Meeting Quality Expectations for Forest Biomass Fuels

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- Forest biomass is being recovered and processed from harvest and thinning sites for industrial and institutional fuel
- Material variability and minimal processing leads to performance issues
- Few quality specifications or conformance procedures currently place

Current Market Practice

Critical Characteristics

- Particle size distribution
  - Handling
- Percent dry (moisture content)
  - Market value
- Ash and contaminant content
  - Boiler & fuel value impacts
- Trace elements
  - Ash fusion temperature, corrosives
- Bulk Density
  - Trucking, handling
- Heating value
  - Fairly consistent for wood and bark
- Material source
  - Forest derived, mill residue, urban wood
  - Certified forest, sustainable
  - Ag wastes
- Processing method
  - Grinder, chipper, stationary hog
  - Screened, washed, ADS
  - Dried

Typical fuel specifications

- Industrial boiler operator:
  - 5-inch minus material, Free of non combustibles
  - Variable price scale related to moisture content
- Industrial boiler operator:
  - Clean, uniform material, Free of foreign substances, Minimal fines
  - 30% to 50% moisture content
- Institutional operator:
  - 90% by weight 3-inch minus in all directions
  - Less than 25% by weight pass through a ¼" screen
  - Less than 5% inorganic material
  - 20% to 50% moisture content
  - Supplier liable for removal of non-compliant materials

- Crowded Lodgepole pine
- <6”, whole tree
- 3 mo. after cutting
- Horizontal grinder
- Grapple & bucket

Biomass from pine thinning

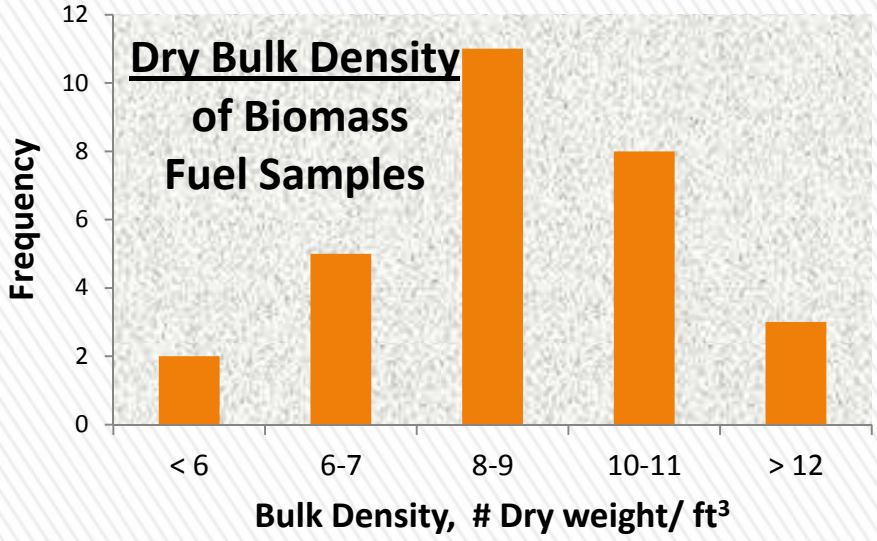
- Doug fir logging slash
- Tops, branches, junk wood
- Shovel logged to landing
- < 1 mo. after harvest
- Mobil chipper

