

Washing treatment to minimize leaching of chlorides and heavy metals from MSWI bottom ash

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Outline

- Introduction
- Characterization of MSWI bottom ash
- Washing methodology
- Removal of washed fines by washing
- Extraction of the Cl⁻ and heavy metals from MSWI

BA

Incineration Process¹

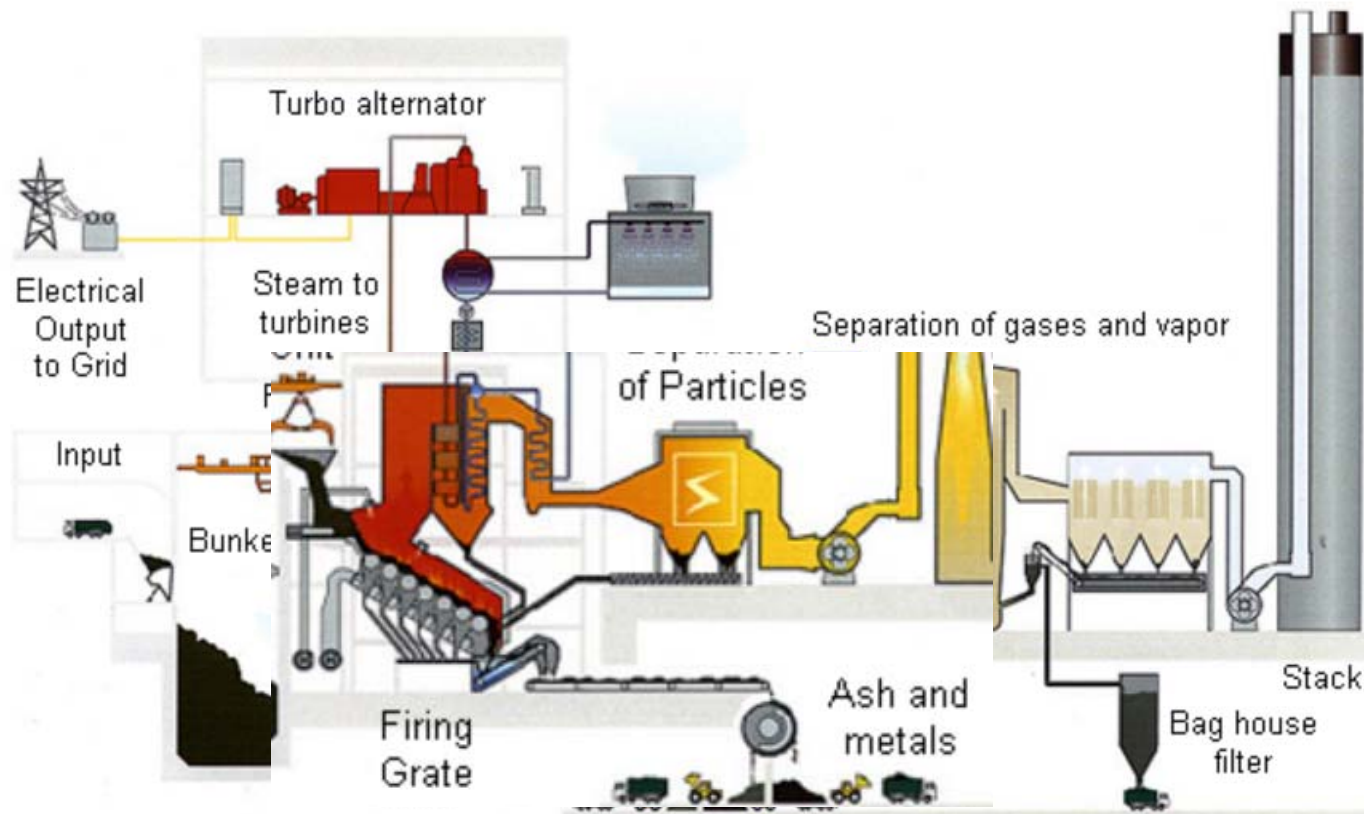
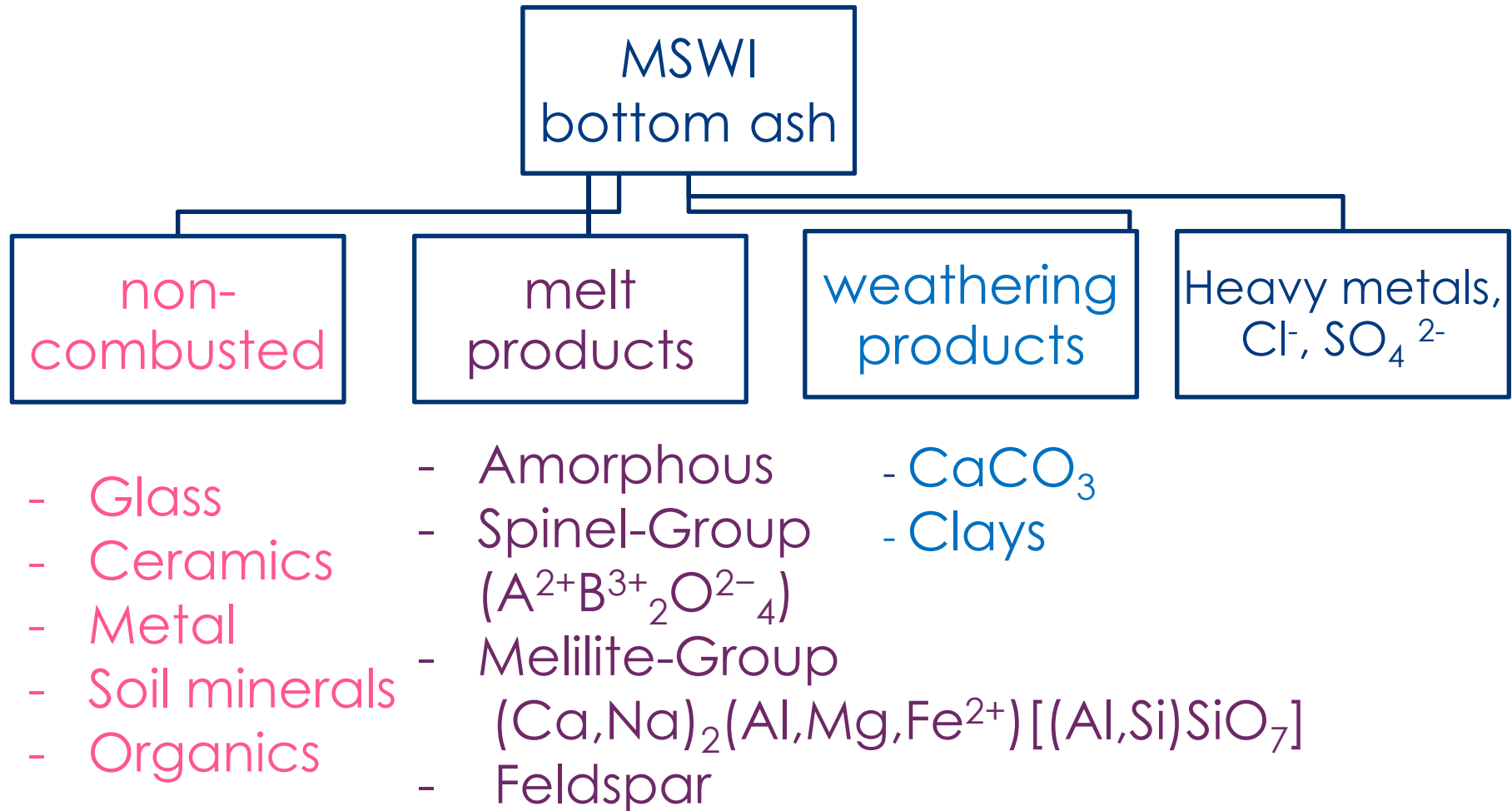
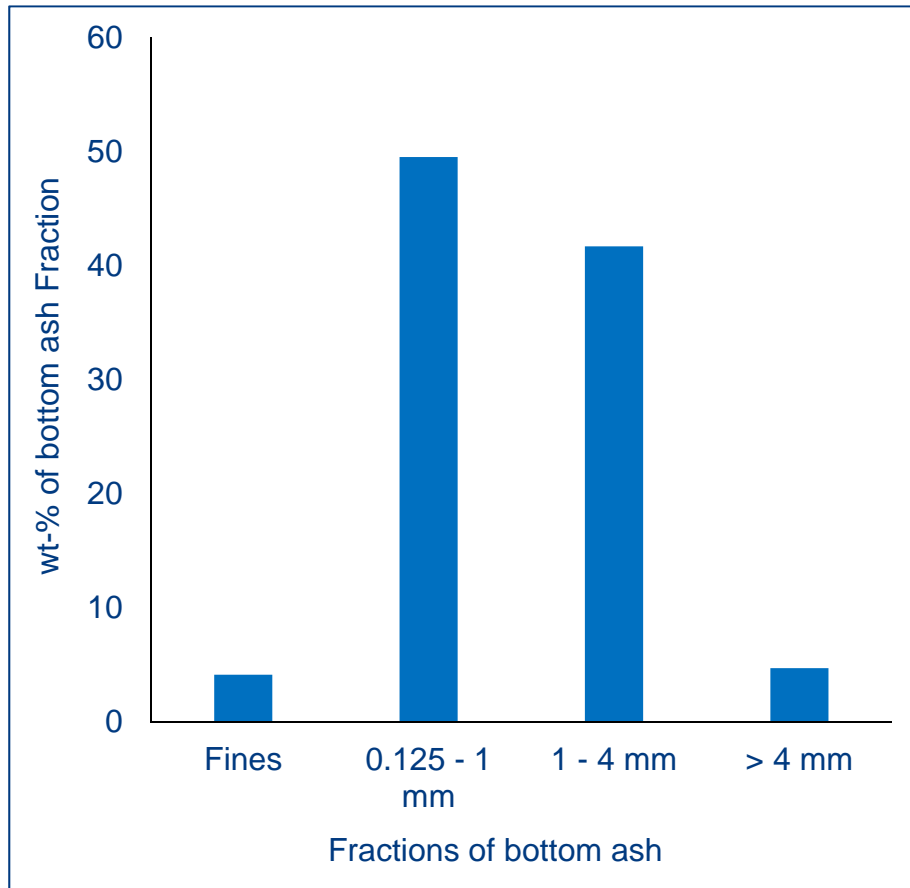


