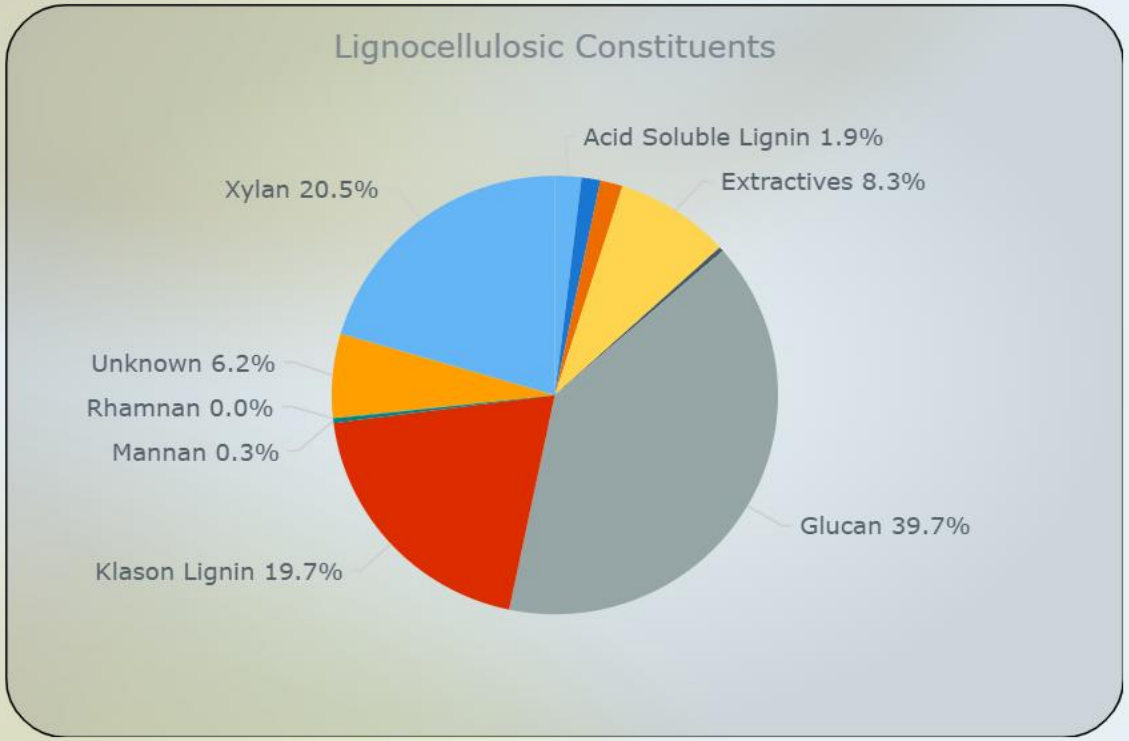
Mammoth Grass Data

Name: Mammoth Grass Sample 01/2023 - MISCANTHUS

Order #: 2625

Type: Other

Analysed: Jan 19 2024



Summary of Analytical Procedure

This sample was processed to extract components that were soluble in water and the remaining solid residue was extracted using 95% ethanol. In addition, the original sample was also extracted using 95% ethanol. These operations allowed for the determination of the total contents of: **water-soluble extractives**, **ethanol-soluble extractives**, and water-insoluble but ethanol-soluble extractives, as well as the **total extractives** removed under a sequential extraction using water then ethanol.

Following the removal of the water and ethanol soluble components, the sample was hydrolysed using acid in order to determine the **lignin** (Klason and acid soluble) and **lignocellulosic sugars** (glucan, xylan, arabinan, galactan, mannan, rhamnan) contents.

The sample was also analysed for its **ash** content and its **elemental composition** (carbon, hydrogen, nitrogen, sulphur, oxygen) with the oxygen content determined by difference.

The **Higher Heating Value** (HHV, often referred to as the Gross Calorific Value) was determined directly using an oxygen bomb calorimeter. The **Lower Heating Value** (LHV, often referred to as the Net Calorific Value) was calculated based on the HHV and the elemental composition of the sample.

