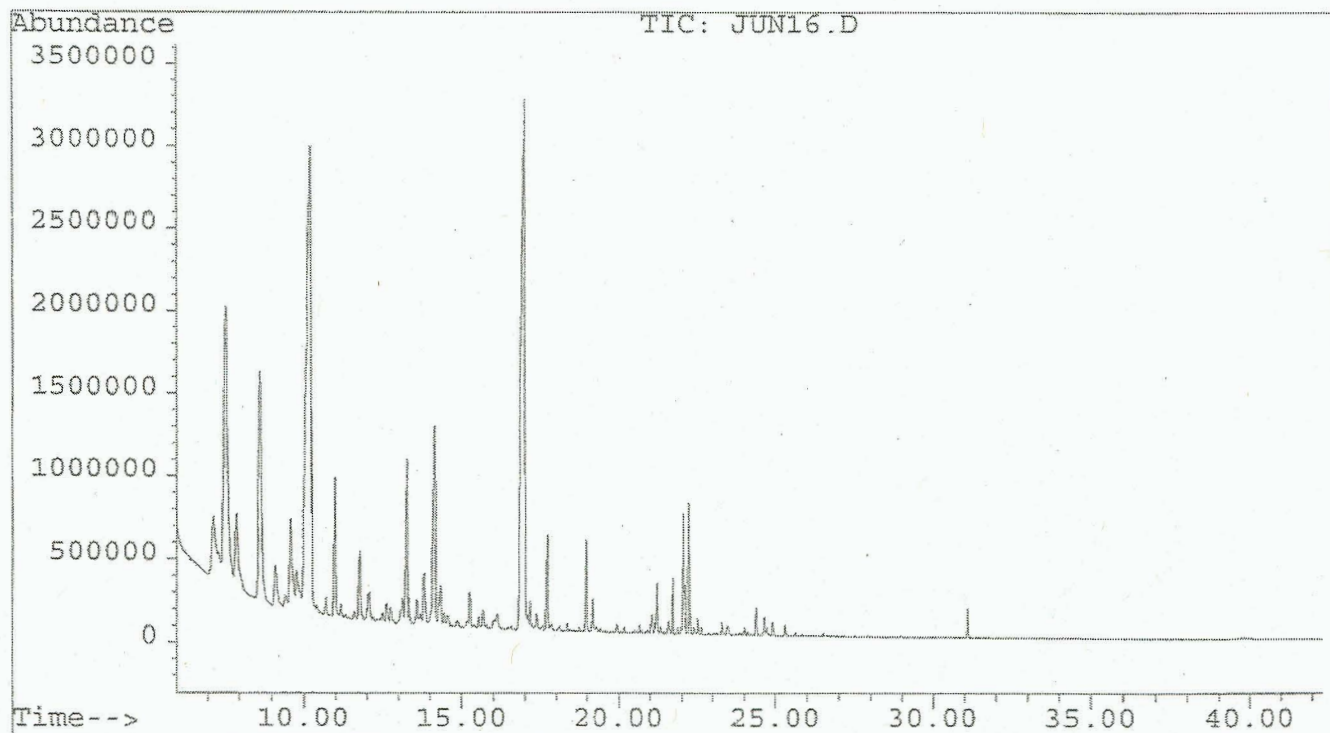
File : C:\HPCHEM\1\DATA\JUN17.D
Operator : Amanda Pierson
Acquired : 18 Nov 103 4:35 pm using AcqMethod JUNIPER1
Instrument : 5971-Inst
Sample Name: Batch 2 Oil, Aug. 9, 2003, 2nd
Misc Info : Juniper Oil from the Harney District
Vial Number: 1



