This supporting information document includes one Figure and seven Tables.

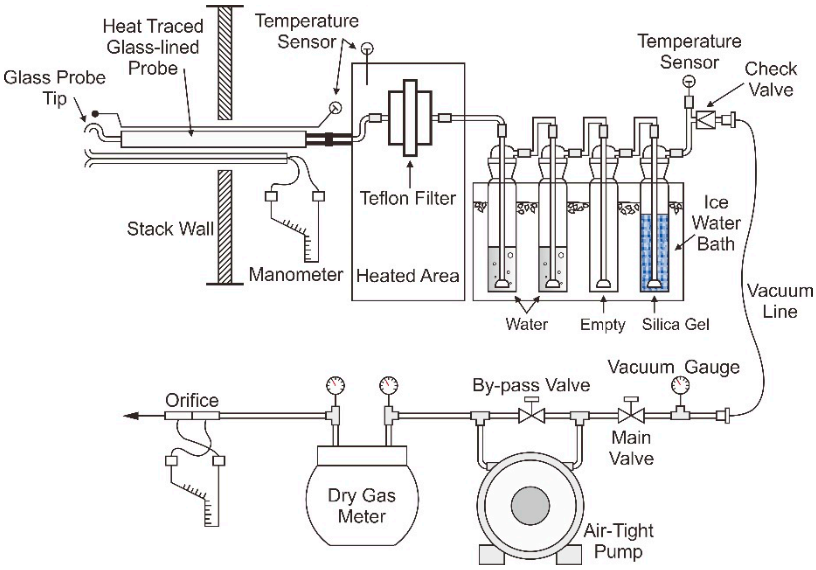

Figure 1. The USA EPA Test Method 5 for particulate matter sampling in the stack flue gas [1].

Table 1. The recovery of Cr in different certified reference materials (CRMs).

CRMs	Certified Value (mg/kg)	Measured Value (mg/kg)	Recovery (%)
NIST 1632d (coal)	13.7	12.9 ± 0.5 (*n* = 3)	94.1
NIST 1633c (fly ash)	258	236.5 ± 10.4 (*n* = 3)	91.7
Jdo-1 (dolomite)	7.9	9.0 ± 0.2 (*n* = 3)	113.8

Table S2. Classification of elements based on their behavior during combustion in the boiler and ducts with their REI factor (Based on Meij, [2]).

Group	Bottom Ash	Captured fly Ash	Behavior in Installation
I	≈1	≈1	Not volatile
II	<0.7	≈1	Volatile, but condensation within the installation on the ash particles
III	<<1	<1	Very volatile, hardly any condensation

Table 3. Concentrations of Cr, V, Ni, and Co in feed coal, bottom ash, and captured fly ash in CFPPs in Guizhou, and the concentration ratios of Cr to V, Ni, and Co in different samples.

CFPPs *	Feed Fuel						
	Concentration (mg/kg)				Ratio 1		
	Cr	V	Ni	Co	Cr/V	Cr/Ni	Cr/Co
#1	97	253	51.9	17.0	0.38	1.86	5.68
#2	69	150	37.2	16.1	0.46	1.85	4.25
#3	96	200	42.0	17.4	0.48	2.28	5.50
#4	40	88	21.7	12.7	0.46	1.86	3.18
#5	40	80	27.0	9.4	0.49	1.47	4.21
#6	45	92	17.6	10.7	0.49	2.54	4.18
#7	78	109	24.8	12.4	0.72	3.16	6.33
#8	42	126	26.6	10.2	0.34	1.59	4.15
#9	65	138	31.5	15.5	0.47	2.05	4.16
#10	68	150	33.3	21.5	0.45	2.04	3.16

