LULEÅ UNIVERSITY OF TECHNOLOGY

Master Thesis

Stabilization of CCA-contaminated soil by addition of iron compounds

Désirée Nordmark
Luleå University of Technology
Department of Civil and environmental engineering
Division of Waste science and technology

Supervisor: Christian Maurice, LTU/ Ramböll
In cooperation with Merox AB

The northernmost University of Technology in Scandinavia
Top-class Research and Education

Contaminated soil – Brown fields

80 000 contaminated sites in Sweden

Wood preservation industry
CCA-preservatives (chromium, cupper and arsenic)

Environmental quality objectives: A Non-Toxic Environment

Soil remediation

Common method today – excavation and landfilling

Innovative method – chemical stabilization

The stabilization is affected by environmental factors as pH, redox potential, organic matter (OM), micro organisms and hydrology

Aim

Investigate iron containing waste products ability to stabilize CCA-contaminated soil

Assess some chemical and physical factors effect on the stabilization

Evaluate the results and make suggestions about how to implement them in large scale soil remediation

Amendments

Amendments	Grain size (mm)	Fe (%)	Ca (%)
LD-slag (Merox AB)	*0-7*	*17*	*40*
Steel grit residue (Merox AB)	*ca 1*	*96,5*	*-*
Zero-valent iron (Höganäs AB)	*ca 0,1*	*91,2*	*-*

Soils from Robertsfors, Forsmo and Buskhyttan

Soil (<4 mm)	As	Cr	Cu
	(mg/kg)		
	148 -1410	*< - 570*	*84 - 929*

< below detection limit

Method

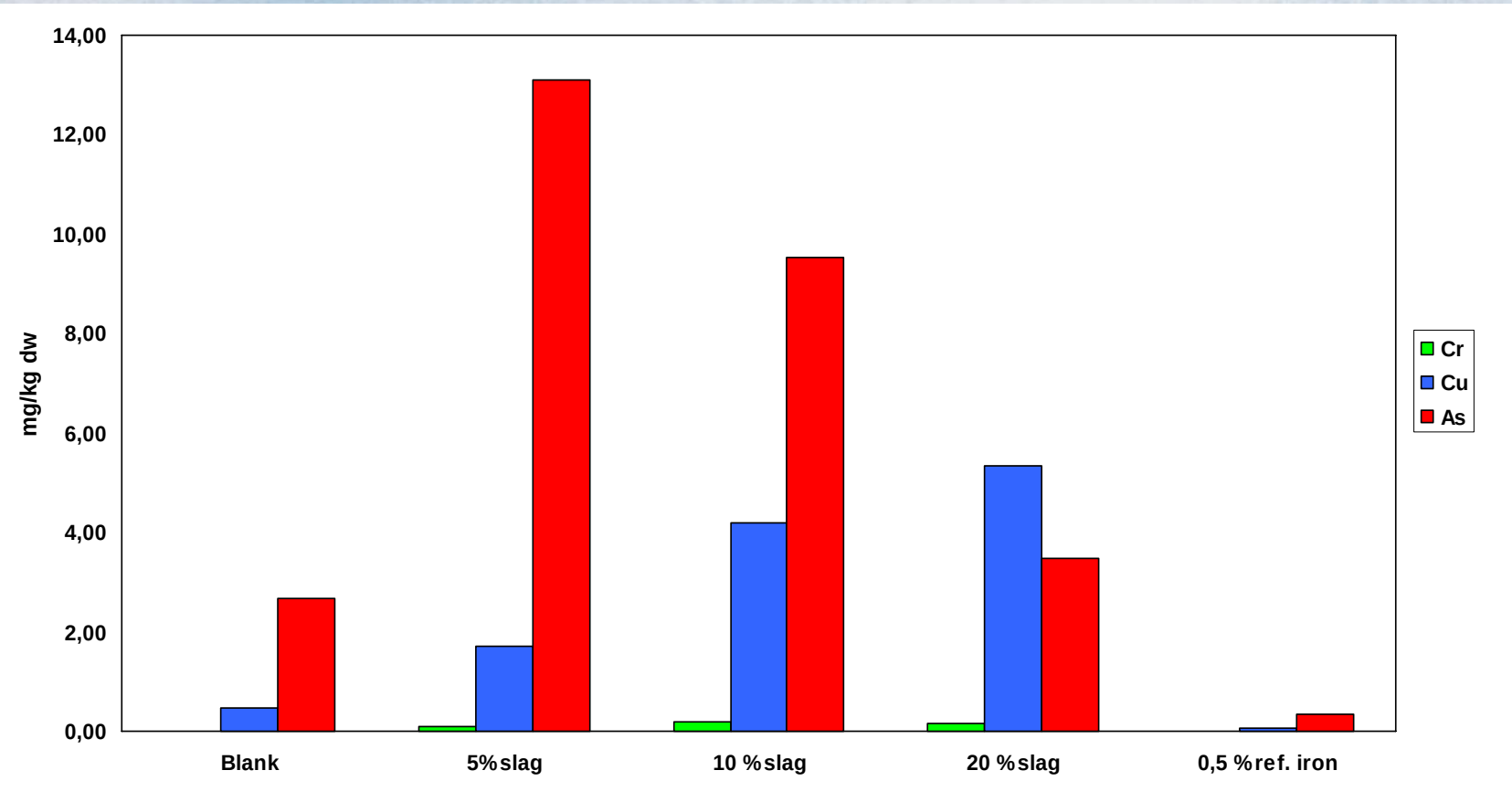
Mixing of contaminated soil and Fe-containing amendments

