



Antimony in ashes

- presence and speciation

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Background

- Antimony is one of the few elements that often exceed regulatory limits posted for leaching from ashes
- The knowledge about the redistribution of antimony during combustion and leaching properties is poor
- Poorly understood speciation in both aqueous and solid phases



Study

- To study the total content of antimony in different types of ashes; bottom and fly ashes; different fuel mixes and different amendments during combustion
- To study the leachability and affecting factors



14 participating boilers, 31 ashes

Dåva, Umeå (Roaster)	Söderenergi, P1 (Roaster)
Kiruna (Roaster)	Nynäshamn (BFB)
Sundsvall (CFB)	Västerås, P5 (CFB)
Lidköping (BFB)	Munksund (CFB)
Linköping (Roaster)	Braviken (Roaster)
Händelö, P13 (CFB)	Eskilstuna (BFB)
Händelö, P14 (CFB)	Högdalen, P6 (CFB)



Analysis and experiments

- Total concentrations
- Leachable concentrations (L/S 2 och L/S 10)
- Sequential leaching
- Leaching as a function of pH
- Attempt to model speciation in the aqueous phase



Total antimony concentrations

- Mean fly ashes (CFB/BFB) 192 mg/kg
 - Mean bottom (CFB/BFB) 86,5 mg/kg
 - Mean fly ashes (roaster) 1 140 mg/kg
 - Mean bottom (roaster) 61,8 mg/kg
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- 75% of the amount of antimony is found in the fly ashes (both boilers and roasters)



Leachable concentrations (L/S 10)

- Mean fly (CFB/BFB) 0,0367 mg/kg
 - Mean bottom (CFB/BFB) 0,1751 mg/kg
 - Mean fly (roaster) 0,0251 mg/kg
 - Mean bottom (roaster) 0,1991 mg/kg
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- Out of the 31 ashes 11 (8 bottom ashes) exceed the regulatory limit for inert deposits

