Influence of a modification of the petcoke/coal ratio on the leachability of fly ash and slag produced from a large PCC power plant

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Supporting information

Information available: 4 pages, 2 Tables, 2 Figures

After calibration of the energy scale with respect to the zero-point of energy defined by the spectrum of the elemental standard, the normalized XAFS spectra were then divided into separate X-ray absorption near-edge structure (XANES) and extended X-ray absorption fine structure (EXAFS) regions. However, the spectral data obtained were only of sufficient quality for analysis of the XANES (X-ray absorption near-edge structure) region of the spectrum.

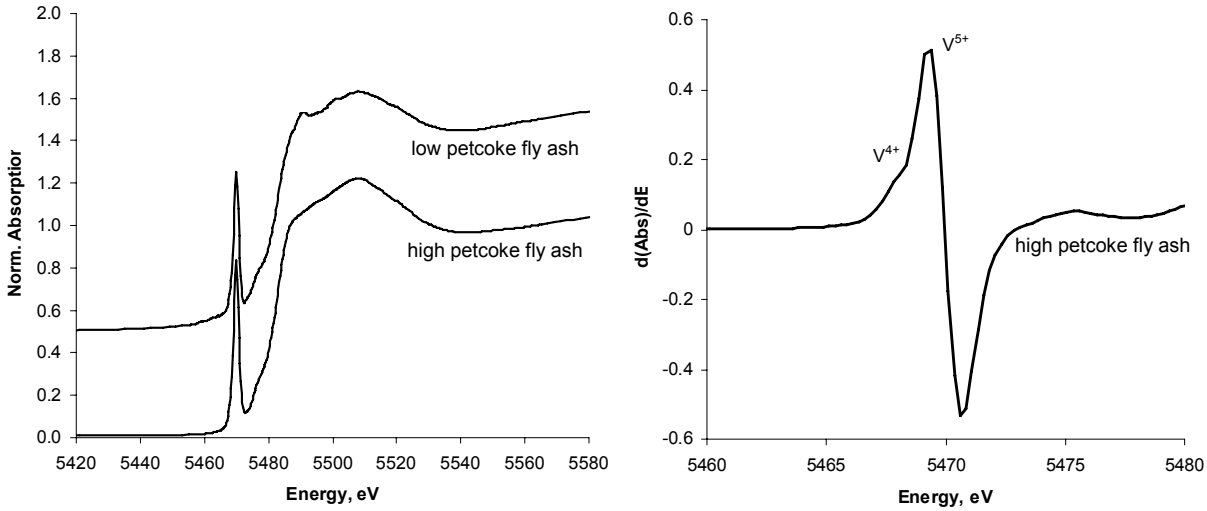

Figure S1. Comparison of V XANES spectra for the low and high-petcoke fly ash (left) and derivative spectrum of the pre-edge region for the high-petcoke fly ash (right).

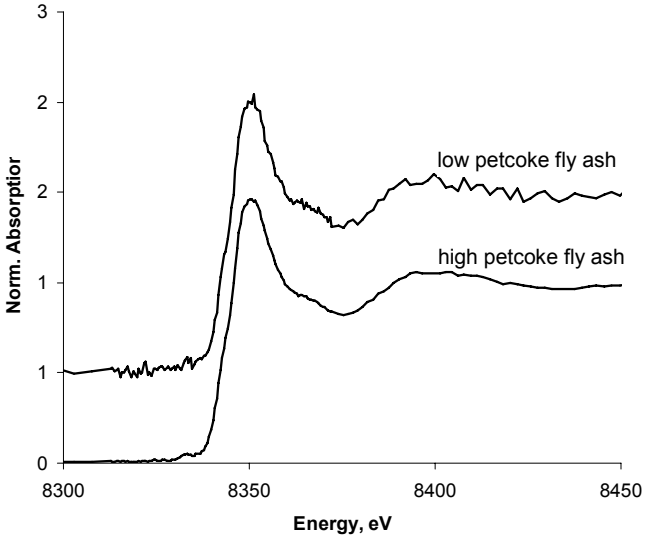

Figure S2. Comparison of Ni XANES spectra for the low and high-petcoke fly ash.

Table S1. Bulk content, leachable content and water extractable fraction according to EN 12457-2 leaching test of a number of elements in the co-fired slag and fly ash selected in this study. The analytical error for each element is also shown.