Stabilization for 2 weeks

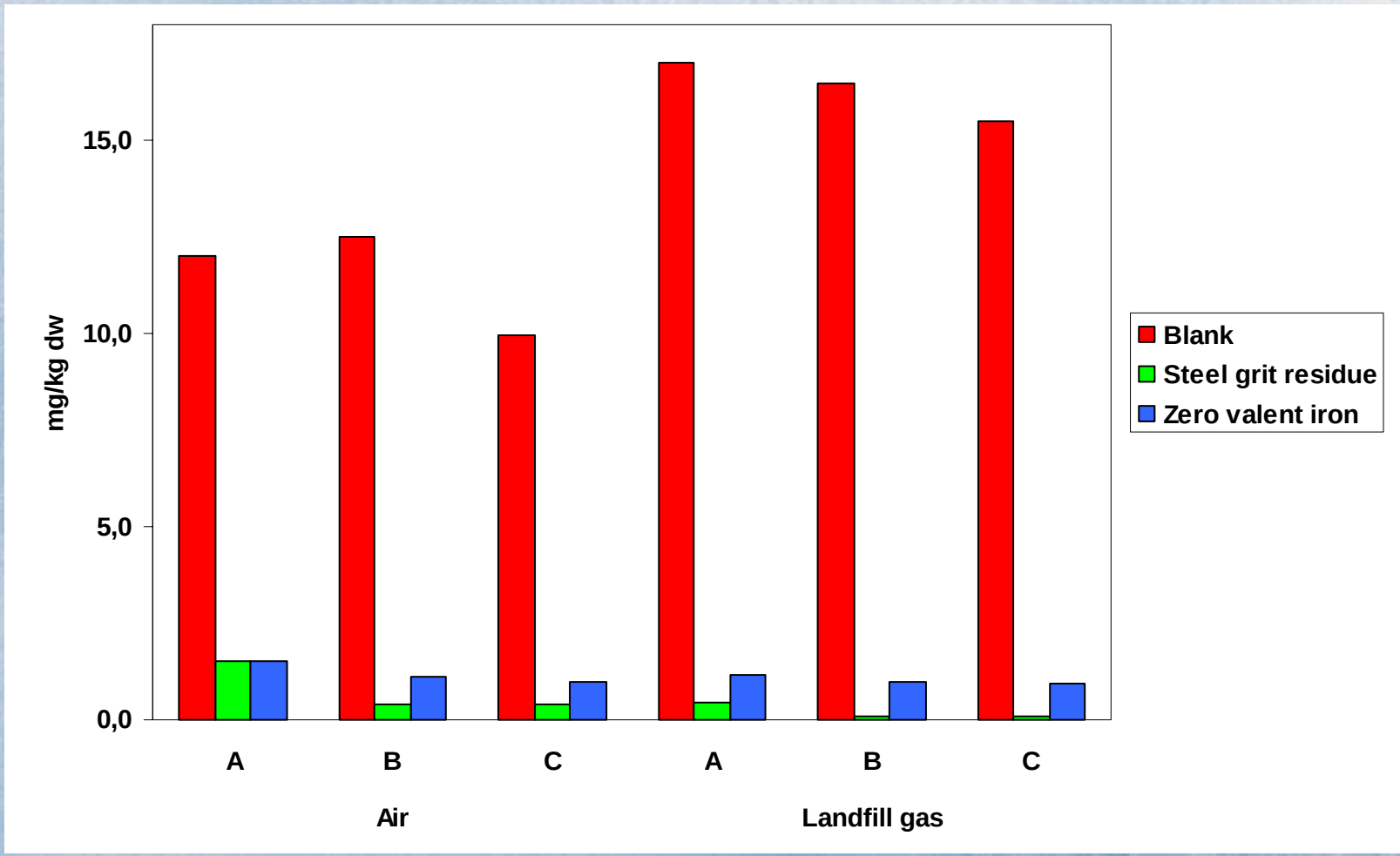
Batch leaching tests in an atmosphere of air or landfill gas (CH_4, CO_2)

