

# Speciation of Copper in leachate from MSWI bottom ash

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# Trace metal leaching ( $\mu\text{g/l}$ )

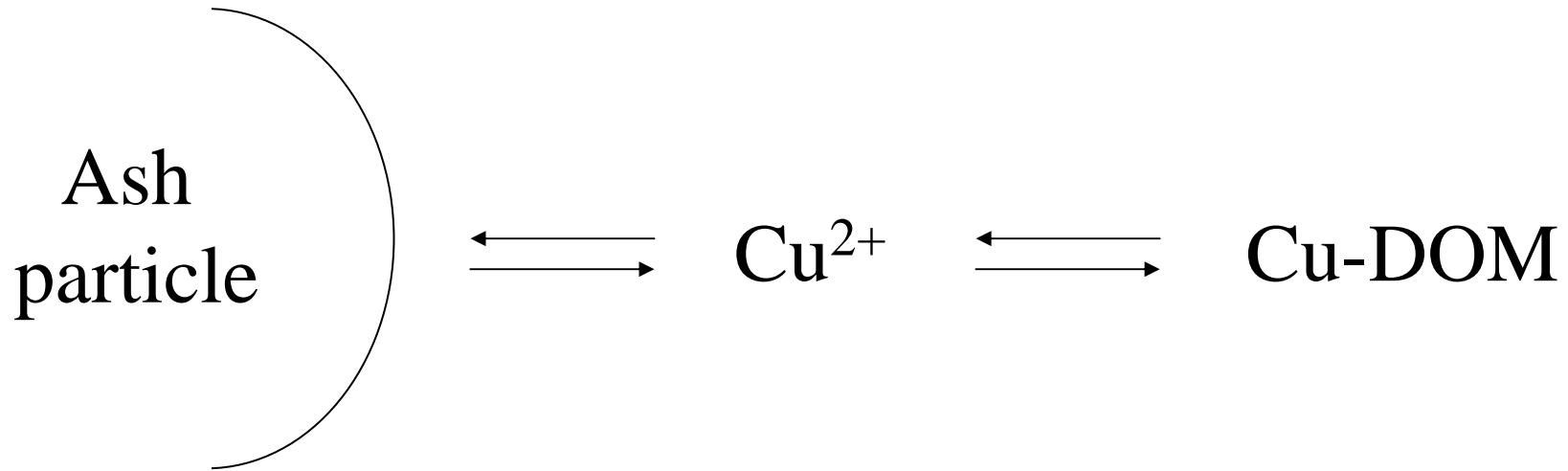
Metal	MSWI bottom ash leachate <sup>1</sup> ( $\mu\text{g/l}$ )	Crushed rock leachate <sup>2</sup> ( $\mu\text{g/l}$ )	Lake background concentration <sup>3</sup> ( $\mu\text{g/l}$ )
Cd	1.1	0.1	0.016
Cr	9.0	0.5	0.2
Cu	1212	5.5	0.5
Ni	18	2.7	0.4
Pb	4.5	0.3	0.24
Zn	34	3.3	2.0

<sup>1</sup> (RVF 2002)

<sup>2</sup> (Tossavainen & Håkansson 1999)

<sup>3</sup> (Naturvårdsverket 1999)

# Cu-complexes with dissolved organic matter (DOM)



- Total Cu leaching
- Toxicity

# Research questions

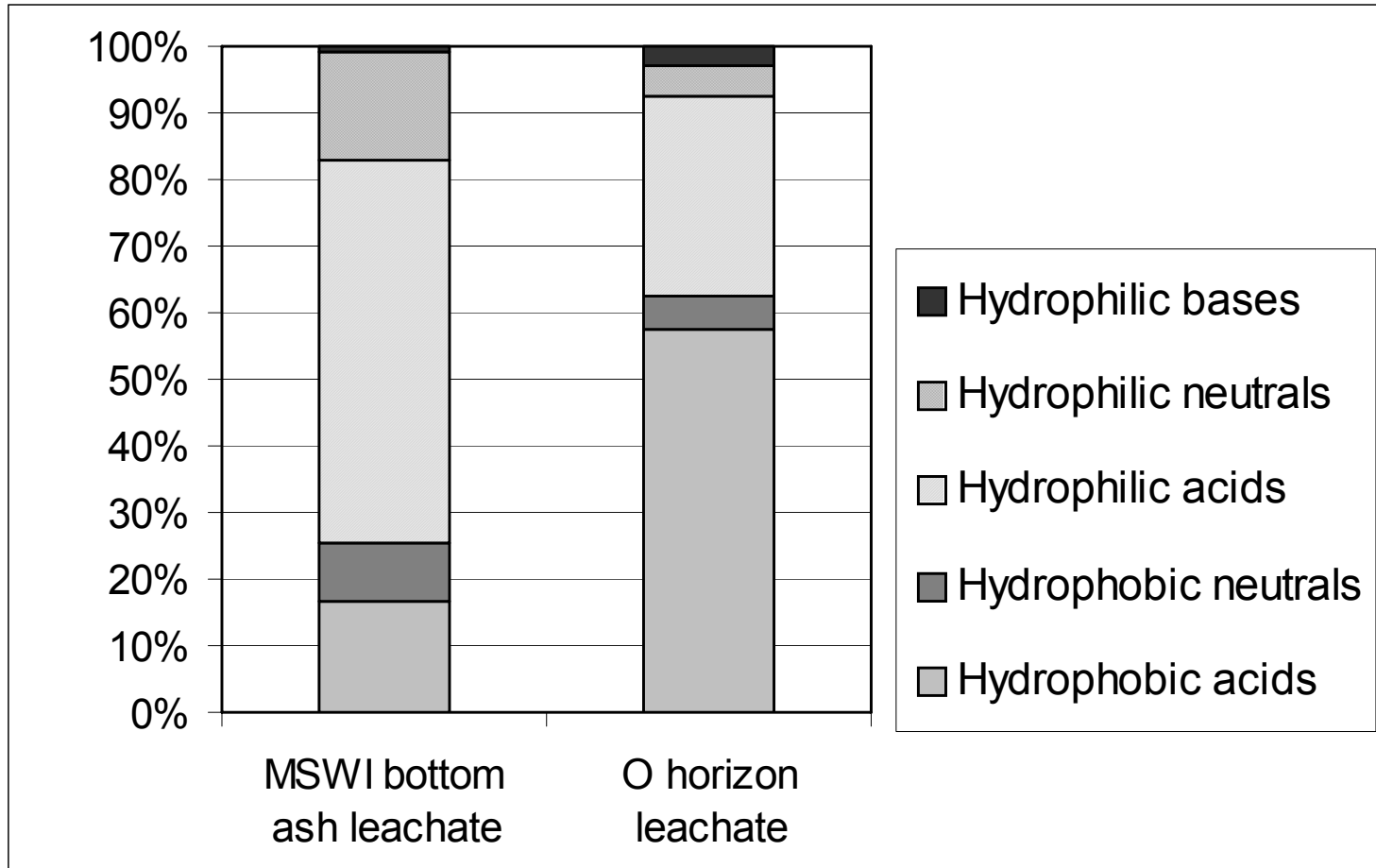
- What are the characteristics of MSWI bottom ash DOM?
- Can Cu speciation in ash leachate be predicted by geochemical modeling?
  - SHM
  - NICA-Donnan

