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Supporting information for:

Beneficial management of biomass combustion ashes

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Consisting of 21 pages with 6 Tables.

Table S1. Ash chemical composition of main feedstock used for biomass combustion (wt. %).

Ash origin	Description	CaO	MgO	K_2O	P_2O_5	SO_3	Cl_2O	SiO_2	Al_2O_3	Fe_2O_3	Na_2O	TiO_2	Refs.
Agriculture residue													
Maize													
Corn straw	Case study, lab ash at 550°C	12.8	3.9	16.1	2.1	1.6		43.4	4.4	2.2	0.14	0.25	[1]
Maize	Case study, calculated based on the elemental analysis of the fuels	17	4.4	22	1.9	1.7	6.62	33	3.7	1.6	0.4		[2]
Corn stalk		3.9	3.08	10.3	10	11.08		50.7		3.14	0.53		[3]
Corn fodder		1.05	3.32	9.59	2.98	3.48		55.3		2.4	0.73		[3]
Corn cob		1.27	2.49	2.04	6.87	8.74		40.3		4.06	1.19		[3]
Corn stalk		0.46	2.7	10.28	0.66	2.2		71.7		7.1	0.33		[3]
Corn cob	Case study, lab ash at 500°C	2.12	1.97	47.57	4.82	3.44	0.69	36.67	0.81	1.5	0.28	0.06	[4]
Corn stalk	Case study, lab ash at 575°C	0.56	4.78	8.37	2.06	7.2		63.3		4.72	0.47		[5]
Corn stover	Not specified	8.66	6.11	20.67	8.68			54.04	1.99		0.15		[5]
Maize	Case study, lab ash	4	0.59	18.5	4.7	1.3	13.97	61.7	0.72	0.17	0.23		[5]
Maize	Case study, lab ash	3.5	3	38.7	9.2	1.8	4.53	31.2	0.38	0.56	0.73		[5]
Maize	Case study, lab ash	9.9	4.25	21.8	2.18	2.03	5.35	36.4	0.51	0.59	0.08		[5]
Corn stalk	Case study, burned appropriately	13	7.35	15		1.32		37	2.37	1.19	0.25		[6]
Rice													
Rice straw	Case study from China, lab ash at 600°C	6.74	2.61	15.25		2.59	4.56	64.68	0.28	0.46	1.09	0.03	[7]
Rice straw	Case study	1.61	1.89	11.3	2.65	0.84		74.31	1.4	0.73	1.85	0.02	[8]
Rice straw	Case study, lab ash at 600°C	3.01	1.75	12.3	1.41	1.24		74.67	1.04	0.85	0.96	0.09	[9]
Rice straw	Case study, lab ash	3.5	1.6	15.3	1.5			69.9	0.3	0.2	0.4	0.01	[10]
Rice straw	Case study, lab ash	10.12	2.47	19.4	1.93	4.95		56.23	1.94	0.98	1.98		[11]
Rice straw	Case study, lab ash	1.65	1.49	16.6	1.86	0.86	1.41	72.23	0.07	0.22	0.42	<0.01	[12]

Rice straw	Case study, lab ash	9.23	1.96	38.92	1.63			44.72	1.13	0.31	2.16	0.03	[13]
Rice straw	Case study, lab ash at 525°C	1.6	1.64	11.95	0.61	0.84	3.90	75.38	0.09	0.1	0.14	0.01	[14]
Rice straw	Case study, lab ash at 550°C	8.9	3.5	16				51			2.8		[15]
Rice straw	Case study, lab ash at 815°C	4.47	2.15	9.1	4.16	3.66	4.15	61.63	2.79	3.14	3.77	0.1	[16]
Wheat													
Wheat stalk	Case study from China, lab ash at 600°C	15.44	4.57	35.49			4.88	37.73	2.18	1.05	0.53	0.13	[17]
Wheat straw	From Danish, case study, lab ash at 500°C	7.28	1.82	16.86	2.27	1.1		59.9	0.81	0.54	0.47	0.04	[18]
Wheat straw	Case study	4.66	2.51	18.4	1.47	5.46		35.84	2.46	0.97	10.5	0.15	[8]
Wheat straw	Case study, lab ash at 600°C	12.27	2.48	12.9	4.3	2.49		55.32	0.84	1.05	1.51	0.22	[9]
Wheat straw	Case study, lab ash at 600°C	9.95	2.45	25.2	3.32	4.92		46.07	1.69	1.85	1.18	0.09	[9]
Wheat straw	Case study, lab ash at 600°C	6.14	1.06	25.6	1.26	4.4		55.32	1.88	0.73	1.71	0.08	[9]
Wheat straw	Case study, lab ash at 600°C	4.91	2.55	21.7	2.04	4.44		37.06	2.23	0.84	9.74	0.17	[9]
Wheat straw	Case study, lab ash	3.7	1.8	20	3.5	1.9	4.41	48	3.5	0.5	14.5		[19]
Wheat straw	Case study, lab ash at 525°C	2.8	1.82	16.55	1.05	2.08	4.39	57.47	0.77	0.39	0.8	0.05	[14]
Wheat straw	Case study, lab ash at 550°C	8.1	2.4	18				44			0.22		[15]
Wheat straw	Danish wheat straw, lab ash	2.7	1.73	23.99		3.83	15.65	27.96	3.43	0.59	5.22		[20]
Wheat straw	Case study, lab ash at 815°C	8.07	2.98	17.38	2.01	4.47	6.37	36.9	8	6.29	9.16	0.43	[16]
Sugarcane													
Bagasse	Case study from Brazil, ash collected from a sugarcane processing plant	5	1.17	6.22	0.98	0.42		61.59	5.92	7.36		1.46	[21]
Sugarcane bagasse	Case study	4.47	3.33	4.15	2.72	2.08		46.61	17.69	14.14	0.79	2.63	[8]
Sugarcane trash	Case study, tops and leaves	13.05	4.3	13.39	2.27	7.31		57.38		1.74	0.27		[8]