Analyze of As, Cr and Cu in leachate

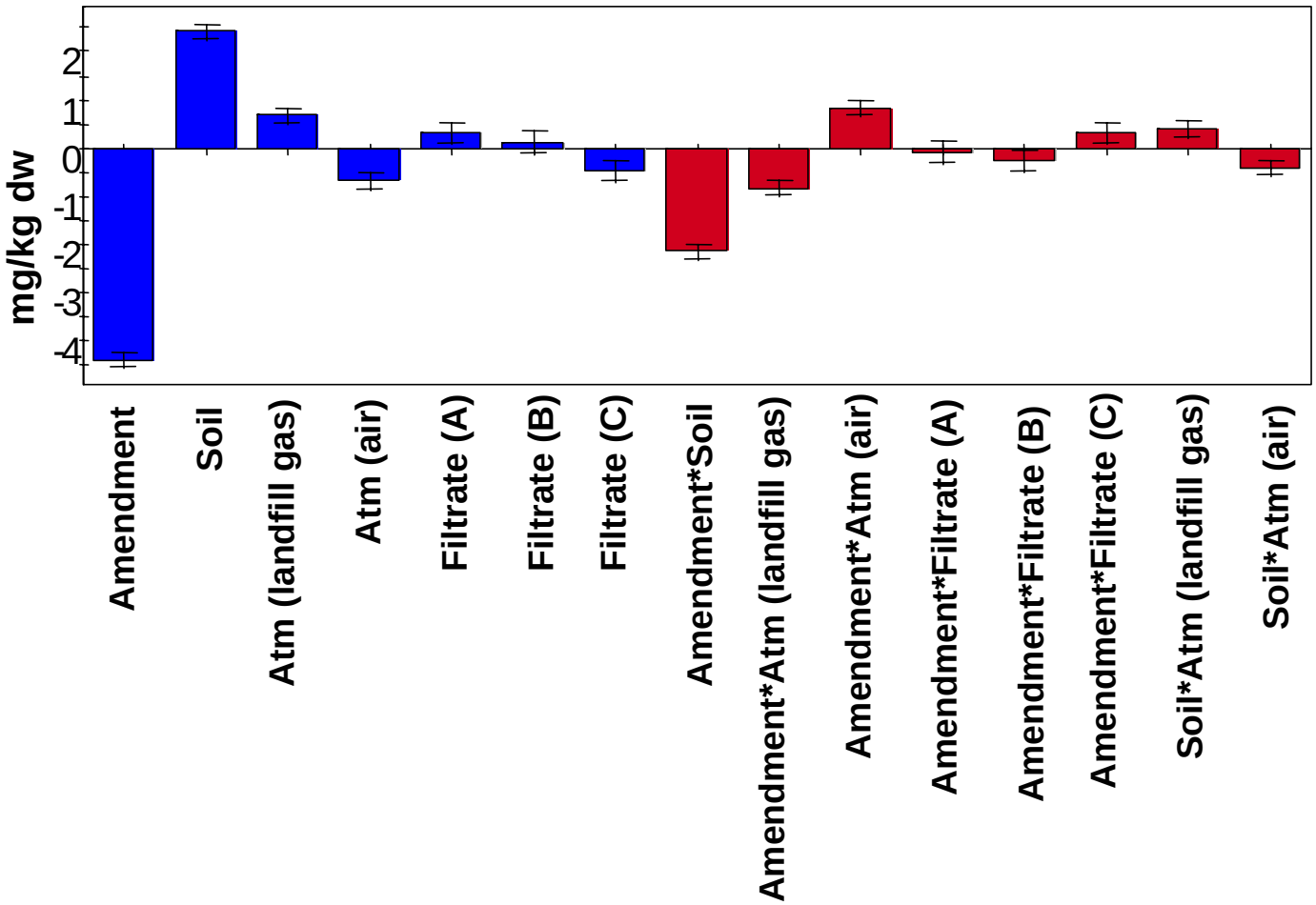
LD-slag as amendment



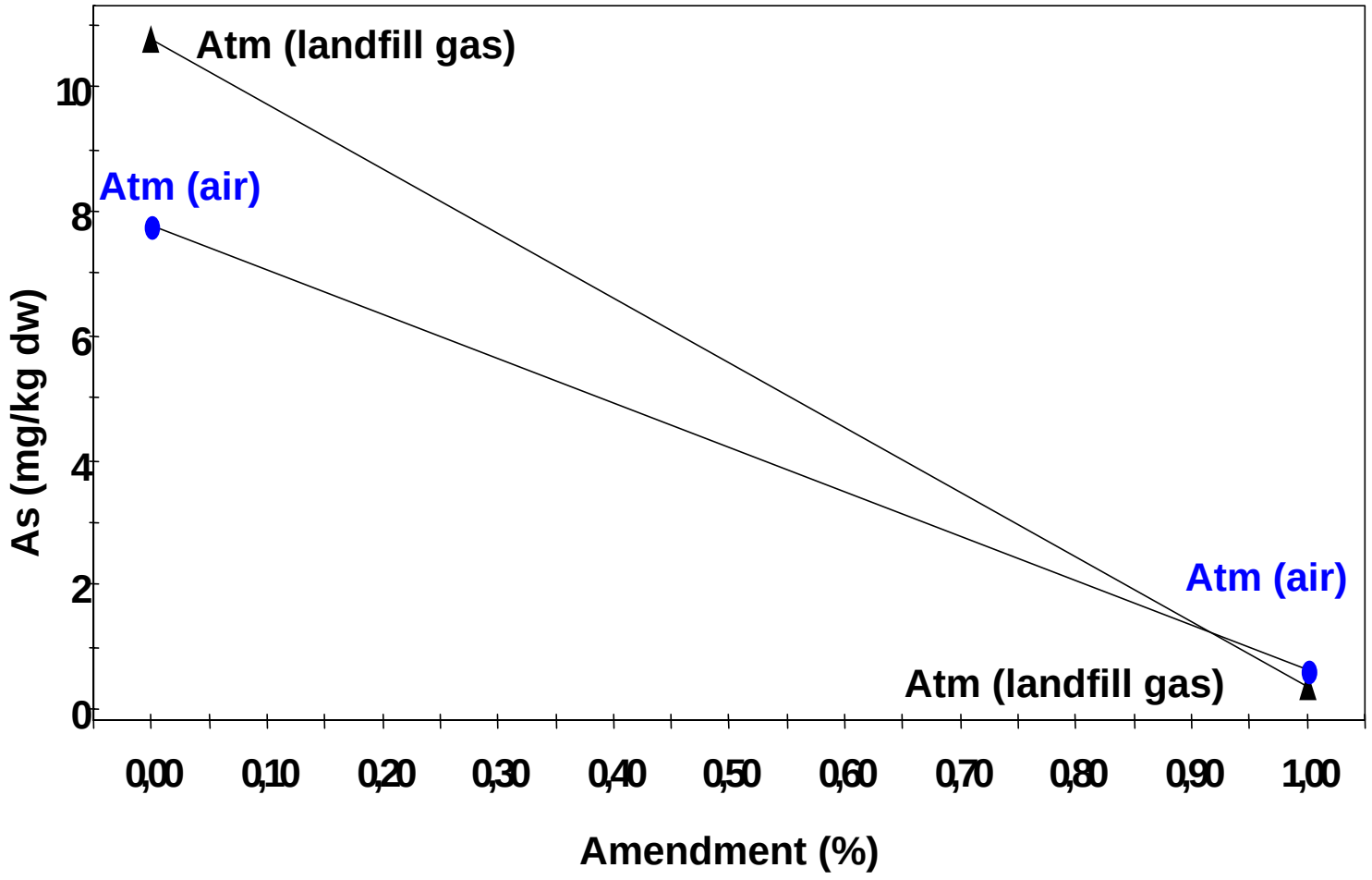
Arsenic leaching
1 % Steel grit residue and Zero-valent iron as amendments



Arsenic leaching – Model of significant factors



Arsenic leaching – Interaction, atmosphere*amendments (%)



Reduction of As, Cr, Cu

Amendment 1 %	Atmosphere	Reduction of As (%)	Reduction of Cr (%)	Reduction of Cu (%)
Steel grit residue	*Air*	*93,4 ±4,9*	*88,4 ±4,2*	*-34,9 ±107*
Steel grit residue	*Landfill gas*	*99,2 ±0,4*	*91,9 ±5,0*	*83,8 ±13,2*
Zero-valent iron	*Air*	*90,3 ±1,7*	*80,8 ±6,7*	*68,1 ±19,5*
Zero-valent iron	*Landfill gas*	*96,0 ±2,2*	*85,5 ±8,7*	*58,2 ±31,9*

Conclusions

LD-slag is not suitable for stabilization of CCA-contaminated soil due to its high content of calcium

Steel grit residue and Zero-valent iron reduces the leachability of As, Cr

The amount of amendment is the factor that has the greatest influence on the mobility of As and Cr

Stabilization can be used as a pre-treatment method to reduce the accepted landfill class of CCA-contaminated soil