# Project outline

1. Sampling and production of leachate
2. Fractionation
3. NaOH titration
4. Measurements of copper activity
  - At different total Cu concentrations
  - At different pH values

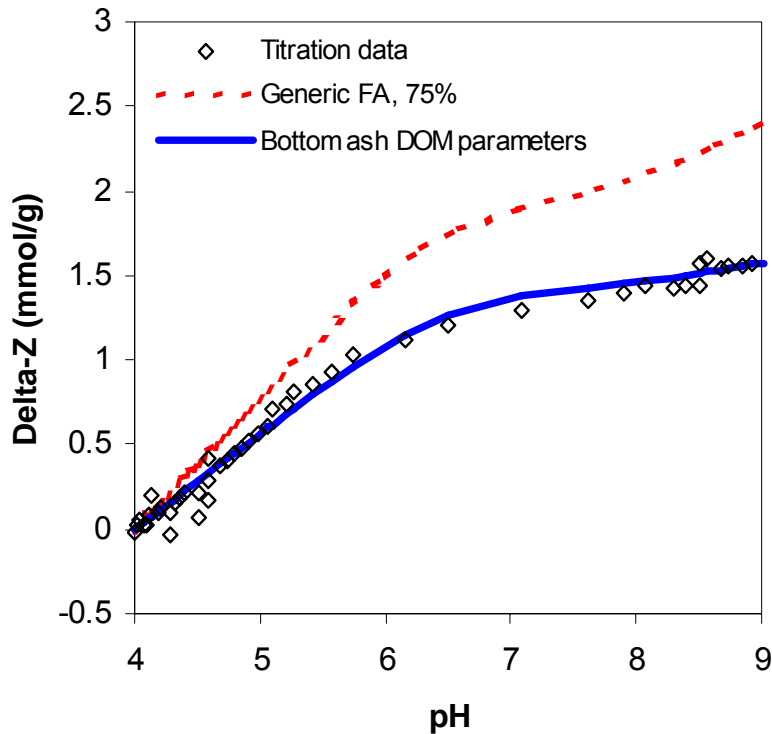
Comparison of experimental results with modeling results (SHM and NICA-Donnan)

