

Supplementary material

Environmental Impacts on Soil and Groundwater of Informal E-Waste Recycling Processes in Ghana

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Table S1 Chemical patterns of organic pollutants

Soil samples Ghana (concentration in µg/kg d.w.)		No. Site	21/0304- 30 Site 1	21/0304- 31 Site 2	21/0304- 32 Site 3	21/0304- 33 Site 4	21/0304- 34 Site 5	21/0304- 35 Site 6	21/0304- 36 Site 7
Chlorobenzenes Cl2 - Cl6	Cl2Bz	1,2-dichlorobenzene	1.07	0.10	0.46	0.61	7.91	9.13	17.21
		1,3-dichlorobenzene	0.38	0.02	0.12	0.13	4.22	5.32	2.57
		1,4-dichlorobenzene	0.82	0.04	0.49	0.53	4.36	11.75	191.06
	Cl3Bz	1,2,3-trichlorobenzene	2.93	0.62	16.29	1.45	10.70	19.58	8.08
		1,2,4-trichlorobenzene	36.43	24.32	29.35	8.85	6.96	10.84	15.60
		1,3,5-trichlorobenzene	0.03	0.01	0.24	0.02	0.55	0.84	0.53
	Cl4Bz	1,2,3,4-tetrachlorobenzene	0.48	0.02	0.22	0.23	5.30	8.66	0.85
		1,2,3,5-tetrachlorobenzene	0.27	0.02	0.29	0.10	2.53	6.34	0.44
		1,2,4,5-tetrachlorobenzene	0.42	0.02	0.22	0.14	3.06	5.05	0.57
	Cl5Bz	pentachlorobenzene	1.18	0.04	0.83	0.45	7.72	16.02	0.90
Polychlorinated Biphenyls - PCB (Indicator congeners according to Ballschmiter)	Cl6Bz	hexachlorobenzene	0.66	0.02	0.30	0.27	3.47	9.39	0.45
		sum chlorobenzenes	44.67	25.23	48.84	12.78	56.78	102.9	238.2
	Cl3BP	PCB #028	2.70	0.06	0.13	0.13	0.83	14.85	13.51
	Cl4BP	PCB #052	2.80	0.07	0.35	0.35	0.43	5.92	10.97
	Cl5BP	PCB #101	5.13	0.09	0.27	0.27	0.96	6.34	31.3
		PCB #118	2.39	0.04	0.06	0.06	0.30	1.43	5.67
	Cl6BP	PCB #138	6.62	0.22	0.22	0.22	1.19	0.54	51.2

		PCB #153	4.40	0.15	0.28	0.28	1.63	0.62	60.3
	CI7BP	PCB #180	2.32	0.17	0.19	0.19	1.16	0.47	29.2
		sum PCB6	24.0	0.75	1.43	1.43	6.20	28.73	196.4
		sum PCB7	26.4	0.80	1.49	1.49	6.50	30.16	202.1
Polybrominated diphenylethers - PBDE	Br3DE	#030	0.13	< 0,01	0.011	0.13	0.75	37.1	< 0,01
		#032	0.28	< 0,01	0.009	0.17	0.94	41.9	< 0,01
		#017	0.30	< 0,01	0.013	0.22	1.79	87.8	0.14
		#025	0.18	< 0,01	0.008	0.14	2.08	65.2	< 0,01
		#028/033	0.70	0.04	0.037	0.60	4.21	130.9	0.55
		#035	0.39	< 0,01	0.012	0.14	2.48	72.4	< 0,01
	Br4DE	BDE-75	0.19	< 0,01	0.02	0.11	1.46	32.3	< 0,01
		Br4DE-x1	0.44	< 0,01	0.03	0.11	1.85	54.7	< 0,01
		BDE-71	1.08	< 0,01	0.09	0.77	5.73	184.2	< 0,01
		BR4DE-x2	0.18	< 0,01	0.03	0.27	1.43	34.0	< 0,01
		BDE-47	5.03	0.46	1.36	10.33	24.57	729.5	4.43
		Br4DE-x3	0.47	< 0,01	0.04	0.37	1.93	40.1	< 0,01
		Br4DE-x4	0.62	< 0,01	0.04	0.17	5.92	90.4	< 0,01
		BDE-66	0.67	< 0,01	0.10	0.56	4.92	144.3	< 0,01
	Br5DE	Br5DE-x1	0.24	< 0,01	< 0,01	< 0,01	1.33	11.4	< 0,01
		Br5DE-x2	0.50	< 0,01	< 0,01	< 0,01	0.47	2.4	< 0,01
		Br5DE-x3	0.26	< 0,01	< 0,01	< 0,01	1.51	13.4	< 0,01
		bde-99	7.23	0.38	2.59	11.87	28.58	301.2	8.12
		bde-100	1.81	0.04	0.53	3.40	5.26	116.8	3.86
		bde-119	0.44	< 0,01	< 0,01	< 0,01	2.50	41.7	< 0,01
	Br6DE	bde-154	2.35	< 0,01	0.68	2.54	4.29	19.9	0.94
		bde-153	4.22	0.01	0.57	1.42	3.39	19.4	0.77
	Br7DE	BDE-183	1.54	< 0,02	0.68	1.42	0.97	57.9	3.43
	BR10DE	BDE-209	< 0,05	< 0,05	< 0,05	5.87	15.38	122.4	0.25
		sum Br3DE - Br7DE	29.25	0.93	6.84	34.72	108.34	2329.08	22.24
		sum Br3DE - Br10DE	29.25	0.93	6.84	40.59	123.72	2451.48	22.49
Polycyclic Aromatic Hydrocarbons (PAH)	US-EPA	naphthalene	10.48	0.94	10.17	14.56	58.33	240.7	5128
	indicative	1-methylnaphthalene	10.18	0.94	10.90	10.80	24.46	534.2	170.5
	indicative	2-methylnaphthalene	5.49	1.84	33.01	7.18	21.85	331.6	219.9
	US-EPA	acenaphthylene	1.68	0.88	12.41	6.60	8.10	35.35	108.7
	US-EPA	acenaphthene	0.31	0.43	4.83	5.46	9.17	49.38	36.88
	indicative	biphenyl	14.06	0.93	11.19	3.40	58.64	175.7	790.6
	US-EPA	fluorene	2.08	0.60	5.40	3.37	19.59	223.4	263.6
	US-EPA	phenanthrene	32.73	9.31	47.23	180.8	131.3	470.7	289.5
	US-EPA	anthracene	7.74	2.74	20.69	74.47	50.36	78.51	99.33
	US-EPA	fluoranthene	102.6	30.62	446.3	1154	119.5	213.4	104.8
	US-EPA	pyrene	91.38	26.72	442.6	1297	110.3	1471	224.3

