

Precious fertilizer or hazardous waste?

Field tests of an electrostatic precipitator in different small scaled biomass boilers: Chemical and physical properties of different ash fractions

Background

Research project „EmMA“

- EmMA: Emissionmonitor Kleinf Feuerungsanlagen (Emission monitor small combustion systems):
Analysis, assessment and optimization of the handling of residues from secondary emission reduction measures (SERM)
- Overview over the existing SERM-systems, suitable for small scaled central biomass boilers with a nominal heat output of **8 – 250 kW_{th}** and which are operated with **natural wood fuels** (logwood, pellets or wood chips)
- Chemical / physical analysis: Intra- and intertechnological comparison of residues from **electrostatic**, **mechanical** and **catalytic precipitators**
- Development of **handling-guidelines** and **disposal / exploitation concepts** for residues from SERM-systems and small scaled biomass boilers

Legal classification of filter ashes (GER)

DüMV (German fertilizer regulation)

- No exploitation of filter ashes as long as they are extracted out of the last precipitating unit of the whole combustion system
- Fertilization of agricultural and horticultural areas only if ashes are **analyzed** and are able to **keep the legal limits**

BioAbfV (German bio-waste regulation)

- Because of the **not known pollutant content** of the filter ashes, the ashes from private households (small scaled biomass boilers) are also **not allowed for fertilization** (private gardening)

According to the German waste classification system (AVV): Without presentable analysis results, filter ashes are classified as **hazardous waste AVV-key 10 01 18*** (* indicates a hazardous waste class)

➔ **Disposal of filter ashes as long as analysis proofs different class**

Challenge: Sampling at small scaled biomass boilers



Figure 1: Used test system, electrostatic precipitator and 50 kW_{th} logwood boiler; Upper left: Used VDI 2066 probe for sampling (EDX, REM)

- Used boiler types :
 - 50 kW_{th} logwood boiler
 - 36 kW_{th} pellet boiler
- Low amount of produced filter ash per time (small sample size)
- Small boiler/precipitator construction
→ Susceptible to the contamination of the sample
- Self-developed special sampling procedure for small scaled biomass boilers (based on LAGA PN98)**