# Fractionation results

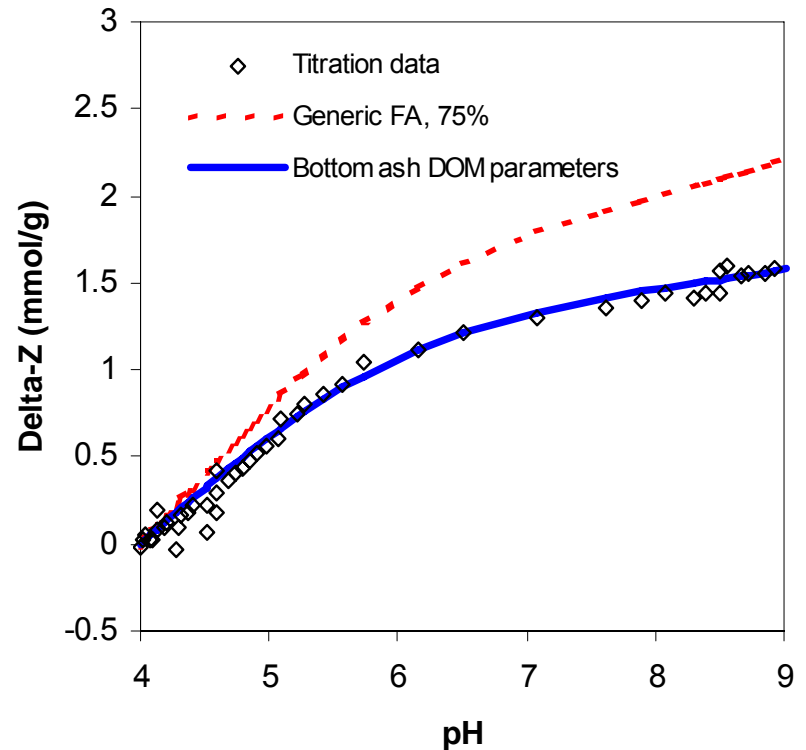


# NaOH titration (cation exchanged leachate)

## SHM

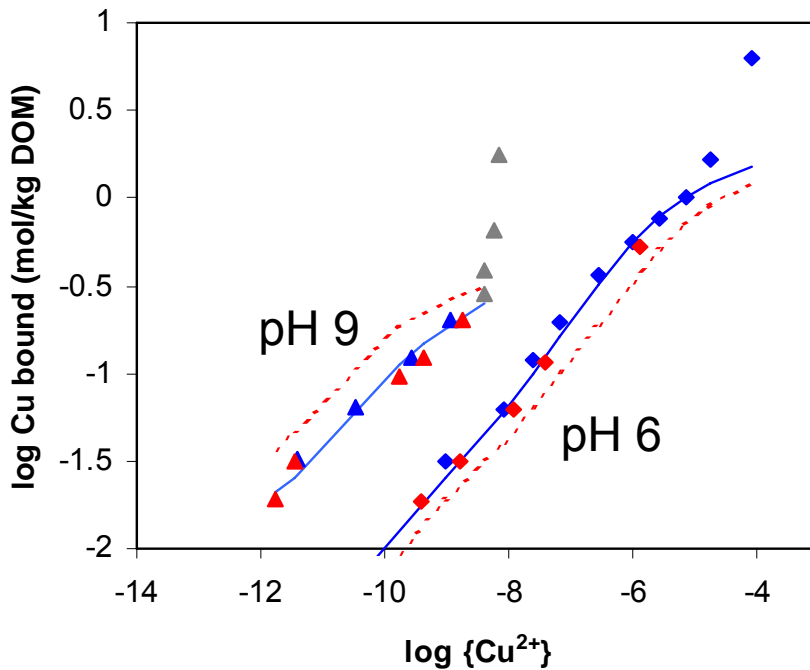


## NICA-Donnan

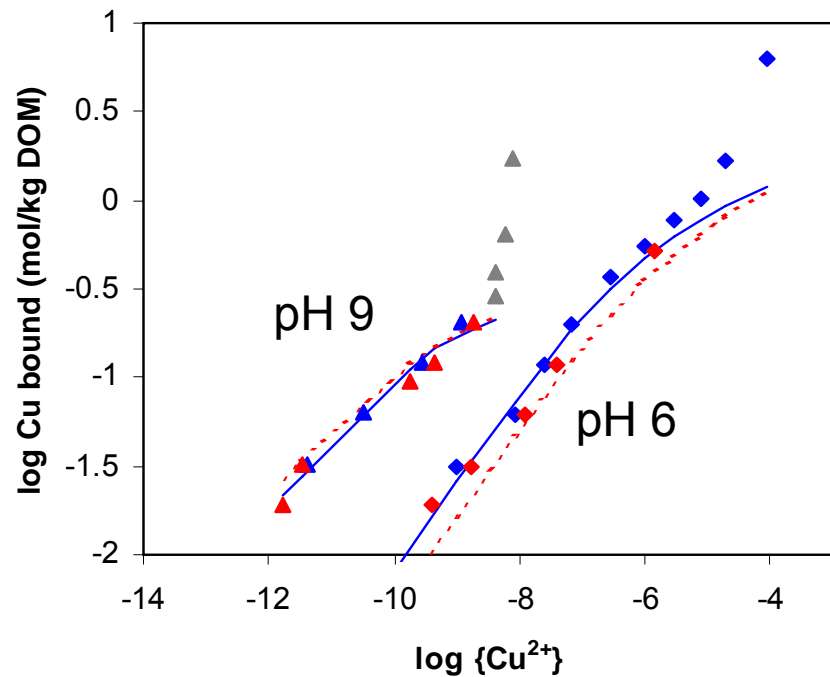


# Measurements of copper activity at different total Cu concentrations (cation exchanged leachate)

SHM

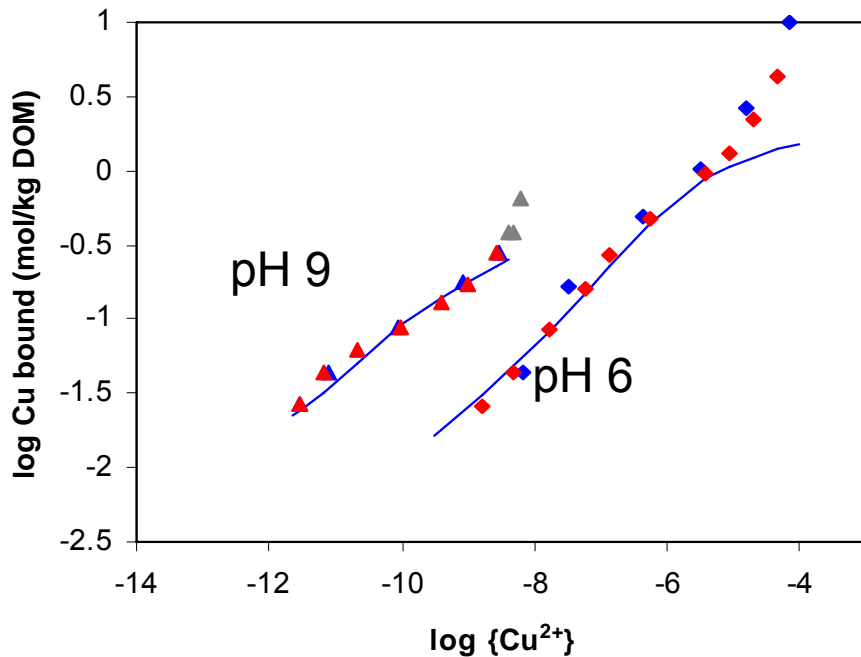


NICA-Donnan

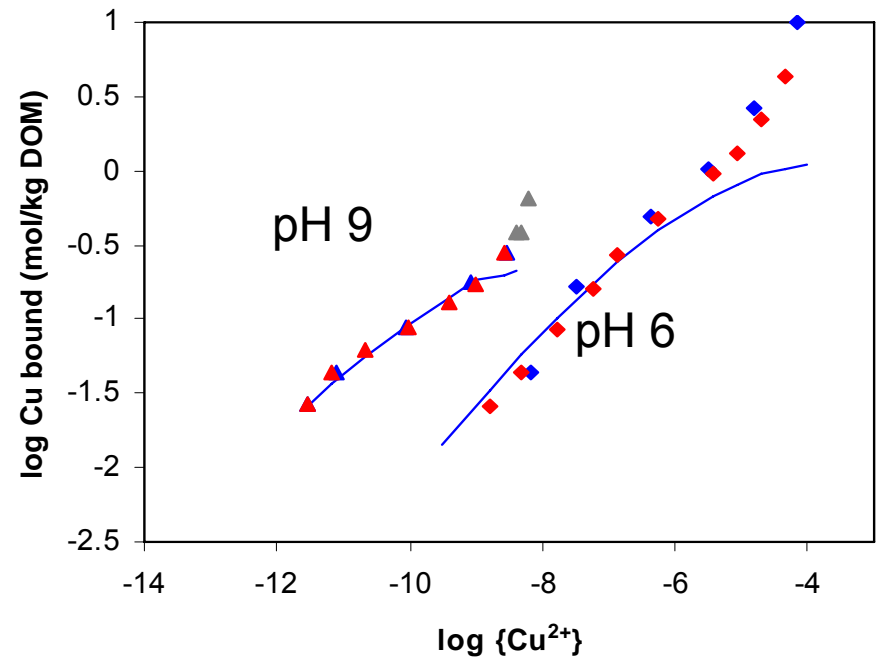


# Measurements of copper activity at different total Cu concentrations (hydrophilic fraction)

SHM

