



**WAGENINGEN EVALUATING PROGRAMS
FOR ANALYTICAL LABORATORIES**

Certificate of Analysis



International Soil-Analytical Exchange

REFERENCE MATERIAL

ISE sample 8570



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, the mean and standard deviation are calculated using all reported data when at least 4 results are left after removal of reported 'lower than' (<) and 0 (= zero) values. No outliers are removed.

This report is divided into two sections: Consensus Values and Indicative Values. The division is made on the reliability of the data. Consensus Values are based on at least 8 results and a maximum relative uncertainty of 6.25%. Indicative Values are based on a maximum relative uncertainty of 35% and a minimum of 4 and maximum of 7 results, or a relative uncertainty greater than 6.25% when there are at least 8 results.

For each determinand the following parameters are given: mean, standard deviation, coefficient of variation, number of results, median, MAD (Median of Absolute Deviation), the uncertainty of the mean (consensus or indicative) value and the relative uncertainty.

All values, expressed on a weight basis (kg or %), are reported as oven-dried (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 ISE samples are dried at 40°C and milled to pass a 0.5 mm sieve.

This ISE sample 8570 of Clay soil, from Netherlands, is prepared for the WEPAL proficiency programs. The sample has been used in 1 period (or round). The results on which the values in this report are based were taken from the period given in the following table:

Year	Round	Number
2019	4	5



Consensus Values ISE 8570



Method: Real totals

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	Rel.Uncert. %
Al	g/kg	49.0	1.96	4.0	22	48.6	0.950	0.523	1.07
As	mg/kg	25.6	1.94	7.6	15	25.2	1.00	0.625	2.44
Ba	mg/kg	283	19.9	7.0	14	280	13.4	6.64	2.34
Br	mg/kg	16.9	1.94	11.4	9	16.9	1.00	0.806	4.76
Ca	g/kg	35.3	1.97	5.6	23	35.3	1.20	0.512	1.45
Co	mg/kg	9.49	1.70	17.9	17	9.28	1.04	0.516	5.44
Cr	mg/kg	76.0	10.8	14.2	20	76.5	7.80	3.02	3.97
Cu	mg/kg	20.2	3.00	14.8	20	20.1	1.70	0.839	4.15
Fe	g/kg	27.3	1.37	5.0	23	27.3	0.800	0.358	1.31
K	mg/kg	16724	851	5.1	23	16539	566	222	1.33
Mg	mg/kg	8986	526	5.9	19	8998	380	151	1.68
Mn	mg/kg	783	44.2	5.7	24	779	23.5	11.3	1.44
Na	mg/kg	6327	400	6.3	19	6299	230	115	1.81
Ni	mg/kg	28.2	2.69	9.6	21	28.1	1.60	0.735	2.61
P	mg/kg	788	89.2	11.3	17	788	54.0	27.0	3.43
Pb	mg/kg	35.9	3.59	10.0	19	36.2	2.10	1.03	2.87
Rb	mg/kg	88.3	3.70	4.2	15	88.0	1.50	1.19	1.35
S	mg/kg	1094	163	14.9	10	1071	108	64.6	5.90
Si	g/kg	312	6.73	2.2	18	312	3.45	1.98	0.636
Sn	mg/kg	3.21	0.307	9.6	9	3.25	0.150	0.128	3.98
Sr	mg/kg	148	5.04	3.4	16	148	2.50	1.58	1.06
Y	mg/kg	24.2	1.54	6.3	11	24.5	1.07	0.579	2.39
Zn	mg/kg	101	4.07	4.0	21	100	3.00	1.11	1.10
Zr	mg/kg	283	14.2	5.0	14	283	10.0	4.75	1.68
C-elementary	g/kg	25.1	0.896	3.6	20	25.1	0.549	0.250	0.996
V	mg/kg	67.5	4.32	6.4	18	67.6	2.67	1.27	1.88
Ti	mg/kg	3568	202	5.7	21	3555	149	55.1	1.54
N - elementary	g/kg	1.44	0.125	8.6	43	1.43	0.080	0.024	1.65
Ce	mg/kg	60.2	7.57	12.6	10	60.4	3.57	2.99	4.97
Nb	mg/kg	12.1	0.924	7.7	10	12.1	0.550	0.365	3.02
Th	mg/kg	9.05	0.492	5.4	8	8.98	0.265	0.218	2.40
Hg	µg/kg	122	10.9	8.9	10	119	8.50	4.30	3.51

