

Supporting Information

Leachability of mercury in coal fly ash from coal-fired power plants in southwest China

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This document contains 1 figure and 3 tables.

Figure:

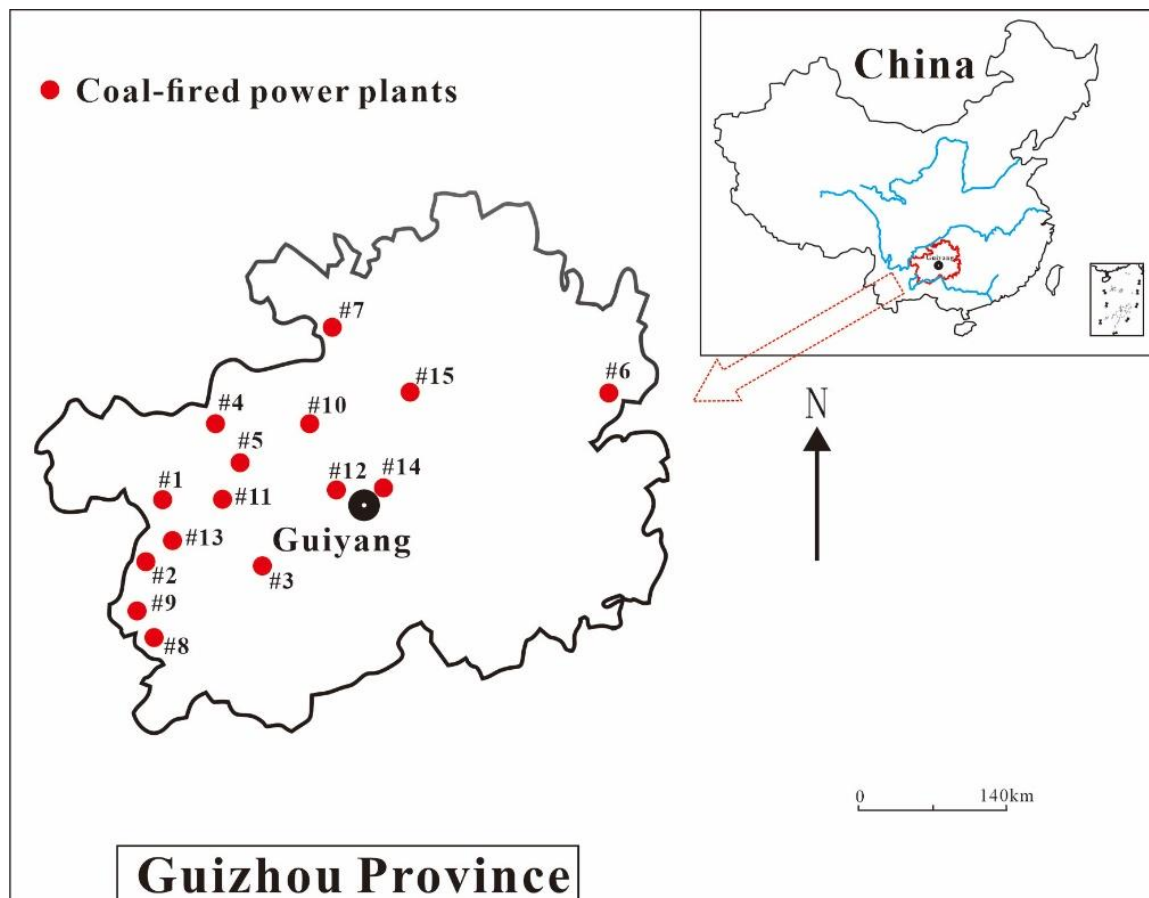


Figure S1 Locations of the 15 studied CFPPs in Guizhou Province, China.

Table:

Table S1 XRF results of coal fly ashes in this study (unit: %)