Figure 1: Waste incineration plant schematic, to know more of each of the units please click on the image (Image: LondonWaste)



Objective of this Study

- Removal of Chlorides and heavy metals from the MSWI bottom ash (Soil Quality Decree).
- Understanding the influence of wet extractions' parameters as L/S, washing time on the leaching of contaminants.
- Particle size dependency of the contaminants in the MSWI bottom (0 – 4 mm)
- Enhance the separation of particles $\leq 125 \mu\text{m}$ by applying different methods.



Distribution of BA in based on the particle size

<i>MSWI bottom ash fractions</i>			
	<i>1 - 4 mm</i>	<i>0.125 - 1 mm</i>	<i>≤ 0.125 mm</i>
CaO	22.5	23.2	28.8
SiO₂	22.9	19.5	12.0
Fe₂O₃	13.1	9.9	6.4
Al₂O₃	8.9	9.3	10.7
SO₃	3.3	4.0	4.6
P₂O₅	1.8	1.7	1.5
MgO	2.1	1.5	1.4
Na₂O	1.8	1.4	1.3
TiO₂	1.2	1.3	1.4
Cl	1.0	1.1	1.4
K₂O	1.2	1.1	1.0
R.O.	1.6	1.8	2.0
LOI	18.5	24.2	27.5

Chemical composition of BA in (wt-%)

Large fraction: 1 – 4 mm, Medium fraction: 0.125 – 1 mm Fine: ≤ 0.125 mm

Washing treatment for the MSWI BA

Sieving

- BA (0-4 mm) was sieved into following fractions
- 1 – 4 mm, 0.125 – 1 mm and ≤ 0.125 mm