Method: Acid extractable (So-called totals)

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	Rel.Uncert. %
As	mg/kg	24.1	2.03	8.4	16	24.4	1.16	0.633	2.62
Ca	g/kg	31.8	2.78	8.7	13	31.6	1.79	0.963	3.03



Consensus Values ISE 8570



Method: Acid extractable (So-called totals)									(cont.)
Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	Rel.Uncert. %
Co	mg/kg	7.87	0.773	9.8	17	7.90	0.454	0.234	2.98
Cr	mg/kg	39.4	7.30	18.6	19	40.3	5.35	2.09	5.32
Cu	mg/kg	17.4	2.30	13.2	22	17.3	1.25	0.613	3.53
Fe	g/kg	24.3	3.07	12.6	14	24.0	1.94	1.03	4.22
Mg	mg/kg	7762	521	6.7	13	7785	338	181	2.33
Mn	mg/kg	738	98.6	13.4	16	730	49.6	30.8	4.18
N	g/kg	1.43	0.139	9.7	24	1.43	0.078	0.036	2.49
Ni	mg/kg	23.4	1.93	8.3	18	23.4	1.31	0.569	2.44
P	mg/kg	727	72.9	10.0	14	727	49.1	24.3	3.35
Pb	mg/kg	31.2	2.96	9.5	19	31.3	1.52	0.850	2.72
S	mg/kg	1154	134	11.6	15	1178	72.4	43.2	3.74
Zn	mg/kg	94.9	9.84	10.4	21	93.3	7.70	2.69	2.83
Hg	µg/kg	119	6.21	5.2	8	120	4.05	2.75	2.31

Method: Aqua Regia (ISO 11466)

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	Rel.Uncert. %
Al	g/kg	17.3	2.52	14.5	20	16.5	2.36	0.704	4.06
As	mg/kg	22.9	2.67	11.6	21	22.6	1.95	0.728	3.18
Ca	g/kg	32.0	3.15	9.8	16	32.5	2.27	0.984	3.07
Cd	mg/kg	0.434	0.077	17.7	23	0.430	0.056	0.020	4.61
Co	mg/kg	7.65	0.863	11.3	19	7.79	0.610	0.248	3.24
Cr	mg/kg	36.6	4.98	13.6	26	36.2	3.42	1.22	3.33
Cu	mg/kg	17.0	2.66	15.6	23	17.3	1.80	0.694	4.08
Fe	g/kg	22.3	3.74	16.7	19	22.3	2.83	1.07	4.80
Hg	µg/kg	125	15.5	12.4	10	128	8.50	6.14	4.92
Mg	mg/kg	7539	1041	13.8	18	7501	581	307	4.07
Mn	mg/kg	703	66.7	9.5	18	689	51.0	19.7	2.80
Ni	mg/kg	22.9	3.31	14.5	25	23.3	2.10	0.829	3.62
P	mg/kg	766	88.3	11.5	13	780	49.1	30.6	4.00
Pb	mg/kg	29.0	3.56	12.3	25	28.3	3.60	0.890	3.06
S	mg/kg	1157	127	11.0	10	1130	81.3	50.2	4.34
Zn	mg/kg	93.4	6.29	6.7	22	93.8	4.35	1.68	1.79

Method: Extraction with boiling 2M HNO3

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	Rel.Uncert. %
Cd	mg/kg	0.434	0.039	9.0	10	0.434	0.016	0.015	3.56
Co	mg/kg	7.00	0.480	6.9	10	6.92	0.169	0.190	2.71



Consensus Values ISE 8570



Method: Extraction with boiling 2M HNO ₃									(cont.)
Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	Rel.Uncert. %
Cr	mg/kg	22.0	1.75	8.0	12	22.2	0.970	0.633	2.87
Cu	mg/kg	17.2	1.58	9.2	12	17.1	1.20	0.571	3.31
Hg	µg/kg	109	8.04	7.4	9	107	4.52	3.35	3.08
Ni	mg/kg	19.4	1.03	5.3	12	19.4	0.650	0.372	1.91
Pb	mg/kg	31.3	2.00	6.4	12	31.4	0.950	0.722	2.31
Zn	mg/kg	87.3	6.36	7.3	12	87.8	4.66	2.29	2.63