Sample ID	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	MgO	CaO	Na ₂ O	K ₂ O	MnO	P ₂ O ₅	TiO ₂	SO ₃	LOI	SUM
P1E1	49.15	23.94	11.24	1.74	4.36	0.64	1.18	0.111	0.212	3.560	0.193	3.39	99.71
P1E2	50.07	24.08	10.70	1.76	4.08	0.62	1.29	0.106	0.220	3.721	0.323	2.73	99.70
P2F1	50.13	25.64	7.37	1.58	2.30	0.92	1.45	0.055	0.253	4.313	1.048	5.08	100.14
P2E1	50.42	25.66	7.39	1.59	2.35	0.96	1.41	0.055	0.250	4.366	0.831	5.29	100.57
P3E1	41.48	21.55	13.72	1.25	2.56	1.14	3.05	0.062	0.129	3.040	0.428	11.50	99.91
P3E2	41.94	21.63	13.90	1.46	2.73	1.26	3.02	0.066	0.149	3.222	0.403	9.60	99.38
P4E1	33.07	17.97	8.24	1.11	17.54	1.43	0.89	0.016	0.096	1.692	6.022	11.91	99.99
P4E2	33.15	18.15	8.23	1.11	18.10	1.52	0.88	0.017	0.096	1.701	4.544	11.99	99.49
P5E1	44.05	28.30	8.67	0.99	2.64	2.35	1.69	0.059	0.219	2.830	0.758	7.39	99.95
P5E2	43.83	28.30	8.66	0.98	2.63	2.23	1.69	0.059	0.214	2.826	0.783	7.25	99.45
P6E1	43.85	23.18	15.07	1.14	2.72	1.54	2.75	0.068	0.118	3.024	1.152	5.48	100.09
P6E2	43.11	23.38	15.95	1.42	2.85	1.57	2.85	0.060	0.094	3.170	0.984	4.67	100.11
P7E1	46.57	30.27	10.75	0.94	2.40	0.81	0.81	0.084	0.177	3.489	0.596	2.97	99.87
P7E2	45.52	28.82	11.76	0.98	2.47	0.76	0.87	0.091	0.168	3.398	0.536	4.47	99.85
P8E1	50.06	22.48	9.08	1.35	6.56	0.58	1.12	0.126	0.238	2.700	0.256	5.44	99.99
P8E2	50.34	21.98	9.11	1.34	6.12	0.98	1.12	0.123	0.267	2.688	0.303	5.94	100.31
P9E1	54.51	22.22	6.64	1.21	4.42	1.99	1.27	0.105	0.268	2.849	0.520	3.36	99.36
P9E2	55.79	22.47	6.92	1.49	4.84	0.76	1.17	0.079	0.224	2.860	0.455	2.82	99.87
P9F1	53.22	21.70	6.32	1.39	4.21	0.62	1.15	0.095	0.263	2.915	0.441	7.31	99.64
P9F2	54.76	22.75	6.43	1.39	4.46	0.63	1.17	0.071	0.272	2.894	0.573	4.87	100.27
P10E1	43.33	28.03	9.66	0.98	4.68	2.27	1.53	0.075	0.095	2.335	0.954	6.22	100.17

Sample ID	SiO₂	Al₂O₃	Fe₂O₃	MgO	CaO	Na₂O	K₂O	MnO	P₂O₅	TiO₂	SO₃	LOI	SUM
P10E2	42.58	27.71	9.59	0.98	4.83	2.18	1.55	0.078	0.096	2.172	1.188	7.31	100.27
P11E1	50.05	23.39	9.26	1.41	1.86	1.49	1.53	0.090	0.166	3.352	0.227	7.42	100.25
P11E2	50.55	22.65	8.98	1.56	2.09	1.45	1.57	0.098	0.177	2.978	0.238	7.91	100.25
P12E1	44.61	24.22	13.43	1.20	2.34	2.00	2.65	0.073	0.155	3.096	0.504	5.95	100.23
P12E2	43.49	23.87	13.78	1.26	2.26	1.57	2.43	0.063	0.143	3.182	0.538	7.68	100.26
P13E1	48.71	21.95	10.82	1.62	3.76	0.56	1.75	0.076	0.275	2.792	0.951	6.61	99.87
P13E2	48.23	20.95	14.86	1.94	4.79	0.57	1.54	0.117	0.207	2.960	0.434	3.42	100.02

Note: XRF results for power plants #14-16 are not available.

Table S2 Hg binding forms in coal fly ashes of utility coal boilers in Guizhou Province

Sample ID ^a	Proportion of the total mercury (%)				
	F1	F2	F3	F4	F5
P1E1	1.35	0.34	2.23	85.71	10.37
P1E2	0.13	0.42	2.73	85.66	11.06
P2F1	0.10	0.28	8.92	80.18	10.52
P2F2	0.00	0.06	6.26	89.04	4.64
P2E1	0.08	0.01	7.39	82.53	9.99
P2E2	0.18	0.79	6.87	84.85	7.31
P3E1	0.20	0.08	5.83	87.90	6.00
P3E2	0.01	0.16	6.12	90.13	3.58
P4E1	1.11	0.56	2.57	89.42	6.35
P4E2	0.82	0.12	2.14	90.74	6.17
P5E1	0.11	5.73	10.30	80.42	3.43
P5E2	0.09	4.19	10.64	81.14	3.95
P6E1	2.24	0.98	8.01	79.46	9.32
P6E2	1.52	4.26	13.67	76.40	4.16
P7E1	0.46	0.07	12.70	79.27	7.49
P7E2	0.25	0.12	13.75	79.03	6.85
P8E1	0.18	8.08	17.63	67.00	7.11
P8E2	0.58	2.67	25.01	66.62	5.11
P9E1	1.09	1.45	22.15	64.42	10.89
P9E2	0.30	0.32	3.66	80.92	14.81
P9F1	0.38	0.13	12.52	79.37	7.60
P9F2	0.04	1.03	19.00	74.61	5.32
P10E1	0.06	0.32	14.59	79.88	5.15
P10E2	0.01	0.08	7.66	87.73	4.51
P11E1	4.45	0.69	6.78	82.79	5.28
P11E2	0.20	0.69	4.74	90.08	4.28
P12E1	0.39	0.65	3.97	87.99	7.00
P12E2	0.51	2.00	5.48	85.10	6.92
P13E1	0.06	0.23	1.05	89.24	9.42
P13E2	0.39	0.18	2.99	90.05	6.39
P14E1	0.06	0.29	3.40	85.90	10.35
P15E1	0.13	0.10	9.75	85.62	4.41
P15E2	1.02	0.12	6.71	86.62	5.52
P15E3	0.16	0.05	13.06	82.70	4.04
Max.	4.45	8.08	25.01	90.74	14.81
Min.	0.00	0.01	1.05	64.42	3.43
Mean	0.55	1.10	8.83	82.60	6.92