A proximate analysis was also undertaken in order to determine the **Volatile Matter** content and **Fixed Carbon** content.

The sample was also analysed for its **moisture** content.

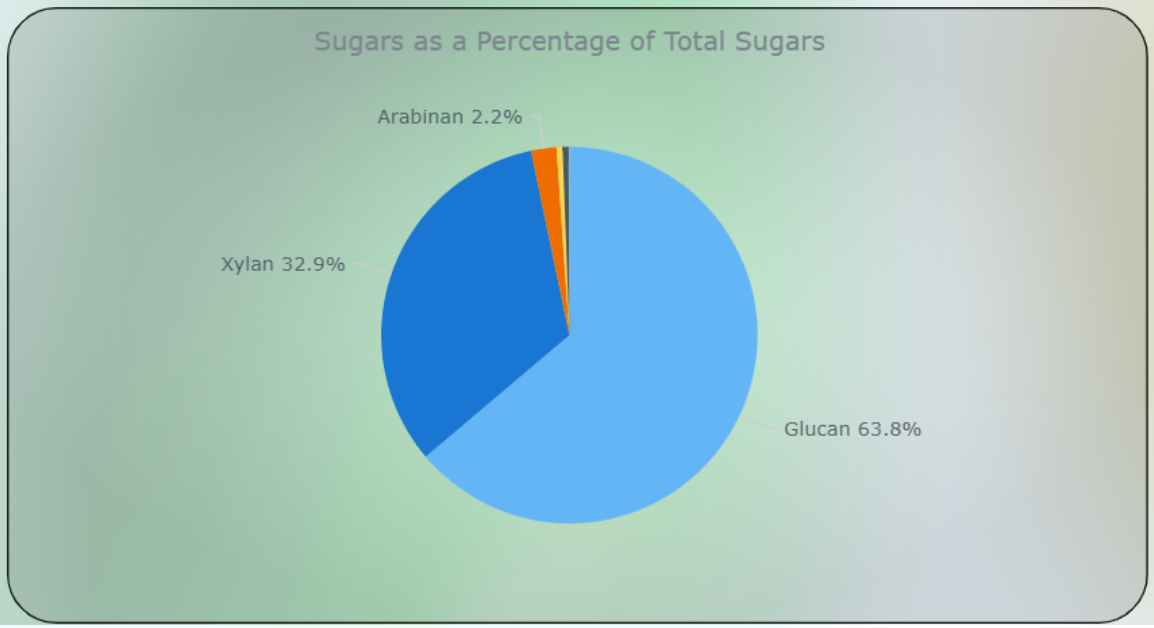
Mammoth Grass Data

Lignocellulosic Data

Sugars Data

Aldoses

	Glucan	Xylan	Arabinan	Galactan	Mannan	Rhamnan
Wet-Chemical Data (% Dry Matter)						
AV.	**39.73**	**20.47**	**1.36**	**0.32**	**0.32**	**0.04**
Rep 1	39.94	20.57	1.33	0.28	0.28	0.05
Rep 2	39.52	20.37	1.40	0.36	0.36	0.04
SD	0.29	0.14	0.05	0.05	0.05	0.01



Total Sugars and Sugar Classes

	Hexosans	Pentosans	Total Sugars
Wet-Chemical Data (% Dry Matter)			
Average	**40.41**	**21.84**	**62.25**
Rep 1	40.55	21.90	62.45
Rep 2	40.28	21.77	62.05
Std. Dev.	0.19	0.09	0.28

Sugars as % of Total Sugar Content

	Glucan	Xylan	Arabinan	Galactan	Mannan	Rhamnan
Aldoses - Wet-Chemical Data (% Total Sugars)						
AV.	**63.82**	**32.89**	**2.19**	**0.52**	**0.52**	**0.07**
Rep 1	63.95	32.94	2.12	0.45	0.45	0.07
Rep 2	63.69	32.83	2.25	0.58	0.58	0.06