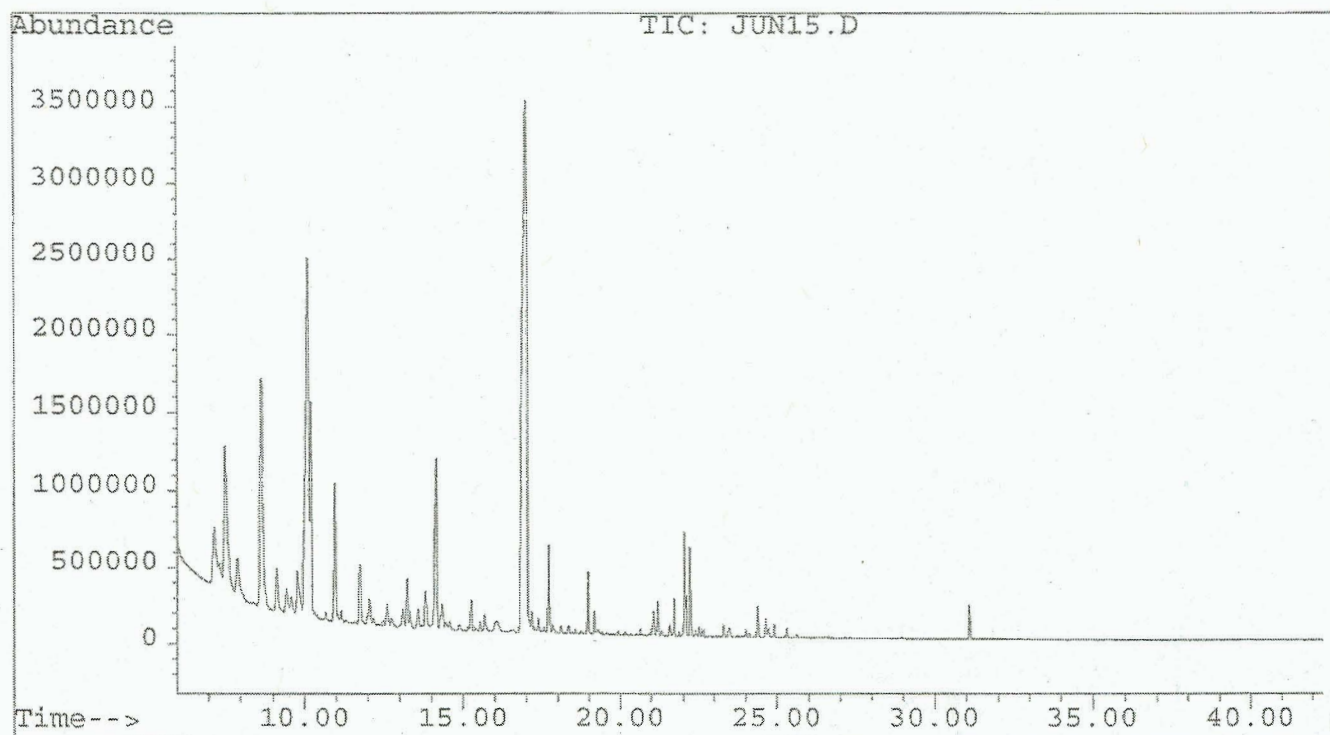
File : C:\HPCHEM\1\DATA\JUN22.D
Operator : Amanda Pierson
Acquired : 21 Nov 103 4:00 pm using AcqMethod JUNIPER1
Instrument : 5971-Inst
Sample Name: batch 1o1l (neat), 2nd
Misc Info : Juniper Oil Harney Dist.
Vial Number: 1



File : C:\HPCHEM\1\DATA\JUN16.D
Operator : Amanda Pierson
Acquired : 18 Nov 103 2:43 pm using AcqMethod JUNIPER1
Instrument : 5971-Inst
Sample Name: Batch 1 Oil, Aug. 6, 2003, 2nd
Misc Info : Juniper Oil from the Harney District
Vial Number: 1