	indicative	cyclopenta[def]fluoranthene	28.16	8.53	90.49	350.3	71.29	130.7	33.52
	indicative	benzo[c]phenanthrene	15.58	3.30	45.76	187.4	33.53	137.5	19.97
	US-EPA	benz[a]anthracene	37.11	22.91	284.5	515.6	51.36	164.7	42.47
	US-EPA	chrysene	32.55	13.94	345.9	523.3	88.66	518.1	36.83
	US-EPA	benzo[b]fluoranthene	21.29	14.92	248.4	319.8	24.65	122.5	19.94
	US-EPA	benzo[k]fluoranthene	18.76	11.64	233.8	279.0	18.94	109.0	10.55
	indicative	benzo[e]pyrene	20.64	23.96	366.4	313.1	44.96	340.2	43.65
	US-EPA	benzo[a]pyrene	24.58	24.62	429.4	548.4	53.92	220.1	24.51
	indicative	perylene	4.14	6.12	153.4	202.3	20.41	125.7	11.04
	US-EPA	indeno[123-cd]pyrene	9.66	5.37	248.7	157.3	21.21	86.74	22.80
	US-EPA	benzo[ghi]perylene	9.05	6.41	321.3	206.5	31.25	272.0	26.07
	US-EPA	dibenzo[ah]anthracene	5.03	3.13	75.68	66.69	5.44	95.88	2.16
		sum PAH	505	221	3888	6427	1077	6147	7730
		sum PAH16	407	175	3177	5352	802	4371	6441
Conventional parameters	acc. DIN EN 13137	TOC (% d.w.)	1.34	0.17	1.24	1.28	3.97	7.68	23.2

Table S2 *Groundwater parameters*

Groundwater parameters									
	Sample No.	Cu mg l-1	Zn mg l-1	Cr mg l-1	Pb mg l-1	Mn mg l-1	Ni mg l-1	As mg l-1	Se mg l-1
Monitored values	1-W	0.327	1.36	0.064	0.677	0.905	0.059	0.019	0.02
	2-W	0.016	0.068	0.011	0.07	0.263	0.048	0.029	0.015
	3-W	0.316	1.49	0.019	0.426	0.899	0.052	0.033	0.18
	4-W	2.97	0.965	0.03	0.016	0.244	0.061	0.08	0.152
	5-W	1.53	0.595	0.024	0.26	0.684	0.027	0.044	0.018
	6-W	0.315	0.341	0.039	0.198	0.851	0.012	0.03	0.02
Limit Values	WHO	2	3	0.05	0.05	0.5	0.2	0.01	0.01
	US EPA	1.5	5	0.05	0.05	-	0.1	0.05	0.05
Standard permissible limit	Si	2	5	0.5	0.05	0.5	0.2	0.05	0.05
Ideal value	Li	1.5	3	0	0	0	0.1	0.01	0.01