

Supplementary Information

Validation Method to Determine Metals in Atmospheric Particulate Matter by Inductively Coupled Plasma Optical Emission Spectrometry

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Table S1. Operational conditions of the Optima DV 7300 spectrometer

Parameter	Standard condition
Ar plasma flow rate	15 L min ⁻¹
Ar nebulizer flow rate	0.6 L min ⁻¹
Ar auxiliary flow rate	1.0 L min ⁻¹
Equipment power	1400 W
Sample aspiration flow rate	1.5 mL min ⁻¹
Reading time	30 s
Replicates	7

Table S2. Spectral lines adopted for the determinations and Pearson's coefficient (r) of the standard addition curve

Element	Spectral lines / nm	r_1	r_2
Al	396.153	0.9996	0.9998
Ca	422.673	0.9998	0.9993
Cd	214.440	0.9999	0.9994
Cr	267.716	0.9999	0.9992
Cu	327.393	0.9999	0.9993
Fe	259.939	0.9999	0.9995
K	766.490	0.9997	0.9994
Mg	280.271	0.9999	0.9991
Mn	257.610	0.9999	0.9999
Na	589.592	0.9999	0.9992
Ni	231.604	0.9999	0.9999
Pb	220.353	0.9999	0.9999
Ti	334.940	0.9999	0.9992
V	292.402	0.9999	0.9994
Zn	206.200	0.9993	0.9978

r_1 : low concentrations (0 to 1.0 mg L⁻¹); r_2 : medium concentrations (1.0 to 8.0 mg L⁻¹).

Table S3. Experimental factorial plan for the determination robustness using Youden and Steiner³⁰ test

Variable	Normal condition	Alternative condition	Experimental condition							
			1	2	3	4	5	6	7	8
Ar plasma flow rate	15 L min ⁻¹ (A)	16 L min ⁻¹ (a)	A	A	A	A	a	a	A	a
Ar nebulizer flow rate	0.6 L min ⁻¹ (B)	0.7 L min ⁻¹ (b)	B	B	B	b	B	B	B	b
Equipments power	1400 W (C)	1500 W (c)	C	c	C	c	C	c	C	c
Sample aspiration flow rate	1.5 mL min ⁻¹ (D)	1.3 mL min ⁻¹ (d)	D	D	D	d	d	d	D	D
Heating temperature	95 °C (E)	105 °C (e)	E	e	E	e	e	E	E	E
Acid volume	3.0 mL (F)	3.3 mL (f)	F	f	F	F	F	f	F	F
Extraction time	2 h (G)	2 h 15 min (g)	G	g	G	G	g	G	G	g

Table S4. Student t test for various dilutions of matrix

Elem.	Matrix dilution							Average	Standard deviation	t calculated	t critic	Result
	1	1:1	1:2	1:4	1:10	1:20	1:40					
Al	5.69	4.84	5.04	5.08	4.31	4.54	4.62	4.87	0.45	0.12	2.57	same
Ca	5.23	4.14	4.66	4.78	4.15	4.41	4.46	4.55	0.38	0.53	–	same
Cd	3.84	4.15	4.91	4.67	4.50	4.60	4.28	4.42	0.36	0.72	–	same
Cr	4.10	4.34	5.04	5.09	4.55	4.64	4.38	4.59	0.37	0.50	–	same
Cu	4.37	4.54	5.34	5.35	4.73	4.82	4.48	4.80	0.40	0.22	–	same
Fe	4.51	4.72	5.60	5.66	5.05	5.16	4.78	5.07	0.44	-0.07	–	same
K	5.05	4.02	4.42	4.61	3.84	4.13	4.14	4.31	0.41	0.75	–	same
Mg	5.52	4.62	5.11	5.12	4.53	4.62	4.64	4.88	0.37	0.14	–	same
Mn	4.06	4.29	4.75	4.80	4.28	4.37	4.34	4.41	0.27	0.98	–	same
Na	7.77	3.77	5.19	5.16	3.67	4.41	4.52	4.93	1.39	0.02	–	same
Ni	3.66	4.53	4.87	4.93	4.42	4.50	4.61	4.50	0.42	0.53	–	same
Pb	3.23	3.61	3.83	6.52	3.27	3.32	3.32	3.87	1.19	0.42	–	same
Ti	4.22	4.30	4.76	4.80	4.27	4.35	4.33	4.43	0.24	1.06	–	same
V	4.13	4.36	4.81	4.84	4.33	4.41	4.39	4.47	0.26	0.90	–	same
Zn	5.75	4.38	4.97	5.03	4.21	4.52	4.64	4.79	0.52	0.18	–	same

Table S5. Pearson coefficients for low, medium and high concentration curves

Element	r_1	r_2	r_3
Al	0.99997	0.99996	0.99999
Ca	0.99987	0.99999	0.99999
Cd	0.99998	0.99999	0.99984
Cr	0.99996	0.99999	0.99995
Cu	0.99994	0.99998	0.99998
Fe	0.99997	0.99999	0.99992
K	0.99835	0.99897	0.99997
Mg	0.99998	1.0	0.99988
Mn	0.99995	0.99981	0.99994
Na	0.99564	0.99998	0.99999
Ni	0.99994	1.0	0.99995
Pb	0.99964	0.99999	0.99994
Ti	0.99987	0.99998	0.99986
V	0.99995	0.99996	0.99986
Zn	0.99998	1.0	0.99990

1: low concentration curve (0.01-0.1 mg L⁻¹); 2: medium concentration curve (0.2-1.0 mg L⁻¹); 3: high concentration curve (2.0-10.0 mg L⁻¹).

Table S6. Relative standard deviation (RSD%) in different analyte concentrations

Element	Concentration of the standard solution / (mg L ⁻¹)				
	0.2	0.5	1.0	2.0	10.0
Al	0.8	1.5	1.3	1.0	1.3
Ca	0.6	0.6	0.7	0.3	0.9
Cd	0.4	0.7	1.0	0.5	1.7
Cr	0.4	0.4	0.8	0.5	1.7
Cu	0.4	0.4	0.8	0.4	1.7
Fe	0.4	0.6	0.8	0.5	1.6
K	0.9	0.9	0.7	0.6	1.1
Mg	0.7	0.8	0.7	0.4	1.2
Mn	0.3	0.5	0.9	0.3	1.7
Na	0.5	0.7	0.7	0.3	0.7
Ni	0.6	0.5	0.9	0.5	1.4
Pb	1.3	1.1	1.0	0.5	1.2
Ti	1.4	0.5	0.9	0.3	1.7
V	2.1	0.5	0.8	0.5	1.7
Zn	0.4	0.7	1.0	0.5	1.0