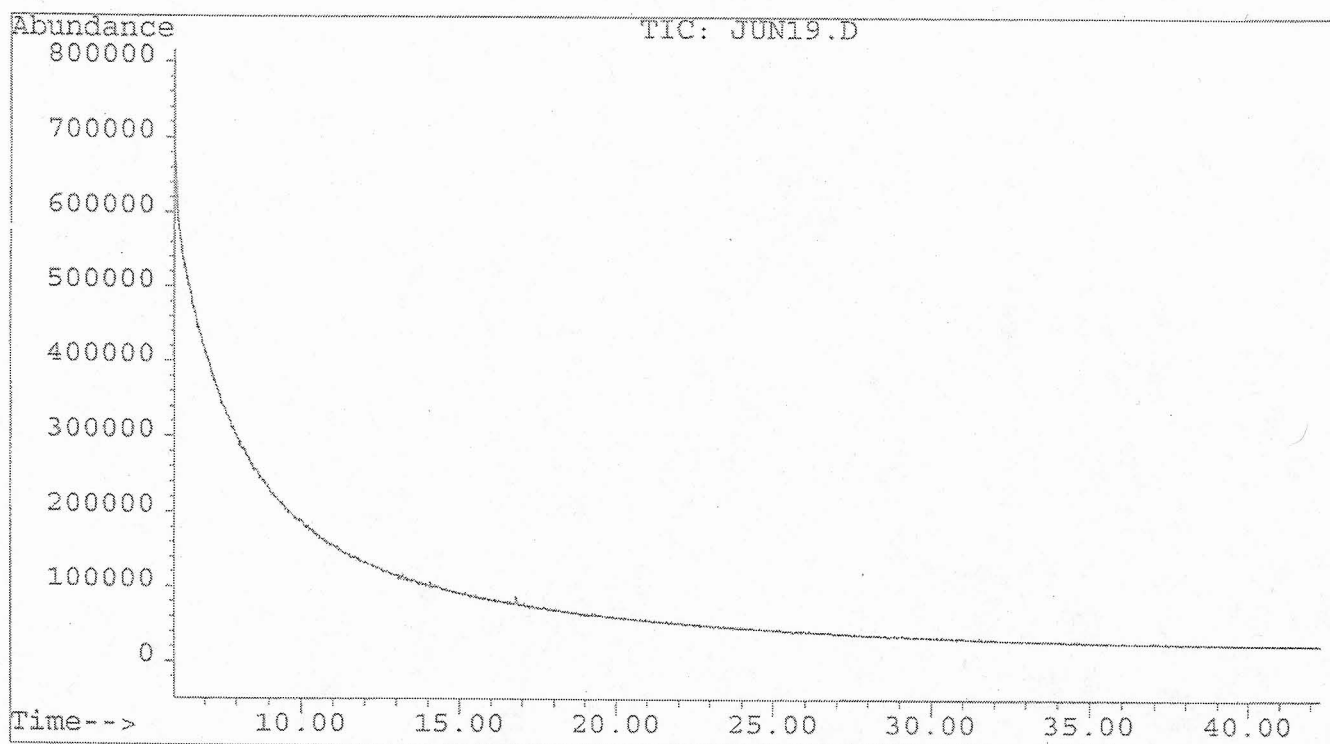


File : C:\HPCHEM\1\DATA\JUN15.D
Operator : Amanda Pierson
Acquired : 18 Nov 03 12:31 pm using AcqMethod JUNIPER1
Instrument : 5971-Inst
Sample Name: Batch 1+2 Oil, Aug. 7, 2003
Misc Info : Juniper Oil from the Harney District
Vial Number: 1



File : C:\HPCHEM\1\DATA\JUN19.D
Operator : Amanda Pierson
Acquired : 18 Nov 103 6:34 pm using AcqMethod JUNIPER1
Instrument : 5971-Inst
Sample Name: Batch 1 Water, Aug. 6, 2003
Misc Info : Blank from the Harney District
Vial Number: 1

Fig 5.



Dairy Calf Bedding Trials

The purpose of this trial was to assess the nature and potential of the regional market for western juniper dairy calf or other large animal bedding. The District would conduct market research to determine size and nature of potential regional market for western juniper dairy calf or other large animal bedding based on OSU preliminary test results. The trials were conducted in a manner that allowed OSU professor Mike Gamroth to submit an abstract and prepare a poster for the American Dairy Science Association.

There are approximately 320 dairies in Oregon. The majority are located in Willamette Valley and Tillamook County, five in Umatilla-Morrow, 16 in Malheur, four in Deschutes, and six in Klamath County. OSU currently pays \$6 per yard or \$43 per unit for cedar shavings. They utilize approximately 10 units per month or one-half yard per cow. The majorities of dairy facilities utilize the cheapest materials possible, but tend to lean towards cedar as their bedding of choice.



Typical cedar shavings used by the dairy industry.



Vermeer Chipper utilized to chip bedding samples

**Chemical and environmental treatment of
whole tree juniper chips to lower fecal
coliform counts.**

Mike Gamroth

Department of Animal Sciences

Oregon State University

October 21, 2004

Introduction

Mastitis is the leading cause of milk loss and the most costly disease to treat on the farm. Bedding materials can be nutrient sources for organisms that cause environmental mastitis and allow for transmission from one cow to another through contact with the bedding.

As dairy herds control contagious mastitis pathogens, such as *Streptococcus agalactiae* and *Staphylococcus aureus*, environmental pathogens become the most significant source of intramammary infections (Eberhart, 1972, 1977).

