

Table S1 Information on waste incinerators collected in some provinces in the North of Vietnam

TT	Sample site	Samples	IC (ton/h)	AOT (h/year)	Type of waste
1	Bac Ninh 1	IW1	5,00	8,03×103	100% municipal waste (plastic, packaging, food waste)
2	Hai Phong 1	IW2	1,00	7,30×1000	100% municipal waste (plastic, packaging, food waste)
3	Ha Noi	IW3	4,50	8,03×1000	100% municipal waste (plastic, packaging, food waste)
4	Hai Phong 2	IW4	1,00	7,30×1000	100% municipal waste (plastic, packaging, food waste)
5	Bac Ninh 2	IW5	5,00	8,03×1000	100% industrial waste (such as nylon, cloth, paper, pressed mud, plastic, chemical)
6	Bac Giang	IW6	3,00	8,03×1000	100% industrial waste (such as nylon, cloth, paper, pressed mud, plastic, chemical)
7	Hai Duong	IW7	2,50	8,03×103	100% industrial waste (such as nylon, cloth, paper, pressed mud, plastic, chemical)

IC=Incineration Capacity; AOT= Average operating time.

Table S2 Total concentrations of heavy metals in waste incinerators (mg/kg)

Samples	Concentration (mg/kg)													Total carbon (TC) (g/kg)	Oranic carbon (OC) (g/kg)
	As	SD	Cd	SD	Cu	SD	Cr	SD	Pb	SD	Zn	SD	PH		
Fly ash (n=21)															
IW1	29.5	6.18	10.0	1.75	1560	108	749	92.5	2231	12.9	2631	335	9.09	12.9	8.76
IW2	101	30.9	6.82	1.55	57.83	15.2	276	32.8	3014	99.1	1012	279	10.3	14.3	4.23
IW3	5.65	0.66	98.4	20.3	1257	600	756	120	1942	28.3	2960	507	11.2	17.6	5.76
IW4	32.0	4.54	5.62	2.10	1236	210	796	107	3201	34.2	3681	306	10.5	11.3	3.24
IW5	19.0	7.46	5.41	1.99	1286	201	815	98.3	1920	56.3	2978	214	9.84	22.7	9.01
IW6	9.03	2.03	5.75	1.33	3171	70.2	315	76.8	1052	12.5	3081	602	9.71	23.1	7.87
IW7	19.3	8.03	14.6	4.59	1989	120	953	213	1826	6.11	3322	432	8.97	14.7	12.1
Mean	30.8	8.55	21.0	4.81	1508	189	666	106	2169	35.6	2809	382	9.94	16.7	7.28
Bottom ash (n=21)															
IW1	12.4	3.19	5.82	3.87	1876	221	694	106	2406	38.9	2238	700	10.7	25.7	10.2
IW2	48.3	12.8	7.64	2.68	304.1	54.2	348	109	2050	25.2	606.4	211	12.3	31.6	18.5
IW3	3.02	0.598	8.23	2.24	3508	302	1510	301	1210	15.3	1847	493	12.5	38.2	14.2
IW4	8.70	0.584	7.32	2.58	2387	149	322	43.6	1998	46.3	2697	652	9.72	28.9	21.3
IW5	7.70	1.23	3.31	1.14	1317	164	802	67.7	1662	10.1	1741	74.7	10.9	65.1	50.9
IW6	12.5	4.34	6.71	3.27	1391	77.3	867	289	1005	29.4	2126	407	12.8	43.8	12.4
IW7	8.67	1.21	8.20	3.42	2750	252	881	188	949.2	7.30	2311	632	10.0	30.4	22.2
Mean	14.5	3.68	6.75	2.96	1933	196	775	149	1612	26.6	1938s	552	11.3	37.7	21.4

SD: standard deviation; TC: Total carbon in ash; OC: Oranic carbon

Table S3 Daily intake and non-carcinogenic risk (HI) of heavy metals in fly ash and bottom ash from waste incinerators

