

# WAGENINGEN EVALUATING PROGRAMS FOR ANALYTICAL LABORATORIES

## **Certificate of Analysis**



**International Biomass Exchange Program** 

REFERENCE MATERIAL
BIMEP sample 444



#### Certificate of Analysis BIMEP 444

#### **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  $^{\circ}$ C and milled to pass a 0.5 mm sieve.

This BIMEP sample 444 of Sewage Sludge from Switzerland is prepared for the WEPAL proficiency programs. The sample is used in 4 periods (or rounds). The results on which the values in this report are based were taken from the periods given in the following table.

Year	Round	Number
2020	2	4
2018	2	3
2014	2	2
2011	4	2

## ВîМЕР



### Consensus Values BIMEP 444

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Method: General Analysis Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	95 % confid	ence limits
Ash	% (m/m)	41.4	0.91	2.2	36	41.2	0.67	0.19	41.04	41.66
Moisture	% (m/m)	9.80	0.692	7.1	38	9.71	0.465	0.140	9.57	- 10.02
Calorific Value (gross)	MJ/kg	13.4	0.21	1.6	34	13.3	0.16	0.05	13.29	- 13.44
Volatile Matter	% (m/m)	56.8	0.95	1.7	26	57.0	0.69	0.23	56.38	57.15
Method: Elementary Analysis										
Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	95 % confid	ence limits
Carbon (C)	% (m/m)	31.6	0.82	2.6	34	31.6	0.56	0.18	31.28	31.85
Hydrogen (H)	% (m/m)	4.40	0.215	4.9	31	4.41	0.144	0.048	4.33	4.48
Nitrogen (N)	% (m/m)	4.78	0.190	4.0	34	4.77	0.128	0.041	4.71	4.84
CI	g/kg	0.572	0.0582	10.2	26	0.574	0.0415	0.0143	0.549	0.596
S	g/kg	8.09	1.123	13.9	31	8.20	0.800	0.252	7.68	8.50