Figure 2: Coarse and filter ash sampling at the logwood boiler

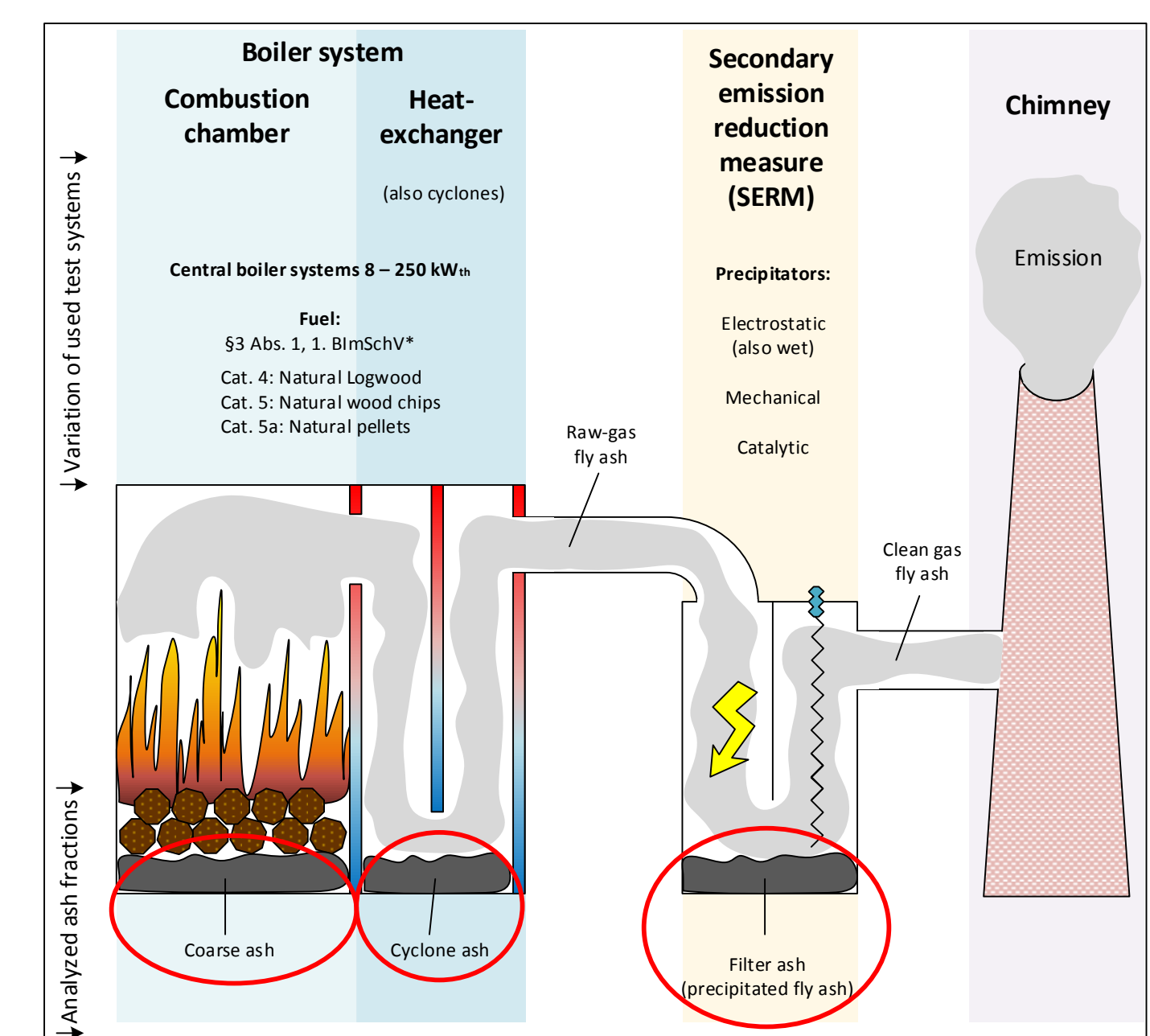


Figure 3: Definition of the analyzed ash fractions

Results

Topicality of results: July 2017