Fly ash						
<i>Child</i>	As	Cd	Cu	Cr	Pb	Zn
ID _{ing}	3.94E-04	2.68E-04	1.93E-02	8.51E-03	2.77E-02	3.59E-02
ID _{inh}	1.10E-08	7.51E-09	5.41E-07	2.39E-07	7.78E-07	1.01E-06
ID _{dermal}	1.10E-06	7.50E-07	5.40E-05	2.38E-05	7.77E-05	1.01E-04
HQ _{ing}	1.31E+00	5.36E-01	4.82E-01	2.84E+00	7.92E+00	1.20E-01
HQ _{inh}	3.68E-05	1.50E-05	1.35E-05	8.35E-03	2.21E-04	3.36E-06
HQ _{dermal}	3.68E-03	1.32E-02	4.50E-03	3.97E-01	1.48E-01	1.68E-03
<i>HI = ΣHQ</i>	1.32E+00	5.48E-01	4.86E-01	3.16E+00	8.05E+00	1.21E-01
<i>Adult</i>						
ID _{ing}	4.22E-05	2.87E-05	2.07E-03	9.12E-04	2.97E-03	3.85E-03
ID _{inh}	3.97E-09	2.70E-09	1.94E-07	8.58E-08	2.80E-07	3.62E-07
ID _{dermal}	1.68E-07	1.15E-07	8.24E-06	3.64E-06	1.19E-05	1.54E-05
HQ _{ing}	1.41E-01	5.74E-02	5.16E-02	3.04E-01	8.49E-01	1.28E-02
HQ _{inh}	1.32E-05	5.40E-06	4.84E-06	3.00E-03	7.95E-05	1.21E-06
HQ _{dermal}	5.61E-04	2.01E-03	6.87E-04	6.07E-02	2.26E-02	2.56E-04
<i>HI = ΣHQ</i>	1.41E-01	5.94E-02	5.23E-02	3.68E-01	8.72E-01	1.31E-02
Bottom ash						
<i>Child</i>	As	Cd	Cu	Cr	Pb	Zn
ID _{ing}	1.85E-04	8.63E-05	2.47E-02	9.91E-03	2.06E-02	2.48E-02
ID _{inh}	5.19E-09	2.42E-09	6.93E-07	2.78E-07	5.78E-07	6.95E-07
ID _{dermal}	5.18E-07	2.42E-07	6.92E-05	2.77E-05	5.77E-05	6.94E-05
HQ _{ing}	6.17E-01	1.73E-01	6.18E-01	3.30E+00	5.89E+00	8.26E-02
HQ _{inh}	1.73E-05	4.84E-06	1.72E-05	9.72E-03	1.64E-04	2.32E-06
HQ _{dermal}	1.73E-03	4.24E-03	5.77E-03	4.62E-01	1.10E-01	1.16E-03
<i>HI = ΣHQ</i>	6.18E-01	1.76E-01	6.23E-01	3.70E+00	5.99E+00	8.36E-02
<i>Adult</i>						
ID _{ing}	1.98E-05	9.24E-06	2.65E-03	1.06E-03	2.21E-03	2.66E-03
ID _{inh}	1.87E-09	8.70E-10	2.49E-07	9.99E-08	2.08E-07	2.50E-07
ID _{dermal}	7.91E-08	3.69E-08	1.06E-05	4.24E-06	8.81E-06	1.06E-05
HQ _{ing}	6.61E-02	1.85E-02	6.62E-02	3.54E-01	6.31E-01	8.85E-03
HQ _{inh}	6.22E-06	1.74E-06	6.20E-06	3.49E-03	5.90E-05	8.33E-07
HQ _{dermal}	2.64E-04	6.47E-04	8.81E-04	7.06E-02	1.68E-02	1.77E-04
<i>HI = ΣHQ</i>	6.64E-02	1.91E-02	6.71E-02	4.28E-01	6.48E-01	9.03E-03

ID_{ing}: daily intake through ingestion, *ID_{inh}*: daily intake through inhalation, *ID_{dermal}*: daily intake through skin contact
HQ_{ing/inh/dermal}: HQ represents the hazard quotient through ingestion, inhalation, and skin contact
HI: Non-carcinogenic risk ($HI = \Sigma HQ_{ing/inh/dermal}$)

