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Gewerbegebiet Freiberg Ost - D-09627 - Bobritzsch-Hilbersdorf

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Hiedanranta
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33400 Tampere
FINLAND

Title : **Test report for order 11827076**
Test report number : **AR-18-FR-028518-01**

Project name : **Analysis of Biochar**

Number of samples : **2**
Sample type : **biochar**
Date of sample taking : **2018-09-26**
Sample Taker: **Client**
Sample reception date : **2018-10-04**
Sample processing time : **2018-10-04 - 2018-11-12**

The test results refer solely to the analysed test specimen. Unless the sampling was done by our laboratory or in our sub-order the responsibility for the correctness of the sampling is disclaimed. This test report is only valid with signature and may only be further published completely and unchanged. Extracts or changes require the authorisation of the EUROFINS UMWELT in each individual case.

Our General Terms & Conditions of Sale (GTCS) are applicable, as far as no specific agreements do exist. The GTCS are available on <http://www.eurofins.de/umwelt/avb.aspx>.

Accredited test laboratory according to DIN EN ISO/IEC 17025:2005 notification under the DAkkS German Accreditation System for Testing. The laboratory is according (D-PL-14081-01-00) accredited.

Attachments

118108446_1
118108446_2
118108447_1
118108447_2

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Digitally signed 13.11.2018
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Prüfleitung



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BLZ 207 300 17
Kto 7000000550
IBAN DE07 2073 0017 7000 0005 50
BIC/SWIFT HYVEDEMM17

								Description		03006062			03006061		
								Date and time of sample taking		2018-09-26			2018-09-26		
								Sample number		118108446			118108447		
Parameter	Lab	Accr.	Method	GW 1 ar	GW 1 db	GW 2 ar	GW 2 db	LOQ	Unit		ar	db		ar	db
Biochar properties															
Bulk density	FR	JE02	DIN 51705: 2001-06						kg/m³	-	195	-	-	203	-
specific surface (BET)	SUIB/o		DIN 66137/DIN ISO 9277						m²/g	-	320 *	-	-	320 *	-
true density	SUIB/o		DIN 66137/DIN ISO 9277						g/cm³	-	1.5	-	-	1.5	-
Fat, crude	FR	JE02	VDLUFÄ Methodenbuch Band III: 2014-09						% (w/w) dm	n.d. **	-	-	n.d. **	-	-
Crude fibre	FR	JE02	VDLUFÄ Methodenbuch Band III: 2014-09						% (w/w) dm	n.d. **	-	-	n.d. **	-	-
Protein, crude	FR	JE02	VDLUFÄ Methodenbuch Band III: 2014-09						% (w/w) dm	n.d. **	-	-	n.d. **	-	-
Moisture	FR	JE02	DIN 51718: 2002-06					0.1	% (w/w)	-	37.2	-	-	35.5	-
Ash content (550°C)	FR	JE02	analog DIN 51719: 1997-07					0.1	% (w/w)	-	1.6	2.6	-	1.6	2.5
HCl-insoluble ash	SA06/o		VDLUFÄ III 8.2						Ma.-% Raw Product	0.53	-	-	0.24	-	-
Fluor total (F)	SA06/o	RE000 3D	VDLUFÄ VII, 2.2.2.1				150		mg/kg 88% DM	< 10	-	-	< 10	-	-
Hydrogen	FR	JE02	DIN 51732: 2014-07					0.1	% (w/w)	-	1.3	2.0	-	1.3	2.0
Carbon	FR	JE02	DIN 51732: 2014-07		> 50		> 50	0.2	% (w/w)	-	57.8	92.1	-	58.9	91.4
Total nitrogen	FR	JE02	DIN 51732: 2014-07					0.05	% (w/w)	-	0.24	0.38	-	0.23	0.36
Oxygen	FR	JE02	DIN 51733: 2016-04						% (w/w)	-	2.2	3.5	-	2.8	4.3
Total inorganic carbon (TIC)	FR	JE02	DIN 51726: 2004-06					0.1	% (w/w)	-	0.1	0.2	-	< 0.1	0.1
carbonate-CO2	FR	JE02	DIN 51726: 2004-06					0.4	% (w/w)	-	0.5	0.8	-	< 0.4	0.4
carbon (organic)	FR	JE02	berechnet						% (w/w)	-	57.7	91.9	-	58.9	91.3
H/C ratio (molar)	FR	JE02	berechnet		< 0.6		< 0.6			-	0.26	0.26	-	0.26	0.26
H/Corg ratio (molar)	FR	JE02	berechnet		< 0.7		< 0.7			-	0.26	0.26	-	0.26	0.26
O/C ratio (molar)	FR	JE02	berechnet		< 0.4		< 0.4			-	0.029	0.029	-	0.036	0.035
Sulphur (S), total	FR	JE02	DIN 51724-3: 2012-07					0.03	% (w/w)	-	< 0.03	< 0.03	-	< 0.03	< 0.03
pH in CaCl2	FR		DIN ISO 10390: 2005-12	10		10				-	7.9	-	-	8.1	-
Conductivity	FR		BGK III. C2: 2006-09					5	µS/cm	-	1000	-	-	257	-
salt content	FR		BGK III. C2: 2006-09					0.005	g/kg	-	1.33	2.11	-	0.723	1.12