#11	54	134	29.2	15.2	0.40	1.85	3.54			
#12	71	162	39.8	18.7	0.44	1.79	3.82			
#13	58	116	32.1	12.2	0.50	1.81	4.75			
#14	46	105	22.6	10.9	0.44	2.04	4.21			
**Mean (No. = 6) ** **					**0.46**	**1.98**	**4.50**			
Mean (No. = 14)					**0.46**	**2.01**	**4.37**			
CFPPs *	**Bottom Ash**							**Ratio 2/Ratio 1**		
	Concentration (mg/kg)				**Ratio 2**					
	Cr	**V**	**Ni**	**Co**	**Cr/V**	**Cr/Ni**	**Cr/Co**	**Cr/V**	**Cr/Ni**	**Cr/Co**
#1	187	437	105.1	35.9	0.43	1.78	5.21	0.92	0.88	1.19
#2	192	379	102.0	40.8	0.51	1.89	4.72	1.09	0.94	1.08
#3	199	386	88.7	39.4	0.51	2.24	5.03	1.11	1.11	1.15
#4	550	240	66.8	30.4	**2.29**	**8.24**	**18.09**	**4.92**	**4.10**	**4.14**
#5	142	199	89.3	26.7	0.71	1.59	5.31	1.53	0.79	1.22
#6	157	295	86.3	36.9	0.53	1.82	4.26	1.15	0.91	0.98
#7	106	176	46.3	21.2	0.60	2.29	5.00	1.30	1.14	1.14
#8	190	360	101.0	32.4	0.53	1.88	5.87	1.14	0.94	1.34
#9	457	345	84.8	33.4	**1.32**	**5.38**	**13.67**	**2.84**	**2.68**	**3.13**
#10	477	317	83.5	40.0	**1.51**	**5.71**	**11.91**	**3.24**	**2.84**	**2.73**
#11	155	312	87.8	35.5	0.50	1.77	4.38	1.07	0.88	1.00
#12	184	413	100.4	43.8	0.45	1.84	4.21	0.96	0.91	0.96
#13	314	255	66.6	33.9	**1.23**	**4.72**	**9.28**	**2.65**	**2.34**	**2.12**
#14	288	302	87.8	36.0	**0.95**	**3.28**	**8.00**	**2.05**	**1.63**	**1.83**
Mean (No. = 6)					**0.83**	**2.93**	**7.10**	**1.79**	**1.45**	**1.63**
Mean (No. = 14)					**0.86**	**3.17**	**7.50**	**1.85**	**1.58**	**1.72**
CFPPs *	**Captured Fly Ash**							**Ratio 3/Ratio 1**		
	Concentration (mg/kg)				**Ratio 3**					
	Cr	**V**	**Ni**	**Co**	**Cr/V**	**Cr/Ni**	**Cr/Co**	**Cr/V**	**Cr/Ni**	**Cr/Co**
#1	195	520	109.0	39.9	0.38	1.79	4.89	0.81	0.89	1.12
#2	155	385	88.6	36.0	0.40	1.75	4.31	0.87	0.87	0.99
#3	213	432	95.6	43.8	0.49	2.23	4.88	1.06	1.11	1.12
#4	106	287	71.2	33.9	0.37	1.49	3.13	0.80	0.74	0.72
#5	130	212	54.9	25.2	0.61	2.37	5.17	1.32	1.18	1.18
#6	136	327	73.1	37.3	0.42	1.87	3.66	0.90	0.93	0.84
#7	105	248	58.2	26.2	0.42	1.81	4.01	0.91	0.90	0.92
#8	186	355	75.1	30.6	0.52	2.47	6.06	1.12	1.23	1.39
#9	130	442	95.8	38.8	0.30	1.36	3.36	0.63	0.68	0.77
#10	162	329	68.4	37.9	0.49	2.37	4.27	1.06	1.18	0.98
#11	168	355	77.8	39.6	0.47	2.15	4.23	1.01	1.07	0.97
#12	186	441	98.1	44.6	0.42	1.90	4.16	0.91	0.94	0.95
#13	164	328	81.0	40.3	0.50	2.02	4.06	1.07	1.00	0.93
#14	170	345	77.2	39.6	0.49	2.20	4.29	1.06	1.09	0.98
Mean (No. = 6)					**0.45**	**1.92**	**4.34**	**0.96**	**0.95**	**0.99**
Mean (No. = 14)					**0.45**	**1.98**	**4.32**	**0.97**	**0.99**	**0.99**

* CFPPs #1–6 were investigated in this study, CFP#7–#14 are internal unpublished data, #7 is a CFB boiler (150 MW) and #8–14 are PC boilers (300-660MW); ** Arithmetic mean of CFPPs #1–6. Data shown in blue and bold indicate the abnormal enrichment of Cr in bottom ash.

Table 4. Comparison of Cr concentrations in solid materials and Cr emission data from different CFPPs.