Washing

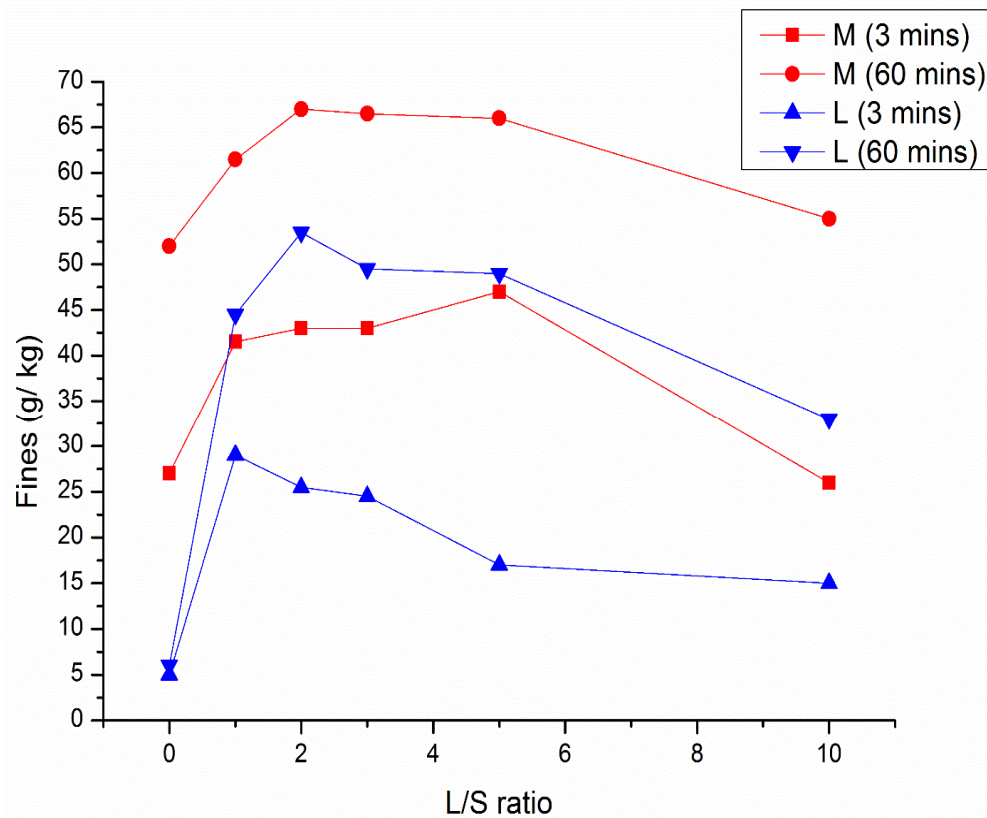
- Different washing parameter were investigated, such as L/S ratio, washing time and amount of liberated fines

Wet-Sieving

- Washing solution were sieved to liberate the fines particles with size of ≤ 0.125 mm

Washed Fines

- Washed fines were studied for their chemical composition



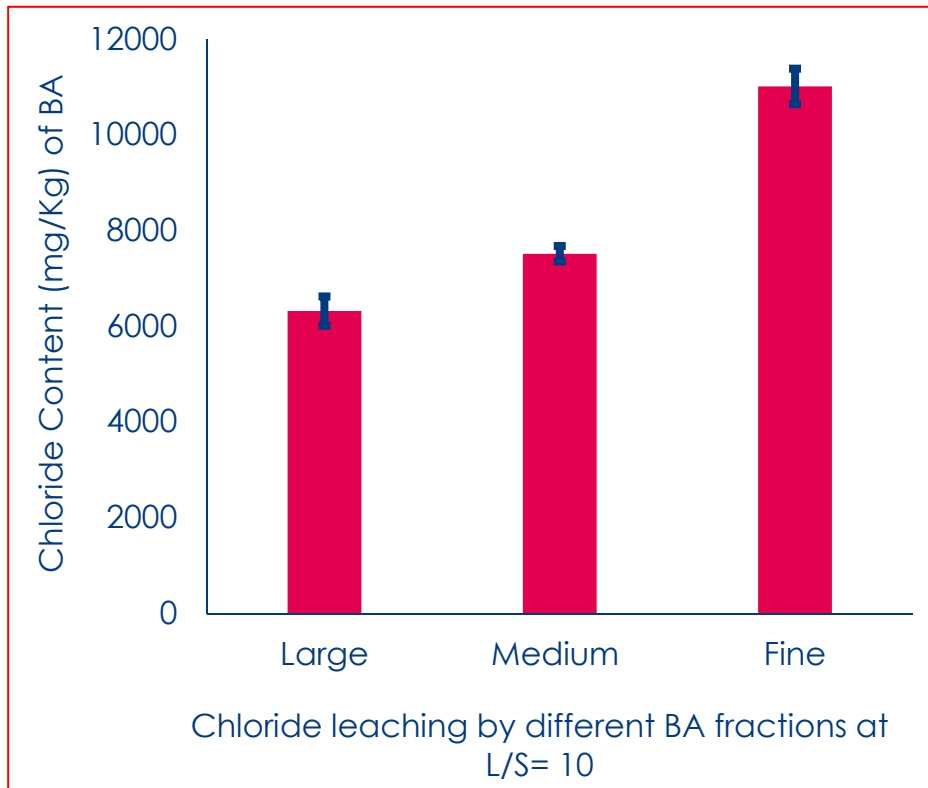
Amount of washed fines liberated under the influence of L/S and time