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Parameter	Lab	Accr.	Method	Limit values				LOQ	Unit		ar	db		ar	db
salt content	FR		BGK III. C2: 2006-09	GW 1 ar	GW 1 db	GW 2 ar	GW 2 db	0.005	g/l	-	0.258	0.412	-	0.147	0.228
thermogravimetry TGA 950°C by N-Atm.	FR		TGA 701 D4C							-	see attachment	-	-	see attachment	-
Polychlorinated dibenzodioxins/-furans (17 PCDD/F) by GC-HRMS															
2,3,7,8-TetraCDD	SA06/o		DIN 38414-S24						ng/kg dw	< 0.1	-	-	< 0.1	-	-
1,2,3,7,8-PentaCDD	SA06/o		DIN 38414-S24						ng/kg dw	< 0.15	-	-	< 0.15	-	-
1,2,3,4,7,8-HexaCDD	SA06/o		DIN 38414-S24						ng/kg dw	< 0.15	-	-	< 0.15	-	-
1,2,3,6,7,8-HexaCDD	SA06/o		DIN 38414-S24						ng/kg dw	< 0.15	-	-	< 0.15	-	-
1,2,3,7,8,9-HexaCDD	SA06/o		DIN 38414-S24						ng/kg dw	< 0.15	-	-	< 0.15	-	-
1,2,3,4,6,7,8-HeptaCDD	SA06/o		DIN 38414-S24						ng/kg dw	0.85	-	-	0.73	-	-
OctaCDD	SA06/o		DIN 38414-S24						ng/kg dw	2.3	-	-	2.9	-	-
2,3,7,8-TetraCDF	SA06/o		DIN 38414-S24						ng/kg dw	0.12	-	-	< 0.05	-	-
1,2,3,7,8-PentaCDF	SA06/o		DIN 38414-S24						ng/kg dw	< 0.1	-	-	< 0.1	-	-
2,3,4,7,8-PentaCDF	SA06/o		DIN 38414-S24						ng/kg dw	< 0.1	-	-	< 0.1	-	-
1,2,3,4,7,8-HexaCDF	SA06/o		DIN 38414-S24						ng/kg dw	< 0.1	-	-	< 0.1	-	-
1,2,3,6,7,8-HexaCDF	SA06/o		DIN 38414-S24						ng/kg dw	< 0.1	-	-	< 0.1	-	-
1,2,3,7,8,9-HexaCDF	SA06/o		DIN 38414-S24						ng/kg dw	< 0.1	-	-	< 0.1	-	-
2,3,4,6,7,8-HexaCDF	SA06/o		DIN 38414-S24						ng/kg dw	< 0.1	-	-	< 0.1	-	-
1,2,3,4,6,7,8-HeptaCDF	SA06/o		DIN 38414-S24						ng/kg dw	0.29	-	-	0.22	-	-
1,2,3,4,7,8,9-HeptaCDF	SA06/o		DIN 38414-S24						ng/kg dw	< 0.1	-	-	< 0.1	-	-
OctaCDF	SA06/o		DIN 38414-S24						ng/kg dw	0.37	-	-	< 0.2	-	-
WHO(2005)-PCDD/F TEQ (lower-bound)	SA06/o		DIN 38414-S24						ng/kg dw	0.0242	-	-	0.0104	-	-
WHO(2005)-PCDD/F TEQ (upper-bound)	SA06/o		DIN 38414-S24				20		ng/kg dw	0.393	-	-	0.384	-	-
WHO(2005)-PCDD/F TEQ (upper-bound)	SA06/o		berechnet				0.75		ng/kg 88% DM	0.346	-	-	0.338	-	-