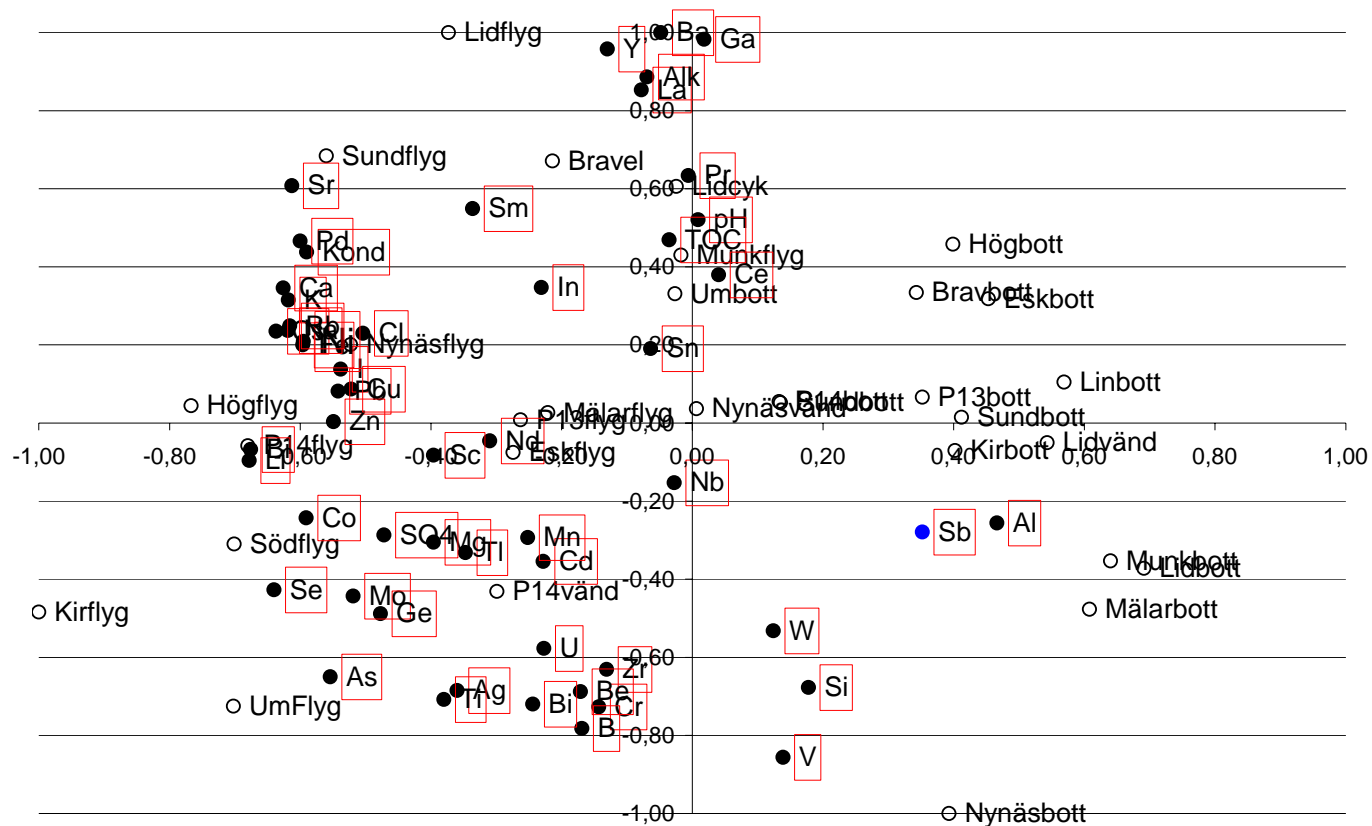


Leachable antimony concentrations

- The leachability is only between 0,06 and almost 1% of the total concentration (cf 94% for chloride) at L/S 10
- During sequential leaching only 24% of the total concentration is released
- 76% is thus associated very hard to the ash matrix



Multivariate analysis of leachable concentrations (L/S 2)



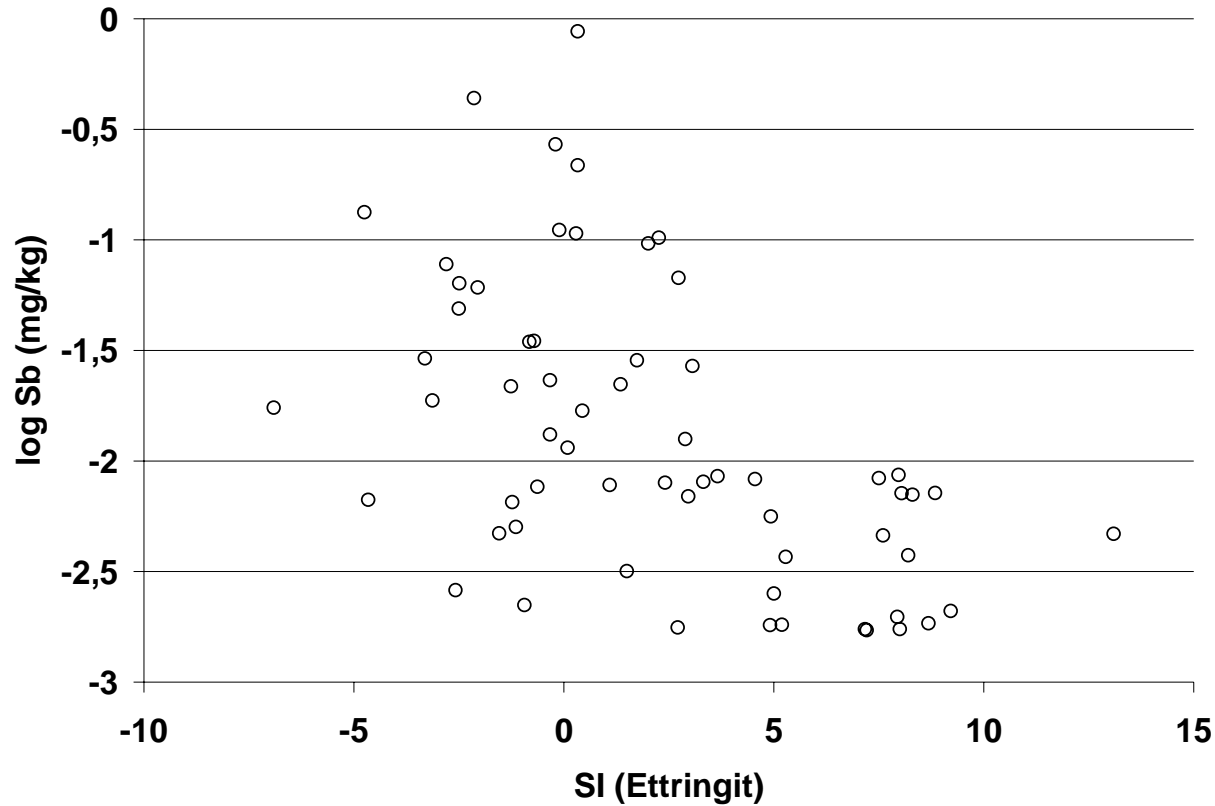


Possible mechanisms

- Covarying substances are aluminium (+) and sulphate (-)
- Ettringite ($\text{Ca}_6\text{Al}_2(\text{SO}_4)_3(\text{OH})_{12} \cdot 26\text{H}_2\text{O}$) is suspected to keep antimony within the ash matrix



Saturation index (SI) for ettringite in all solutions





Conclusions

- High total concentrations as a consequence of combustion of waste (municipal, plastics)
- In roasters antimony is enriched in the fly ash
- No relation between total and leachable concentrations
- Likely association with ettringite