	fraction												
Sugarcane bagasse	Case study, lab ash at 600°C	2.95	1.97	2.97	1.31	0.5	0.09	42.62	23.16	16.18	0.57	2.76	[22]
Bagasse	Case study, bagasse collected from HC&S Co. Paia sugar factory, lab ash	3.5	1.45	2.59	1.13	0.9		41.87	22.25	20.9	0.26	3.87	[23]
Bagasse	Case study, lab ash at 550°C	3.9	5.5	18.9	3	3.5	1.10	48.8	6.4	1.9	0.8		[5]
Bagasse	Case study, lab ash	4.16	2.34	4.49	0.93			72.29	7.99	6.16	0.95	0.55	[24]
Bagasse	Case study, lab ash	4.31	3.22	1.67	0.89	0.4	0.00	45.88	20.55	15.45	0.96	3.77	[25]
Bagasse	Case study, sugarcane bagasse, screened	5.35	5.81	9.81	5.04	5.08		46.88	11.4	7.98	2.45	1.39	[5]
Sugarcane	Case study, sugarcane from Italy, lab ash at 500°C	4.9	3.48	24.1	5.96	8.24		49.2	0.98	0.43	0.66	0.07	[18]
Bagasse	Case study, bagasse from South Africa, ashes at 815°C	4.5		2.9				62.6	3.3	2.4	2.8		[5]
Sugarcane bagasse	Case study, ash collected from Madras Sugar Limited, Tamil Nadu, India	7.77	1.98	9.28		4.45		72.95	1.68	1.89			[26]
Soybean													
Soya husk	Case study	21.4	7.1	30.5	4.9	3.7		1.7	7.4	2.5	5.3	0.2	[27]
Bean straw		4.67	0.9	22.34	2.29	4.7		29.9		2.7	0.52		[3]
Bean straw		6.3	3.65	25.3	7.3	2.28		32.7		3.93	0.82		[3]
Bean plant	From Phyllis2 database (#2888), lab ash, case study	21.5	6.39	6.66	6.68			8.98	0.5	0.32	0.69	0.03	[5]
Soybean stalk	Case study, lab ash	33.2	9.83	18.8	2.62	1.15		30.4	2.15	0.83	0.91	0.05	[28]
Energy crops (herbaceous)													
Miscanthus - 1	From Phyllis2 database (#568), lab ash, miscanthus from the second year of cultivation, harvest in feb.1991	7.1	2.85	14.8	1.75	3.7	1.78	63	0.45	0.36	0.18		[5]

Miscanthus - 2	From Phyllis2 database (#569), lab ash, miscanthus from the second year of cultivation, harvest in jan.1991	4.1	2.59	4.6	1.85	1.7	0.09	82.3	0.76	0.36	0.15		[5]
Miscanthus - 3	From Phyllis2 database (#570), lab ash, miscanthus from the second year of cultivation, harvest in jan.1991	3	2.02	3.7	1.64	2.1	0.05	85.7	0.3	0.61	0.15		[5]
Miscanthus - 4	From Phyllis2 database (#571), lab ash, miscanthus from the third year of cultivation, harvest in jan.1992	7.9	2.82	7.5	2.44	2.26	1.63	57.7	1.01	0.82	0.1		[5]
Miscanthus - 5	From Phyllis2 database (#575), lab ash, miscanthus from the third year of cultivation, harvest in jan.1992	7.7	2.01	7.3	2.94	2.3	1.32	61.3	1.38	0.87	0.23		[5]
Miscanthus - 6	Miscanthus from Italy, case study, lab ash at 500°C	7.56	4.81	25.3	5.27	2.1		42.79	0.51	0.4	0.6	0.03	[18]
Miscanthus - 7	Miscanthus giganteus, case study, lab ash at 500°C	8.6	5.9	27	6.3	4.9	4.29	39	1.6	1.1	2.2		[5]
Miscanthus - 8	Miscanthus grass, not specified but seems quite like case study	6.37	6.63	12.1	4.2	0.63		68.64	0.48	0.25	0.62	0.02	[5]
Miscanthus - 9	Miscanthus sinensis gracillimus (6-7 ft high leaf fraction) from Oregon, lab ash at 600°C	13.62	1.07	18.7	6.24	1.7		56.07	0.78	0.93	0.27	0.02	[5]
Miscanthus - 10	Miscanthus (whole stem 6-7 ft high) from Oregon, lab ash at 600°C	9.61	2.46	11.6	4.2	2.63		61.84	0.98	1.35	0.33	0.05	[5]
Pennisetum Purpureum Schum	Case study, lab ash at 815°C	1.9	9.9	30.5	7.2	5.7		43	<0.1	1.4	<0.01	0.03	[29]
Pennisetum purpureum	Case study, ash from biomass power plant and sintered at 500°C in the lab	14.2	1	32.2	2.54	1.67		47.1		0.37			[30]
Bana grass	Also named Pennisetum	3.57	1.71	42.8	2.74	0.85		33.65	0.8	0.63	0.38	0.07	[9]