Method: Extraction with 0.01M CaCl ₂ 1:10									
Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	Rel.Uncert. %
K	mg/kg	66.1	8.52	12.9	9	66.1	6.60	3.55	5.38
N - NH ₄ (as N)	mg/kg	8.96	1.50	16.8	12	8.75	0.670	0.542	6.05

Method: Soil characteristics									
Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	Rel.Uncert. %
pH - H ₂ O	...	7.69	0.311	4.0	90	7.65	0.260	0.041	0.534
pH - KCl	...	7.17	0.236	3.3	34	7.16	0.150	0.051	0.705
pH - CaCl ₂	...	7.24	0.163	2.2	21	7.27	0.070	0.044	0.613
TIC=Tot.Inorg C(as CaCO ₃)	%	7.99	1.34	16.7	25	8.00	0.833	0.334	4.18
EC-SC (ISO 11265)	mS/m	19.0	3.69	19.4	33	18.9	2.20	0.802	4.22
Fraction < 63 µm	%	89.1	3.99	4.5	14	88.2	2.62	1.33	1.50
Org.matter (L.O.I.)	%	4.53	0.696	15.4	32	4.56	0.360	0.154	3.40
TC=Total C (org.+inorg.)	g/kg	24.9	0.897	3.6	32	25.0	0.500	0.198	0.795
TOC=Total Org. C	g/kg	15.1	2.08	13.8	37	15.3	1.43	0.428	2.84
C - org others (W&B a.o.)	g/kg	15.5	2.16	13.9	46	15.7	1.35	0.399	2.56

Method: Other determinations									
Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	Rel.Uncert. %
Moisture-content	%	2.46	0.572	23.3	37	2.46	0.370	0.117	4.78

Method: Pot. CEC using 1M NH ₄ -acetate at pH=7									
Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	Rel.Uncert. %
K	cmol+/kg	0.441	0.064	14.5	57	0.430	0.040	0.011	2.39
Mg	cmol+/kg	1.00	0.216	21.5	56	1.04	0.160	0.036	3.59
Ca	cmol+/kg	33.0	11.5	34.9	54	32.8	7.62	1.96	5.94



Consensus Values ISE 8570

Method: Mehlich-3

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	Rel.Uncert. %
B	mg/kg	2.07	0.154	7.4	11	2.06	0.082	0.058	2.80
Ca	mg/kg	6305	823	13.0	22	6477	633	219	3.48
Cu	mg/kg	5.89	0.879	14.9	19	5.80	0.489	0.252	4.28
Fe	mg/kg	425	52.6	12.4	19	428	27.3	15.1	3.55
K	mg/kg	173	10.6	6.1	23	174	6.09	2.77	1.60
Mg	mg/kg	137	14.7	10.7	22	138	7.80	3.93	2.86
Mn	mg/kg	135	20.4	15.0	19	134	11.1	5.84	4.31
Na	mg/kg	22.3	4.37	19.6	17	22.8	2.29	1.32	5.94
P	mg/kg	86.1	8.49	9.9	24	86.3	5.25	2.17	2.52
Zn	mg/kg	9.59	1.50	15.7	20	9.52	0.995	0.420	4.37

Method: Extraction with 0.01M CaCl₂ - 0.005M DTPA 1:10 (w/v)

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	Rel.Uncert. %
Cu	mg/kg	3.70	0.496	13.4	16	3.69	0.270	0.155	4.19
Zn	mg/kg	3.83	0.674	17.6	16	3.79	0.540	0.210	5.49

Method: Phosphorus and related analysis

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	Rel.Uncert. %
P - Olsen (as P)	mg/kg	41.8	8.53	20.4	41	41.5	6.52	1.67	3.98
P - AL (as P)	mg/kg	212	26.1	12.3	9	211	16.4	10.9	5.12

Method: UK Soil Methods

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	Rel.Uncert. %
K - NH ₄ NO ₃ (1/5)	mg/l	164	14.2	8.7	15	167	9.75	4.57	2.79
Mg - NH ₄ NO ₃ (1/5)	mg/l	93.0	9.97	10.7	15	96.4	7.44	3.22	3.46
pH - H ₂ O (2/5)	...	7.62	0.309	4.1	13	7.61	0.180	0.107	1.41