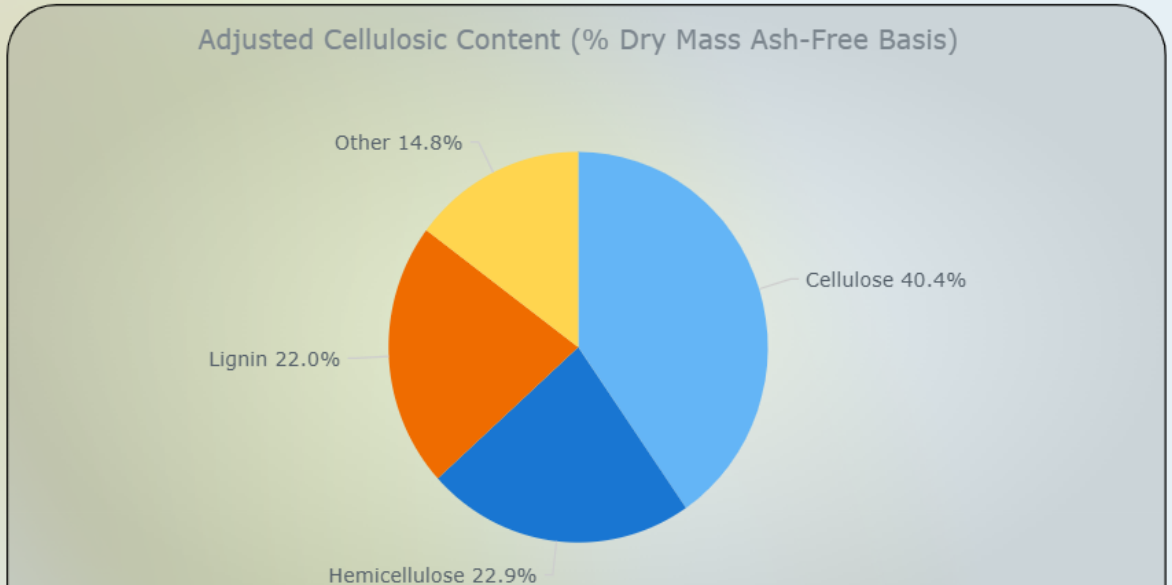
Mammoth Grass Data

	Klason Lignin	Acid Soluble Lignin	Acid Insoluble Residue
Wet-Chemical Data (% Dry Matter)			
Average	**19.68**	**1.92**	**20.02**
Rep 1	19.64	1.95	19.99
Rep 2	19.71	1.89	20.04
Std. Dev.	0.06	0.04	0.03

	Ash	Acid Insoluble Ash	Full Extr.	Water Soluble Extr.	Ethanol Soluble Extr.	Water Insoluble, Ethanol Soluble Extr.
Wet-Chemical Data (% Dry Matter)						
AV.	**1.62**	**0.34**	**8.34**	**5.77**	**6.32**	**2.57**
Rep 1	1.46	0.36	8.73	6.04	6.15	2.69
Rep 2	1.77	0.33	7.96	5.50	6.49	2.46
SD	0.22	0.02	0.54	0.38	0.24	0.16