	purpureum, lab ash at 600°C, case study												
Bana grass	Also named Pennisetum purpureum, lab ash at 600°C, case study	6	5.36	31.8	4	2.55	10.46	33.99	0.74	0.78	1	0.05	[22]
Bana grass	Green bana grass, lab ash at 600°C, case study	4.84	5.75	18.8	5.46	1.86	7.73	53.5	0.4	0.38	1.12	2.82	[31]
Bana grass	Purple bana grass, lab ash at 600°C, case study	3.92	5.21	20.1	3.28	1.47	9.29	53.9	0.54	0.33	1.09	0.13	[31]
Bana grass	Case study, lab ash at 750°C, young banagrass harvested on May 2006 at age 4 weeks	3.6	4.66	39.74	4.05	0.45		37.88	1.15	1.2	0.46	0.29	[32]
Bana grass	Case study, lab ash at 750°C, young banagrass harvested on December 2006 at age 4 weeks	4.59	4.21	42.5	6.32	0.68		41.35	0.72	0.79	0.43	0.18	[32]
Bana grass	Case study, lab ash at 750°C, mature banagrass harvested on December 2006 at age 10 weeks	3.6	4.84	28.44	4.43	1.35		52.85	0.24	0.28	0.51	0.05	[32]
Energy crops (woody)													
Willow	Case study, lab ash at 600°C, 3-year cultivation	45.62	1.16	13.2	10.04	1.15		8.08	1.39	0.84	2.47	0.06	[9]
Willow	Case study, lab ash at 600°C, 1-year cultivation	34.83	2.46	12.2	10.36	1.7		16.76	3.01	0.85	3.05	0.07	[9]
Willow	Case study, lab ash at 600°C, 1-year cultivation	36.51	1.54	19.9	12.9	1.94		2.83	0.12	0.42	1.97	0.06	[9]
Willow	Case study, lab ash at 600°C, 1-year cultivation	40.48	3.04	13.9	8.16	1.7		1.11	0.09	0.21	0.77	0	[9]
Willow	Case study, lab ash at 600°C, 1-year cultivation	32	7.67	22.1	11.68	3.09		1.89	0.16	0.3	0.65	0.04	[9]
Willow	Case study, lab ash at 600°C, 3-year cultivation	41.2	2.47	15	7.4	1.83		2.35	1.41	0.73	0.94	0.05	[9]
Willow	Case study, lab ash at	34.18	2.98	18.4	7.1	2.92		2.05	1.97	0.35	2.67	0.03	[9]

