

Lodge Pole Pine

REFERENCE MATERIAL

Pedigree

Institution: Tricon Lumber
 Location: Mineral County, MT
 Harvested: 2014

Received at INL: 2014
 Sample Preparation: Ground 2-inch chips to pass through a 1-inch sieve using a Vermeer BG480 grinder then material was dried in a drum dryer

Composition

Table 1. Chemical composition^a of Reference Lodge Pole Pine (mean of analyses completed 2/2015 & 4/2015)

%Structural Ash	%Extractable Inorganics	%Water Extracted Glucan ^b	%Water Extracted Xylan ^b	%Water Extractives Others
0.27	0.13	0.13	0.04	2.45
%EtOH Extractives	%Lignin	%Glucan	%Xylan	%Galactan
1.74	30.50	41.37	5.90	2.84
%Arabinan+Mannan ^c	%Acetate	%Total		
12.30	1.17	98.83		

^aDetermined using NREL “Summative Mass Closure” LAP (NREL/TP-510-48087)

^bDetermined by HPLC following an acid hydrolysis of the water extractives

^c%Arabinan value includes %mannan, because arabinose and mannose co-elute on the HPLC column

Proximate, Ultimate & Calorimetry

Table 2. Proximate, ultimate, and calorific values for Reference Lodge Pole Pine (reported on a dry basis; completed 3/2015)

Proximate ^a			Ultimate ^b			Calorimetry ^c	
%Volatile	%Ash	%Fixed Carbon	%Hydrogen	%Carbon	%Nitrogen	HHV	LHV
84.50	1.08	14.41	6.06	50.14	Below detection limit	8760	7371

^aProximate analysis was done according to ASTM D 5142-09

^bUltimate analysis was conducted using a modified ASTM D5373-10 method (Flour and Plant Tissue Method) that uses a slightly different burn profile

^cHeating values (HHV, LHV) were determined with a calorimeter using ASTM D5865-10

Elemental Ash

Table 3. Elemental ash composition^a of Reference Lodge Pole Pine (completed 4/2015)

%Al as Al ₂ O ₃	%Ca as CaO	%Fe as Fe ₂ O ₃	%K as K ₂ O	%Mg as MgO	%Mn as MnO	%Na as Na ₂ O	%P as P ₂ O ₅	%Si as SiO ₂	%Ti as TiO ₂	%S as SO ₃
5.19	10.98	6.87	7.63	3.24	0.53	6.94	1.57	44.26	0.23	3.19

^aDetermined as described in ASTM standards D3174, D3682 and D6349

^aDetermined as described in ASTM standards D3174, D3682 and D6349

Lignin Chemistry

Table 4. Lignin chemistry of Reference Lodge Pole Pine (completed 1/2016)

Monolignol Composition ^a			Linkage Analysis ^b			
p-Hydroxyphenyl (H) content (% of total H+G+S)	Guaiacyl (G) content (% of total H+G+S)	Syringyl (S) content (% of total H+G+S)	β -aryl ether (β -O-4) (fraction of total) ^c	Phenylcoumaran (β -5/a-O-4) (fraction of total)	Resinol (β - β) (fraction of total)	Dibenzodioxocin (5-5/4-O- β) (fraction of total)
0	100	0	73	21	4	1

^aDetermined by integration of peak volumes of ball-milled whole cell wall samples, swelled in 4:1 DMSO:Py, and analyzed by gel-state HSQC NMR (Mansfield, S. D., et al. (2012) Nature Protocols, 7(9), 1579-1589)

^bQuantitative data on the different types of chemical linkages between monolignols in a biomass sample. Determined by integrating peak volumes in solution-state HSQC NMR spectra of acetylated whole cell wall samples

^cEther bond between the β carbon on one monolignol to the phenolic oxygen on a second monolignol. This is typically the most common linkage found in native lignin samples (Vanholme, R., et al. (2010) Plant Physiol., 153, 895-905)

Particle Characteristics

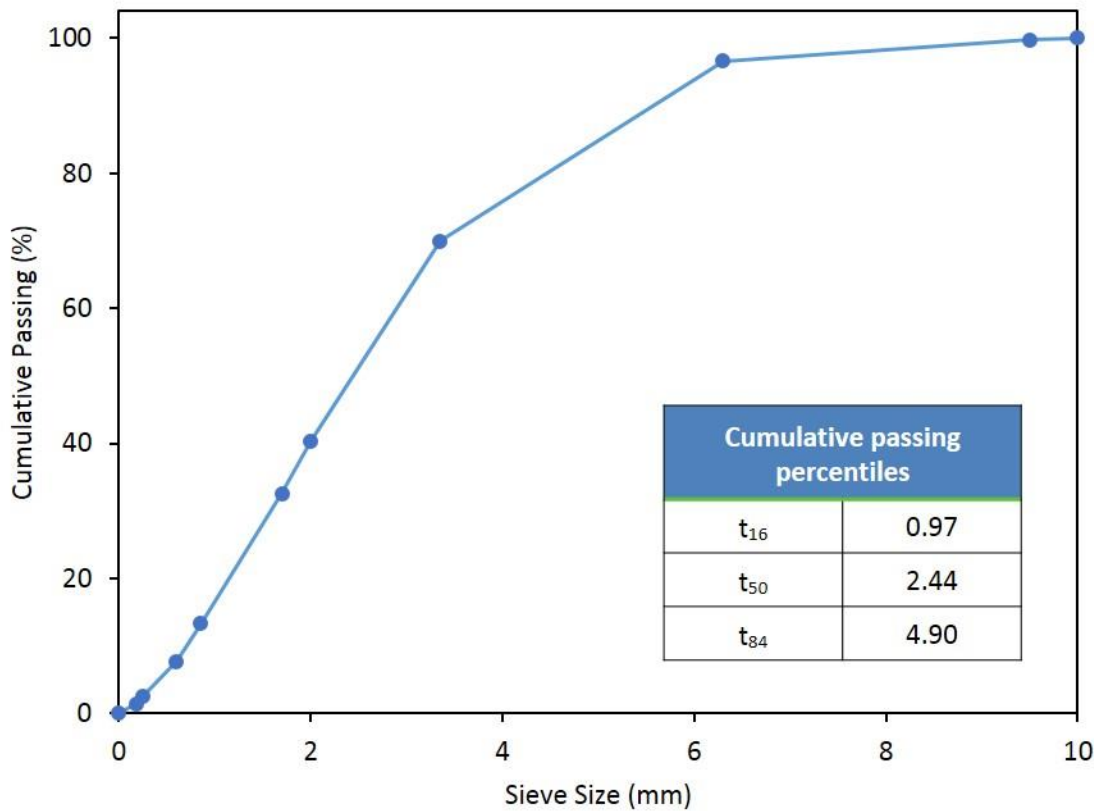


Figure 1. Cumulative passing percent of 1-inch Reference Lodge Pole Pine determined according to ANSI/ASAE S319.4 using a Ro-Tap test sieve shaker (Model RX-29, W.S. Tyler) and a 15 minute total sieving time (completed 4/2015). The cumulative passing percentile sieve sizes (e.g., t_{16}) were calculated by interpolation and represent theoretical sieve sizes that would retain 16, 50 or 84% of the particles by mass.

Contact

For questions regarding biomass material or analytical data please contact Amber Hoover at amber.hoover@inl.gov or 208-526-5992.

Visit the Bioenergy Feedstock Library (<https://bioenergylibrary.inl.gov>) for more information on biomass feedstocks.

Revised on 11/28/2016.