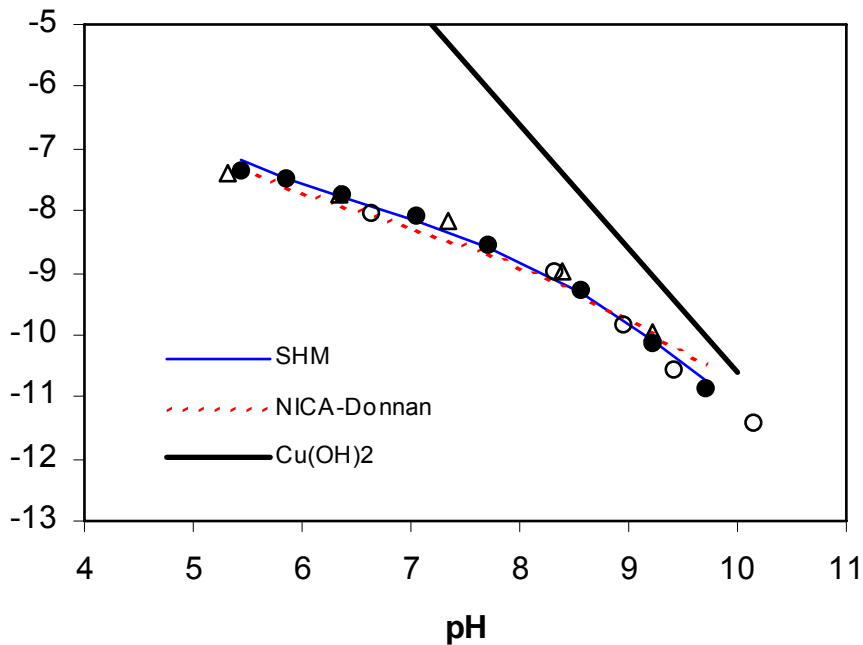


NICA-Donnan

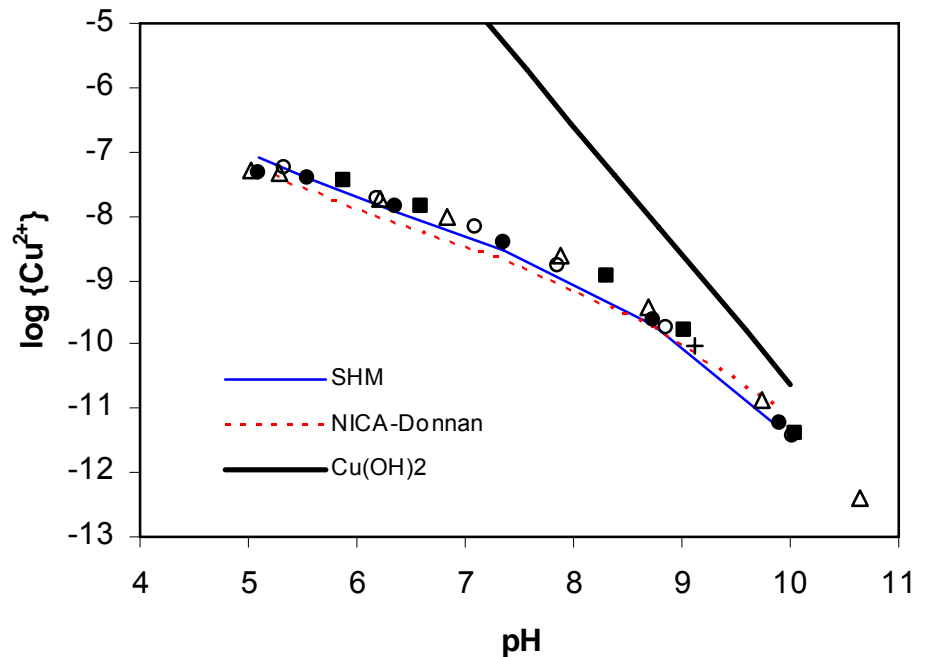


# Measurements of copper activity at different pH values

## Cation exchanged leachate



## Hydrophilic fraction



# Remaining questions

- How should competing cations be treated in the models?
- Are there any further parameters that need to be adjusted?
- Is the investigated ash sample representative for MSWI bottom ash in general?

# Conclusions

- Hydrophilic components are important for Cu binding and constitute a large part of the total DOM