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				Limit values				Sample number		118108446			118108447		
Parameter	Lab	Accr.	Method	GW 1 ar	GW 1 db	GW 2 ar	GW 2 db	LOQ	Unit		ar	db		ar	db
Polychlorinated biphenyl (12 WHO PCB) by GC-HRMS															
PCB 77	SA06/o		analog DIN 38407-3						ng/kg dw	< 0.2	-	-	< 0.2	-	-
PCB 81	SA06/o		analog DIN 38407-3						ng/kg dw	< 0.2	-	-	< 0.2	-	-
PCB 105	SA06/o		analog DIN 38407-3						ng/kg dw	66	-	-	48	-	-
PCB 114	SA06/o		analog DIN 38407-3						ng/kg dw	< 3	-	-	< 3	-	-
PCB 118	SA06/o		analog DIN 38407-3						ng/kg dw	170	-	-	130	-	-
PCB 123	SA06/o		analog DIN 38407-3						ng/kg dw	< 2	-	-	< 2	-	-
PCB 126	SA06/o		analog DIN 38407-3						ng/kg dw	< 0.3	-	-	< 0.3	-	-
PCB 156	SA06/o		analog DIN 38407-3						ng/kg dw	24	-	-	16	-	-
PCB 157	SA06/o		analog DIN 38407-3						ng/kg dw	< 2	-	-	< 2	-	-
PCB 167	SA06/o		analog DIN 38407-3						ng/kg dw	30	-	-	20	-	-
PCB 169	SA06/o		analog DIN 38407-3						ng/kg dw	< 0.3	-	-	< 0.3	-	-
PCB 189	SA06/o		analog DIN 38407-3						ng/kg dw	< 3	-	-	< 3	-	-
WHO(2005)-PCB TEQ (lower-bound)	SA06/o		analog DIN 38407-3						ng/kg dw	0.0087	-	-	0.00642	-	-
WHO(2005)-PCB TEQ (upper-bound)	SA06/o		analog DIN 38407-3				0.35		ng/kg dw	0.0481	-	-	0.0458	-	-
WHO(2005)-PCDD/F+PCB TEQ (upper-bound)	SA06/o		analog DIN 38407-3						ng/kg dw	0.441	-	-	0.43	-	-
WHO(2005)-PCB TEQ (upper-bound)	SA06/o		berechnet						ng/kg 88% DM	0.0423	-	-	0.0403	-	-
WHO(2005)-PCDD/F+PCB TEQ (upper-bound)	SA06/o		berechnet				1.25		ng/kg 88% DM	0.388	-	-	0.379	-	-

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								Sample number		118108446			118108447		
Parameter	Lab	Accr.	Method	GW 1 ar	GW 1 db	GW 2 ar	GW 2 db	LOQ	Unit		ar	db		ar	db

Polychlorinated biphenyl (7 PCB) by GC-HRMS

PCB 28	SA06/o		DIN EN 15305:2008-05						µg/kg 88% DM	0.056	-	-	0.067	-	-
PCB 52	SA06/o		DIN EN 15305:2008-05						µg/kg 88% DM	< 0.050	-	-	< 0.050	-	-
PCB 101	SA06/o		DIN EN 15305:2008-05						µg/kg 88% DM	< 0.020	-	-	< 0.020	-	-
PCB 153	SA06/o		DIN EN 15305:2008-05						µg/kg 88% DM	0.046	-	-	0.034	-	-
PCB 138	SA06/o		DIN EN 15305:2008-05						µg/kg 88% DM	0.029	-	-	< 0.020	-	-
PCB 180	SA06/o		DIN EN 15305:2008-05						µg/kg 88% DM	0.037	-	-	0.024	-	-
Total 6 Indicator PCB excl. LOQ	SA06/o		DIN EN 15305:2008-05				10		µg/kg 88% DM	0.17	-	-	0.13	-	-

Elements from the micro wave pressure digestion acc. to DIN 22022-1

Copper (Cu)	FR	JE02	DIN EN ISO 17294-2: 2005-02		< 100		< 100	1	g/metric tonne	-	-	6	-	-	6
Nickel (Ni)	FR	JE02	DIN EN ISO 17294-2: 2005-02		< 50		< 30	1	g/metric tonne	-	-	< 1	-	-	5
Zinc (Zn)	FR	JE02	DIN EN ISO 17294-2: 2005-02		< 400		< 400	1	g/metric tonne	-	-	76	-	-	74
Chromium (Cr)	FR	JE02	DIN EN ISO 17294-2: 2005-02		< 90		< 80	1	g/metric tonne	-	-	6	-	-	5
Boron (B)	FR	JE02	DIN EN ISO 17294-2: 2005-02					1	mg/kg	-	-	7	-	-	7
Manganese (Mn)	FR	JE02	DIN EN ISO 17294-2: 2005-02					1	mg/kg	-	-	535	-	-	522