Summary Lignocellulosic Composition

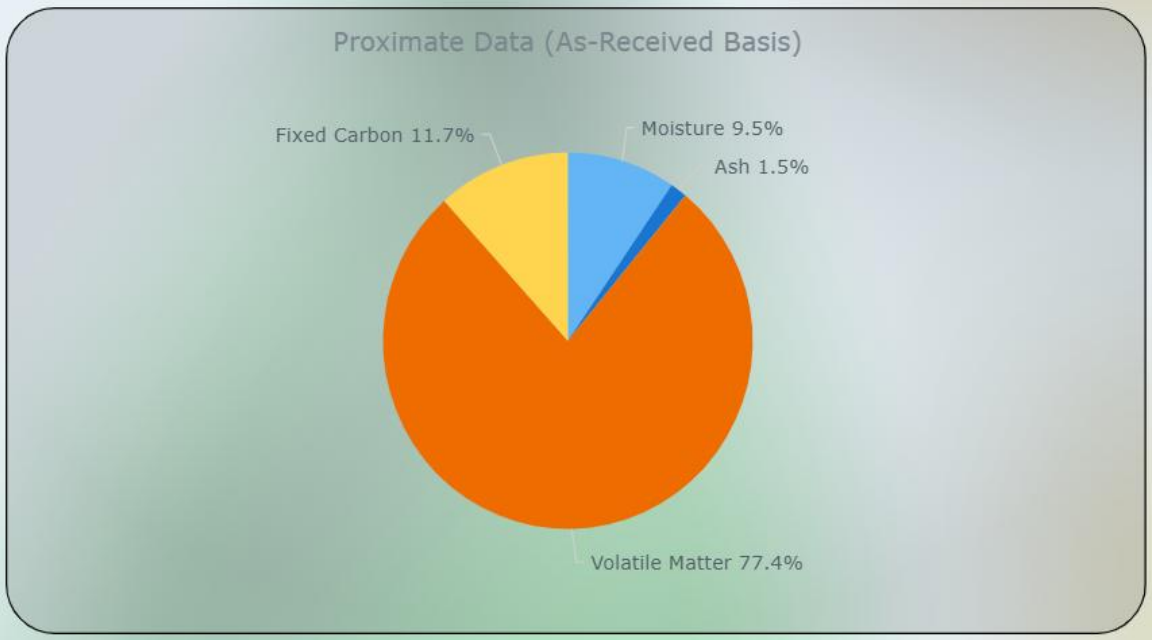
	Cellulose	Hemicellulose	Lignin	Total Lignocellulose
Wet-Chemical Data (% Dry Matter)				
AV.	**39.73**	**22.52**	**21.60**	**83.85**
Rep 1	39.94	22.72	21.56	84.22
Rep 2	39.52	22.32	21.63	83.47
SD	0.29	0.28	0.05	0.53
Adjusted Cellulosic Content for D3 RINS (% Dry Mass Ash-Free Basis)				
AV.	**40.38**	**22.89**	**21.95**	**85.23**
Rep 1	40.60	23.09	21.91	85.60
Rep 2	40.17	22.69	21.99	84.84