Indicative Values ISE 8570



Method: Real totals

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	Rel.Uncert. %
Cd	mg/kg	0.407	0.032	7.8	6	0.406	0.022	0.016	3.96
Ga	mg/kg	11.6	2.34	20.1	11	12.0	1.30	0.880	7.57
Li	mg/kg	42.6	4.77	11.2	4	42.2	2.45	2.98	7.00
Mo	mg/kg	0.371	0.157	42.4	4	0.356	0.071	0.098	26.5
Sb	mg/kg	0.743	0.085	11.4	4	0.745	0.039	0.053	7.13
Be	mg/kg	1.65	0.179	10.9	4	1.63	0.075	0.112	6.79
Tl	mg/kg	0.612	0.044	7.2	5	0.602	0.027	0.025	4.03
La	mg/kg	30.7	4.96	16.2	9	30.0	2.31	2.07	6.74
Nd	mg/kg	27.7	5.08	18.3	7	28.0	2.60	2.40	8.67
Sc	mg/kg	12.6	2.96	23.5	4	13.3	1.50	1.85	14.7
U	mg/kg	2.48	0.325	13.1	6	2.54	0.165	0.166	6.67
Cs	mg/kg	5.99	0.927	15.5	4	6.00	0.450	0.579	9.67
W	mg/kg	2.01	0.069	3.4	5	2.00	0.040	0.038	1.92

Method: Acid extractable (So-called totals)

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	Rel.Uncert. %
Al	g/kg	19.7	5.81	29.5	11	19.4	3.21	2.19	11.1
B	mg/kg	32.4	20.1	62.0	8	31.7	8.97	8.87	27.4
Ba	mg/kg	59.4	11.6	19.5	9	64.3	10.5	4.82	8.12
Cd	mg/kg	0.384	0.158	41.2	15	0.410	0.100	0.051	13.3
K	mg/kg	4068	1910	46.9	14	4209	1375	638	15.7
Mo	mg/kg	0.204	0.078	38.0	5	0.196	0.039	0.043	21.2
Na	mg/kg	194	57.4	29.6	11	188	52.5	21.6	11.1
Sn	mg/kg	2.05	0.437	21.4	8	1.91	0.175	0.193	9.44
V	mg/kg	39.9	7.87	19.7	9	41.2	5.73	3.28	8.21
Be	mg/kg	0.943	0.217	23.0	7	0.960	0.140	0.102	10.9

Method: Aqua Regia (ISO 11466)

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	Rel.Uncert. %
B	mg/kg	24.3	1.97	8.1	6	24.7	0.810	1.01	4.13
Ba	mg/kg	54.7	11.8	21.6	10	57.2	9.15	4.67	8.53
Be	mg/kg	0.918	0.096	10.5	7	0.930	0.090	0.045	4.95
K	mg/kg	3857	1395	36.2	14	4014	639	466	12.1
Li	mg/kg	25.2	4.96	19.6	7	25.0	3.10	2.34	9.28
Mo	mg/kg	0.250	0.083	33.2	9	0.250	0.050	0.035	13.8
Na	mg/kg	184	32.5	17.7	12	188	22.0	11.7	6.37
Sb	mg/kg	0.381	0.047	12.3	4	0.392	0.025	0.029	7.70



Indicative Values ISE 8570



Method: Aqua Regia (ISO 11466)									(cont.)
Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	Rel.Uncert. %
Se	mg/kg	0.309	0.096	31.0	9	0.330	0.060	0.040	12.9
Sn	mg/kg	1.98	0.234	11.8	4	1.98	0.160	0.146	7.38
Sr	mg/kg	86.2	6.24	7.2	7	86.9	3.51	2.95	3.42
Ti	mg/kg	322	194	60.2	5	333	135	108	33.6
Tl	mg/kg	0.277	0.027	9.8	4	0.276	0.013	0.017	6.10
V	mg/kg	36.7	8.40	22.9	11	35.7	4.80	3.17	8.62

Method: Extraction with boiling 2M HNO₃

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	Rel.Uncert. %
Tl	mg/kg	0.121	0.002	1.8	4	0.121	0.001	0.001	1.15

Method: Extraction with 0.1M NaNO₃

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	Rel.Uncert. %
Cu	µg/kg	122	5.29	4.3	4	121	2.50	3.31	2.71