	600°C, top fraction												
Willow	Case study, lab ash at 600°C, bottom fraction	44.68	2.16	15.3	7.18	2.33		1.82	1.48	0.49	0.86	0.05	[9]
Salix (willow)	Case study	30.8	5.1	26.5	11.5	3		0.4	0.3	0.2	0.3	0.02	[33]
Salix (low Si)	Case study, lab ash	30.8	3.3	25.2	14.7	3.7	0.37	4.3	2.2	0.9	0.1	0.1	[34]
Salix (high Si)	Case study, lab ash	30.6	3.5	26	15.5	3.2	0.88	17	6.7	1.5	0.22	0.1	[34]
Hybrid poplar	Case study, lab ash at 600°C	44.4	4.32	20.08	0.15	3.95		0.88	0.31	0.57	0.23	0.16	[9]
Hybrid poplar	Case study, lab ash at 600°C	49.92	18.4	9.64	1.34	2.04		5.9	0.84	1.4	0.13	0.3	[9]
Poplar-coarse	Case study, lab ash at 600°C	44.4	4.32	20.08	0.15	3.95		0.88	0.31	0.57	0.23	0.16	[9]
Poplar	Case study, lab ash at 600°C	35.92	15.07	9.55	2.18	2.55			0.66	0.46	3.1		[35]
Short rotation coppice		33.3	8.6	13.8	17			17.3	4.4	3.8	1	0.3	[36]
SRC poplar	Case study, lab ash, SRC sites located in Santarém (central Portugal)	48.06	10.84	18.29	11.84			2.97	3.64	1.68	1.1		[37]
SRC poplar	Case study, lab ash, SRC sites located in Santarém (central Portugal)	41.58	13.47	19.7	15.97			2.34	1.98	1.22	1.74		[37]
SRC poplar	Case study, lab ash, poplar sampled in Lochristi site in Belgium	45.23	7.22	32.82	8.41			2.37	0.39	0.46	0.97		[37]
SRC poplar	Case study, lab ash, poplar sampled in Lochristi site in Belgium	53.22	9.38	23.32	9.51			1.52	0.23	0.31	1.07		[37]
SRC poplar	Case study, lab ash, poplar sampled in Lochristi site in Belgium	48.63	9.19	27.42	8.02			2.78	0.45	0.57	1.21		[37]
SRC poplar	Case study, lab ash, poplar sampled in Lochristi site in Belgium	53.95	0.24	26.12	11.39			3.91	0.37	0.57	1.46		[37]
SRC poplar	Case study, lab ash, poplar sampled in Lochristi site in Belgium	46.99	7.8	29.06	9.99			1.52	0.31	1.43	1.39		[37]
SRC poplar	Case study, lab ash, poplar sampled in Lochristi site in	48.62	7.76	26.57	10.53			1.52	0.64	0.89	1.19		[37]

	Belgium												
SRC poplar	Case study, lab ash, poplar sampled in Lochristi site in Belgium	51.08	7.48	27.09	8.74			1.43	0.69	0.77	0.97		[37]
Forest residues													
Temperate hardwood bark													
Beech bark	Case study	69.53	11.5	2.6	2.3	0.8		12.4	0	1.1	0.9		[3]
Birch white bark	Case study	65.48	4.2	6.6	2.9	3.2		3	0.6	2.9	1.3		[3]
Birch yellow bark	Case study	64.17	5.4	8	3.8	1.3		4.1	0.3	0.8	1.7		[3]
Elm bark	Case study	76.23	2	4.4	1.3	0.8		3.6	0	0.3	0.7	0.1	[3]
Eucalyptus bark	Case study, lab ash	46.6	8.8	7.5	1.9	2.8	7.11	8.1	2.5	0.9	1.5	0.1	[38]
Hemlock bark	Case study	59.03	13.1	4.6	2.1	1.9		10	2.1	1.3	1.1		[3]
Maple hard bark	Case study	56.28	19.4	5.8	1.1	1.4		39.5	3.8	1.7	2.2		[3]
Maple soft bark	Case study	69.75	2.3	6.3	0.3	2		6.1	3.1	0.8	0.9	0.1	[3]
Poplar bark	Case study	70.48	1.9	7.2	2	0.6		1.5	0.5	0.6	3.9		[3]
Softwood bark													
Jack pine bark	Case study	54.34	5.5	4.1	2.8	2.6		16	6.3	5	3.1	0.2	[3]
Pine bark	Case study	40.6	4.5	7.6	4.8	2		1.3	5.3	0.3	0.5	0.12	[33]
Black spruce bark	Case study	73.87	1.7	6.2	2.2	1.4		6.4	1.1	1.1	2.5		[3]
White spruce bark	Case study	70.52	6.4	7.3	2.6	2.2		2	0.6	0.7	0.8		[3]
Red spruce bark	Case study	64.73	4.7	5.3	2.2	1.3		7.6	0	3.1	2	0.1	[3]
Tamarack bark	Case study	52.6	8.5	5.3	4.7	2.6		7.3	8.4	3.6	3.2	0.1	[3]
Wood fuel													
Temperate hardwood													
Red oak wood	Case study, lab ash	17.5	1.1	9.5	1.8	2.6	0.98	49	9.5	8.5	0.5		[19]
Hybrid poplar	Case study, lab ash at 600°C	49.92	18.4	9.64	1.34	2.04		5.9	0.84	1.4	0.13	0.3	[9]