- The ash leachate contains humic-type material
- There are differences between DOM in the ash leachate and in natural water that need to be accounted for when modeling Cu speciation
- Good fits were achieved for cation exchanged samples when acid-base parameters and Cu binding constants were adjusted

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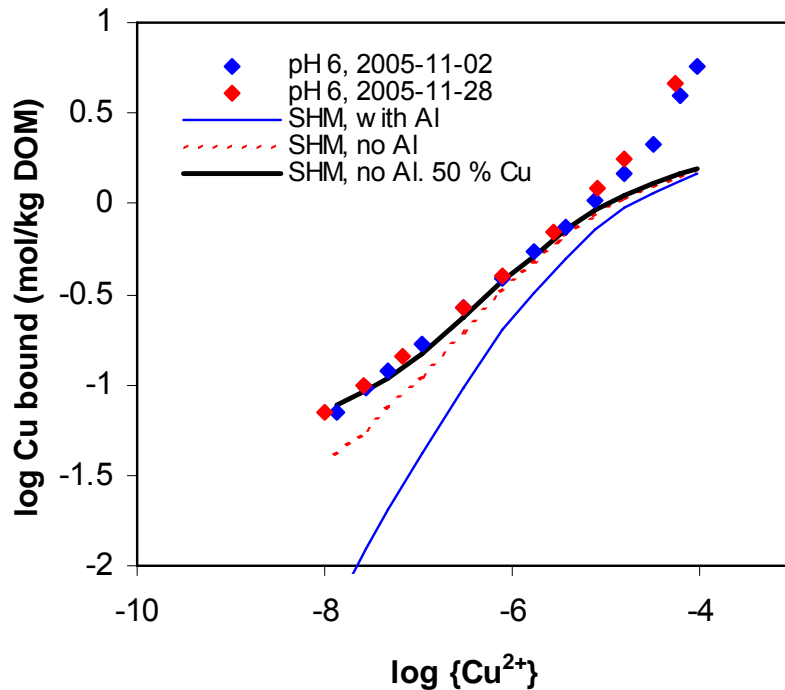
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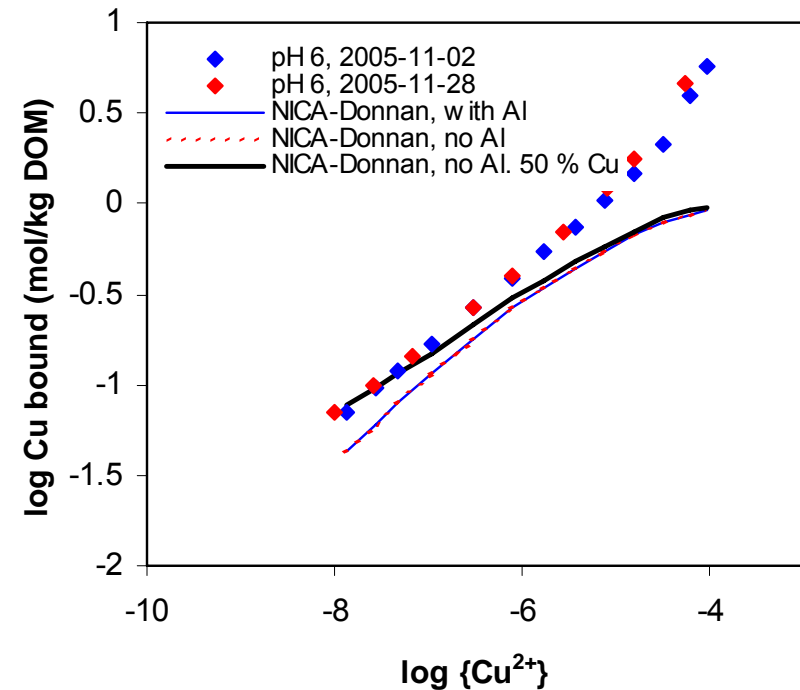