Large fraction: 1 – 4 mm,
Medium fraction: 0.125 – 1 mm
Fine: ≤ 0.125 mm

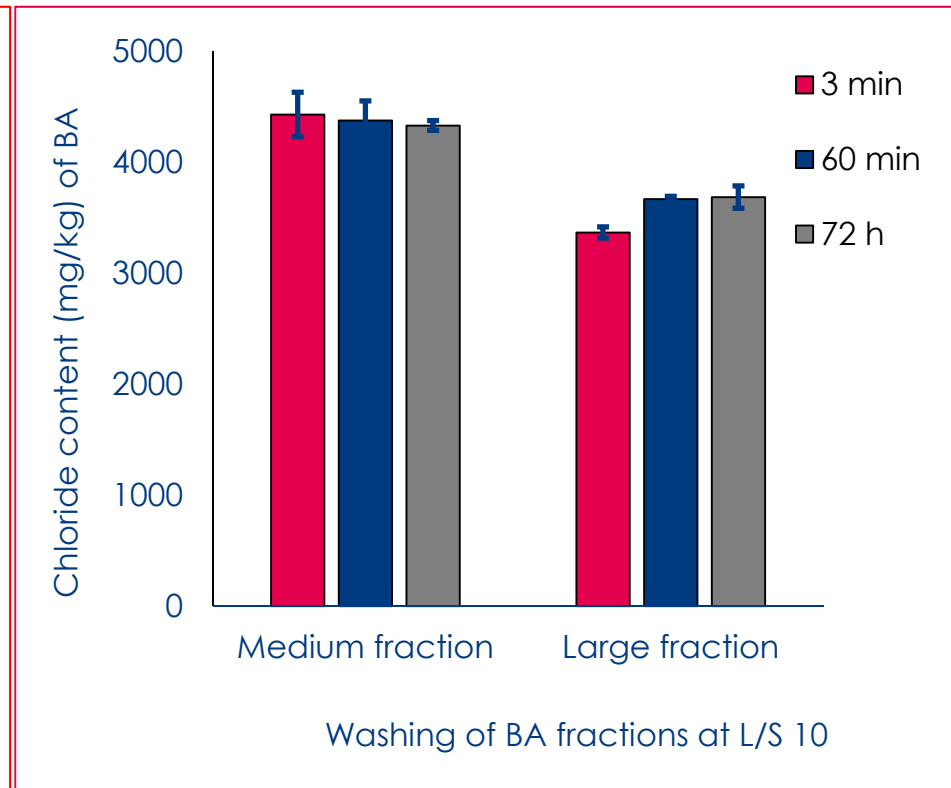
	Washed fines	
	WF - Large	WF - Medium
SiO ₂	10.681	9.128
CaO	34.858	36.297
Fe ₂ O ₃	6.424	5.886
Al ₂ O ₃	10.107	9.624
SO ₃	4.707	4.577
P ₂ O ₅	1.401	1.237
MgO	1.336	1.161
TiO ₂	1.745	1.735
K ₂ O	0.841	0.819
Na ₂ O	0.040	0.193
ZnO	1.145	1.139
CuO	0.416	0.458
Cl	0.172	0.149
MnO	0.202	0.116
PbO	0.195	0.204
ZrO ₂	0.022	0.023
Cr ₂ O ₃	0.111	0.000
SrO	0.131	0.140
NiO	0.021	0.023
V ₂ O ₅	0.001	0.021
Rb ₂ O	0.002	0.002
BaO	0.164	0.163
LOI	25.500	27.100

WF-Large & WF- medium: washed fines from large and medium fractions, respectively