Poplar-coarse	Case study, lab ash at 600°C	44.4	4.32	20.08	0.15	3.95		0.88	0.31	0.57	0.23	0.16	[9]
Beech wood	From Phyllis2 database, not specified but seems quite like case study	26.1	9.2	23.5				20	7	1.4	1.8		[5]
Birch wood	From Phyllis2 database, lab ash	45	10.8	11.4	17	2.2		2.8	1.4	0.7	1.3	0.1	[5]
Oak wood	Case study, lab ash	46.24	7.11	18.62	4.02	--		16.21	2.37	0.54	0.24	--	[39]
Salix (willow)	Case study	30.8	5.1	26.5	11.5	3		0.4	0.3	0.2	0.3	0.02	[33]
Salix (low Si)	Case study, lab ash	30.8	3.3	25.2	14.7	3.7	0.37	4.3	2.2	0.9	0.1	0.1	[34]
Salix (high Si)	Case study, lab ash	30.6	3.5	26	15.5	3.2	0.88	17	6.7	1.5	0.22	0.1	[34]
Maple wood	Case study, collected from a domestic wood furnace	29.31	4.95	11.53				5.65	0.99	0.78	0.23	0.16	[40]
Oak wood	Case study, lab ash	65	8.3	9.9	7.5	2.2		2.3	0.9	0.5	0.8	0.1	[5]
Tropical hardwood													
Olive tree wood	Case study, lab ash at 600°C	32.8	2.4	19.9	8.5	2.1		8.1	1.6	0.7	2.9	0.0	[41]
Amaranth wood	Case study, lab ash	26.9	5.2	33.6	5.4	6.5	2.82	1.6	0.81	0.42	0.57		[5]
Amaranth wood	Case study, lab ash	15.8	3.66	34.5	7.91	3.3	4.64	3.7	0.25	0.22	0.12		[5]
Amaranth wood	Case study, lab ash	18.6	3.95	35.3	7.35	4.53	4.09	2.1	0.34	0.28	0.16		[5]
Amaranth wood	Case study, lab ash	20.6	4.12	27.5	6.48	4.35	5.83	7.1	0.39	0.35	0.23		[5]
Amaranth wood	Case study, lab ash	20.5	4	31.7	6.74	3.26	4.40	7.5	0.27	0.23	0.27		[5]
Coconut trunk	Case study	11.74	5.37	10.41	3.55	0.87		42.66	13.94	8.28	2.05	0.96	[5]
Teak wood	Case study of Nigeria, lab ash at 815°C	26.82	5.42	18.28	4.18	3.2		30.34	4.86	3.6	3	0.3	[42]
Melina wood	Case study of Nigeria, lab ash at 815°C	27.02	5.26	18.11	4.07	3.24		31.68	4.2	3.28	2.86	0.28	[42]
Rosewood	Case study, lab ash at 550°C	67.8	7.5	10.8	0.5	1	4.29	2.6	0.7	4.4	1.1	0.1	[43]
Softwood													
Fir wood	Case study, Douglas fir wood	37.08	5.86	17	1.86	11.2	0.01	12.26	2.83	4.24	3.16	0.08	[5]
Pine wood	Case study, lab ash	51.3	8	10.04	2.82	--		14.45	2.71	1.61	0.17	--	[39]

Spruce wood	Case study	17.2	1.1	9.6		2.6	0.98	49.3	9.4	8.3	0.5		[44]
Swedish wood	Case study	30.49	5.93	9.46	2.37	4.04		18.9	4.69	2.67	2.1	0.98	[45]
Christmas trees	Case study, lab ash at 600℃	9.5	2.52	7.86	2.4	11.36		38.89	14.74	9.3	0.53	0.36	[9]
Ponderosa pine wood	Case study	49.27	13.53	10.03	2.82	13.46		6.15	0.92	1.53	1.28	1.2	[5]
Spruce wood	Case study, lab ash	42.2	2.4	7.3	2.84	1.29	0.21	8.5	1.03	0.78	0.23		[5]
Spruce wood	Case study, lab ash	31.9	3.55	10.3	3.39	1.46	0.16	21.9	0.56	0.83	0.24		[5]
Spruce wood	Case study, lab ash	32	3.94	13.5	4.22	0.97	0.06	18.2	0.42	0.74	0.28		[5]
Pine	Case study, lab ash at 550℃	13	4.5	7.9				52			1.9		[15]
Juniper wood	Case study, lab ash	38.4	2.21	8.3	2.17	1.01	0.07	22.4	4.93	4.14	0.63	0.29	[46]
Mixed conifer	White fir and ponderosa pine, lab ash at 525℃	32.06	4.93	10.72	3.13	0.86		9.35	3.12	1.14	0.39	0.13	[14]
Municipal solid waste													
Municipal solid waste ash - 1	Case study, lab prepared ash	25.41	3.68	2.34	1.18	4.5		38.12	11.18	2.88	4.18	2.33	[47]
Municipal solid waste ash - 2	From Phyllis2 database, ash from waste incineration plant (typical data for Netherlands)	11	2	1		2		45	26	8	5		[5]
Municipal solid waste ash - 3	Case study from Netherlands, bottom ash from WtE plant	13.45	1.81	0.88	0.79	1.28	0.32	54.23	7.86	13.83	2.81	0.84	[48]
Municipal solid waste ash - 4	Case study, fly ash from plant	25.19	2.98	2.53	1.15	20.48	3.80	14.33	6.8	2.86	3.5	2.34	[49]
Municipal solid waste ash - 5	Case study, bottom ash from plant	13.01	1.99	1.32	0.69	2	0.37	39.15	7.18	10.01	5.12	2	[49]
Municipal solid waste ash - 6	Case study, textile filter ash from a bubbling fluidized bed	50.79	1.67	2.75	0.92	1.75		7	4.19	0.8	4.31	0.31	[50]
Municipal solid waste ash - 7	Case study, bottom and fly ash combined at the incinerator, measured for 3 times and has the standard deviation but not shown	9.1	1.5	1.7	1.1	2.92	1.27	33.4	13.4	8.7	4.2	1.6	[51]

