WAGENINGEN EVALUATING PROGRAMS

FOR ANALYTICAL LABORATORIES

Certificate of Analysis

BiMEP

International Biomass Exchange Program

REFERENCE MATERIAL

BIMEP sample 404

WAGENINGEN
UNIVERSITY & RESEARCH

BiMEP

Certificate of Analysis BIMEP 404

General Information

In this report an overview is given of analytical data for this sample collected in our proficiency testing program. The consensus values are calculated using a robust statistical model. With this NDA model mean and standard deviation are calculated using all reported data when at least 8 results are left after removal of reported 'lower than' (<) and 0 (= zero) values. No outliers are removed.

This report is divided into three sections: Consensus Values, Indicative Values and Values for Information. The division is made on the reliability of the data. Consensus Values are based on at least 16 results while the coefficient of variation is smaller than 25 %. Indicative Values are based on at least 8 and less than 16 results or a coefficient of variation between 25 % and 50 %. Other values, based on more than 2 and less than 8 results or a coefficient of variation higher than 50 %, are given for information only.

In the sections with Consensus Values and Indicative Values the following parameters are given: mean, standard deviation, coefficient of variation, number of results, median and MAD (Median of Absolute Deviation) and the uncertainty in the consensus values. The confidence limits (at 95 % probability) are calculated for these determinands.
In the section with Information Values the following parameters are given: median, MAD and number of results. For determinands which have at least 5 results reported as smaller than (<) the median of these ‘smaller than results’ is calculated. In some cases this median of ‘<’ values is much smaller than median and mean of the indicative values. This may be caused by a too optimistic (too low) value for the detection limit reported by a (small) majority of participating laboratories who report ‘<’-values.

All values, expressed on a weight basis (kg or %), are reported in oven dry (105 °C) material. Moisture is reported in the material as received.

Sample information

WEPAL reference materials are from natural sources only. There is no spiking, mixing or other alterations of the samples. For sample preparation the BIMEP samples are dried at 40 °C and milled to pass a 0.5 mm sieve.

This BIMEP sample 404 of Sewage Sludge from Netherlands is prepared for the WEPAL proficiency programs. The sample is used in 6 periods (or rounds). Only results from the last 5 periods are used. In this way the consensus values will reflect the latest 'state of the art' in the analytical techniques used in the laboratories. The results on which the values in this report are based were taken from the periods given in the following table.

Year	Round	Number
2019	2	4
2017	3	2
2014	1	1
2011	2	2
2009	3	1

Consensus Values BIMEP 404

Method: General Analysis

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	95 % confidence limits
Ash	% (m/m)	39.5	0.76	1.9	46	39.5	0.54	0.14	39.30 - 39.75
Moisture	% (m/m)	7.99	0.813	10.2	49	7.95	0.550	0.145	7.76 - 8.23
Calorific Value (gross)	MJ/kg	14.2	0.23	1.6	47	14.1	0.16	0.04	14.11 - 14.25
Volatile Matter	% (m/m)	56.2	0.82	1.5	36	56.2	0.60	0.17	55.95 - 56.51

Method: Elementary Analysis

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	95 % confidence limits
Carbon (C)	% (m/m)	32.6	0.80	2.5	44	32.4	0.58	0.15	32.40 - 32.89
Hydrogen (H)	% (m/m)	4.60	0.178	3.9	41	4.63	0.122	0.035	4.55 - 4.66
Nitrogen (N)	% (m/m)	4.53	0.105	2.3	42	4.55	0.073	0.020	4.49 - 4.56
Cl	g/kg	0.874	0.1141	13.1	35	0.880	0.0800	0.0241	0.834 - 0.913
S	g/kg	13.5	1.54	11.4	40	13.2	1.05	0.30	13.0 - 14.0

Method: Major Elements

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	95 % confidence limits
Al	g/kg	24.6	2.71	11.0	19	24.8	1.91	0.78	23.3 - 25.9
Ca	g/kg	40.1	4.38	10.9	19	40.3	2.94	1.26	38.0 - 42.2
Fe	g/kg	53.1	7.51	14.2	19	54.3	5.50	2.15	49.5 - 56.7
K	g/kg	2.69	0.577	21.4	19	2.66	0.390	0.165	2.41 - 2.97
Mg	g/kg	3.85	0.622	16.2	19	3.90	0.450	0.178	3.55 - 4.15
P	g/kg	31.6	3.06	9.7	19	31.6	2.23	0.88	30.1 - 33.1

Method: Minor Elements

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	95 % confidence limits
Ba	mg/kg	373	28.1	7.5	19	367	20.1	8.1	359 - 386
Co	mg/kg	5.63	0.812	14.4	18	5.70	0.565	0.239	5.23 - 6.03
Cr	mg/kg	46.8	8.70	18.6	19	47.7	5.66	2.50	42.6 - 51.0
Cu	mg/kg	372	30.6	8.2	23	374	21.0	8.0	359 - 385
Hg	mg/kg	1.59	0.330	20.8	19	1.62	0.228	0.095	1.43 - 1.74
Mn	mg/kg	488	74.4	15.2	22	494	49.5	19.8	455 - 521
Mo	mg/kg	6.20	1.169	18.9	16	6.21	0.800	0.365	5.58 - 6.82
Ni	mg/kg	36.8	3.87	10.5	19	35.8	2.70	1.11	34.9 - 38.6
Pb	mg/kg	156	16.3	10.5	21	153	11.5	4.4	149 - 163
Sn	mg/kg	30.4	5.24	17.2	16	31.0	3.45	1.64	27.7 - 33.2
V	mg/kg	15.0	2.34	15.6	19	15.5	1.69	0.67	13.8 - 16.1
Zn	mg/kg	1080	134	12.4	23	1090	96	35	1022 - 1138

Indicative Values BIMEP 404

Method: Elementary Analysis

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	95 % confidence limits
Oxygen (O)	% (m/m)	18.0	1.10	6.1	8	18.4	0.80	0.49	17.1 - 18.9

Method: Major Elements

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	95 % confidence limits
Na	g/kg	1.50	0.411	27.4	19	1.49	0.298	0.118	1.30 - 1.70
Si	g/kg	40.8	3.50	8.6	15	39.7	2.54	1.13	38.9 - 42.7

Method: Minor Elements

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	95 % confidence limits
As	mg/kg	10.0	2.51	25.0	17	10.5	1.80	0.76	8.75 - 11.3
Be	mg/kg	0.265	0.0851	32.1	9	0.300	0.0600	0.0355	0.201 - 0.329
Cd	mg/kg	1.91	0.532	27.9	18	2.00	0.390	0.157	1.64 - 2.17
Sb	mg/kg	3.31	1.024	30.9	14	3.39	0.665	0.342	2.72 - 3.90
Se	mg/kg	1.61	0.733	45.5	11	1.75	0.479	0.276	1.12 - 2.09
Ti	mg/kg	1300	595	45.6	15	1470	335	192	977 - 1631

Informative Values BIMEP 404

Method: Water Soluble Elements

Element	Unit	Median	MAD	N
Cl	g/kg	0.801	0.1034	5
K	g/kg	0.286	0.1195	4
Na	g/kg	0.474	0.3062	4

Method: Minor Elements

					Results smaller than (<)	
Element	Unit	Median	MAD	N	Median of <	N
F	mg/kg	154	105.3	14		
Te	mg/kg	-	-	0	0.500	9
Tl	mg/kg	0.130	0.0300	3	0.700	8