				Limit values				Sample number		118108446			118108447		
Parameter	Lab	Accr.	Method	GW 1 ar	GW 1 db	GW 2 ar	GW 2 db	LOQ	Unit		ar	db		ar	db

Elements from the pressure digestion acc. to DIN EN 13805

Arsenic (As)	SA06/o	RE000 3D	DIN EN ISO 17294-2: 2005-02				2		mg/kg 88% DM	0.016	-	-	0.032	-	-
Lead (Pb)	SA06/o	RE000 3D	DIN EN ISO 17294-2: 2005-02				10		mg/kg 88% DM	0.35	-	-	0.50	-	-
Cadmium (Cd)	SA06/o	RE000 3D	DIN EN ISO 17294-2: 2005-02				1		mg/kg 88% DM	0.0065	-	-	0.0082	-	-
Mercury (Hg)	SA06/o	RE000 3D	DIN EN ISO 15763:2010-04				0.1		mg/kg 88% DM	0.0020	-	-	< 0.0020	-	-

Elements fr. the borate digestion acc. to DIN 51729-1/-11 after inciner. (550°C)

Phosphorus as P2O5	FR	JE02	DIN EN ISO 11885 (E22): 2009-09					0.1	% (w/w)	-	-	1.9	-	-	3.9
Magnesium as MgO	FR	JE02	DIN EN ISO 11885 (E22): 2009-09					0.1	% (w/w)	-	-	4.8	-	-	5.0
Calcium as Calciumoxid	FR	JE02	DIN EN ISO 11885 (E22): 2009-09					0.1	% (w/w)	-	-	28.8	-	-	30.9
Potassium as K2O	FR	JE02	DIN EN ISO 11885 (E22): 2009-09					0.1	% (w/w)	-	-	9.3	-	-	10.2
Sodium as Na2O	FR	JE02	DIN EN ISO 11885 (E22): 2009-09					0.1	% (w/w)	-	-	1.9	-	-	1.0
Iron as Fe2O3	FR	JE02	DIN EN ISO 11885 (E22): 2009-09					0.1	% (w/w)	-	-	1.6	-	-	1.5
Silicon as SiO2	FR	JE02	DIN EN ISO 11885 (E22): 2009-09					0.1	% (w/w)	-	-	13.5	-	-	11.7
sulphur as SO3	FR	JE02	DIN EN ISO 11885 (E22): 2009-09					0.1	% (w/w)	-	-	4.8	-	-	1.6

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Parameter	Lab	Accr.	Method	GW 1 ar	GW 1 db	GW 2 ar	GW 2 db	LOQ	Unit		ar	db		ar	db
DIN 51729-1/-11 after inciner. (550°C)-ref. OS															
Calcium (Ca)	FR	JE02	DIN EN ISO 11885 (E22): 2009-09						% (w/w)	-	-	0.5	-	-	0.5
Iron (Fe)	FR	JE02	DIN EN ISO 11885 (E22): 2009-09						% (w/w)	-	-	0.0	-	-	0.0
Potassium (K)	FR	JE02	DIN EN ISO 11885 (E22): 2009-09						% (w/w)	-	-	0.2	-	-	0.2
Magnesium (Mg)	FR	JE02	DIN EN ISO 11885 (E22): 2009-09						% (w/w)	-	-	0.1	-	-	0.1
Sodium (Na)	FR	JE02	DIN EN ISO 11885 (E22): 2009-09						% (w/w)	-	-	0.0	-	-	0.0
Phosphorus	FR	JE02	DIN EN ISO 11885 (E22): 2009-09						% (w/w)	-	-	0.0	-	-	0.0
Sulphur (S)	FR	JE02	DIN EN ISO 11885 (E22): 2009-09						% (w/w)	-	-	0.0	-	-	0.0
Silicon (Si)	FR	JE02	DIN EN ISO 11885 (E22): 2009-09						% (w/w)	-	-	0.2	-	-	0.1
Elements from toluene extraction															
Naphthalene	SA06/o		DIN ISO 13877					10	µg/kg 88% DM	4500	-	-	3600	-	-
Acenaphthylene	SA06/o		DIN ISO 13877					10	µg/kg 88% DM	140	-	-	130	-	-
Acenaphthene	SA06/o		DIN ISO 13877					10	µg/kg 88% DM	66	-	-	63	-	-
Fluorene	SA06/o		DIN ISO 13877					10	µg/kg 88% DM	150	-	-	140	-	-
Phenanthrene	SA06/o		DIN ISO 13877					10	µg/kg 88% DM	630	-	-	600	-	-
Anthracene	SA06/o		DIN ISO 13877					10	µg/kg 88% DM	140	-	-	140	-	-
Fluoranthene	SA06/o		DIN ISO 13877					10	µg/kg 88% DM	150	-	-	190	-	-
Pyrene	SA06/o		DIN ISO 13877					10	µg/kg 88% DM	150	-	-	180	-	-