Coliform bacteria are always present in dairy confinement facilities and can cause serious mastitis. Clean housing and milking hygiene practices have been shown to help control new infections (Carroll, 1980; Eberhart, 1972; Natzke 1976; Smith, 1985; Hogan 2003).

Organic bedding material can be a source of environmental mastitis pathogens. Some studies have related counts of environmental bacteria on bedding materials with numbers found on teat skin and in quarter milk samples (Fairchild, 1982; Hogan 1990; Janzen, 1982). While some studies and farm experiences show little correlation of bedding cleanliness and rate of clinical mastitis (Fairchild, 1982; Natzke, 1976), limiting bacterial growth on bedding would reduce the challenge of environmental bacteria to the udder. Sawdust and wood products generally contain more coliform bacteria, where straw bedding contain high numbers of environmental streptococci and green hardwood sawdust containing bark material is associated with a higher incidents of *Klebsiella* mastitis. Byproducts of wood processing are an important source of organic

bedding on dairy farms. However, economic and environmental pressure on the wood industry could reduce supplies of suitable wood sawdust and shavings.

Alternative bedding materials and techniques to extend the service life of beddings would be helpful in freestall confinement facilities.

Some studies have reported the suitability of alternative bedding materials and the effectiveness of organic bedding treatments to retard organism growth (Hogan, 1989, 1990; Janzen, 1982, Zehner, 1986).

Two samples of fresh chipped whole tree juniper were cultured by the OSU College of Veterinary Medicine Diagnostic Lab in late 2003. Both showed high counts of fecal coliform bacteria, including *E. coli* and *Klebsiella* species. Such counts would indicate the material is unacceptable as a dairy cattle bedding. The objective of this study was to evaluate alternative chemical and environmental treatments to limit the fecal coliform contamination of whole-tree green chipped juniper and dry chipped juniper.

Materials and Methods

Four chemical/environmental treatments with the potential to reduce bacteria counts were tested on two types of chipped juniper. Whole juniper trees with needles (GREEN) and without needles (DRY) were chipped through a Vermeer BC1230A self-powered mobile chipper to about 2.5 to 4.0 cm (1 to 1-1/2 inch) in size. Chips were collected in plastic garbage bags and immediately hauled 415 km (250 mi) to the OSU dairy in Corvallis on Sunday, April 21, 2004.



Whole tree (GREEN) chips



Whole tree without needles

(DRY) chips

That night approximately 1 kg (2.2 lb) portions of the chips were poured into 40 cm x 60 cm (16" x 24") aluminum pans prior to treatment. Samples of the untreated GREEN and DRY chips were sealed in plastic bags and refrigerated overnight. These samples were delivered the next morning to the OSU Veterinary Diagnostic Lab for dilution and plating on MacConkey agar plates. All fecal coliform counts were cultured on the same medium and colony forming units (CFU) were counted after 48 hours incubation at 37°C (98.6° F). The only exception was when bacterial colonies overgrew the culture dish before 48 hours.

Treatments to control bacteria were: 50 ppm iodophor solution sprayed over the surface of the panned chips (GERMICIDE), calcium hydroxide powder or hydrated lime at 120 ml (4 oz) /cubic foot of chips mixed into panned chips (LIME), open air drying of chips in the dairy barn (AIR DRY), and composting chips held in 19 liter (5 gal) buckets and turned every 5 days (COMPOSTED).

Chips treated with lime and germicide were sampled after 14 hours and placed in plastic bags for immediate delivery to the lab. Air dry and composted were sampled at 7 days and 15 days and delivered to the lab.

Finally, two 19 liter (5 gal) buckets of bedding were poured onto the cow feed alley the first night, the second morning, and on day 5 to imitate bedding kicked into the alley and flushed into the manure system.

Table 1. Fecal coliforms in fresh and treated chipped juniper – March, April 2004.							
	Fresh	Lime	Germicide	Air dry	Air dry	Composted	Composted
		12 h	12 h	1 week	2 weeks	1 week	2 weeks
GREEN	2,000	-	600	1,500	7,500	TNTC	5,000
DRY	TNTC	100	TNTC	TNTC	100,000	TNTC	10,000
TNTC >100,000							

As with previous samples of chipped green juniper, bacteria counts of fresh samples were very high as shown in Table 1. Two previous samples of the green juniper had coliform counts too numerous to count (TNTC). The green whole tree fresh sample was lower for this trial at 2,000 CFU/g. The dry chipped material was TNTC on first analysis.