Chloride content of BA fractions



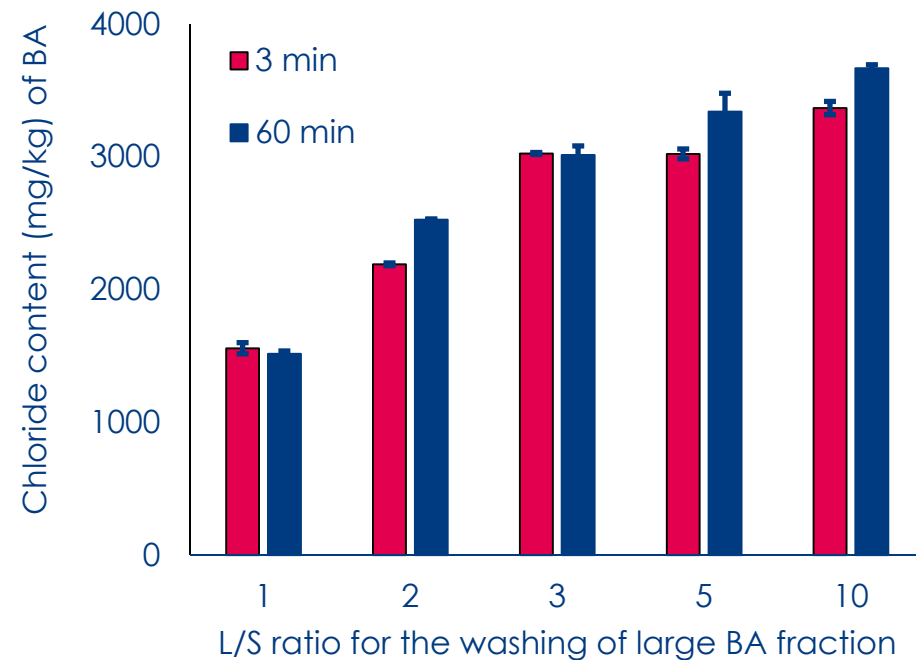
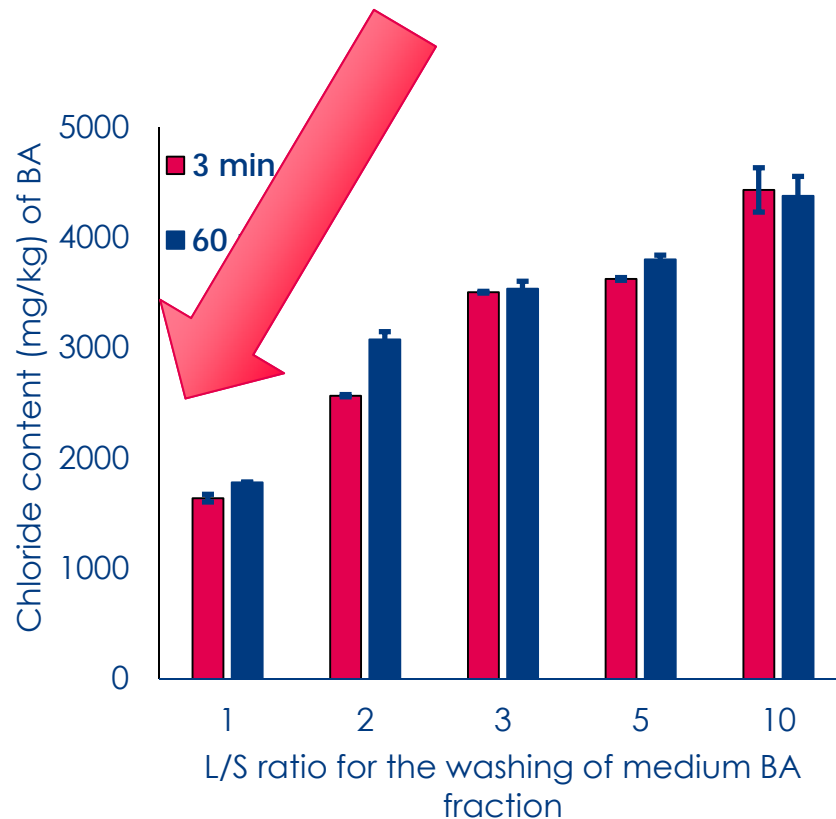
Effect of washing time