Mammoth Grass Data

Data Relevant for Combustion

Proximate Analysis

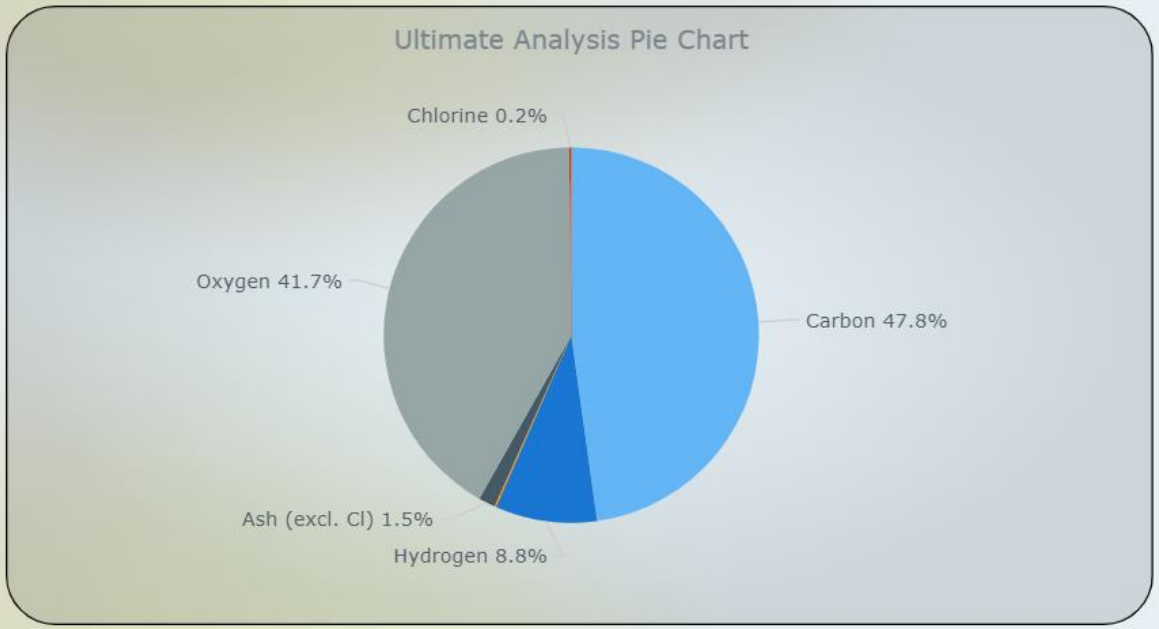


	Moisture	Total Solids (TS)	Ash	Volatile Solids (VS)	Volatile Matter	Fixed Carbon
Dry Mass Basis (% Dry Matter)						
AV.			**1.62**	**98.38**	**85.49**	**12.89**
Rep 1			1.46	98.54	85.46	12.93
Rep 2			1.77	98.23	85.53	12.85
SD			0.22	0.22	0.05	0.05
As Received Basis (% Wet Mass)						
AV.	**9.50**	**90.50**	**1.46**	**89.03**	**77.37**	**11.66**
Rep 1	9.82	90.18	1.32	89.18	77.34	11.70
Rep 2	9.18	90.82	1.60	88.90	77.41	11.70
SD	0.45	0.45	0.20	0.20	0.05	0.05
Dry Ash-Free Basis (%)						
AV.					**86.90**	**13.10**
Rep 1					86.86	13.14
Rep 2					86.94	13.06
SD					0.05	0.05