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Parameter	Lab	Accr.	Method	Limit values				LOQ	Unit		ar	db		ar	db
Benz(a)anthracene	SA06/o		DIN ISO 13877					10	µg/kg 88% DM	48	-	-	71	-	-
Chrysene	SA06/o		DIN ISO 13877					10	µg/kg 88% DM	45	-	-	65	-	-
Benzo(b)fluoranthene	SA06/o		DIN ISO 13877					10	µg/kg 88% DM	35	-	-	39	-	-
Benzo(k)fluoranthene	SA06/o		DIN ISO 13877					10	µg/kg 88% DM	15	-	-	21	-	-
Benzo(a)pyrene	SA06/o		DIN ISO 13877				25	10	µg/kg 88% DM	42	-	-	57	-	-
Indeno(1,2,3-cd)pyrene	SA06/o		DIN ISO 13877					10	µg/kg 88% DM	26	-	-	65	-	-
Dibenz(a,h)anthracene	SA06/o		DIN ISO 13877					10	µg/kg 88% DM	< 10	-	-	< 10	-	-
Benzo(g,h,i)perylene	SA06/o		DIN ISO 13877					10	µg/kg 88% DM	81	-	-	37	-	-
Total 16 EPA-PAH excl. LOQ	SA06/o		DIN ISO 13877						µg/kg 88% DM	6200	-	-	5500	-	-
Total 16 EPA-PAH excl. LOQ	SA06/o		berechnet		12		4		mg/kg dw	7.1	-	-	6.2	-	-

Explanations

LOQ - Limit of quantification

ar - as received

db - dry basis

Lab - Abbreviation of the performing laboratory

Accr. - Abbreviation of the accreditation of the performing laboratory

GW 2: highest concentration according to Directive 2002/32/EC on undesirable substances in animal feed in the latest version

* Comment on parameter 'specific surface (BET)': negative C-value, BET too low

The C-value is a qualitative measure for the pore volume distribution. A negative C-value is an indication for a high portion of micropores, whose surface can only be measured insufficiently with the method chosen.

** n.d - not determined:

These methods apply for animal feed conventional type. The methods are not validated for the matrix biochar and can lead to implausible results:

"Crude protein, crude fibre and crude fat are completely decomposed in the process of pyrolysis and therefore no longer existent in the biochar. Biochar is considered as completely pyrolyzed, if the H/Corg ratio is below 0.7. If the H/Corg ratio is below 0.7 according to EBC premium, the analysis of crude protein, crude fibre and crude fat can be spared, as their content is specified as 0 g kg⁻¹ by definition." [1]

[1] - EBC (2012) 'European Biochar Certificate – Richtlinien für die nachhaltige Produktion von Pflanzenkohle', European Biochar Foundation (EBC), Arbaz, Switzerland.
<http://www.european-biochar.org/en/download>. Version 7.4 of 14th August 2017, DOI: 10.13140/RG.2.1.4658.7043

The parameters identified by FR have been performed by the laboratory Eurofins Umwelt Ost GmbH (Bobritzsch-Hilbersdorf). The accreditation code JE02 identifies the parameters accredited according to DIN EN ISO/IEC 17025:2005 D-PL-14081-01-00 .

The parameters identified by SA06 have been performed by the laboratory SYNLAB Analytics & Services Germany GmbH (Jena). The accreditation code RE0003D identifies the parameters accredited according to DIN EN ISO/IEC 17025:2005 D-PL-14004-10-00 .

The parameters identified by SU1B have been performed by the laboratory TU Bergakademie Freiberg (IEC) (Freiberg).

/o - The analysis has been outsourced.

Explanations regarding Limits

Analysis performed according to guidelines for sustainable production of biochar of the european biochar certificate.

