Switchgrass

REFERENCE MATERIAL

Pedigree

Institution: Oklahoma State University
Location: Garvin County, OK
Cultivar: Alamo

Harvested: 2012
Received at INL: 2013
Sample Preparation: Ground to pass through a 1-inch sieve using a Vermeer BG480 grinder

Composition

Table 1. *Chemical composition[a] of Reference Switchgrass (mean of analyses completed 11/2014 & 2/2015)*

%Structural Ash	%Extractable Inorganics	%Structural Protein	%Extractable Protein	%Water Extracted Glucan[b]
1.88	2.07	1.51	0.54	2.28
%Water Extracted Xylan[b]	**%Water Extractives Others**	**%EtOH Extractives**	**%Lignin**	**%Glucan**
0.09	6.68	2.68	16.24	33.21
%Xylan	**%Galactan**	**%Arabinan[c]**	**%Acetate**	**%Total**
21.65	1.43	3.27	3.07	96.60

[a]Determined using NREL "Summative Mass Closure" LAP (NREL/TP-510-48087)

[b]Determined 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 Switchgrass (reported on a dry basis; completed 6/2014)*

Proximate[a]			Ultimate[b]			Calorimetry[c]	
%Volatile	%Ash	%Fixed Carbon	%Hydrogen	%Carbon	%Nitrogen	HHV	LHV
80.2	4.2	15.6	5.7	47.2	0.5	8077	6749

[a]Proximate analysis was done according to ASTM D 5142-09

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

[c]Heating values (HHV, LHV) were determined with a calorimeter using ASTM D5865-10

Elemental Ash

Table 3. *Elemental ash composition[a] of Reference Switchgrass (completed 6/2014)*

%Al as Al_2O_3	%Ca as CaO	%Fe as Fe_2O_3	%K as K_2O	%Mg as MgO	%Mn as MnO	%Na as Na_2O	%P as P_2O_5	%Si as SiO_2	%Ti as TiO_2	%S as SO_3
0.25	7.37	1.63	17.55	9.79	0.19	1.61	4.45	53.53	0.01	2.73

[a]Determined as described in ASTM standards D3174, D3682 and D6349

Lignin Chemistry

Table 4. *Lignin chemistry of Reference Switchgrass (completed 12/2015)*

Monolignol Composition[a]			Linkage Analysis[b]				Cinnamate Content[a]	
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)	ß-aryl ether (ß-O-4) (fraction of total)[c]	Phenylcoumaran (ß-5/a-O-4) (fraction of total)	Resinol (ß-ß) (fraction of total)	Dibenzodioxocin (5-5/4-O-ß) (fraction of total)	Ferulate content (% of total cinnamates)	p-Coumarate (% of total cinnamates)
3	70	27	94	5	1	0	27	73

[a]Determined 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)

[b]Quantitative 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

[c]Ether bond between the ß 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

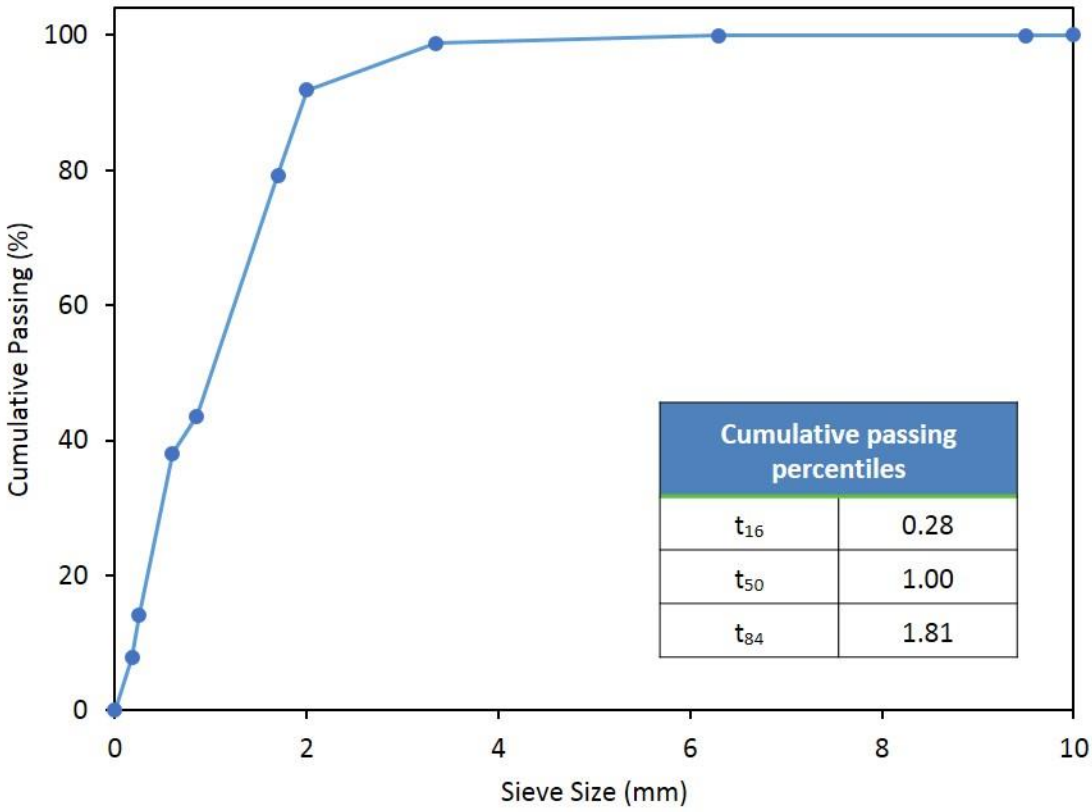

Figure 1. *Cumulative passing percent of 1-inch Reference Switchgrass determined according to ANSI/ASAE S319.4 using a Ro-Tap test sieve shaker (Model RX-29, W.S. Tyler) and a 15 minute total sieving time (completed 4/2015). The cumulative passing percentile sieve sizes (e.g., t_{16}) were calculated 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.

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