# Cu titration (untreated leachate, pH 6)

## SHM

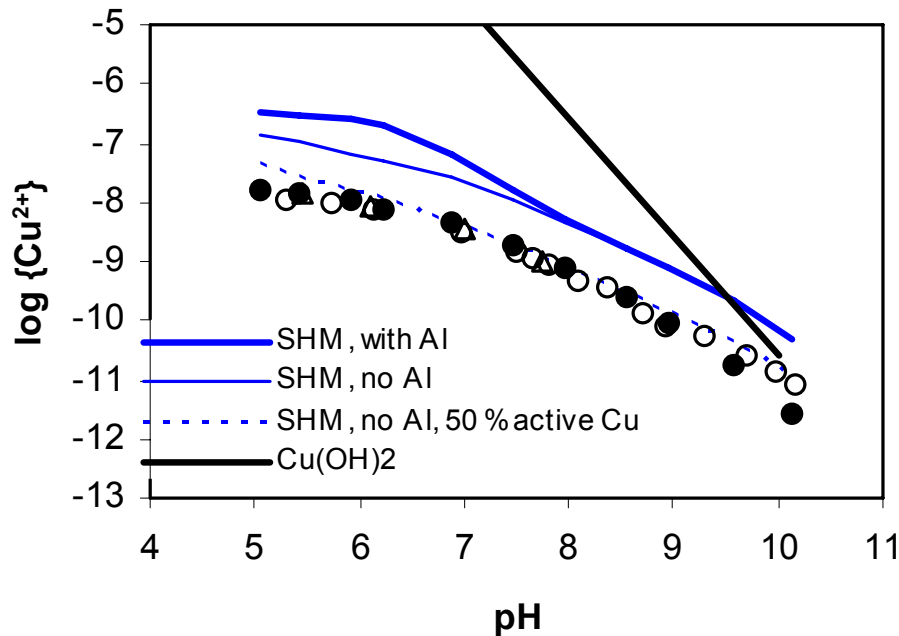


## NICA-Donnan

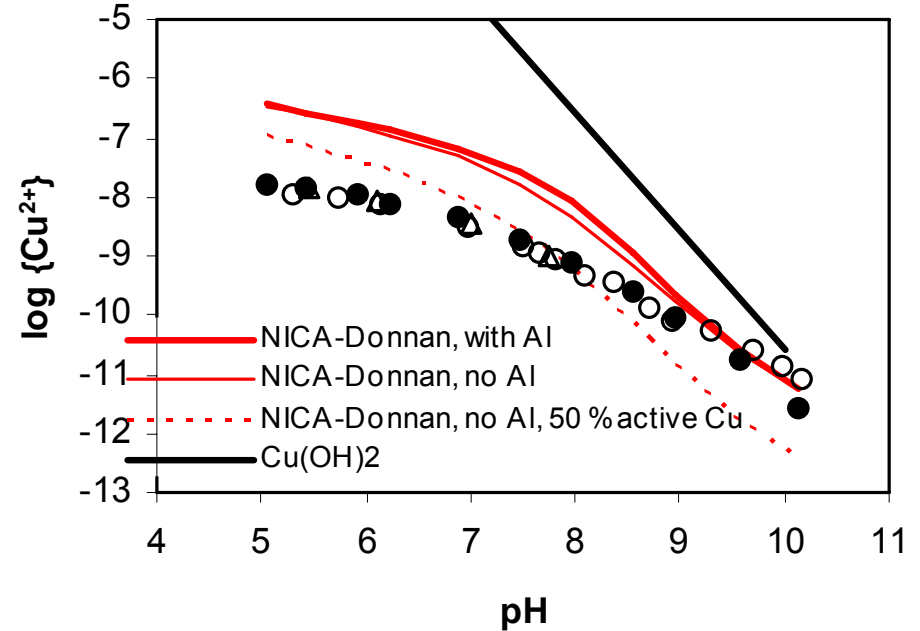


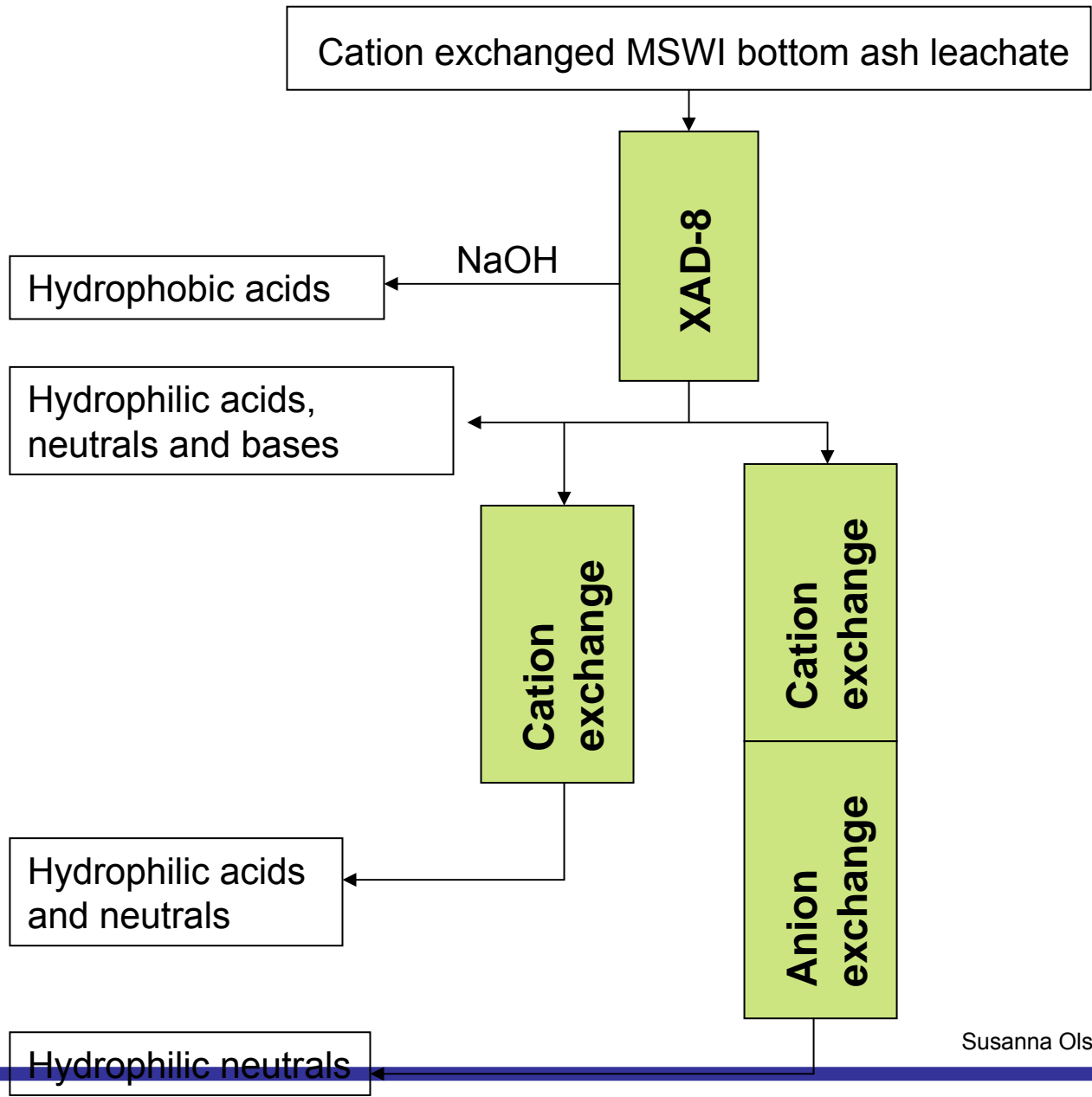
# Alkalimetric titration (untreated leachate)