Region	Boiler Type	APCDs	Installed Capacity (MW)	Coal (mg/kg)	Bottom Ash (mg/kg)	Fly Ash (mg/kg)	Gypsum (mg/kg)	Stack Flue Gas (μg/Nm^3)	Emission Factors	Ref.
Guizhou, China	CFB	SNCR + ESP–FF + WFGD	300	96.5	187	195	38.9	1.95 (0.01%) *	12.64 mg/t coal 9.81 μg/(kW·h) 0.71 g/TJ	This study
Anhui, China	CFB	ESP	330	46.6	92.7 (49.2%) *	59.4 (47.3%) *	-	5.11 (3.5%) *		[3]
Shanxi, China	CFB	FF	300	42	120	48	-		-	[4]
Guizhou, China (No. = 5)	PC	SCR + ESP(-FF) + WFGD	200–660	39.9–95.6 (57.8 ± 21.7)	142–550 (248 ± 153)	106–214 (148 ± 36)	24.0–42.0 (33.5 ± 6.7)	1.36–2.16 (1.8 ± 0.3) (0.01–0.03%) *	15.30 ± 3.86 mg/t coal 7.30 ± 2.59 μg/(kW·h) 0.70 ± 0.21 g/TJ	This study
North China	PC	SCR + ESP–FF + WFGD	320	14.6	- (4.53%) *	32.9–43.3 (75.9%) *	126.6 (18.1%) *	- (1.5%) *	0.07–0.09 g/TJ	[5]
China	PC	SCR + ESP + WFGD	100	13	-	-	35	3.11	25.07 mg/t coal	[6]
Hebei,China	PC	SCR + ESP + WFGD	320	20.4	-	-	-	0.72 (<0.05%)	0.246 g/TJ	[7]
Jiangsu, China	PC	SCR + ESP–FF + WFGD	350	7.7–10.0			-	0.79–1.44	0.30–0.52 g/TJ	[8]
China	PC	SCR + ESP + WFGD + WESP	660	12.8	48	87	28	0.44–0.48	3.81–4.15 mg/t coal	[9]
North China	PC	SCR + ESP + WFGD + WESP	300 MW	14.50	52.1	76.9	8.94	2.229 (0.14%) *		[10]
China	PC	SCR + ESP + WFGD + WESP	660	12.3	47.9	76.15	5.9	1.33 (<0.1%) *	10.71 mg/t coal	[11]
Canada	PC	ESP	800 MW	22.4	176	103	-	(1.00%) *	(2.08 kg/day) **	[12]
Canada	PC	ESP	760	33.2	156	101	-	5.3 (0.17%) *	(0.4 kg/day) **	[13]
Canada	PC	Cyclone + FF	150	51.7	344	192	-	(0.58%) *	(0.71 kg/day) **	[14]
U.S.A	PC	Venture wet scrubber	190	-	-	-	-	55–82	-	[15]
U.S.A	PC	ESP	770	-	-	-	-	126–156	-	[15]
U.S.A.	PC	SCR + ESP + Mg-WFGD	-	195	374 (39%) *	131 (58%) *	61	(<2%) *		[16]
21 CFPPs in Japan				13.8			-	0.505 (0.421%) *	1.68 μg/(kW·h)	[17]
Netherland	PC	ESP + WFGD	600	18	-	214	-	-	3.4 μg/(kW·h) 0.38 g/TJ	[18]

Note: * share (%) in total Cr output; ** daily emissions of Cr (kg/day) from each CFPP.

Table 5. Material consumption, production rate, and PM content in the stack flue gas of the six utility boiler systems.

CFPPs	#1	#2	#3	#4	#5	#6
Feed fuel (t/d)	1070 [a] 2339 [b]	5053	2032	3551	2366	4293
Limestone (t/d)	36	448	108	140	265	n.a.
Bottom ash (t/d)	563	139	101	149	141	137
Fly ash (t/d)	1120	2056	1054	841	800	1192
Gypsum (t/d)	58	815	202	252	495	n.a.
Stack flue gas (10^4 Nm^3/d)	2213	3995	1420	3367	1571	3390
Actual operating power (MW)	183	448	153	368	190	450

[a] gangue; [b] coal slime; n.a. not applicable.

Table 6. Cr flow and mass balance of the six tested utility boilers.

CFPPs	#1	#2	#3	#4	#5	#6
Input (g/d)	329,501	347,859	196495	146,862	99,816	192,651
Feed fuel	91,573 [a] 237,372 [b]	346,834	194,319	143,095	93,450	192,651
Limestone	555	1025	2176	3768	6366	n.a.
Output (g/d)	326,116	375,366	251,322	181,744	129,442	184,202
Bottom ash	105,320	26,678	20,045	81,967	20,003	21,605
ESP/ESP–FF Fly ash	218,491	318,800	224,941	89,165	104,014	162,551
Gypsum	2262	29,802	6306	10,565	5395	n.a.
Flue gas	43	86	30	46	30	46
Output/Input (%)	99.0	107.9	127.9	123.8	129.7	95.6

[a] gangue; [b] coal slime; n.a., not applicable.

Table 7. Cr contributions (%) from the different input and output materials in the six tested utility boilers.

Direction	Samples	#1	#2	#3	#4	#5	#6
Input	Feed fuel	27.79 [a] 72.04 [b]	99.71	98.89	97.43	93.62	100
	Limestone	0.17	0.29	1.11	2.57	6.38	n.a.
Output	Bottom ash	32.30	7.11	7.98	45.10	15.45	11.73
	ESP/ESP–FFFly ash	67.00	84.93	89.50	49.06	80.36	88.25
	Gypsum	0.69	7.94	2.51	4.81	4.17	n.a.
	Stack flue gas	0.01	0.02	0.01	0.03	0.02	0.03

[a] gangue; [b] coal slime; n.a., not applicable.

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