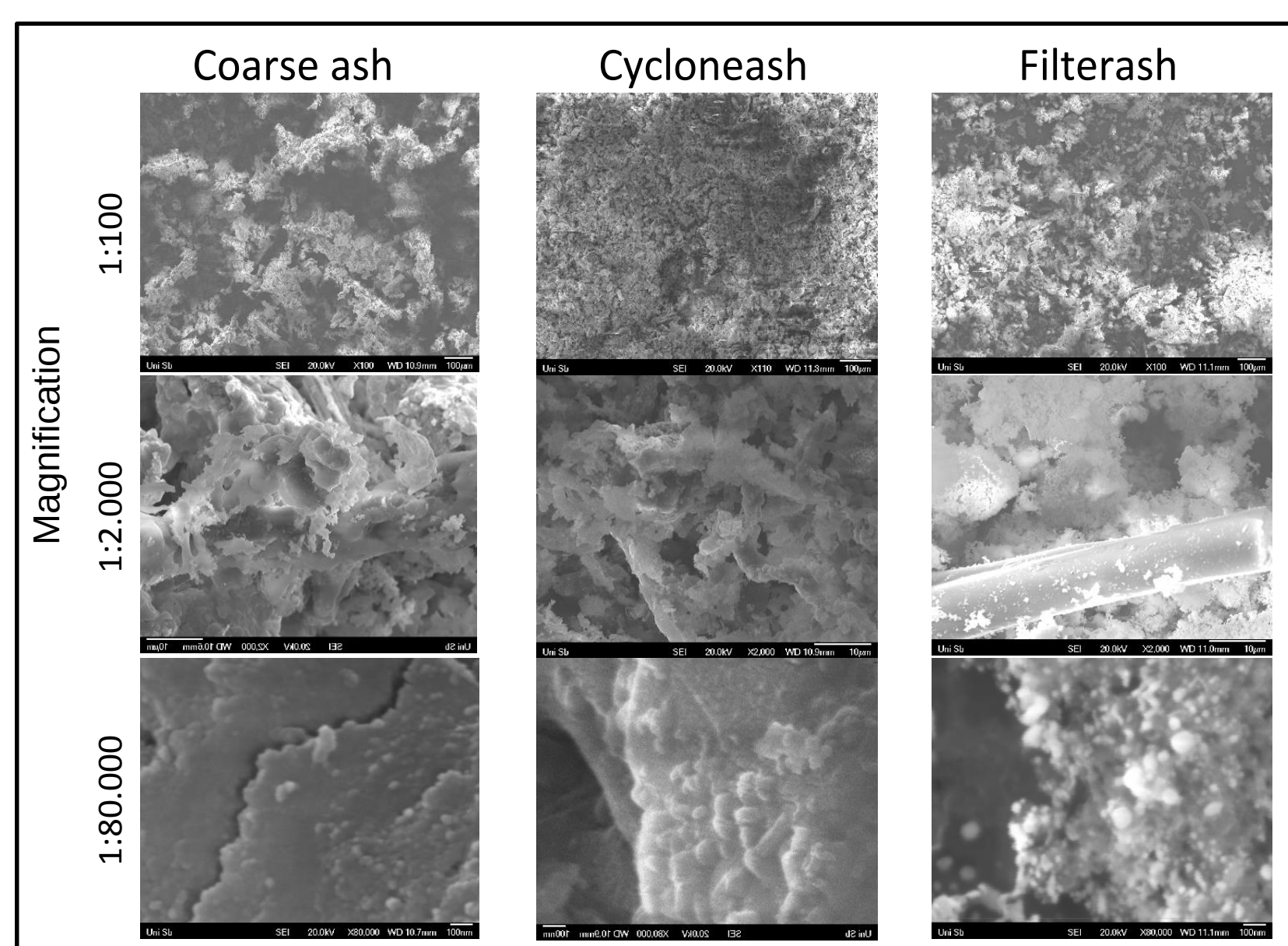


Figure 4: Scanning electron microscope pictures of the different ash fractions (50 kW_{th} logwood boiler; fuel: natural logwood oak; SERM: Electrostatic precipitator manufacturer A)