	here.												
Municipal solid waste ash - 8	Case study from South Korea, fly ash from a stoker-type incinerator	13.71	3.32	16.38	3.9	14.23	35.54	10.91	4.91		31.14	1.33	[52]
Municipal solid waste ash - 9	Case study from France, fly ash from MSW incineration plant	16.42	2.52	5.8	0.34	3	8.82	27.23	11.72	1.8	5.86	0.84	[53]
Municipal solid waste ash - 10	Case study from Italy, bottom ash from solid waste incinerators	16.45	3.67	1.41	1.29		0.29	47.76	10.55	8.61	3.51	0.79	[54]
Sewage sludge													
Sewage sludge ash - 1	From Phyllis2 database, lab ash analysis, ash at 550℃	14	2.7	3.4	23	0.68		28	7.4	17	0.88		[5]
Sewage sludge ash - 2	From Phyllis2 database, sewage sludge from Germany, case study	9.1	2.8	2.19	15.4	1.14		38.3	14.8	12.5	2.21	0.8	[5]
Sewage sludge ash - 3	From Phyllis2 database, sewage sludge from Germany, case study	12.5	2.8	0.84	19.3	2.6		22.4	9	24.6	4.6	0.73	[5]
Sewage sludge ash - 4	From Phyllis2 database, all values are the average of the minimum and maximum values for sewage sludge from the Saar region in Germany	4.7	1.1	0.89	5.6	0.26		20.05	6.7	6.35	0.36	0.35	[5]
Sewage sludge ash - 5	From Phyllis2 database, sludge from UK	20.8	2.9	1.6	9.8			36.5	13.3	5.4	0.5	1.3	[5]
Sewage sludge ash – 6	From Phyllis2 database, lab ash analysis, ash at 550℃	11	1.5	1.5	23	2.5		26	6.1	27	0.82		[5]
Sewage sludge ash – 7	Case study, lab ash	5.88	1.66	1.57	15.12			27.8	13.79	24.31	1.05		[55]
Sewage sludge ash - 8	From Phyllis2 database, ash generated at 815℃	22.2	2.3	1.1	16.7	3.1		33.6	15.6	3.6	5	1.3	[5]
Sewage sludge ash - 9	From Phyllis2 database, ash study in UK	19.8	3.2	2	8.7	2		41.3	14.3	6.8	0.7	1.2	[5]
Sewage sludge ash -	Case study, lab prepared	22.09	2.4	1.56	1.98	5.25		38.36	18.74	8.19	1.21	0.91	[47]

10	ash at 550°C												
Sewage sludge ash - 11	Case study, from a fluidized bed combustor operating at 850 °C	20.6	1.9	1.7	14.8	2.8		34.2	12.6	4.7	1	0.9	[56]
Sewage sludge ash - 12	Case study in UK (sample A obtained from an incinerator)	11.9	3.9	1.8	15.1	1.5		32.2	13.5	16.6	2.1	1.4	[57]
Paper sludge													
Paper sludge ash - 1	Case study from Japan, obtained from paper company	33.2	4.5	--				35.9	22.8	0.9	0.6	2.2	[58]
Paper sludge ash - 2	Case study from Korea, obtained from paper company	4.2	7.8	0.3	0.3			44	29.2	5.9	0.8	2.5	[59]
Paper sludge ash - 3	Case study, obtained from one of the paper companies in Japan	25.8	6.9	0.2				40.9	22.9	1.3	0.2	1.8	[60]
Paper sludge ash - 4	Case study from Japan, 1 ample, incinerator ash by the Fuji Paper Making Union	27.1	7.1	0.2	0.9			32.6	27.3	0.7	0.1	1.4	[61]
Paper sludge ash - 5	From Phyllis2 database, ash produced at 815°C, case study	45	2.4	0.7	0.2	0.29		27.8	19.4	1.2	0.4	0.5	[5]
Paper sludge ash - 6	From Phyllis2 database, industrial ash from wastepaper production	33.4	3.98	1	0.37			32.7	16.3	5.76	0.72		[5]
Paper sludge ash - 7	Case study, lab analysis	4.16	1.81	0.37	0.22	0.64		60.65	28.56	0.75	1.11	1.73	[62]
Paper sludge ash - 8	Case study, lab analysis	33.7	3	0.1	0.3	0.7	0.00	22.7	17.9	0.6	0	0.2	[63]
Recovered wood													
Demolition wood - 1	Case study, lab prepared ash	12.65	45.88	2.2	0.65	3.75		18.55	4.98	2.05	1.97	3.98	[47]
Furniture wood waste	Case study, lab ash at 600°C	13.89	3.28	3.77	0.5	1		57.62	12.23	5.63	2.36	0.5	[9]

Demolition wood - 2	Case study, lab ash at 600°C	13.51	2.55	2.14	0.94	2.45		45.91	15.55	12.02	1.13	2.09	[9]
Waste wood	Mixture of wood and particle board, ash at 550°C	22.4	2.8	2.2	0.6	15.86		35.8	5.3	3	2.4	4.1	[5]

Table S2. Concentration of trace metals in woody biomass ash (ppm) [64].