		LOW PETCOKE						HIGH PETCOKE					
			Slag			Fly ash			Slag			Fly ash	
	An err%	bulk %	leachable mg/kg	extract %	bulk %	leachable mg/kg	extract %	bulk %	leachable mg/kg	extract %	bulk %	leachable mg/kg	extract %
Si	4	24.75	89	<0.5	24.03	6	<0.5	25.04	69	<0.5	23.85	9	<0.5
Al	3	12.65	45	<0.5	13.69	80	<0.5	12.57	33	<0.5	12.71	32	<0.5
Ca	1	2.12	76	<0.5	2.03	2098	10	2.11	45	<0.5	1.97	3073	16
K	3	2.97	50	<0.5	3.04	285	1	3.00	49	<0.5	3.00	587	2
Mg	5	1.18	18	<0.5	1.10	39	<0.5	1.20	18	<0.5	1.09	337	3
Na	5	0.52	22	<0.5	0.63	168	3	0.60	19	<0.5	0.61	315	5
Fe	2	6.33	13	<0.1	5.16	0.1	<0.5	6.36	9	<0.5	4.85	0.1	<0.5
Ti	3	1.07	1	<0.1	1.24	1	<0.5	1.06	1	<0.5	1.19	1	<0.5
P	5	0.14	3	<0.5	0.28	0.5	<0.5	0.17	3	<0.5	0.22	2	<0.5
S	7	0.01	27	23	0.20	1868	93	0.01	19	36	0.35	3190	92
	An err%	bulk mg/kg	leachable mg/kg	extract %	bulk mg/kg	leachable mg/kg	extract %	bulk mg/kg	leachable mg/kg	extract %	bulk mg/kg	leachable mg/kg	extract %
As	4	23	0.2	1	167	1	0.7	19	0.2	1	136	2	2
B	n.a.	58	0.3	1	112	18	16	44	0.4	0.9	87	17	19
Ba	1	1486	0.2	<0.5	1670	1	<0.5	1433	0.1	<0.5	1645	0.5	<0.5
Cd	33	1	0.01	<0.5	2	0.02	1	1	<0.01	<0.5	2	0.04	2
Cl	n.a.	597	<40	-	716	<40	-	700	<40	-	637	<40	-
Co	6	36	1	3	45	0.03	<0.5	41	1	2	53	0.03	<0.5
Cr	3	252	0.1	<0.5	299	3	1	292	0.1	<0.5	347	1	<0.5
Cu	5	128	0.05	<0.5	148	0.1	<0.5	130	0.02	<0.5	150	0.1	<0.5
F	n.a.	<10	3	-	190	29	15	<10	4	-	123	21	17
Ga	4	39	0.1	<0.5	56	0.3	0.6	38	0.04	<0.5	56	0.3	0.5
Ge	7	4	0.01	<0.5	7	0.03	0.5	2	0.02	0.8	8	0.1	0.9
Hf	12	5	<0.01	<0.5	6	0.01	<0.5	6	0.01	<0.5	7	0.01	<0.5
Hg	n.a.	0.002	<0.001	-	0.0205	<0.001	-	0.002	<0.001	-	0.0037	<0.001	-
Li	n.a.	295	1	0.5	329	14	4	314	2	0.6	322	19	6
Mn	3	847	0.1	<0.5	755	0.02	<0.5	827	0.1	<0.5	749	0.1	<0.5
Mo	8	6	0.1	2	17	5	30	11	0.2	2	40	12	30
Ni	3	187	0.05	<0.5	229	0.2	<0.5	1229	0.1	<0.5	1812	0.3	<0.5
Pb	7	49	0.02	<0.5	140	<0.01	<0.5	55	0.02	<0.5	158	0.01	<0.5
Rb	3	216	0.1	<0.5	255	1	<0.5	215	0.1	<0.5	241	1	0.5
Sb	10	9	0.05	0.5	19	0.5	2	11	0.03	<0.5	17	0.4	2
Se	18	11	0.1	0.5	17	0.4	2	13	0.05	<0.5	18	0.3	1
Sn	17	2	0.02	0.8	8	<0.01	<0.5	3	0.01	<0.5	7	<0.01	<0.5
Sr	4	553	0.4	<0.5	697	12	2	544	0.3	<0.5	686	15	2
Ta	65	12	0.02	<0.5	11	0.03	<0.5	20	0.01	<0.5	8	0.04	0.5
Th	7	10	<0.01	<0.5	21	0.01	<0.5	16	0.01	<0.5	12	0.01	<0.5
Tl	14	1	0.02	3	3	0.01	<0.5	1	<0.01	0.9	3	0.01	<0.5
U	10	3	0.02	0.6	<3	0.03	-	7	<0.01	<0.5	2	0.02	1
V	3	283	1	<0.5	380	7	2	2837	6	<0.5	3890	190	5
Y	11	34	<0.01	<0.5	39	<0.01	<0.5	36	<0.01	<0.5	39	<0.01	<0.5
Zn	4	159	<0.01	<0.5	210	0.01	<0.5	105	0.02	<0.5	224	<0.01	<0.5
La	9	72	0.01	<0.5	88	<0.01	<0.5	74	0.01	<0.5	86	<0.01	<0.5
Ce	4	142	0.02	<0.5	165	<0.01	<0.5	142	0.01	<0.5	163	<0.01	<0.5
Pr	14	16	<0.01	<0.5	18	<0.01	<0.5	16	<0.01	<0.5	16	<0.01	<0.5
Nd	3	64	<0.01	<0.5	66	<0.01	<0.5	62	<0.01	<0.5	78	<0.01	<0.5
Sm	8	9	<0.01	<0.5	10	<0.01	<0.5	12	<0.01	<0.5	10	<0.01	<0.5
Eu	17	4	<0.01	<0.5	2	<0.01	<0.5	3	<0.01	<0.5	2	<0.01	<0.5
Gd	15	6	<0.01	<0.5	9	<0.01	<0.5	8	<0.01	<0.5	9	<0.01	<0.5
Tb	9	1	<0.01	<0.5	2	<0.01	<0.5	2	<0.01	<0.5	1	<0.01	<0.5
Dy	11	7	<0.01	<0.5	9	<0.01	<0.5	7	<0.01	<0.5	6	<0.01	<0.5
Ho	12	1	<0.01	<0.5	1	<0.01	<0.5	1	<0.01	<0.5	1	<0.01	<0.5
Er	14	2	<0.01	<0.5	4	<0.01	<0.5	4	<0.01	<0.5	5	<0.01	<0.5
Tm	24	1	<0.01	<0.5	2	<0.01	<0.5	2	<0.01	<0.5	2	<0.01	<0.5
Yb	5	5	<0.01	<0.5	5	<0.01	<0.5	7	<0.01	<0.5	5	<0.01	<0.5
Lu	19	1	<0.01	<0.5	1	<0.01	<0.5	2	<0.01	<0.5	1	<0.01	<0.5