GW 1: basic quality grade (referred to dry basis)

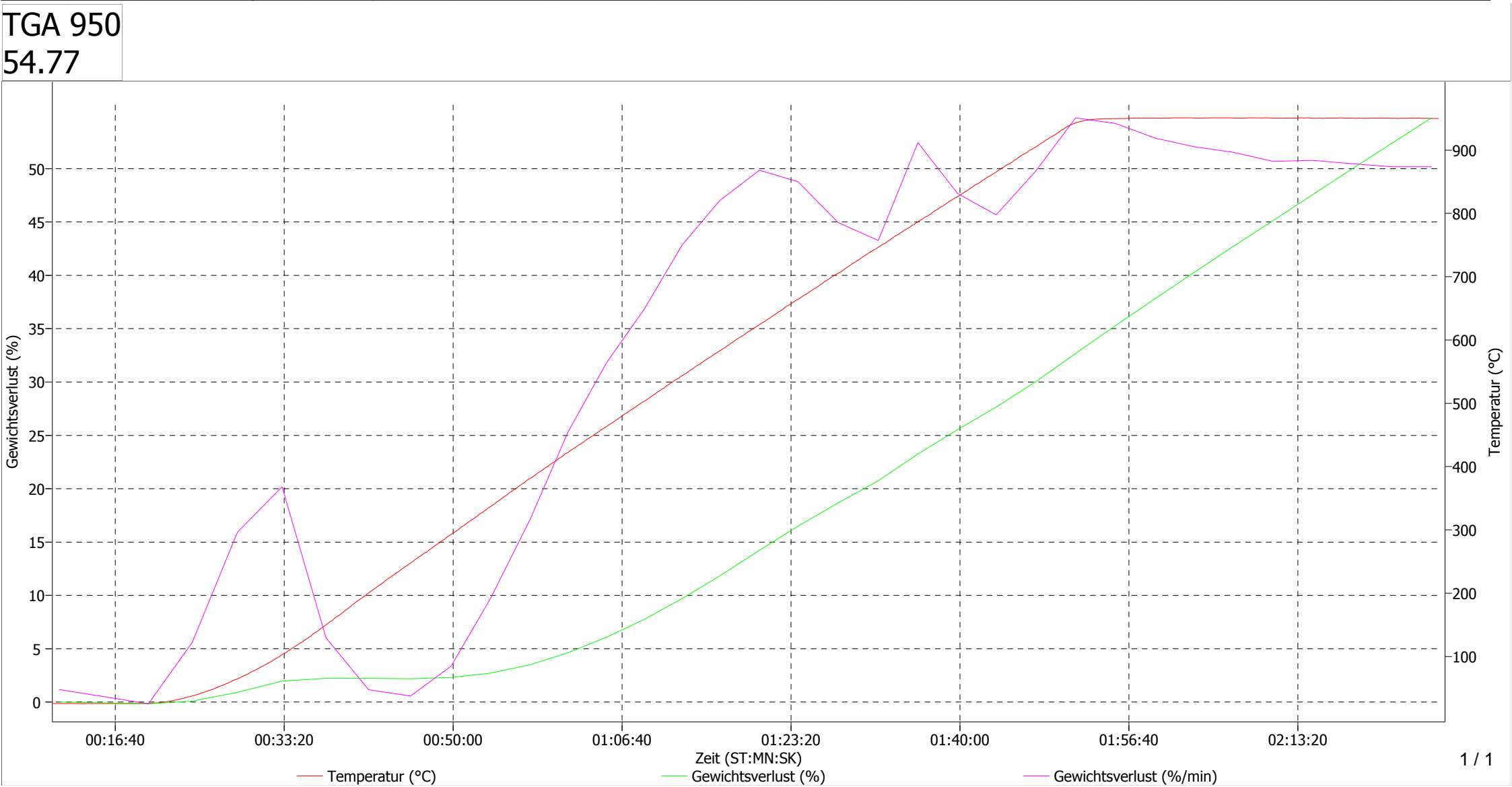
GW 2: premium quality grade (referred to dry basis)

Ho,V / Hu,p: complies calorific value at constant volume or pressure

EUROFINS UMWELT assumes no responsibility for the legal liability of the cited limits.