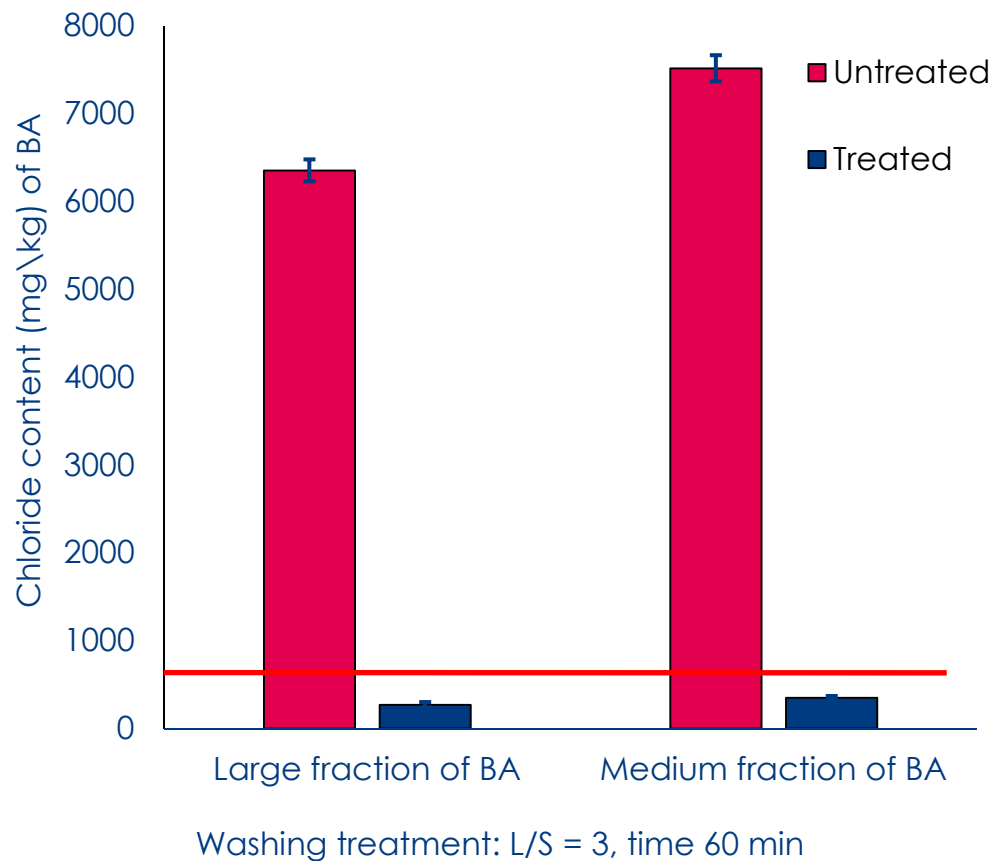
Large fraction: 1 – 4 mm, Medium fraction: 0.125 – 1 mm Fine: ≤ 0.125 mm