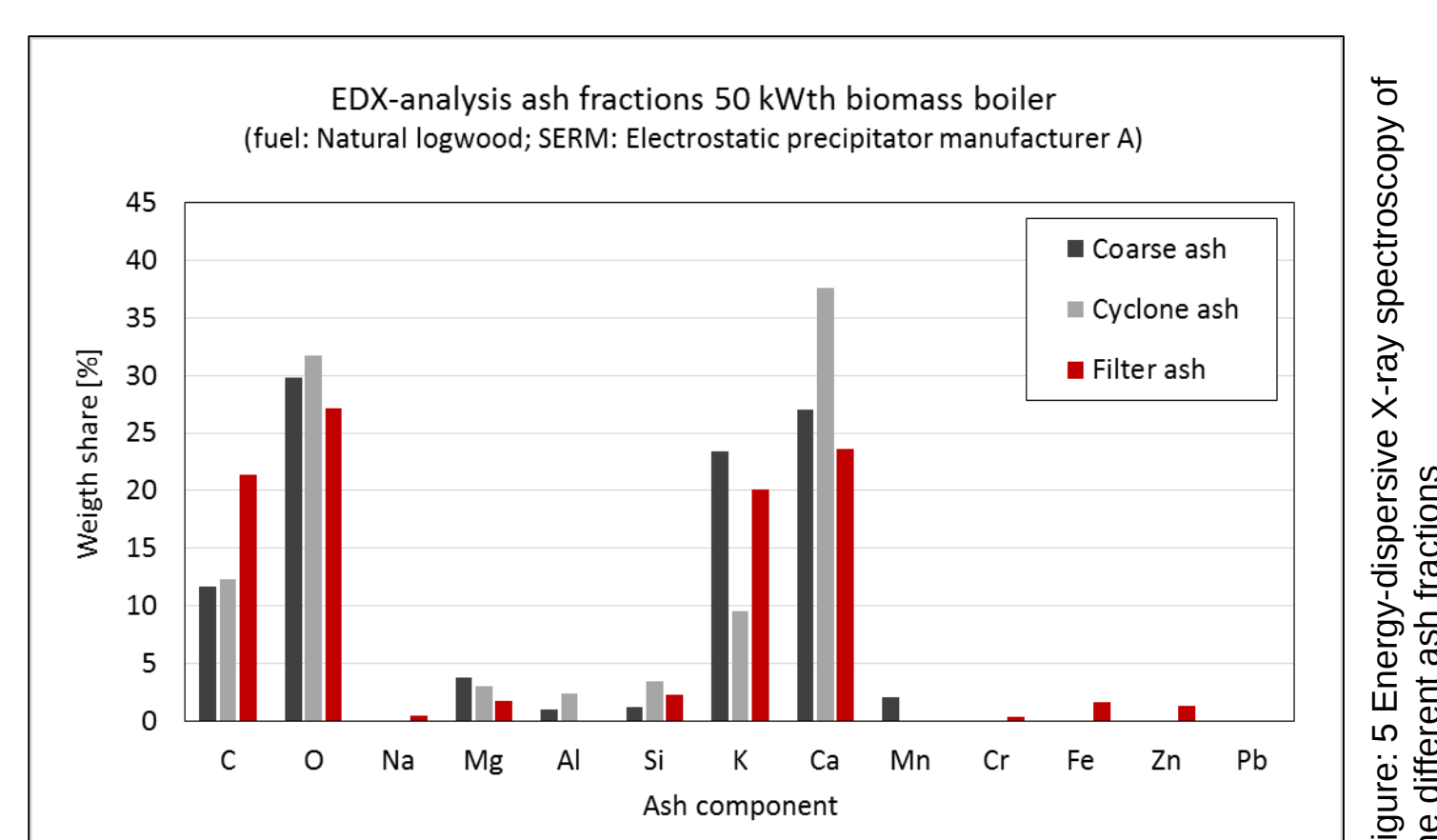


Figure 5: Energy-dispersive X-ray spectroscopy of the different ash fractions

Table1 : Full table of results from the analysis of the logwood and the pellet boiler filter ash

Boilertype		36 kW boiler			50 kW logwood boiler		
Fuel		Pellets A1 Firestixx			Logwood oak (f<20%)		
SERM		Electrostatic Precipitator (manufacturer A)					
Unit	Component	Filter ash	Cyclone ash	Coarse ash	Filter ash	Cyclone ash	Coarse ash
Ma.%	Dry substance	98	96.1	99.6	85.7	99	99.4
	pH	10.3	10.9	12.1	12.8	13	12.9
Ma.%	N overall	0.01	0.25	0.1	0.55	0.23	0.16
Ma.%	GV/LOI 1025° C (organic)	13.4	13.7	22.3	26.4	28.7	35.3
mg/kg	Cyanid	4.9	5.5	2.4	18	5.6	3.4
Ma.%	water soluble part	29	40	74	55	82	83
mg/kg	Sb	1	1	1	1	1	1
mg/kg	Ba	102	110	180	300	1,500	2,500
mg/kg	Zn	10,200	10,700	3,300	1,800	670	220
mg/kg	Hg	1	1	1	1	1	1
Ma.%	S	7.58	6.93	2.3	5.1	2	0.61
mg/kg	B	490	910	617	420	530	440
Ma.%	P as P ₂ O ₅	1.21	1.76	4.1	2.1	2.4	2.5
Ma.%	Ca as CaO	9.1	13.6	27.7	16	30	28
Ma.%	K as K ₂ O	30.3	25.6	12.7	18	8.6	9.5
Ma.%	Na as Na ₂ O	0.65	0.69	0.4	0.48	0.57	0.31
Ma.%	Mg as MgO	1.9	2.8	5.5	6.2	3.6	4.4
Ma.%	Cl	4.1	3.1	0.81	3.4	1.2	0.097
mg/kg	F	56	110	33	11	40	20
Ma.%	SO ₄	24	18	7.9	16	4.1	1.7
mg/kg	Cr- VI	-	-	-	-	77	22

Laboratory SEM/EDX analysis:
University of the Saarland

Laboratory chemical analysis:
Dorfer Analysezentrum und Anlagenplanungsgesellschaft mbH (ANZAPLAN), D-92242 Hirschau