## SHM

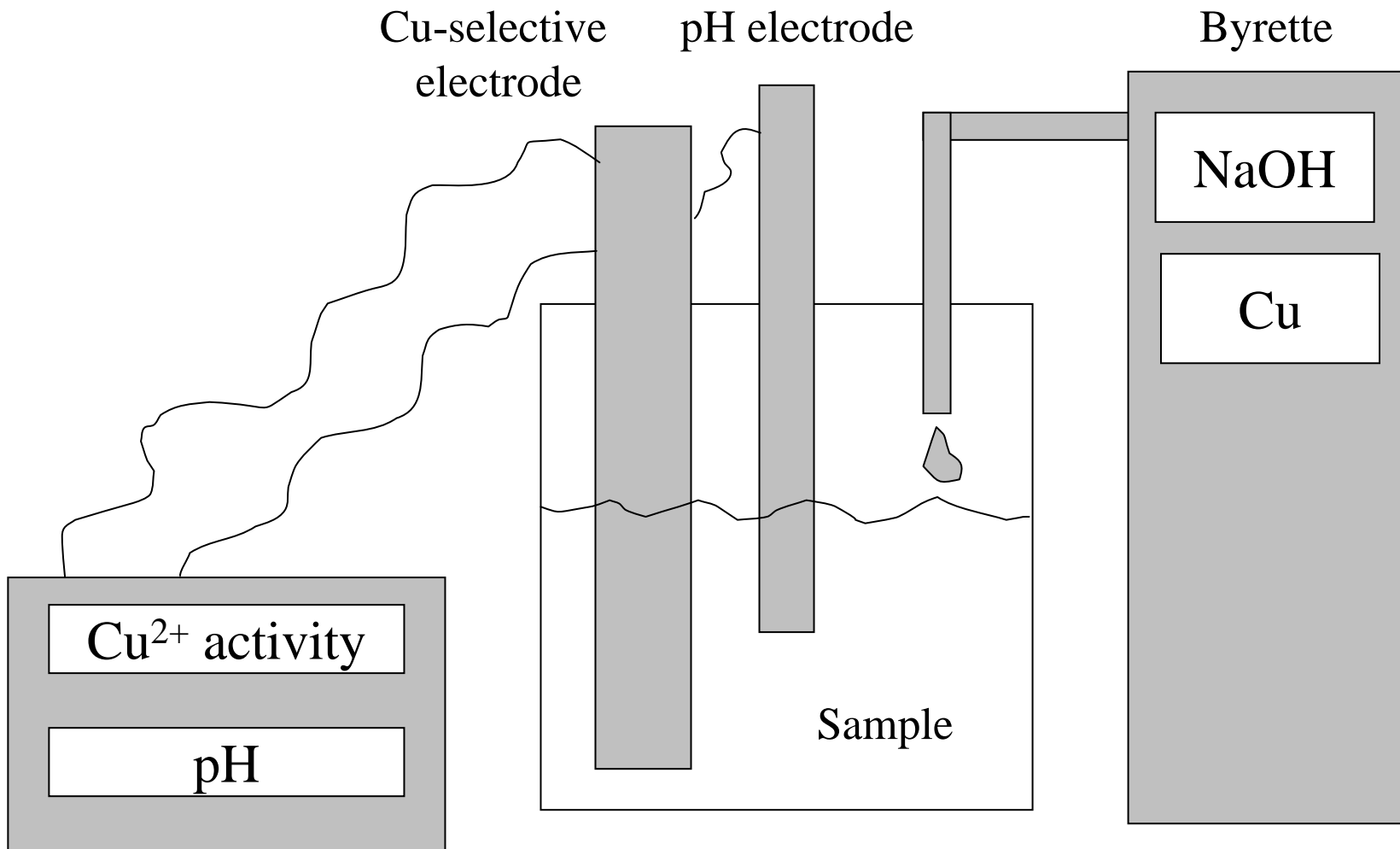


## NICA-Donnan



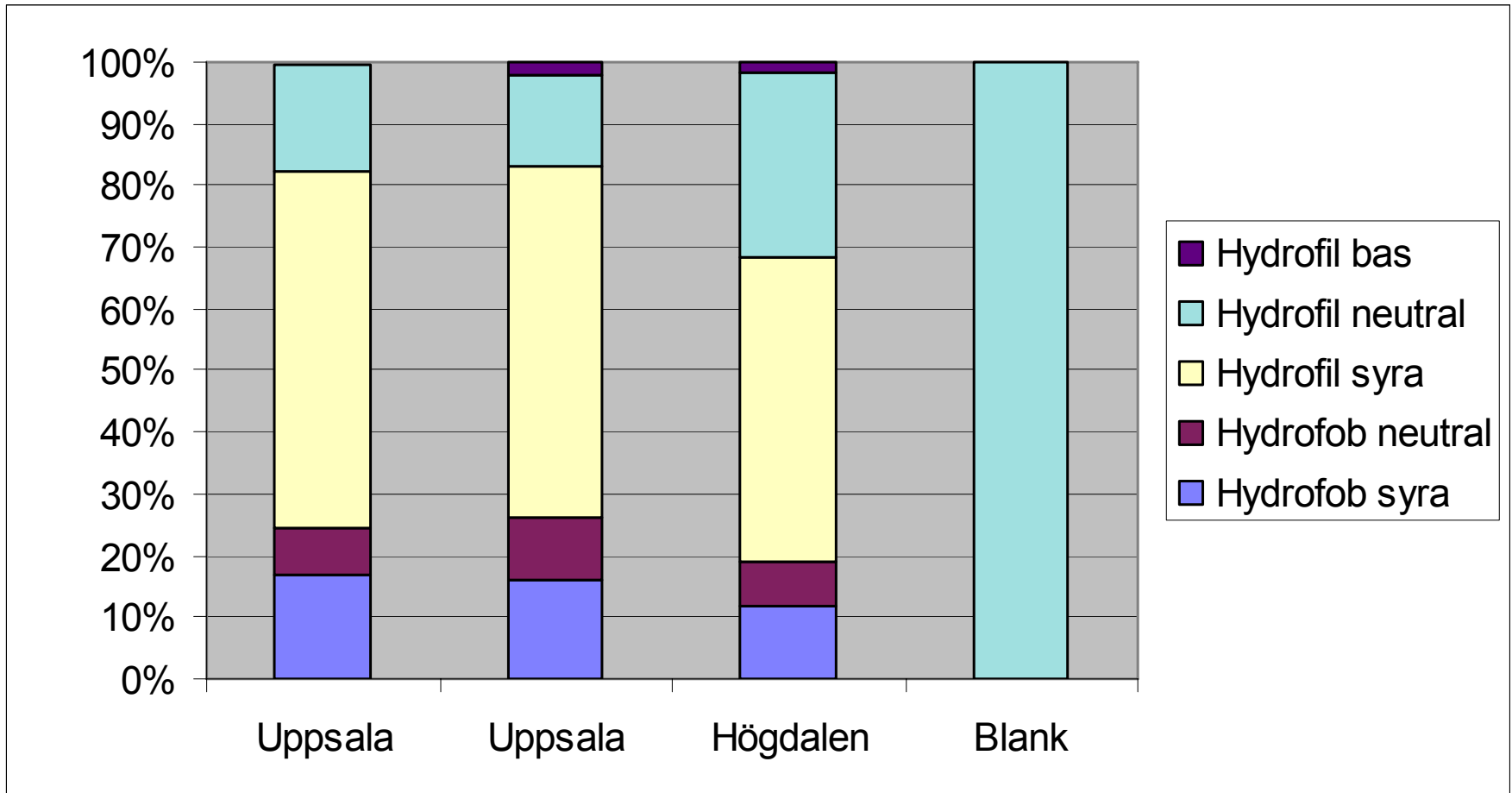


# Measurement of Cu binding properties



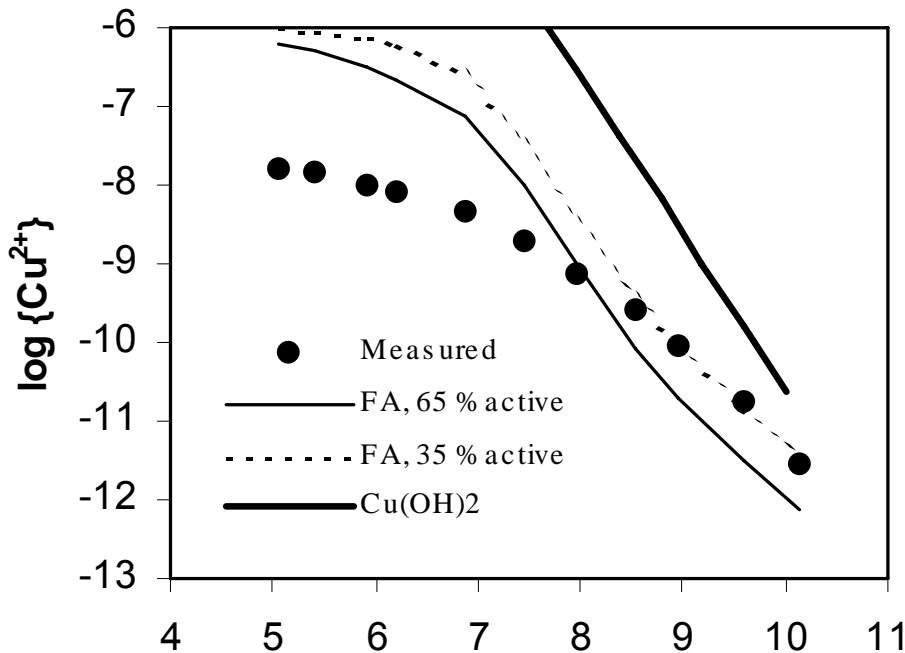
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# Fractionation of DOC in leachwater