n.a.: not available

Table S2. Criteria for the acceptance of waste at landfills based on RD 2003/33/EC (30) and comparison with leachable concentrations according to EN 12457-2 leaching test of the co-fired fly ash and slag selected in this study and p25-p75 range of PCC fly ash (18). Values in mg/kg.

p25-p75 PCC EU range		Category			Low petcoke		High petcoke	
		Inert	Non hazardous	Hazardous	slag	fly ash	slag	fly ash
0.06-0.5	As	0.5	2	25	0.2	1	0.2	2
2-8	Ba	20	100	300	0.2	1	0.1	0.5
<0.01-0.01	Cd	0.04	1	5	0.01	0.02	<0.01	0.04
1-4	Cr	0.5	10	70	0.1	3	0.1	1
0.04-0.08	Cu	2	50	100	0.05	0.1	0.02	0.1
n.a.	Hg	0.01	0.2	2	<0.001	<0.001	<0.001	<0.001
3-5	Mo	0.5	10	30	0.1	5	0.2	12
0.08-0.2	Ni	0.4	10	40	0.05	0.2	0.1	0.3
0.01	Pb	0.5	10	50	0.02	<0.01	0.02	0.01
0.01-0.2	Sb	0.06	0.7	5	0.05	0.5	0.03	0.4
0.2-1	Se	0.1	0.5	7	0.1	0.4	0.05	0.3
0.2-0.3	Zn	4	50	200	<0.01	0.01	0.02	<0.01
n.a.	Cl^-	800	15000	25000	<40	<40	<40	<40
n.a.	F^-	10	150	500	3	29	4	21
2391-5721	SO_4^{2-}	1000	20000	50000	351	6096	162	10420
0.4-2	V	-	-	-		7	6	190

n.a.: not available.