## ВîМЕР





Method: Elementary Analysis Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	95 % confidence lim		o limite
Oxygen (O)	% (m/m)	21.2	5.83	27.6	9	18.9	3.82	2.43	16.8	-	25.6
Method: Major Elements											
Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	95 % conf	idenc	e limits
AI	g/kg	17.9	1.82	10.2	11	18.0	1.00	0.69	16.7	-	19.1
Ca	g/kg	57.6	5.90	10.2	12	56.9	4.22	2.13	53.9	-	61.3
Fe	g/kg	42.7	4.39	10.3	12	42.8	3.13	1.58	40.0	-	45.5
K	g/kg	3.28	0.830	25.3	12	3.32	0.600	0.300	2.76	-	3.80
Mg	g/kg	6.19	1.086	17.5	12	6.22	0.702	0.392	5.51	-	6.88
Na	g/kg	1.32	0.377	28.6	12	1.41	0.257	0.136	1.08	-	1.5
P	g/kg	30.5	2.64	8.7	12	30.0	1.85	0.95	28.8	-	32.1
Si	g/kg	42.8	7.05	16.5	9	42.9	4.90	2.94	37.5	-	48.1
Method: Minor Elements											
Method: Minor Elements											
Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	95 % conf	idenc	
Element As	mg/kg	5.06	1.071	21.2	9	5.03	0.770	0.446	4.26	-	5.8
<b>Element</b> As Ba	mg/kg mg/kg	5.06 428	1.071 14.9	21.2 3.5	9 10	5.03 423	0.770 10.8	0.446 5.9	4.26 417	-	5.8° 438
<b>Element</b> As Ba Cd	mg/kg mg/kg mg/kg	5.06 428 1.33	1.071 14.9 0.229	21.2 3.5 17.1	9 10 12	5.03 423 1.40	0.770 10.8 0.172	0.446 5.9 0.083	4.26 417 1.19	- - -	5.87 438 1.48
<b>Element</b> As Ba Cd Co	mg/kg mg/kg mg/kg mg/kg	5.06 428 1.33 6.72	1.071 14.9 0.229 1.175	21.2 3.5 17.1 17.5	9 10 12 12	5.03 423 1.40 6.64	0.770 10.8 0.172 0.851	0.446 5.9 0.083 0.424	4.26 417 1.19 5.98	- - -	5.87 438 1.48 7.46
<b>Element</b> As Ba Cd Co Cr	mg/kg mg/kg mg/kg mg/kg mg/kg	5.06 428 1.33 6.72 78.7	1.071 14.9 0.229 1.175 9.24	21.2 3.5 17.1 17.5 11.7	9 10 12 12 11	5.03 423 1.40 6.64 76.6	0.770 10.8 0.172 0.851 6.33	0.446 5.9 0.083 0.424 3.48	4.26 417 1.19 5.98 72.6	- - - -	5.87 438 1.48 7.46 84.8
Element As Ba Cd Co Cr	mg/kg mg/kg mg/kg mg/kg mg/kg mg/kg	5.06 428 1.33 6.72 78.7 261	1.071 14.9 0.229 1.175 9.24 20.3	21.2 3.5 17.1 17.5 11.7 7.8	9 10 12 12 11 13	5.03 423 1.40 6.64 76.6 262	0.770 10.8 0.172 0.851 6.33 14.6	0.446 5.9 0.083 0.424 3.48 7.0	4.26 417 1.19 5.98 72.6 249	- - - - -	5.87 438 1.48 7.46 84.8 273
Element As Ba Cd Co Cr Cu	mg/kg mg/kg mg/kg mg/kg mg/kg mg/kg	5.06 428 1.33 6.72 78.7 261 1.24	1.071 14.9 0.229 1.175 9.24 20.3 0.416	21.2 3.5 17.1 17.5 11.7 7.8 33.5	9 10 12 12 11 13	5.03 423 1.40 6.64 76.6 262 1.29	0.770 10.8 0.172 0.851 6.33 14.6 0.306	0.446 5.9 0.083 0.424 3.48 7.0 0.164	4.26 417 1.19 5.98 72.6 249 0.948	- - - - -	5.87 438 1.48 7.46 84.8 273 1.53
Element As Ba Cd Co Cr Cu Hg	mg/kg mg/kg mg/kg mg/kg mg/kg mg/kg mg/kg	5.06 428 1.33 6.72 78.7 261 1.24 381	1.071 14.9 0.229 1.175 9.24 20.3 0.416 37.4	21.2 3.5 17.1 17.5 11.7 7.8 33.5 9.8	9 10 12 12 11 13 10 14	5.03 423 1.40 6.64 76.6 262 1.29 374	0.770 10.8 0.172 0.851 6.33 14.6 0.306 26.9	0.446 5.9 0.083 0.424 3.48 7.0 0.164 12.5	4.26 417 1.19 5.98 72.6 249 0.948 359	- - - - - -	5.83 438 1.48 7.46 84.8 273 1.50