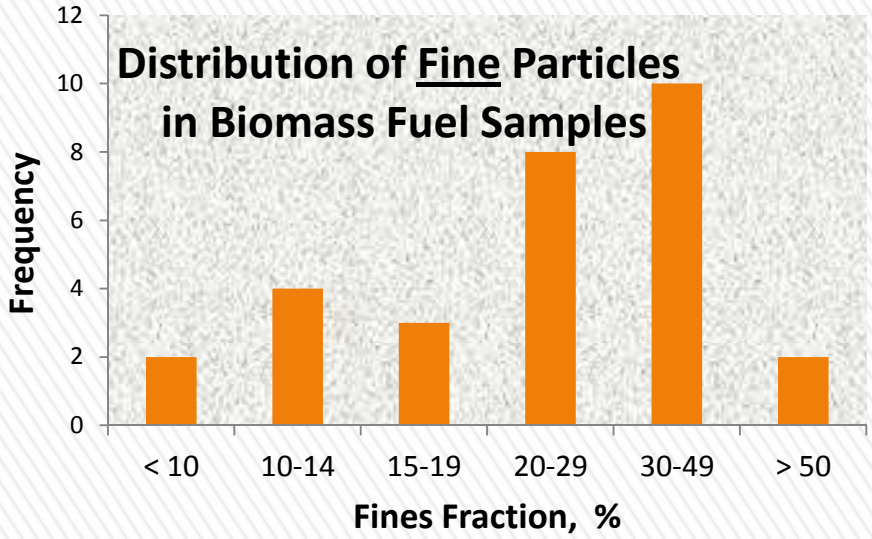
Biomass from harvest residue

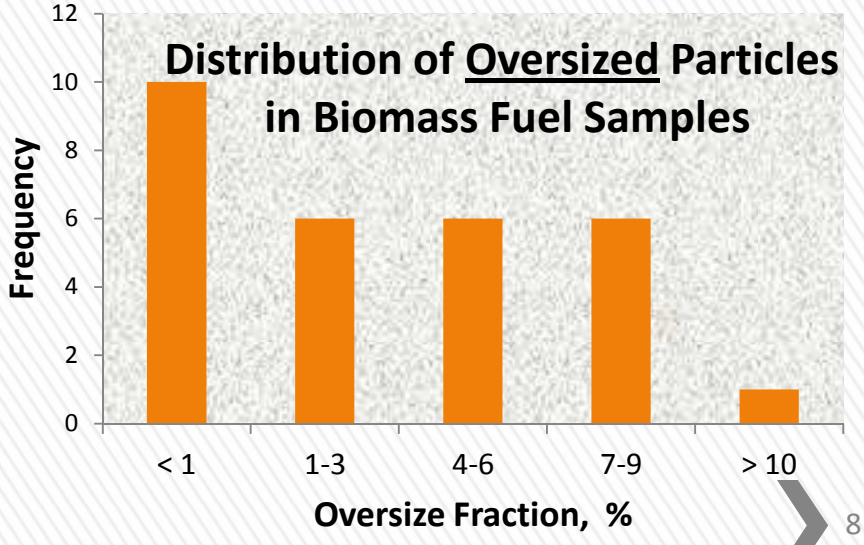
- Doug fir logging slash
- Tops, branches, junk wood
- Collected & forwarded to roadside piles
- 1+ yr. after harvest
- Horizontal grinder, 4” screen

Biomass from harvest residue

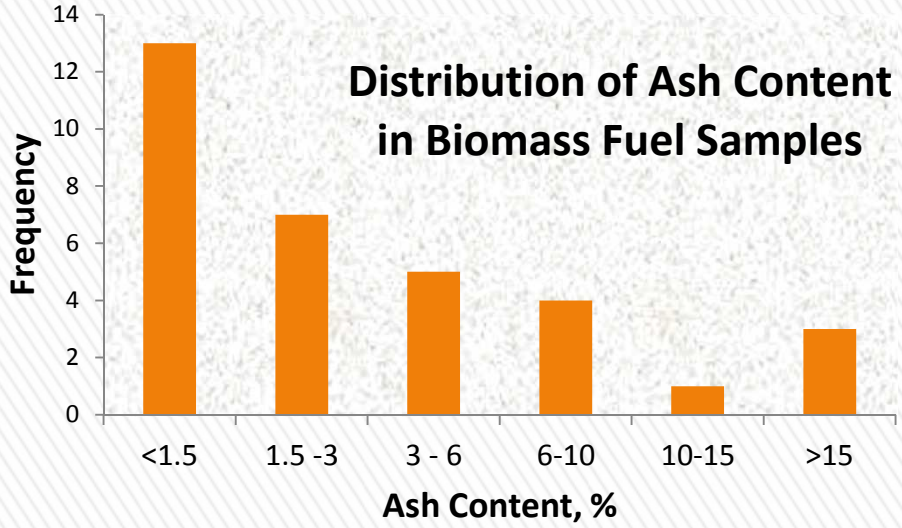
- OSU lab equipped to evaluate fuel quality
- Tested over 50 samples

