



CERTIFICATE OF ANALYSIS

Customer #

607

Order #

1484

Order Status

Order Fulfilled

Report #

1484-CCPF

Date of Report

5th April 2021

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)
Hazel Mix Woodchip	26.27	4.26	76.77	18.97	49.08	5.65	1.41	0.03	0.0583	39.57	20.1869	18.9555
Oaten Straw	33.68	7.00	73.49	19.51	46.06	5.51	0.61	0.05	0.8941	40.75	19.2522	18.0493

- Data can also be viewed online at www.celignis.com/output/analytical_elem_customer_list.php?order=1484

Lab Manager Signature:

CELIGNIS LIMITED

Unit 11 Holland Road, Plassey Technology Park,
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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)
Hazel Mix Woodchip	26.27	3.14	56.60	13.98	36.18	4.17	1.04	0.02	0.0430	29.17	14.8834	13.3337
Oaten Straw	33.68	4.65	48.73	12.94	30.55	3.66	0.41	0.03	0.5929	27.03	12.7672	11.1465

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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)
Hazel Mix Woodchip	80.19	19.81	51.26	5.90	1.48	0.03	0.0609	41.33	21.0849	19.7987
Oaten Straw	79.02	20.98	49.53	5.93	0.66	0.06	0.9615	43.82	20.7023	19.4088

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Date of Report 5th April 2021			
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
Hazel Mix Woodchip	4.26	4.19	4.33	0.10	76.77	76.59	76.96	0.26	18.97	19.15	18.78	0.26
Oaten Straw	7.00	7.04	6.97	0.05	73.49	73.58	73.39	0.14	19.51	19.41	19.60	0.14

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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
Hazel Mix Woodchip	26.27	26.67	25.88	0.56	3.14	3.09	3.19	0.08	56.60	56.47	56.74	0.19	13.98	14.12	13.85	0.19
Oaten Straw	33.68	32.97	34.40	1.01	4.65	4.67	4.62	0.03	48.73	48.80	48.67	0.09	12.94	12.87	13.00	0.09

- 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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607	1484	Order Fulfilled	1484-CCPF	5th April 2021

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

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.
Hazel Mix Woodchip	80.19	80.00	80.38	0.27	19.81	20.00	19.62	0.27
Oaten Straw	79.02	79.13	78.92	0.15	20.98	20.87	21.08	0.15

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

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
Hazel Mix Woodchip	49.08	49.27	48.88	0.28	5.65	5.50	5.80	0.22	1.41	1.44	1.39	0.04	0.03	0.03	0.03	0.00	0.0583	0.0598	0.0568	0.0022	39.57	39.50	39.64	0.10
Oaten Straw	46.06	46.18	45.95	0.17	5.51	5.52	5.51	0.00	0.61	0.55	0.68	0.10	0.05	0.05	0.05	0.00	0.8941	0.9121	0.8761	0.0255	40.75	40.70	40.81	0.08

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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
Hazel Mix Woodchip	36.18	36.33	36.04	0.20	4.17	4.05	4.28	0.16	1.04	1.06	1.02	0.03	0.02	0.02	0.02	0.00	0.0430	0.0441	0.0418	0.0016	29.17	29.12	29.23	0.07
Oaten Straw	30.55	30.63	30.47	0.11	3.66	3.66	3.65	0.00	0.41	0.36	0.45	0.06	0.03	0.04	0.03	0.00	0.5929	0.6049	0.5810	0.0169	27.03	26.99	27.06	0.05

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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
Hazel Mix Woodchip	51.26	51.47	51.05	0.29	5.90	5.74	6.06	0.23	1.48	1.51	1.45	0.04	0.03	0.03	0.03	0.00	0.0609	0.0625	0.0593	0.0023	41.33	41.26	41.40	0.10
Oaten Straw	49.53	49.66	49.41	0.18	5.93	5.93	5.92	0.01	0.66	0.59	0.73	0.10	0.06	0.06	0.05	0.00	0.9615	0.9809	0.9421	0.0274	43.82	43.76	43.88	0.08

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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
Hazel Mix Woodchip	956.0	488.4	467.6	51.1	915.3	467.6	447.7	95.7	674.8	344.7	330.1	73.7
Oaten Straw	923.8	469.2	454.6	50.8	859.1	436.3	422.8	93.0	569.7	289.3	280.4	66.3

- 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
Hazel Mix Woodchip	20.1869	20.2288	20.1450	0.0592	18.9555	18.9974	18.9136	0.0592
Oaten Straw	19.2522	19.2251	19.2793	0.0383	18.0493	18.0222	18.0764	0.0383

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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
Hazel Mix Woodchip	26.27	26.67	25.88	0.56	14.8834	14.9143	14.8525	0.0437	13.3337	13.3646	13.3028	0.0437
Oaten Straw	33.68	32.97	34.40	1.01	12.7672	12.7492	12.7851	0.0254	11.1465	11.1286	11.1645	0.0254

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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
Hazel Mix Woodchip	21.0849	21.1286	21.0411	0.0619	19.7987	19.8424	19.7549	0.0619
Oaten Straw	20.7023	20.6732	20.7314	0.0412	19.4088	19.3797	19.4379	0.0412

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