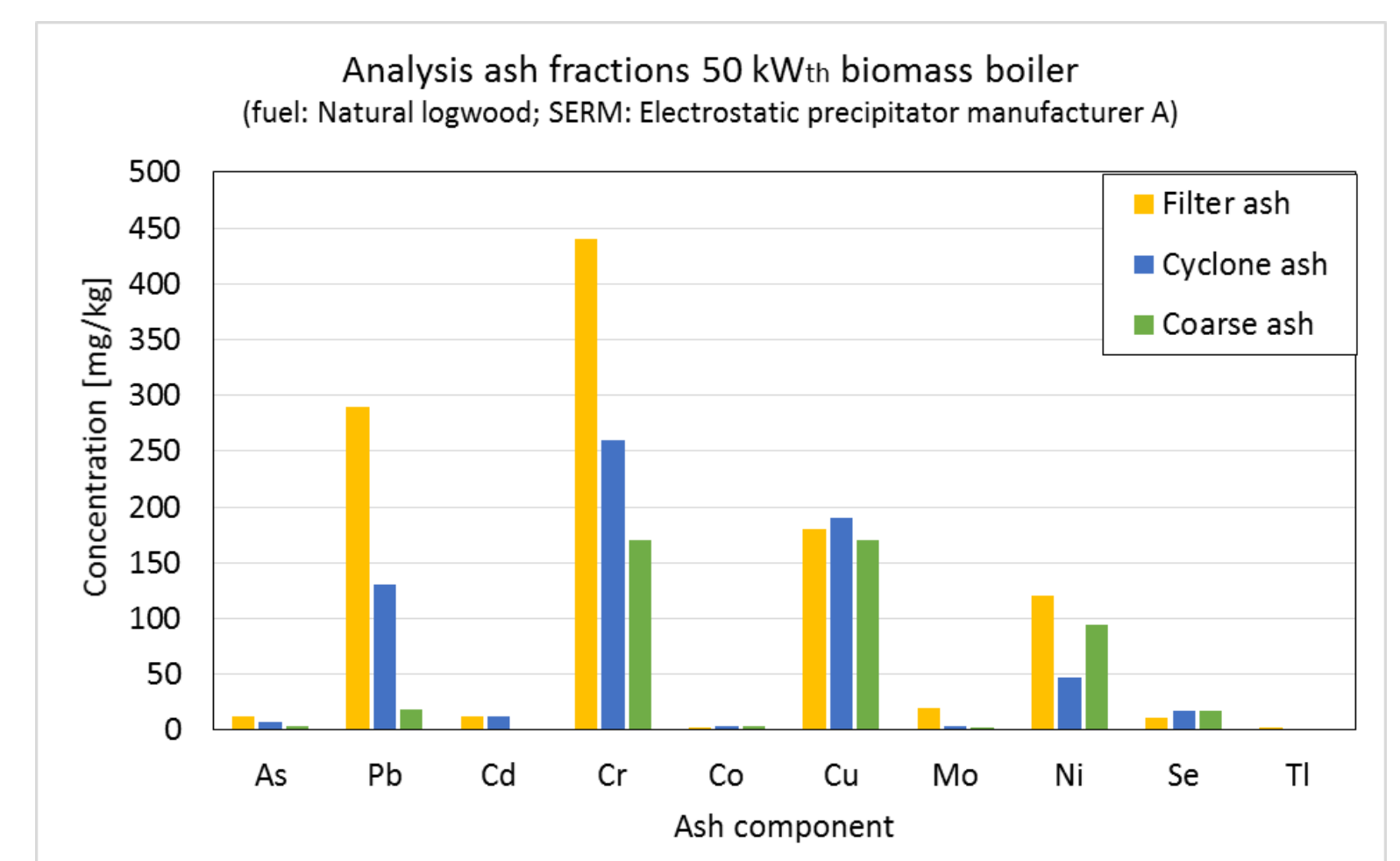


Figure 6: Graph of selected results from the analysis of the logwood boiler filter ash