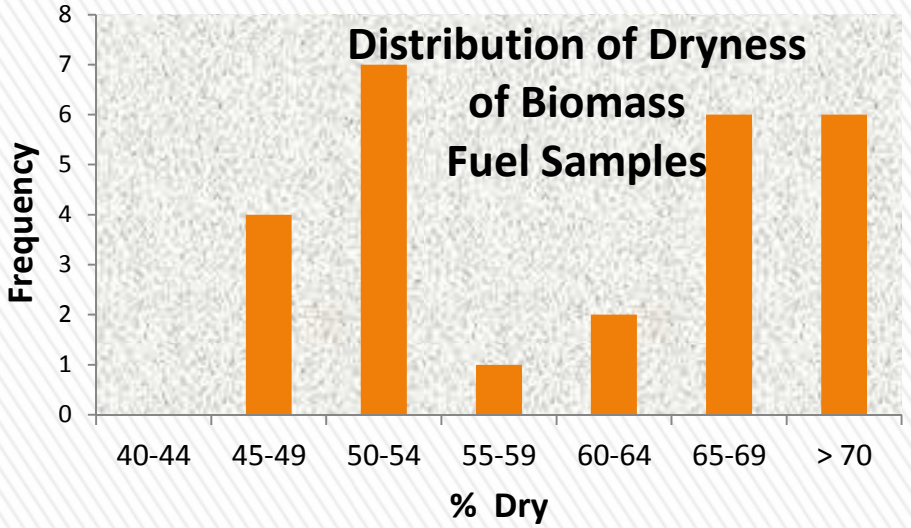


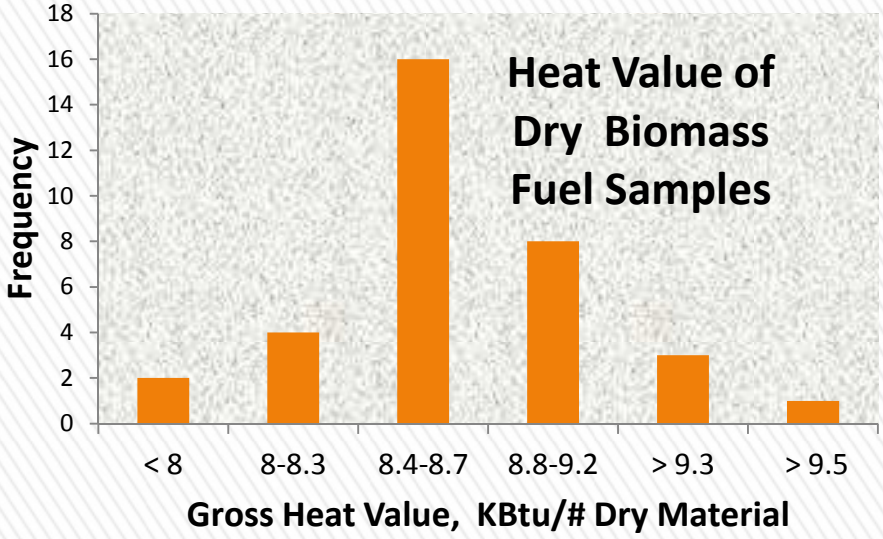


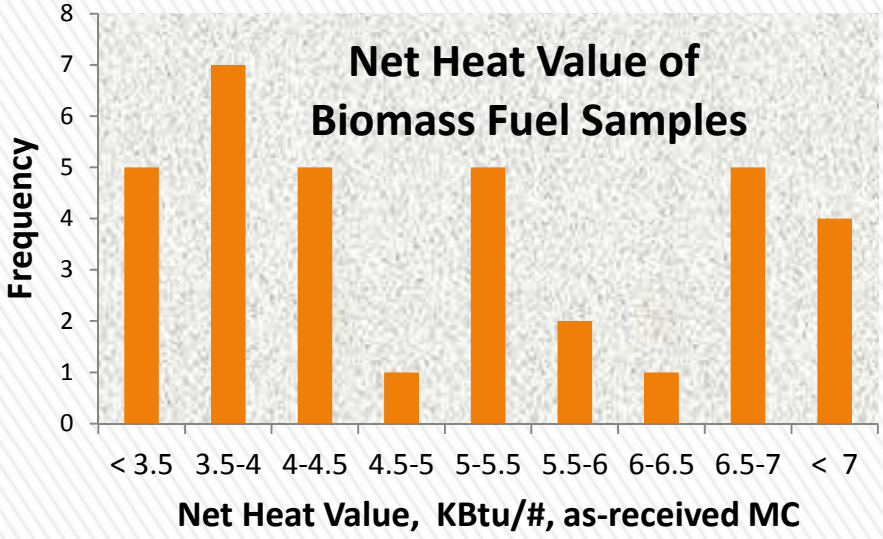


High variability









High variability

Wood Fuel MC (wet basis)	MMBTU per green ton, net	MMBtu per bdt, net	Net heat loss due to fuel moisture, %	Relative fuel value compared to $50/bdt @ 30% mc	Fuel cost, $/MMBtu
0	13.8	13.8	0	53.67	3.89
8	12.5	13.6	1.5	52.84	3.89
20	10.6	13.3	3.7	51.53	3.89
30	**9.0**	**12.9**	**6.5**	**50.00**	**3.89**
40	7.3	12.2	11.6	47.31	3.89
50	5.7	11.4	17.4	44.33	3.89
60	4.1	10.3	25.4	39.86	3.89