Element As Ba Cd Co Cr Cu Hg Mn	mg/kg mg/kg mg/kg mg/kg mg/kg mg/kg mg/kg mg/kg	5.06 428 1.33 6.72 78.7 261 1.24 381 5.72	1.071 14.9 0.229 1.175 9.24 20.3 0.416 37.4 0.514	21.2 3.5 17.1 17.5 11.7 7.8 33.5 9.8 9.0	9 10 12 12 11 13 10 14	5.03 423 1.40 6.64 76.6 262 1.29 374 5.70	0.770 10.8 0.172 0.851 6.33 14.6 0.306 26.9 0.350	0.446 5.9 0.083 0.424 3.48 7.0 0.164 12.5 0.194	4.26 417 1.19 5.98 72.6 249 0.948 359 5.38	- - - - -	5.87 438 1.48 7.46 84.8 273 1.53 402 6.06
Element As Ba Cd Co Cr Cu Hg Mn Mo	mg/kg	5.06 428 1.33 6.72 78.7 261 1.24 381 5.72 41.8	1.071 14.9 0.229 1.175 9.24 20.3 0.416 37.4 0.514 7.10	21.2 3.5 17.1 17.5 11.7 7.8 33.5 9.8 9.0 17.0	9 10 12 12 11 13 10 14 11	5.03 423 1.40 6.64 76.6 262 1.29 374 5.70 42.0	0.770 10.8 0.172 0.851 6.33 14.6 0.306 26.9 0.350 5.00	0.446 5.9 0.083 0.424 3.48 7.0 0.164 12.5 0.194 2.68	4.26 417 1.19 5.98 72.6 249 0.948 359 5.38 37.1	- - - - - - - -	5.87 438 1.48 7.46 84.8 273 1.53 402 6.06 46.5
Element As Ba Cd Co Cr Cu Hg Mn Mo Ni	mg/kg	5.06 428 1.33 6.72 78.7 261 1.24 381 5.72 41.8	1.071 14.9 0.229 1.175 9.24 20.3 0.416 37.4 0.514	21.2 3.5 17.1 17.5 11.7 7.8 33.5 9.8 9.0 17.0 19.5	9 10 12 12 11 13 10 14	5.03 423 1.40 6.64 76.6 262 1.29 374 5.70 42.0 57.1	0.770 10.8 0.172 0.851 6.33 14.6 0.306 26.9 0.350 5.00 8.00	0.446 5.9 0.083 0.424 3.48 7.0 0.164 12.5 0.194 2.68 4.02	4.26 417 1.19 5.98 72.6 249 0.948 359 5.38 37.1	- - - - - - -	5.87 438 1.48 7.46 84.8 273 1.53 402 6.06 46.5 64.1
Element As Ba Cd Co Cr Cu Hg Mn Mo Ni Pb	mg/kg	5.06 428 1.33 6.72 78.7 261 1.24 381 5.72 41.8 57.1 3.00	1.071 14.9 0.229 1.175 9.24 20.3 0.416 37.4 0.514 7.10 11.14 0.138	21.2 3.5 17.1 17.5 11.7 7.8 33.5 9.8 9.0 17.0	9 10 12 12 11 13 10 14 11 11	5.03 423 1.40 6.64 76.6 262 1.29 374 5.70 42.0 57.1 3.05	0.770 10.8 0.172 0.851 6.33 14.6 0.306 26.9 0.350 5.00 8.00 0.114	0.446 5.9 0.083 0.424 3.48 7.0 0.164 12.5 0.194 2.68 4.02 0.061	4.26 417 1.19 5.98 72.6 249 0.948 359 5.38 37.1 50.1 2.89	- - - - - - - -	5.87 438 1.48 7.46 84.8 273 1.53 402 6.06 46.5 64.1 3.11
Element As Ba Cd Co Cr Cu Hg Mn Mo Ni	mg/kg	5.06 428 1.33 6.72 78.7 261 1.24 381 5.72 41.8	1.071 14.9 0.229 1.175 9.24 20.3 0.416 37.4 0.514 7.10 11.14	21.2 3.5 17.1 17.5 11.7 7.8 33.5 9.8 9.0 17.0 19.5 4.6	9 10 12 12 11 13 10 14 11 11 12 8	5.03 423 1.40 6.64 76.6 262 1.29 374 5.70 42.0 57.1	0.770 10.8 0.172 0.851 6.33 14.6 0.306 26.9 0.350 5.00 8.00	0.446 5.9 0.083 0.424 3.48 7.0 0.164 12.5 0.194 2.68 4.02	4.26 417 1.19 5.98 72.6 249 0.948 359 5.38 37.1		5.87 438 1.48 7.46 84.8 273 1.53 402 6.06 46.5

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### **Informative Values** BIMEP 444

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1.00



Method: Water Soluble E Element Cl	lements Unit g/kg	<b>Median</b> 0.525	<b>MAD</b> 0.1600	<b>N</b> 4
K	g/kg	1.04	0.187	4
Na	g/kg	0.666	0.1095	4
Method: Minor Elements				
Element	Unit	Median	MAD	N
Be	mg/kg	0.240	0.0300	5
F	mg/kg	73.8	70.71	12

389

0.536

1170

1.47

mg/kg

mg/kg

mg/kg