Influence of L/S ratio on leaching of chlorides from different BA fractions

L/S = 1 have 1.5 g of Cl and it can still dissolve 22 times more Cl

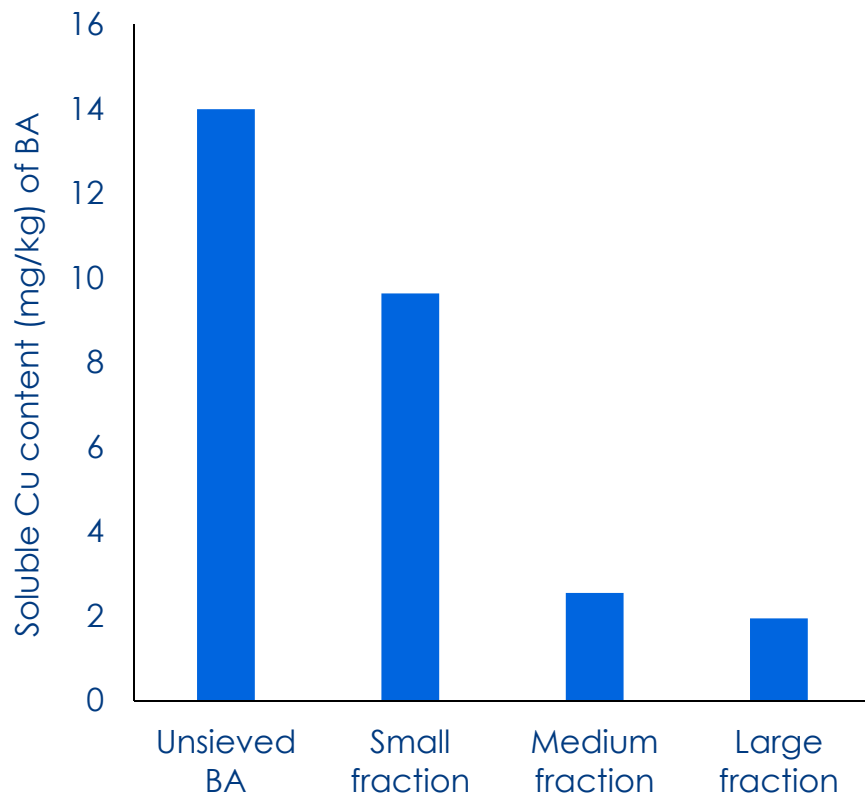


Large fraction: 1 – 4 mm, Medium fraction: 0.125 – 1 mm Fine: ≤ 0.125 mm

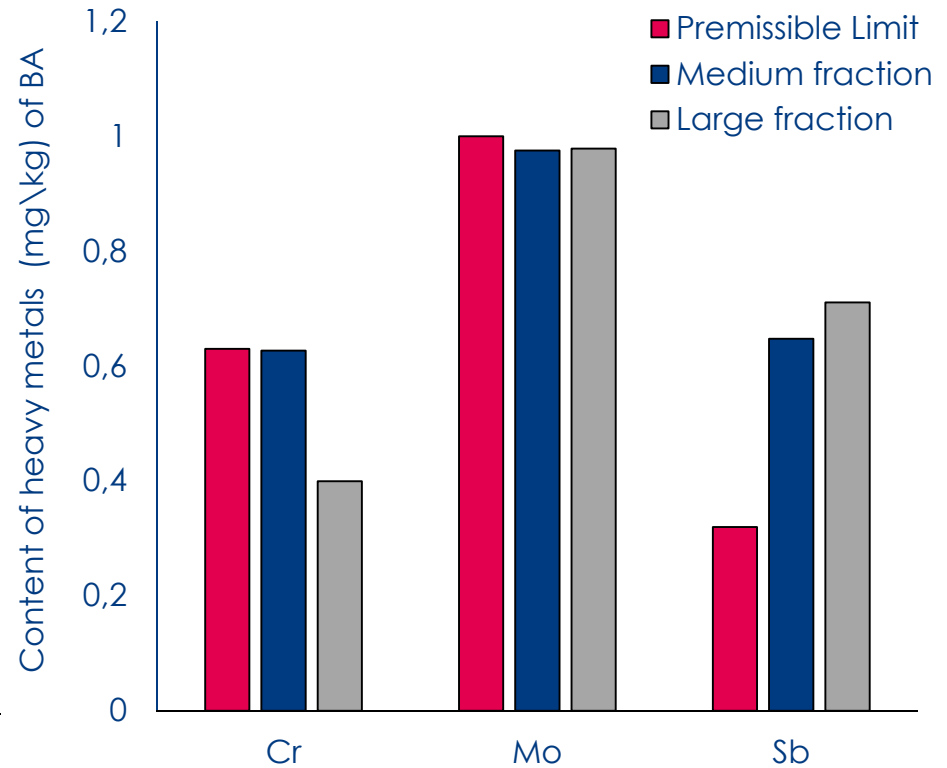


Chlorides	Solubility (g/L)	
ZnCl ₂	432	
CaCl ₂	745	
FeCl ₂	680	Quite Possible
FeCl ₃	920	
AlCl ₃	450	
SbCl ₃	985	
CrCl ₃	585	Possible; but rare
CuCl ₂	750	
NaCl	359	Most likely
KCl	344	

Large fraction: 1 – 4 mm, Medium fraction: 0.125 – 1 mm Fine: ≤ 0.125 mm



Particle size dependency of soluble Cu content in MSWI BA fractions



Effect of washing on the removal of different heavy metals present in MSWI BA

Large fraction: 1 – 4 mm, Medium fraction: 0.125 – 1 mm Fine: ≤ 0.125 mm

Conclusions

- Most of the chlorides are highly soluble and washing time does not have significant effect on their leaching.
- BA was treated twice with the L/S of 3 to bring the level of contaminants under the limit established by Dutch legislation.
- Most of the contaminants, heavy metals and chlorides concentrate in fine particles of size ≤ 0.125 mm.
- By removing these particles, relatively clean MSWI bottom ash can be obtained.
- Further research is required for the removal of copper and antimony

References

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- Thanks for your attention!
- Questions?

