

**CERTIFICATE OF ANALYSIS****Customer #**

607

Order #

1383

Order Status

Order Fulfilled

Report #

1383-CCPF

Date of Report

21st December 2020

Report for: Bernard Carey, Biomass to Biochar Ltd, Derrycon Upper, Mountshannon, Co. Clare, Ireland

Thermal Summary Data - Dry Matter Basis (% Dry Mass)

Sample Name	Moisture Content (% Wet Basis)	Ash	Volatile Matter	Fixed Carbon	Carbon	Hydrogen	Nitrogen	Sulphur	Chlorine	Oxygen	HHV (MJ/kg)	LHV (MJ/kg)
Juncus Sample	17.43	3.18	78.13	18.69	48.74	6.06	1.42	0.06	0.3396	40.54	19.2023	17.8833

- Data can also be viewed online at www.celignis.com/output/analytical_elem_customer_list.php?order=1383

Lab Manager Signature:

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Thermal Summary Data - As Received Basis (% Wet Mass)

Sample Name	Moisture Content	Ash	Volatile Matter	Fixed Carbon	Carbon	Hydrogen	Nitrogen	Sulphur	Chlorine	Oxygen	HHV (MJ/kg)	LHV (MJ/kg)
Juncus Sample	17.43	2.63	64.51	15.43	40.24	5.00	1.17	0.05	0.2804	33.47	15.8546	14.3397

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Thermal Summary Data - Dry Ash-Free Basis (% DAF)

Sample Name	Volatile Matter	Fixed Carbon	Carbon	Hydrogen	Nitrogen	Sulphur	Chlorine	Oxygen	HHV (MJ/kg)	LHV (MJ/kg)
Juncus Sample	80.70	19.30	50.34	6.26	1.47	0.06	0.3508	41.87	19.8328	18.4705

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Report for: Bernard Carey, Biomass to Biochar Ltd, Derrycon Upper, Mountshannon, Co. Clare, Ireland

Proximate Analysis - Dry Matter Basis (% Dry Mass)

Sample Name	Ash				Volatile Matter				Fixed Carbon			
	Average	Rep. #1	Rep. #2	Std Dev	Average	Rep. #1	Rep. #2	Std Dev	Average	Rep. #1	Rep. #2	Std Dev
Juncus Sample	3.18	3.24	3.12	0.09	78.13	78.07	78.19	0.09	18.69	18.75	18.63	0.09

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Proximate Analysis - As Received Basis (% Wet Mass)

Sample Name	Moisture Content				Ash				Volatile Matter				Fixed Carbon			
	Av.	R1	R2	SD	Av.	R1	R2	SD	Av.	R1	R2	SD	Av.	R1	R2	SD
Juncus Sample	17.43	17.59	17.28	0.22	2.63	2.68	2.57	0.07	64.51	64.46	64.56	0.07	15.43	15.48	15.38	0.07

- Av. = Average of the replicate analyses; R1/2 = data for replicate 1/2; SD = standard deviation between replicates. Lab Manager Signature:

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Proximate Analysis - Dry Ash-Free Basis (% DAF)

Sample Name	Volatile Matter				Fixed Carbon			
	Av.	Rep #1	Rep #2	Std Dev.	Av.	Rep #1	Rep #2	Std Dev.
Juncus Sample	80.70	80.63	80.76	0.09	19.30	19.37	19.24	0.09

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Ultimate Analysis - Dry Matter Basis (% Dry Mass)

Sample Name	Carbon				Hydrogen				Nitrogen				Sulphur				Chlorine				Oxygen			
	Av.	R1	R2	SD	Av.	R1	R2	SD	Av.	R1	R2	SD	Av.	R1	R2	SD	Av.	R1	R2	SD	Av.	R1	R2	SD
Juncus Sample	48.74	48.62	48.86	0.18	6.06	6.05	6.07	0.01	1.42	1.44	1.40	0.02	0.06	0.07	0.05	0.01	0.3396	0.3346	0.3447	0.0072	40.54	40.65	40.43	0.15

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Ultimate Analysis - As Received Basis (% Wet Mass)

Sample Name	Carbon				Hydrogen				Nitrogen				Sulphur				Chlorine				Oxygen			
	Av.	R1	R2	SD	Av.	R1	R2	SD	Av.	R1	R2	SD	Av.	R1	R2	SD	Av.	R1	R2	SD	Av.	R1	R2	SD
Juncus Sample	40.24	40.14	40.35	0.14	5.00	4.99	5.01	0.01	1.17	1.19	1.16	0.02	0.05	0.06	0.04	0.01	0.2804	0.2762	0.2846	0.0059	33.47	33.56	33.38	0.13

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Ultimate Analysis - Dry Ash-Free Basis (% DAF)

Sample Name	Carbon				Hydrogen				Nitrogen				Sulphur				Chlorine				Oxygen			
	Av.	R1	R2	SD	Av.	R1	R2	SD	Av.	R1	R2	SD	Av.	R1	R2	SD	Av.	R1	R2	SD	Av.	R1	R2	SD
Juncus Sample	50.34	50.21	50.47	0.18	6.26	6.25	6.27	0.01	1.47	1.49	1.45	0.03	0.06	0.07	0.05	0.01	0.3508	0.3455	0.3560	0.0074	41.87	41.98	41.76	0.16

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Stoichiometric Methane Potential (SMP) (ml of gas per g)

Sample Name	Volatile Solids Basis (ml per g VS)				Dry Mass Basis (ml per g)				As-Received Basis (ml per g)			
	Biogas	Methane	CO ₂	% CH ₄	Biogas	Methane	CO ₂	% VS	Biogas	Methane	CO ₂	% TS
Juncus Sample	938.9	487.8	451.1	52.0	909.0	472.3	436.8	96.8	750.5	389.9	360.6	82.6

- SMP calculated according to the Buswell equation (www.celignis.com/anaerobic-digestion.php#buswell).

- TS = total solids, VS = volatile solids.

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Calorific Value - Dry Matter Basis (MJ/kg)

Sample Name	Gross Calorific Value (MJ/kg)				Net Calorific Value (MJ/kg)			
	Average	Rep. #1	Rep. #2	Std Dev	Average	Rep. #1	Rep. #2	Std Dev
Juncus Sample	19.2023	19.2273	19.1772	0.0354	17.8833	17.9083	17.8583	0.0354

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Calorific Value - As Received Basis (MJ/kg)

Sample Name	Moisture Content (% Wet Basis)				Gross Calorific Value (MJ/kg)				Net Calorific Value (MJ/kg)			
	Average	Rep. #1	Rep. #2	Std Dev	Average	Rep. #1	Rep. #2	Std Dev	Average	Rep. #1	Rep. #2	Std Dev
Juncus Sample	17.43	17.59	17.28	0.22	15.8546	15.8753	15.8340	0.0292	14.3397	14.3604	14.3190	0.0292

- Data can also be viewed online at www.celignis.com/output/analytical_elem_customer_list.php?order=1383

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Calorific Value - Dry Ash-Free Basis (MJ/kg)

Sample Name	Gross Calorific Value (MJ/kg)				Net Calorific Value (MJ/kg)			
	Average	Rep. #1	Rep. #2	Std Dev	Average	Rep. #1	Rep. #2	Std Dev
Juncus Sample	19.8328	19.8586	19.8070	0.0366	18.4705	18.4964	18.4447	0.0366

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