^a, P: CFPP ID; E: Fly ash collected from ESP; F: Fly ash collected from FF; Max.: maximum; Min.: Minimum.

Table S3 Hg concentrations in extracts under different leaching situations

Leaching situation		Hg concentration (mean $\pm$ SD, ng/L)		
		CFPP #1	CFPP #2	CFPP #3
pH	2	3.36 $\pm$ 0.55 (n=3)ab*	2.15 $\pm$ 0.35 (n=3)b	3.18 $\pm$ 1.88 (n=3)a
	4	3.60 $\pm$ 0.55 (n=3)ab	2.44 $\pm$ 0.53 (n=3)b	2.12 $\pm$ 0.74 (n=3)a
	5.5	2.78 $\pm$ 0.54 (n=3)b	1.92 $\pm$ 0.19 (n=3)b	1.74 $\pm$ 0.26 (n=3)b
	7	1.05 $\pm$ 0.03 (n=3)c	0.77 $\pm$ 0.12 (n=3)c	0.28 $\pm$ 0.16 (n=3)c
	8	0.89 $\pm$ 0.53 (n=3)c	0.31 $\pm$ 0.16 (n=3)c	0 c
	9	0.52 $\pm$ 0.34 (n=3)c	0.36 $\pm$ 0.26 (n=3)c	0.11 (n=1)c
	10.5	0.79 $\pm$ 0.30 (n=3)c	0.67 $\pm$ 0.37 (n=3)c	0.09 $\pm$ 0.07 (n=3)c
	12	0.64 $\pm$ 0.44 (n=3)c	0.51 $\pm$ 0.14 (n=3)c	0.03 $\pm$ 0.03 (n=3)c
	13	4.22 $\pm$ 0.37 (n=3)a	3.47 $\pm$ 0.57 (n=3)a	3.21 $\pm$ 0.60 (n=3)a
Solid-liquid ratio	1:1	2.20 $\pm$ 0.62 (n=3)bc	0.15 $\pm$ 0.18 (n=3)c	0.14 $\pm$ 0.14 (n=3)c
	1:2	1.34 $\pm$ 0.35 (n=3)bc	0.43 $\pm$ 0.08 (n=3)c	0.56 $\pm$ 0.07 (n=3)bc
	1:5	1.25 $\pm$ 0.29 (n=3)c	0.32 $\pm$ 0.23 (n=3)c	0.33 $\pm$ 0.10 (n=3)bc
	1:10	2.78 $\pm$ 0.54 (n=3)b	1.92 $\pm$ 0.19 (n=3)a	1.74 $\pm$ 0.26 (n=3)a
	1:20	6.44 $\pm$ 1.20 (n=3)a	1.04 $\pm$ 0.41 (n=3)b	0.72 $\pm$ 0.44 (n=3)b

*note, n is the sample numbers; the different letters after the mean values for each column indicate that there is significant difference ($p < 0.05$) in the Hg concentrations between different pH or solid-liquid ratio treatment, respectively, on the contrary, the same letter implying there is no significant difference ($p > 0.05$).

Table S4 Hg release fraction of coal fly ash under different leaching situations

Leaching situation		Hg release fraction (%)		
		CFPP #1	CFPP #2	CFPP #3
pH	2	0.029	0.007	0.011
	4	0.031	0.007	0.007
	5.5	0.024	0.006	0.006
	7	0.009	0.002	0.001
	8	0.008	0.001	0
	9	0.004	0.001	0.000
	10.5	0.007	0.002	0.000
	12	0.005	0.002	0.000
	13	0.036	0.011	0.011
Solid-liquid ratio	1:1	0.002	0.000	0.000
	1:2	0.002	0.000	0.000
	1:5	0.005	0.001	0.001
	1:10	0.024	0.006	0.006
	1:20	0.110	0.006	0.005