Mammoth Grass Data

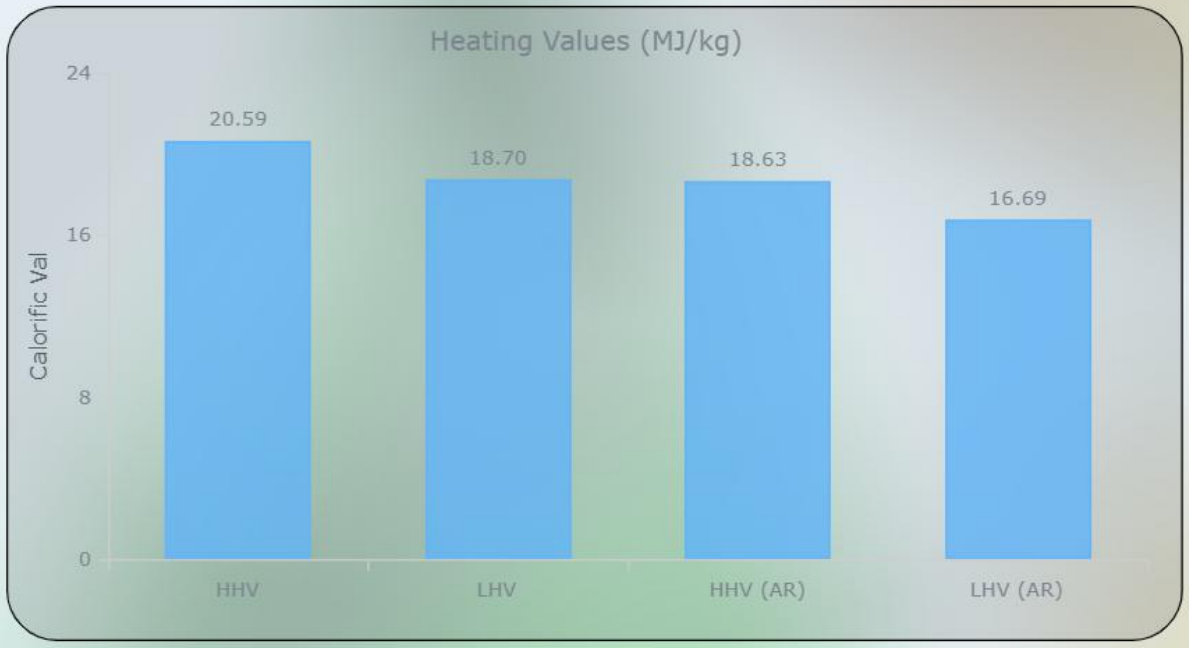
Ultimate Analysis

	Carbon	Hydrogen	Nitrogen	Sulphur	Oxygen	Chlorine
Dry Matter Basis (% Dry Matter)						
AV.	**47.81**	**8.75**	**0.10**	**0.05**	**41.68**	**0.1630**
Rep 1	47.81	8.66	0.10	0.05	41.77	0.1644
Rep 2	47.81	8.84	0.10	0.04	41.59	0.1616
SD	0.00	0.13	0.00	0.00	0.13	0.0020
As-Received Basis (% Wet Mass)						
AV.	**43.27**	**7.91**	**0.09**	**0.04**	**37.72**	**0.1475**
Rep 1	43.27	7.83	0.09	0.04	37.80	0.1488
Rep 2	43.27	8.00	0.09	0.04	37.64	0.1462
SD	0.00	0.12	0.00	0.00	0.11	0.0018
Dry Ash-Free Basis (%)						
AV.	**48.60**	**8.89**	**0.10**	**0.05**	**42.37**	
Rep 1	48.60	8.80	0.10	0.05	42.46	
Rep 2	48.60	8.98	0.10	0.05	42.28	
SD	0.00	0.13	0.00	0.00	0.13	



Mammoth Grass Data

Heating Values

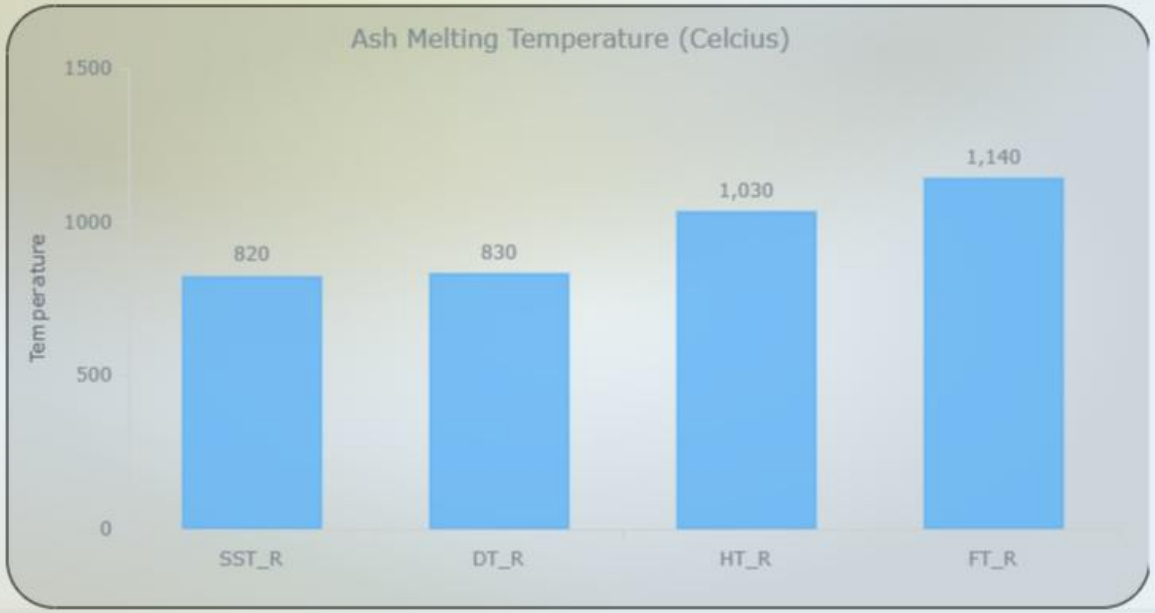


	HHV (Measured)	LHV (Measured)
Dry Matter Basis (MJ/kg)		
Average	**20.5940**	**18.7048**
Rep 1	20.6065	18.7173
Rep 2	20.5815	18.6924
Std. Dev.	0.0176	0.0176
As-Received Basis (MJ/kg)		
Average	**18.6374**	**16.6956**
Rep 1	18.6487	16.7069
Rep 2	18.6261	16.6844
Std. Dev.	0.0160	0.0160
Dry Ash-Free Basis (MJ/kg)		
Average	**20.9323**	**19.0121**
Rep 1	20.9450	19.0248
Rep 2	20.9197	18.9994
Std. Dev.	0.0179	0.0179