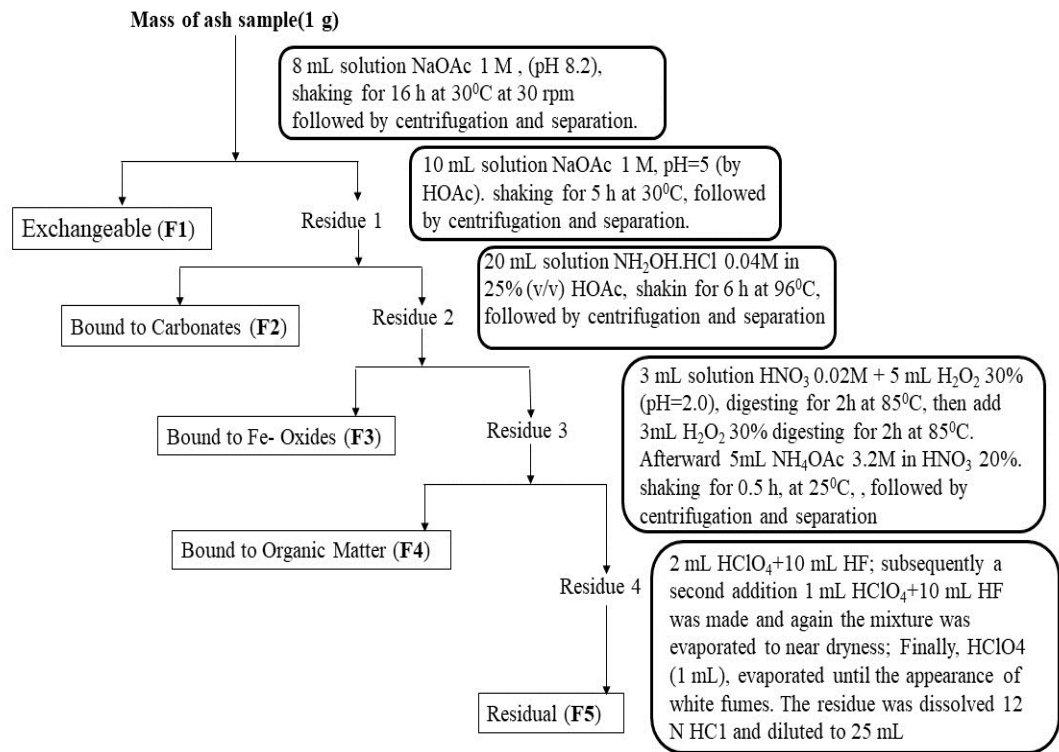


Fig S1 Tessier sequential extraction procedure

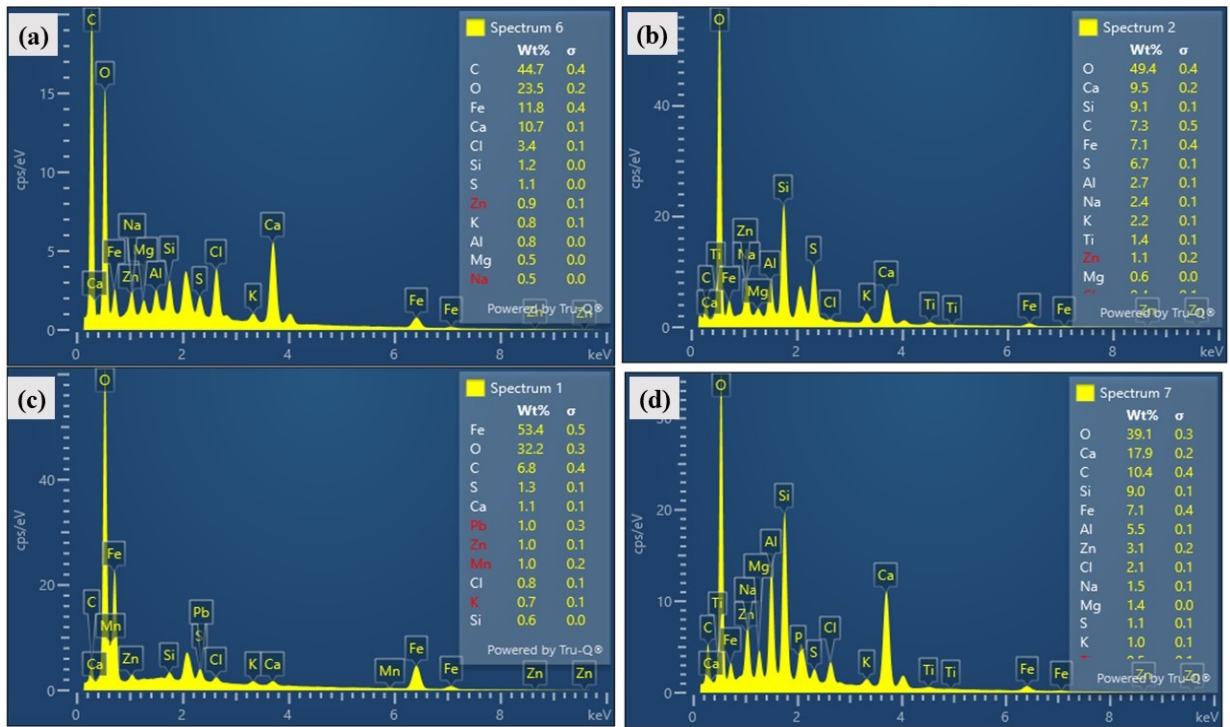


Fig S2 The EDX spectrum with major peaks of fly ash and bottom ash collected from industrial (a,c) and municipal (b,d) waste incinerators