Sample ID	Zn	B	Cu	Pb	Cr	Ni	Mo	As	Se	Cd	Hg
Ash 1	794	127	78	66	14	12	NM	10	NM	3	<4.9
Ash 2	310	NM	76.9	58.8	16.8	40.9	NM	NM	NM	6.7	NM
Ash 3	200	NM	40	38	9.1	11.6	NM	NM	NM	4.2	<0.1
Ash 4	370	55	120	59	27	47	NM	NM	NM	4.4	<0.84
Ash 5	560	290	70	70	25	50	3	3	NM	16	NM
Ash 6	700	8.1	144.6	130.1	86.3	46.8	113.8	NM	NM	20.8	NM
Ash 7	76	257	58	24	7	12	NM	NM	NM	1	NM
Ash 8	288	NM	143	29.2	50.8	97.3	0.5	6.2	NM	2.8	NM
Ash 9	184	NM	65.9	34.6	19	27.8	NM	NM	NM	2.1	NM
Ash 10	460	NM	210	220	130	30	NM	36	NM	13	0.4
Ash 11	794	127	78	66	14	12	NM	10	NM	3	<4.9
Ash 12	372	NM	138	64	31.4	31.1	NM	NM	NM	4.8	2.8
Ash 13	210	NM	96	NM	NM	NM	NM	63.6	NM	4.2	NM
Ash 14	2200	NM	3.4	NM	NM	NM	NM	33.3	NM	<0.1	NM
Ash 15	131	76.3	48.3	79.8	56.5	15.3	15.9	NM	NM	0.3	NM
Ash 16	320	103	66.3	87.3	63.9	17.4	10.8	NM	NM	3	NM
Ash 17	211	92.1	50.8	70.3	50.9	20.9	12.7	NM	NM	0.9	NM
Ash 18	63	69.6	40.2	64.9	42.5	7.7	8.5	NM	NM	0.2	NM
Ash 19	370	114	70.4	55.7	46	7.8	10	NM	NM	5.8	NM
Ash 20	377	118	75.9	69.7	47.9	10.3	11	NM	NM	1.5	NM
Ash 21	286	99.2	45.6	52.9	60.7	ND	10.2	NM	NM	5.2	NM
Ash 22	317	142	87.9	93.3	83.3	6.5	11.8	NM	NM	2.6	NM
Ash 23	337	NM	31.2	25.4	3.4	ND	ND	NM	ND	10.6	ND
Ash 24	972	NM	52.6	41.4	11.4	7.9	ND	NM	ND	5.8	0.1
Ash 25	153	NM	55.5	22.7	8.6	26.8	ND	NM	ND	3.1	0
Ash 26	454	NM	11.4	51.6	30.2	23.8	15.2	NM	0.4	4	0.4
Median value (below)											
	329	***108.5***	***68.2***	***61.5***	***30.8***	***16.4***	***10.2***	***10.0***	***0.0***	***3.6***	***0.0***

Sample ID numbers are those used in the reference [64].

Table S3. Concentration of trace metals in miscanthus ash (ppm) [5].

Miscanthus (ID number)	Pb	Cd	Cu	Hg
#568	20	0.6	53	0
#569	12	0.2	22	0
#570	8	0.6	20	0
#571	13	0.1	54	0
#572	5	0	23	0
#573	8	0.3	18	0
#575	13	0.2	42	0
#576	15	0.1	70	0
#577	22	0.6	518	0.1
#580	20	0.2	135	0
#581	13	0.1	39	0
#582	21	0.1	102	0
#583	15	0.1	57	0
#584	23	0.3	72	0
#585	15	0.1	46	0
#586	17	0.4	33	0
#587	34	1	114	0
#588	12	0.1	53	0
#589	34	0.2	88	0
#590	17	0.2	33	0
#592	18	0.6	81	0
#593	23	0	52	0
#594	11	0.1	57	0
#595	6	0	27	0
#597	27	0.7	113	0
#598	13	0.8	210	0
#599	12	0.1	87	0
#600	1.1	0.1	1.6	0
#605	2.8	0.1	1.8	0
#607	2.1	0.1	2	0

Table S4. Concentration of trace metals in sewage sludge ash (ppm).