Mammoth Grass Data

Ash Melting Temperatures (Degrees Celcius)

	SST (Shrinkage Starting)	DT (Ash Deformation)	HT (Ash Hemisphere)	FT (Ash Flow)
Reducing Conditions	820	830	1,030	1,140



Mammoth Grass Data

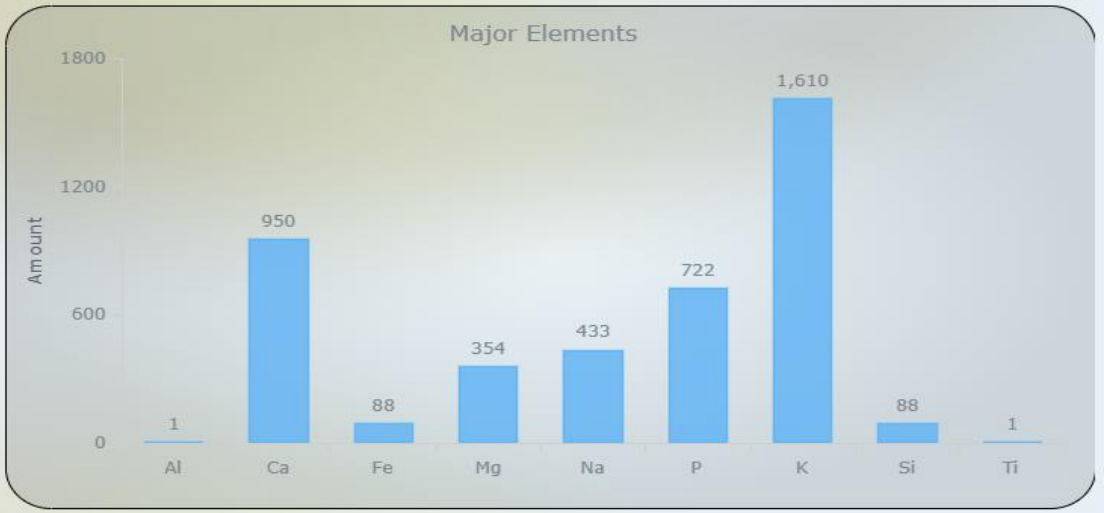
Elemental Composition

Fixed Order (mg/kg)

	AV.	R1	R2	SD
Major Elements				
Aluminium (Al)	**<1**	3	<1	<1
Calcium (Ca)	**950**	913	986	52
Iron (Fe)	**88**	85	91	4
Magnesium (Mg)	**354**	356	351	4
Phosphorus (P)	**722**	676	768	65
Potassium (K)	**1,610**	1,547	1,673	89
Silicon (Si)	**88**	83	93	7
Sodium (Na)	**433**	449	417	23
Titanium (Ti)	**<1**	<1	<1	<1
Minor Elements				
Arsenic (As)	**9**	9	8	1
Caldmium (Cd)	**<1**	<1	<1	<1
Cobalt (Co)	**5**	4	5	1
Chromium (Cr)	**12**	11	13	1
Copper (Cu)	**4**	3	4	1
Mercury (Hg)	**<1**	<1	<1	<1
Manganese (Mn)	**128**	123	132	6
Molybdenum (Mo)	**2**	2	2	0
Nickel (Ni)	**12**	11	13	1
Lead (Pb)	**<1**	<1	<1	<1
Antimony (Sb)	**<1**	<1	<1	<1
Vanadium (V)	**<1**	<1	<1	<1
Zinc (Zn)	**49**	51	47	3