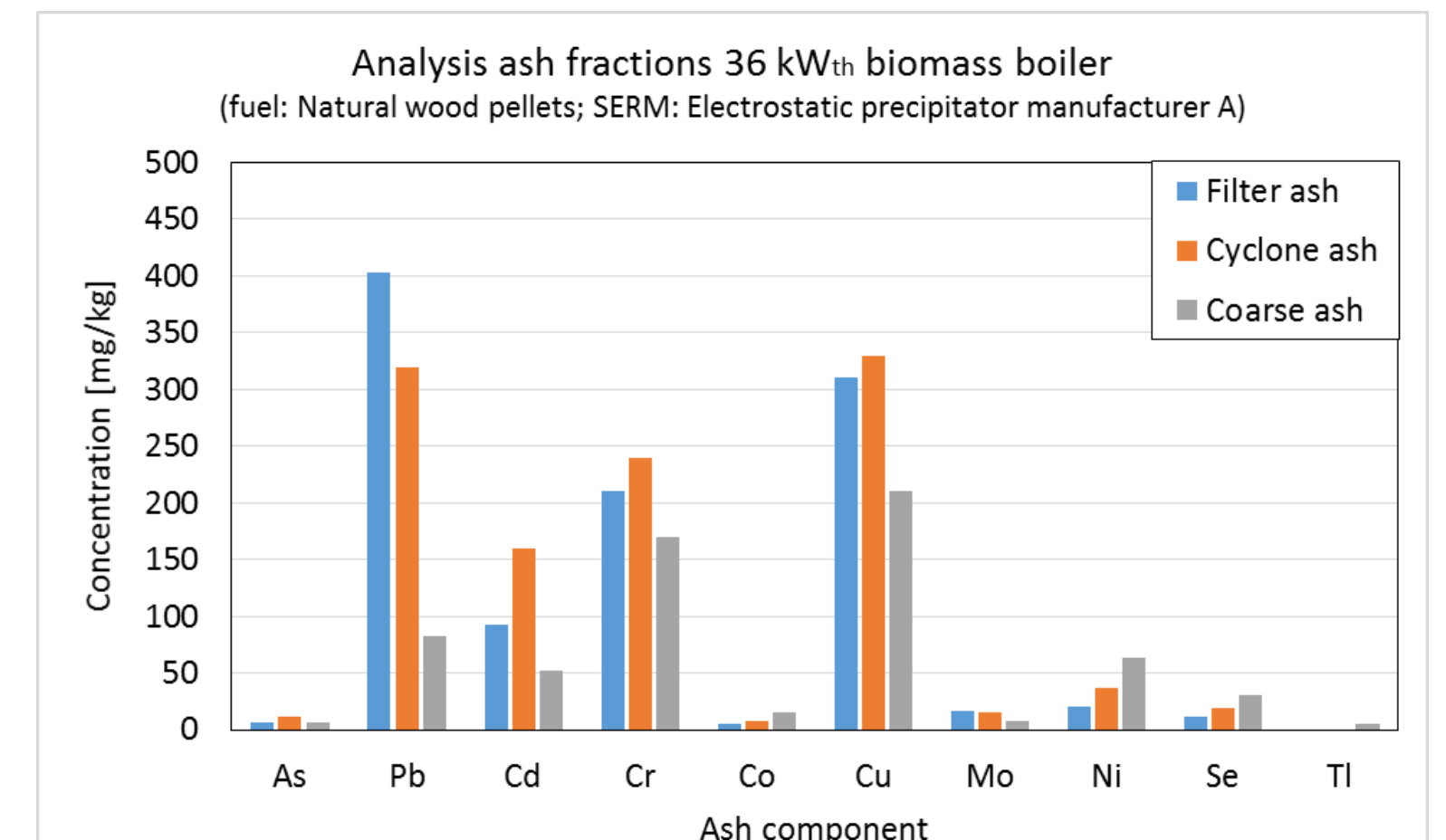


Figure 7: Graph of selected results from the analysis of the pellet boiler filter ash

Contact



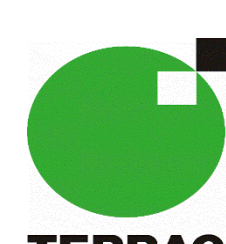
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