10/12/2018 9:43:28 AM

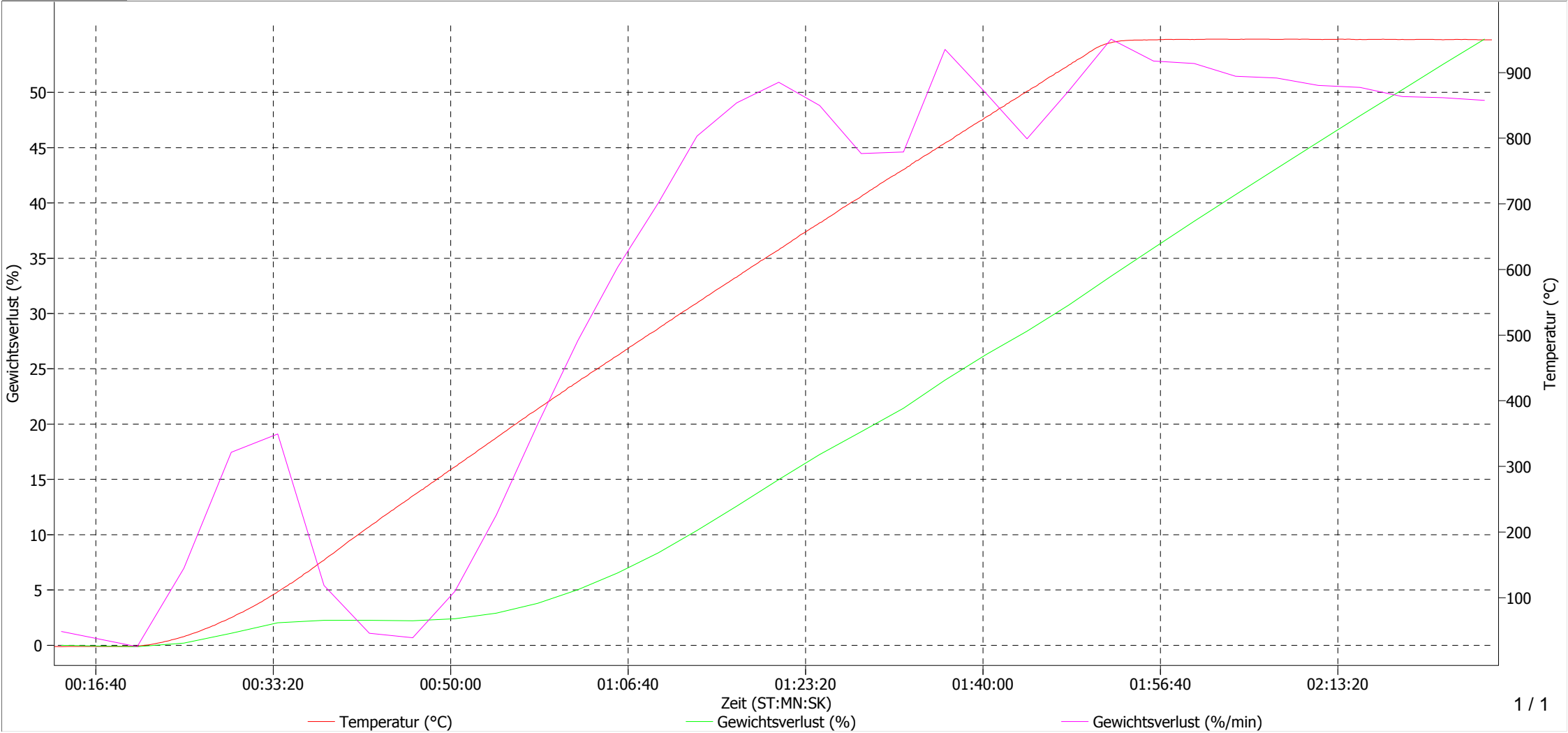
Name	Position	Kommentar	Methode	Ausgangsgewicht	Wasser	Asche 550	Asche 815	Asche 950	TGA 950	Kuehlung Gewicht	Asche 450	GV 550	(wf) GV 550	GV 550 wf	wf GV 550	Tiegelgewicht	Datum der Analyse
118108446	9	a5fw	TGA 950 N (Pflanz	0.9834					54.77							18.560	10/12/2018 9:18:58 AM