Ranked

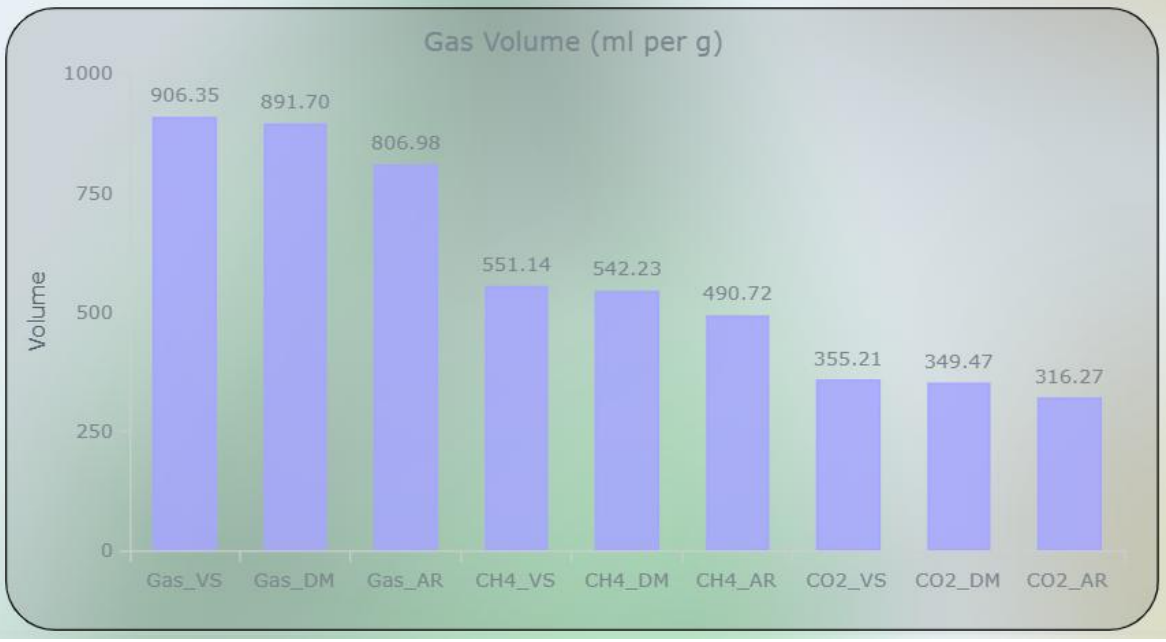
	Amount (mg/kg)
Potassium (K)	1,610
Calcium (Ca)	950
Phosphorus (P)	722
Sodium (Na)	433
Magnesium (Mg)	354
Manganese (Mn)	128
Iron (Fe)	88
Silicon (Si)	88
Zinc (Zn)	49
Chromium (Cr)	12
Nickel (Ni)	12
Arsenic (As)	9
Cobalt (Co)	5
Copper (Cu)	4
Molybdenum (Mo)	2
Aluminium (Al)	<1
Antimony (Sb)	<1
Caldmium (Cd)	<1
Lead (Pb)	<1
Mercury (Hg)	<1
Titanium (Ti)	<1
Vanadium (V)	<1



Mammoth Grass Data

Anaerobic Digestion Data

Stoichiometric Methane Potential (SMP)



	Biogas (ml/g)	Methane (ml/g)	CO_2 (ml/g)	% CH_4
Volatile Solids Basis (ml per g VS)	906.3	551.1	355.2	60.8
Dry Matter Basis (ml per g)	891.7	542.2	349.5	60.8
As-Received Basis (ml per g)	807.0	490.7	316.3	60.8

Click here for information on how the SMP is calculated.

Note that the yields provided are only the maximum possilbe based on the compositional data, the actual yields of biogas when processing your sample in an AD system are likely to be lower.

Mammoth Grass Data

Predicted Biofuel Yields

Tech.	6	7 Total	7 Diesel	7 Naptha
Litres per tonne	435	173	134	38
GJ per tonne	9.16	5.82	4.63	1.19

Click here for information on these different representative technologies.

Note that the yields provided are only calculated estimates, the actual yields of biofuel when processing your sample in such processes may differ.