Air drying and composting had little effect on bacteria counts. Levels of fecal coliform never reached acceptable levels. Chips were too large making the volume too porous to heat adequately when composting. However, the chips could pack tightly enough during air drying to conserve moisture which supports

bacterial growth. The chips are simply the wrong size for either of these practices.

The sprayed-on germicide had no effect on bacteria counts in the DRY chips and reduced the count to 600 CFU/g in the GREEN chips.

Hydrated lime dusted on the chips reduced bacteria counts after 14 hours of contact time. GREEN chips showed no growth of bacteria and DRY chips were 100 CFU/g. This was the only treatment that helped reduce bacteria counts to levels near acceptability. From previous work, we know that lime-treated bedding become re-contaminated and grows bacteria while in cow freestalls (Gamroth, 1992). For this reason, it is likely that only the GREEN chips showing no growth would be acceptable as bedding.

Some dairy producers use hydrated lime to help dry and sanitize conventional bedding in freestalls. This means there would be no additional treatment costs for using the GREEN juniper chips with lime. Cost of this treatment on conventional or juniper would be about \$.10/stall/week.

Chip size

Some equipment plugging occurred with chips. A large piece was found caught in the intake of the chopper/agitator pump in the reception pit. Temporary plugging occurred in other sections of the transfer piping between the reception pit and the mechanical liquid-solid separator. A more uniform 2.5 cm (1 in) chip with no pieces larger than 5 cm (2 in) will be required in any system where manure is pumped. This will likely require post-chipping screening or the current

material would need to be used only in solid manure handling systems or for mud control much like “hog fuel” from the lumber industries.



Whole-tree without needles chips showing the large chunks of juniper unacceptable to liquid manure handling systems.

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As mentioned in the OSU paper, the western juniper trial chip material would require further or different processing to reduce chip size and potential for over-size, which becomes quite cost prohibitive.

Most confinement dairies in the west use a liquid manure handling system. There are smaller dairies in Oregon, Washington, and Idaho that are exclusively a solid system, which may have some interest in pursuing western juniper bedding trials. Dairy heifer producers in eastern Oregon are open lot solid manure systems. The Midwest might have a higher proportion of solid systems.

It is unclear as to the next logical steps for western juniper to break into the dairy calf bedding market.

Western Juniper & Ponderosa Pine Wood Pellet Trial

This was the most promising trial of the three field trials implemented. With the assistance of both a BLM thinning and Forest Service roadside clearing contract, contractors were able to provide West Oregon Wood Products a walking floor trailer load of 7 cu yards of freshly cut ponderosa pine and 7 cu yards of western juniper. Chris Sharron, West Oregon Wood Products, in Columbia City, Oregon is working with Larry Swan, US Forest Service to determine if green fuels reduction/forest thinning could meet their quality and financial benchmarks.



The initial testing of product was promising. West Oregon Wood Products liked the color, density, and fragrance of the juniper product. The samples were extremely clean with little to no dirt.

Their processing system was not set-up to evenly dry chips, so the actual quality was not good, but that was expected (i.e. small pockets of moisture created steam pockets during compression, which made the surface of the compressed log highly fractured, similar to a lake bottom when it dries out).



First run sample (top)
Second run sample (bottom)

West Oregon Wood Products had enough material left over from the initial testing to grind prior to introducing for a second run. The short log shown above from first run couldn't achieve proper moisture content, and a full size log from this recent run.

West Oregon had to mix the two species (juniper, pine) together to get enough product for a test run and allowed them to try some different things mainly, different moisture contents. In the end, they were able to get 15 logs that held together.

The company currently obtains raw material (sawdust) for about \$20/bone dry ton (about equivalent to \$10/green ton). The price is low because it's a manufacturing residue that has to be disposed of daily. If a higher price is required for raw material, that means the marketing effort will have to be front-loaded more and there has to be sufficient volume to even consider the investment. The initial test results were promising enough for West Oregon Wood Products to think about logical next steps.

Chris Sharron was interested in having an analysis done for heat value and ash content on the “trial” firelog. He projected that the heat value of the “Harney product” would exceed WOWP High Energy Firelogs, because of the needles and bark. He also projected that the ash would probably test a bit higher, again, due to bark and/or other possible grit contaminations. However, unlike pellets, slightly higher ash content is not an issue for a firelog product. The SWCD found enough budget savings to pay for a Minnesota Valley Testing Laboratories burn test.