Method: Extraction with 0.01M CaCl₂ 1:10

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	Rel.Uncert. %
B	µg/kg	352	37.1	10.5	5	350	22.0	20.7	5.89
Cu	µg/kg	104	20.2	19.5	4	105	11.4	12.7	12.2
Mg	mg/kg	64.2	6.07	9.5	7	62.2	1.62	2.87	4.47
Mn	mg/kg	4.63	1.67	36.2	4	4.80	0.800	1.05	22.6
N - NO ₃ (as N)	mg/kg	1.82	0.950	52.2	11	1.88	0.470	0.358	19.7
Na	mg/kg	14.2	1.42	10.0	7	14.8	0.900	0.673	4.74
P	mg/kg	0.877	0.445	50.8	7	0.830	0.250	0.210	24.0

Method: Soil characteristics

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	Rel.Uncert. %
Fraction < 2 µm	%	23.0	5.55	24.1	22	23.8	3.47	1.48	6.43
Fraction > 63 µm	%	11.8	3.97	33.6	15	11.9	2.12	1.28	10.8
Fraction < 16 µm	%	44.4	14.3	32.3	7	44.8	6.75	6.78	15.3

Method: Other determinations

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	Rel.Uncert. %
B - Hot water	mg/kg	1.28	0.538	42.1	10	1.38	0.270	0.213	16.7



Indicative Values ISE 8570

Method: Pot. CEC using 1M NH₄-acetate at pH=7

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	Rel.Uncert. %
CEC	cmol+/kg	16.5	5.49	33.4	33	16.9	2.52	1.19	7.26
Na	cmol+/kg	0.124	0.054	43.1	45	0.130	0.035	0.010	8.03

Method: Pot. CEC using 1M or 0.1M BaCl₂-TEA at pH=8.1 (ISO 13536 OR BZE)

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	Rel.Uncert. %
CEC	cmol+/kg	20.8	2.32	11.2	5	20.3	1.19	1.30	6.24

Method: Act. CEC using cobaltihexamine (AFNOR NFX 31 130)

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	Rel.Uncert. %
CEC	cmol+/kg	19.4	0.956	4.9	7	19.5	0.641	0.452	2.33
Na	cmol+/kg	0.084	0.020	24.2	7	0.084	0.011	0.010	11.4
K	cmol+/kg	0.438	0.040	9.1	7	0.433	0.024	0.019	4.31
Ca	cmol+/kg	21.4	1.36	6.4	7	21.4	0.751	0.644	3.01
Mg	cmol+/kg	0.965	0.184	19.0	7	0.912	0.115	0.087	8.99

Method: Mehlich-3

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	Rel.Uncert. %
Al	mg/kg	249	41.6	16.7	11	240	24.7	15.7	6.31

Method: Extraction with 0.01M CaCl₂ - 0.005M DTPA 1:10 (w/v)

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	Rel.Uncert. %
Fe	mg/kg	46.3	18.1	39.1	17	49.0	9.82	5.48	11.9
Mn	mg/kg	43.5	12.0	27.6	17	43.7	5.68	3.64	8.37

Method: Extraction with 1M KCl 1:10 (w/v)

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	Rel.Uncert. %
N - NH ₄ (as N)	mg/kg	16.5	3.65	22.2	10	16.3	2.25	1.44	8.76
N - NO ₃ (as N)	mg/kg	2.12	0.941	44.5	14	2.18	0.430	0.314	14.9

Method: Phosphorus and related analysis

Element	Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	Rel.Uncert. %
P - Bray (as P)	mg/kg	14.6	19.8	135.7	32	14.0	12.8	4.38	30.0
Al - Ox	mg/kg	492	133	27.0	4	465	66.5	83.2	16.9
Fe - Ox	mg/kg	3950	1927	48.8	4	3991	873	1204	30.5
P - Ox	mg/kg	429	19.1	4.4	4	424	10.1	11.9	2.78
P - w (as P)	mg/l soil	14.0	4.09	29.1	4	14.6	1.93	2.56	18.2



Method: UK Soil Methods

Element

P – NaHCO₃ (1/20)

Indicative Values ISE 8570



Unit	Mean	Std.Dev.	CV %	N	Median	MAD	Uncertainty	Rel.Uncert. %
mg/l	37.9	6.99	18.5	12	36.9	3.99	2.52	6.66