Net values assume moisture impacts on normal industrial boiler efficiencies
Source: USFS fuel value calculator

Impact of moisture content on net heat value

- Biomass fuels are highly variable
  - Quality affects performance
- Users have different requirements
  - Different types of industrial boilers
  - Institutional thermal systems
- Provide basis for supplier QC/QA
  - Consistent products
- Allows competitive free market to function
  - Spot Market
- Public Acceptance
  - Certified fuel grades
  - Emission permitting

Why are formal specs needed?

- List of realistic quality limits
- Reference methods for measuring quality
  - Sampling is vital!
- Regular testing on agreed-upon lot size
- Clear penalties and responsibilities for disposition of non-complying material
- Pricing that reflects supplier's processing requirements to meet quality limits

Elements of a fuel quality specification

» Wood Chip Heating Fuel Specification

- > **Issued by Biomass Energy Resource Center**
- > Grade A: Paper Grade Chip (high quality)
- > Grade B: Bole Chip (medium quality)
- > Grade C: Whole Tree Chip (low quality)
- > Grade D: Urban derived Wood Fuel (lowest quality)

What's out there?

» Wood Chip Heating Fuel Specification

» Grade B: Bole Chips

BERC

PARAMETER	MAXIMUM	TYPICAL	MINIMUM
Particle Size			
Dimensions (length x width x thickness)	3.5" x 3.5" x 0.75"	2" x 2" x 0.25"	1" x 0.75" x 0.12"
Coarse materials (% retained by 3" mesh screen)	15%	10%	No minimum
Main materials (% retained by ½" mesh screen)	100%	90%	80%
Fines materials (% passed through ½" mesh screen)	20%	10%	No minimum
Ash Content			
Ash content by weight	3%	1.5%	No minimum
Alkali content (lbs/MMBtu)	0.5	0.3	No minimum
Moisture Content			
Moisture content by weight	50%	42%	25%
Energy Content			
At given moisture content	50%	42%	25%
Btu/green pound	4,125	4,785	6,600
Contaminants (rocks, ice, dirt & debris)	None	None	No minimum

What's out there?

- CEN/TS 14961
  - Developed from individual EU country standards
  - Flexible system, solid biofuels specified by:
    - Origin (woody, herbaceous, fruit, mixed)
    - Source (whole trees, logging residue, stem wood, mill residue, used wood)
    - Trade form (pellets, chips, hog fuel)
    - Properties (particles size distribution, moisture, ash)

- ISO Technical Committee 238
  - Bringing in Asia, US and other non-European standards
  - US represented by ASABE (American Society of Agricultural and Biological Engineers)

What's out there?

Table 8 —Specification of properties for hog fuel

	Master table			
	Origin: According to 6.1 and Table 1.		Woody biomass (1)	
	Traded Form		Hog fuel	
Normative	**Dimensions** (mm) [a]			
		Main fraction > 80% of weight	Fine fraction < 5 % of weight	Coarse fraction, max. length of a particle, mm < 1 % of weight
	P45	3,15 mm ≤ P ≤ 45 mm	< 1 mm	> 63 mm
	P63	3,15 mm ≤ P ≤ 63 mm	< 1 mm	> 100 mm
	P100	3,15 mm ≤ P ≤ 100 mm	< 1 mm	> 200 mm
	P300	3,15 mm ≤ P ≤ 300 mm	< 1 mm	> 400 mm
	Moisture (w-% as received)			
	M20	≤ 20 %	Dried	
	M30	≤ 30 %	Suitable for storage	
	M40	≤ 40 %	Limited for storage	
	M55	≤ 55 %		
	M65	≤ 65 %		
	Ash (w-% of dry basis)			
	A0.7	≤ 0,7 %		
	A1.5	≤ 1,5 %		
	A3.0	≤ 3,0 %		
	A6.0	≤ 6,0 %		
	A10.0	≤ 10,0 %		

From CEN/TS 14961

Next steps

- OSU providing service to industry
  - Offer sampling and analysis services
  - Support development of individual standards
  - Make test data available for public use
- Encourage standardized testing protocols
  - Adopt ASTM, TAPPI, other methods
- Encourage performance standards and quality specifications
  - Pattern off of CEN/TS 14961: "free classification" system
  - Move toward a National Standard (ANSI)

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Thank you!