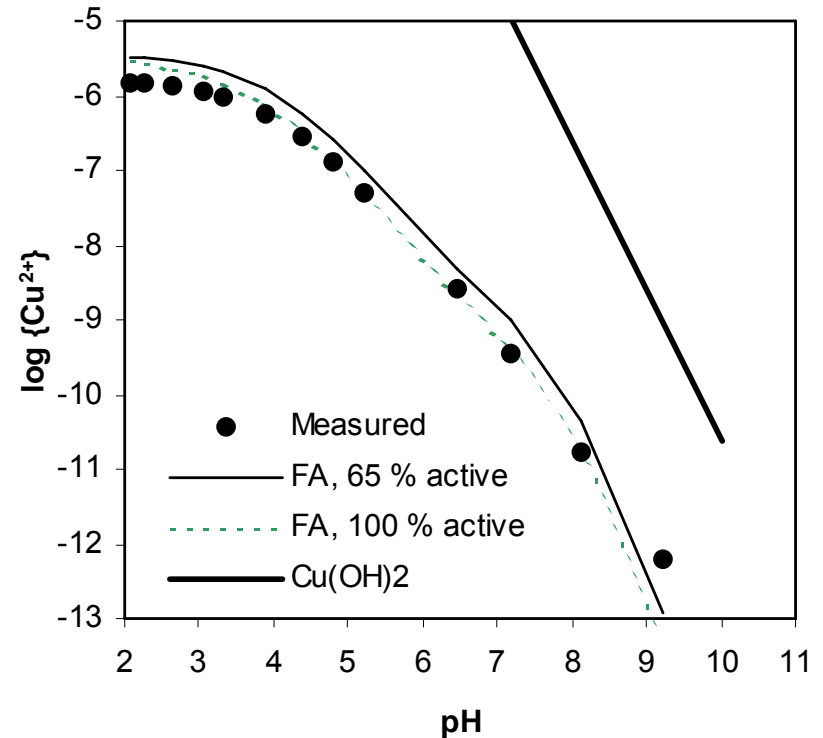


# pH dependence of the $\text{Cu}^{2+}$ activity in ash and soil leachates

MSWI bottom ash  
Leachate:

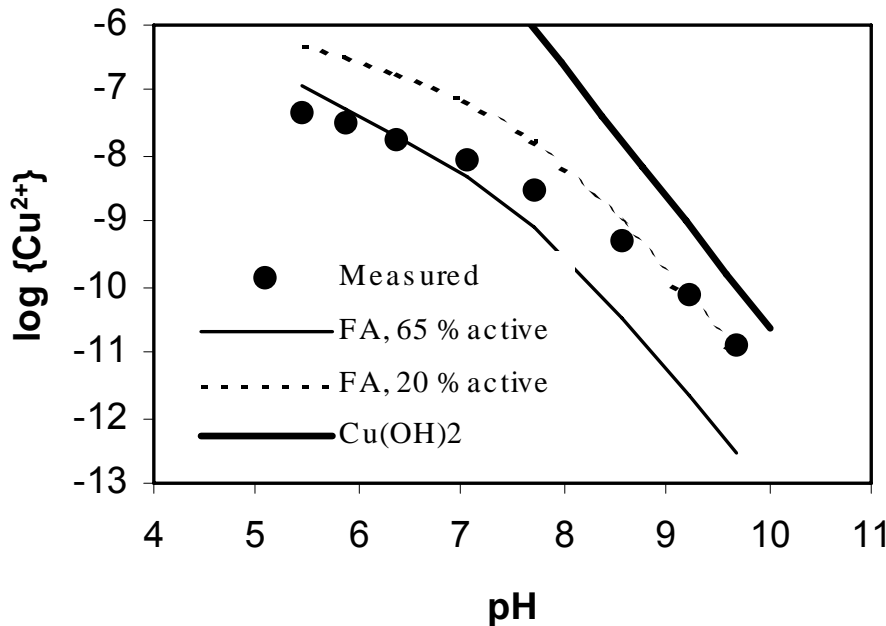


soil leachate:

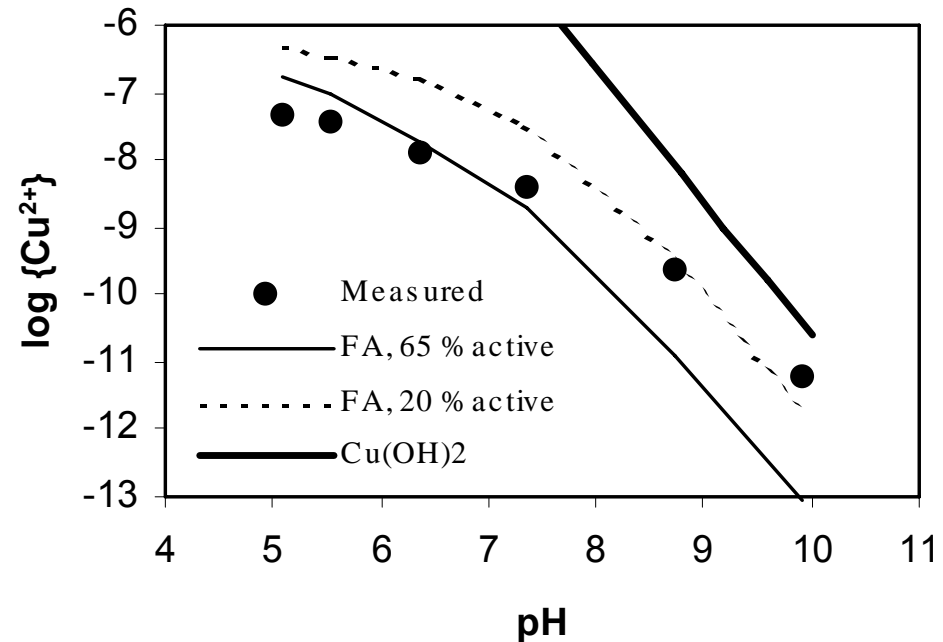


# pH dependence of the $\text{Cu}^{2+}$ activity in ash leachate sub samples

Leachate with all DOC fractions:



Leachate with only the hydrophilic fraction:



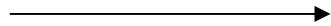
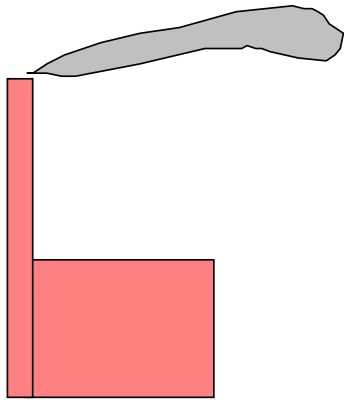
The removal of the hydrophobic fraction has little effect on the Cu binding. Also the hydrophilic fraction seems to form Cu-DOC complexes.

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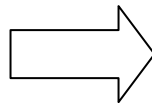
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# Municipal solid waste incineration bottom ash



3,8 million tonnes of municipal  
solid waste per year

Almost 40 % is incinerated



3-400 000 tonnes  
of bottom ash