Sample ID	Ba	Zn	Cu	Pb	Cr	Ni	Mo	V	As	Se	Sb	Cd	Hg
SSA1 [65]		1763	947	118	70	45.5	11.6		13.1			3.73	0.23
SSA2 [65]		2181	1166	201	126	60	22		17.8			4.71	<0.1
SSA3 [65]		1839	1230	184	115	80.2	22.3		12.1			3.8	<0.1
SSA4 [65]		2170	1000	264	130	98	20		40			3.6	<0.1
SSA5 [65]		1540	550	89.9	96.6	42.4	13.4		13.1			2.35	<0.1
SSA6 [65]		2151	1267	134	88.4	39.5	79.5		16.3			3.03	<0.1
SSA7 [65]		1577	470	113	91.9	42.7	4.92		4.25			2.23	<0.1
SSA1 [66]		2543	1113	236	145	83.2	27.8		34.1			6.53	<0.07
SSA2 [66]		2146	972	109	92.2	49.6	13.2		18.9			3.07	<0.07
SSA3 [66]		1517	674	53.1	106	54.9	11.8		19.1			2.34	<0.07
SSA [67]		2292	1073	256	151	64.3	25.1		22.6			3.54	<0.07
A [57]		1621	298	523	212	74.6	23.2		14	2	23.2	9.4	1.6
B [57]		1057	118	327	88	4	6		17	4	29	3	0.1
C [57]		943	120	309	131	7.7	6.3		58.8	1.6	31.7	3.1	0.1
D [57]		644	150	275	120	15.2	5.9		7.7	2.5	14.9	2.5	0.1
E [57]		2099	575	608	510	136	42.5		87	2.6	137	30	0.3
F [57]		984	269	347	27.5	13.5	12.2		13	5.8	13.9	2.3	3.3
G [57]		1120	296	408	31.1	15.6	13.2		14.6	7.1	16.8	2.7	3.9
Sewage sludge ash [68]		1727	547	162	481	114						2.64	
SSA [69]		2330	767	122.6	159	73.3			11.1			2.1	1.1
SSA[56]	1430	7103	2483	720	2636	621		63	23		73	14	
	Median value (below)												
	--	***1763***	***674***	***236***	***120***	***54.9***	***13.3***	***--***	***16.65***	***2.6***	***26.1***	***3.07***	***0.0***

Sample ID numbers refer to the reference given.

Table S5. Concentration of trace metals in MSW fly ash (ppm).

Sample ID	Ba	Zn	Cu	Pb	Cr	Ni	Mo	V	As	Se	Sb	Cd	Hg
MSW [70]		6350	680	1530	204	42	16.2	23.4	18.8	40.8	90.2	160	8.9
MSW fly ash [50]	770	5780	5400	5730	190	30	10	10	80			90	3
Fly ash [49]	140	17000	840	3000	450	220	22	70	240	10	1100	83	0.05
Fly ash [52]			1653	758	332							629	
MSWI fly ash [53]		11000	670	4000	450	50	25	32	21	50	110	270	
MSWI fly ash [71]		6700	1100	4900	300							500	
A [72]		11472	754	4729	666							269	
B [72]		4866	1345	2234	3213							101	
C [72]		8377	1484	3157	174							134	
Fly ash [73]		5416.32	3113.91	3204.83	517.22	170.24			283.64			109.4	
SELCHP fly ash [74]	320	7520	530	3030		70							
Ash B [75]		5800	5400	5700	190							90	
MSWI fly ash [76]	400	37000	2000	4600	490	100	36	49	460	<10	1900	270	0.51
Fly ash A [77]		18100	1340	732	124		23.7				1090	165	
Fly ash B [77]		21300	1740	888	121		27.6				953	204	
	Median value (below)												
	360	***7948.5***	***1345***	***3157***	***316***	***70***	***23.7***	***32***	***160***	***25.4***	***1021.5***	***162.5***	***1.755***

Sample ID numbers refer to the reference given.

Table S6. Concentration of trace metals in MSW bottom ash (ppm).

Sample ID	Ba	Zn	Cu	Pb	Cr	Ni	Mo	V	As	Se	Sb	Cd	Hg
BAW [48]		3160	4620	1374	175	149	7.8	23.7	8.55	<2	71.3	11.46	<0.05
BAM [48]		2480	3280	1438	186	162	9.24	24.2	6.68	<2	42.8	21.7	<0.05
Bottom ash [49]	1300	3800	2700	1400	490	240	<20	60	68	<10	86	4	<0.05
R-04 [78]	1126	3193	2321	687	393	105		1	<1		4	1	
S-08 [78]	942	3098	2288	1149	158	79		2	<1		5	<1	
S-09 [78]	835	3295	1710	1079	441	133		3	<1		4	<1	
F-09 [78]	904	3253	2481	698	363	119		2	<1		4	1	
Bottom ash [79]		600	500	2700	900	180			13			3	2.6
Bottom ash [80]	1134	8000		614	140				ND	ND		ND	ND
IBA [81]		5840	2240	1019	1370	394							
	Median value (below)												
	1034	***3223***	***2321***	***1114***	***378***	***149***	***7.8***	***3***	***0***	***0***	***5***	***1***	***0***

Sample ID numbers refer to the reference given.

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