Table 2. Harney County Juniper/Pine Whole Tree Finished Product Firelog

Analyte	As Received	Dry Basis
<i>Total Moisture</i>	4.92 wt. %	
<i>Ash</i>	1.37 wt. %	1.44 wt. %
<i>Total Sulfur</i>	0.04 wt. %	0.04 wt. %
<i>Calorific Value BTU/lb</i>	8406 BTU/lb	8841 BTU/lb



Study logs bundled by WOWP



Side view of product



Burning sample run #2

The “trial test” cost per cubic yard of material used to produce the product seen above was \$207.00 per cu yard hauled to production in Columbia City. The estimated cost per bdt/green will be communicated to the ad hoc steering committee by the end of December based on good faith estimations from the contractor involved in implementing the trial.

WOWP concluded that the only feasible way to utilize material in this area would be to locate a plant close to the source.

The next logical step would be to conduct a feasibility study and run through various harvesting, processing and marketing alternatives and costs to see if there's a profitable approach to business development in Harney County. The information developed will lead to the decision whether or not to pursue a business plan, investors, and partners.

"From a production and marketing standpoint, the raw materials generated from the Harney County thinning project were quite suitable for the manufacturing of a fire log fuel product", Chris Sharron.

CROP- Pulling Us Together

Biomass inventory studies conducted by Mater Engineering for other regions in Oregon and the US have documented a lack of inter-regional resource coordination and the need to create a new *coordinated resource offering protocol* (CROP) for government agencies (BLM, USFS, State Forestry Divisions, State Department of Transportation, etc.). Mater Engineering created biomass maps for the region based on the inventory data. The maps graphically illustrate projected resource flow *within each district* from year to year within the projected 5-year period. Mater Engineering worked with the primary government agencies to see if 5-year projections could be “levelized” in and between government agencies to create a marketable resource picture for economic investment. Based on agency discussions, “levelized” biomass maps for the region were created that may be used to invite technology and business investment to the region.

There appears to be good potential for converting 20,000 bdt or more to densified fuel & fiber products. The unused capacity of the existing L-P Hines boiler could consume an additional 14,000 bdt/yr to produce steam for industrial or district heat. A small quantity could be used for fuel and domestic heating in the county. There will be ~711 mmbf of wood resources removed off of public lands in the next five years. The projected removal off of public lands will provide “levelized” supply of ~140 mmbf/year which may be attractive to industry investors. Harney County has the potential to generate 220,000 bdt/yr from forest treatments & residues from harvesting 2220 bdt/yr from forest treatments and residues from the 142mmbf of timber.

The by-products of a 40 mmbf small log mill could fuel a 5MWe cogeneration plant with dry kilns. Sawmill & forest residues delivered to Hines at \$18/bdt and \$30/bdt respectively are significantly lower than fuel oil and propane and might represent significant savings to an industrial or commercial user.

Pelletized wood, if delivered in bulk to a home or schools, might represent a savings compared with fuel oil as fossil prices rise. This presents an opportunity to pursue biomass heating systems for Harney district schools and Harney district hospital similar to that of the Fuels for Schools Program in Darby, Montana. In this project, the local school district partnered up with the US Forest Service to install a biomass heating system that will save the district money on its heating bills and promote community involvement in renewable energy development and forest stewardship. Vermont has been heating public buildings and schools with wood for many years.

Recommendations for next steps

- ✚ Place the CROP resource offering maps on the Harney County website,
- ✚ Develop a FAQ fact sheet on CROP for the Harney County website,
- ✚ Present the Harney County CROP as a new environmental & economic model for forest restoration,
- ✚ Secure funding for Harney Soil & Water Conservation District to manage and monitor the CROP program in the investor landscape,
- ✚ Partner with The Pinchot Institute for Conservation in Washington, DC to help facilitate funding for such an effort,
- ✚ Utilize the CROP model to further CROP model development across multiple US landscapes as a means of inviting sustainable forestry investment back into forest-based communities,
- ✚ Secure funding to conduct a feasibility study and trial harvest, process and marketing analysis to see if there's a profitable approach to business development in Harney County,
- ✚ Provide education and outreach to private landowners on how residue utilization can help reduce burning costs and generate new revenue sources, while being compatible with best management practices for maintaining soil productivity

In conclusion, all the conditions of the grant and the intent of the grant have been satisfied and next recommended steps have been identified.