10/12/2018 9:43:47 AM

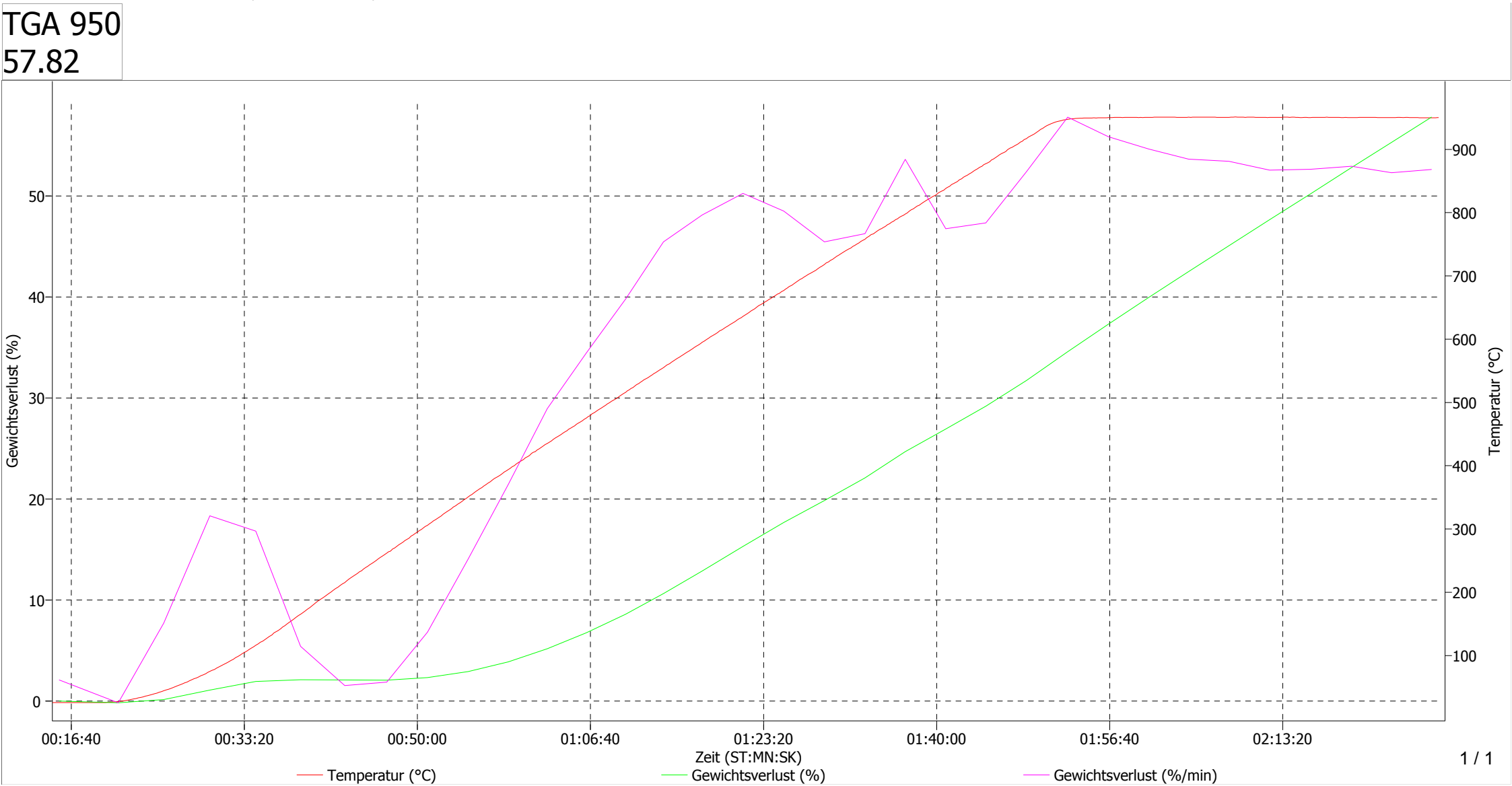
Name	Position	Kommentar	Methode	Ausgangsgewicht	Wasser	Asche 550	Asche 815	Asche 950	TGA 950	Kuehlung Gewicht	Asche 450	GV 550	(wf) GV 550	GV 550 wf	wf GV 550	Tiegelgewicht	Datum der Analyse
118108446	12	a5fw	TGA 950 N (Pflanz	1.0583					54.83							19.3798	10/12/2018 9:18:59 AM

TGA 950
54.83



10/12/2018 9:42:28 AM

Name	Position	Kommentar	Methode	Ausgangsgewicht	Wasser	Asche 550	Asche 815	Asche 950	TGA 950	Kuehlung Gewicht	Asche 450	GV 550	(wf) GV 550	GV 550 wf	wf GV 550	Tiegel gewicht	Datum der Analyse
118108447	15	a5fw	TGA 950 N (Pflanz	0.9679					57.82							22.623	10/12/2018 9:19:00 AM



10/12/2018 9:42:51 AM

Name	Position	Kommentar	Methode	Ausgangsgewicht	Wasser	Asche 550	Asche 815	Asche 950	TGA 950	Kuehlung Gewicht	Asche 450	GV 550	(wf) GV 550	GV 550 wf	wf GV 550	Tiegelgewicht	Datum der Analyse
118108447	14	a5fw	TGA 950 N (Pflanz	0.9107					58.43							19.0126	10/12/2018 9:18:59 AM

TGA 950
58.43

