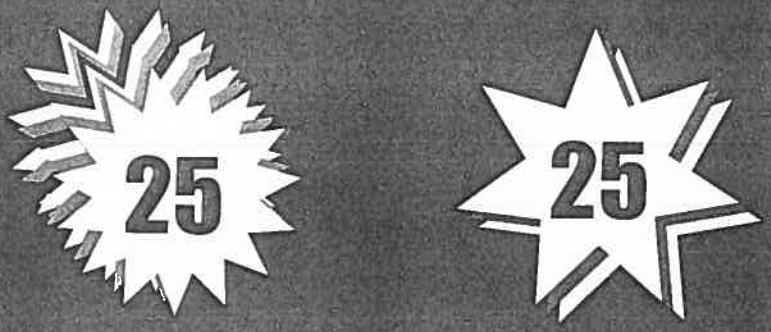
SILVER ANNIVERSARY



International Conference on Heavy Metals in the Environment

Final Program

6-10 August, 2000
University of Michigan
Ann Arbor, Michigan, USA

Water and Wastewaters

III-69. Chromium removal from the tanning and plating industries by using Sargassum Sp. biomass
S. Aparicio (LULEÃ University of Technology, Sweden), R. Santos, L. Sobral (Center for Mineral Technology, Brazil)

III-70. Heavy metals removal from municipal and industrial sludges
M. Lasheen, A. Ashmawy, H. Ibrahim (Department of Water Pollution, National Research Center, Dokki, Cairo, Egypt)

III-71 Characterization and leaching of heavy metals from municipal solid waste incinerator fly ash
C. Ferreira (Escola Superior Agrária de Coimbra, codigo postal Bencanta, Portugal), S. Llamas (Facultad de Ingenieria, Universidad Nacional de Cuyo, Argentina) and M. Almeida (Faculdade de Engenharia da Universidade do Porto, Portugal)

III-72. Distribution and sequential extraction of heavy metals in solidwaste from the industrial belt of Delhi, India
M. Moturi (Kenya Industrial Research and Development Institute, Kenya), M. Rawat and V. Subramanian (School of Environmental Sciences, Jawaharlal Nehru University, India)

III-73. Assessment of pollution load with respect to heavy metals from the wastewater of some industrial areas of Delhi, India
M. Rawat (1), M. Moturi (2), V. Subramanian (1), (1. School of Environmental Sciences, Jawaharlal Nehru University, India, 2. Kenya Industrial Research and Development Institute)

III-74. Development of granules for the heavy metal removal from mine waters
T. Zoumis and W. Calmano (Department of Environmental Science and Technology, Technical University of Hamburg-Harburg, Germany)

III-75. Adsorption of heavy metals by bone charcoal: its potential as a water treatment clean-up
J. Wilson, I. Pulford (Environmental, Agricultural and Analytical Chemistry Department, University of Glasgow, UK) and S. Thomas (Tate and Lyle Process Technology, Scotland, UK)

III-76. Structure of fruticulose-green moss spruce forest in vicinities of metallurgical plant
T. Chernenkova and A. Severtsov (Institute of Ecology and Evolution, Russian Academy of Sciences)

III-77. Reducing the heavy metals toxicity in sludge amended soil using VA Mycorrhizae
S. Radwan and R. Abdel-Aziz (Dept. of Agricultural Microbiology, National Research Center, Egypt)

III-78. Chromium in tannery effluent and its recovery
A. Deep, S. Tandon, A. Khwaja (Department of Chemistry, University of Roorkee, India)

III-79. Recovery of Heavy Metals from Spent Nickel-Cadmium Batteries
L. Barros, A. Pacheco, F. Margarido (CVRM, Instituto Superior Técnico, Portugal)

III-80. Removal of lead from aqueous solutions using activated alumina
T. Kramer, P. Wootton, C. Lange (Department of Civil Engineering, Auburn University, Alabama)

III-81. Laboratory flux measurement system to study mercury fluxes over soils
E. Bahlmann and R. Ebinghaus (GKSS Research Center, Germany)

CHARACTERIZATION AND LEACHING OF HEAVY METALS FROM TWO MUNICIPAL SOLID WASTE INCINERATOR FLY ASHES

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Summary

Fly ashes from two Municipal Solid Waste (MSW) Incinerators were studied regarding heavy metals composition, their availability for extracting and mobility. A sequential extraction with an acid solution was attempted and pH and conductivity values of solutions were registered. Also, Mn, Ni, Fe, Cu, Zn, Pb and Cd were determined in the eluates using Absorption Atomic Spectrophotometry (AAS).

This study is a step in a research whose goal is obtaining a less toxic residue that could be used instead of being landfilled.

OBJECTIVES

- better knowledge of fly ash properties and leaching characteristics
- obtain a less toxic residue

Microwave Acid Digestion

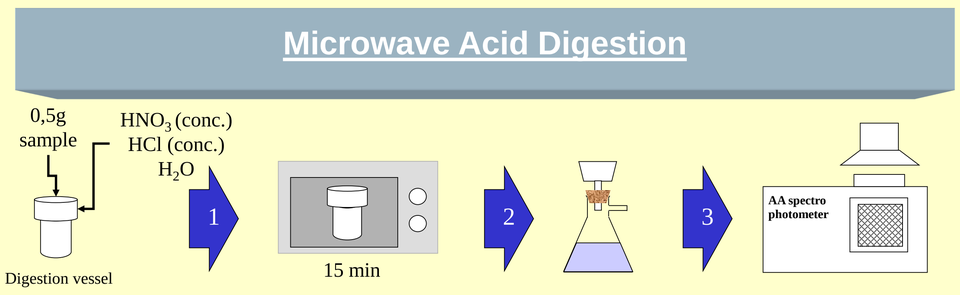


TABLE 1
Heavy metals in Municipal solid waste Fly Ash
(Sample B)

Element	mg/Kg
Mn	442
Ni	147
Fe	8 389
Cu	631
Zn	11 825
Pb	5 516
Cd	222

RESULTS:

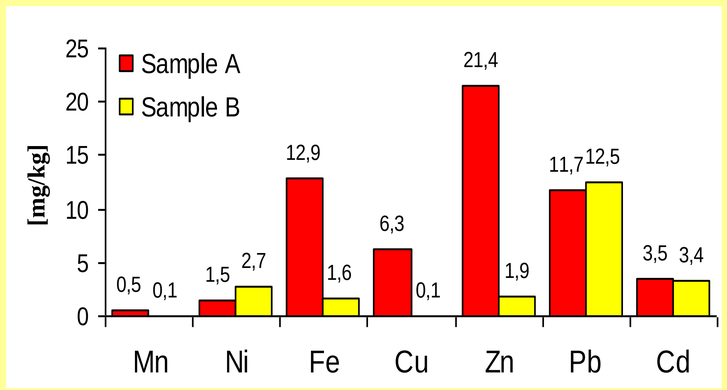
- **Zinc**, **Iron** and **Lead** are the major constituents and altogether represent almost 95% of metals.
- **Zinc** has the highest concentration, with almost 12 g per kilogram of fly ash (dry weight), **Iron** 8g/kg and **Lead** 5g/kg.
- All the other metals are below 1g/kg.

Mobility Test – NEN 7343 –

The mobility test (NEN 7343) was performed to evaluate the mobility of heavy metals on both samples

In this column test seven fractions were collected and analyzed for heavy metals by Atomic Absorption Spectrophotometry

Cumulative L/S is 10.



Comparison of cumulative mass of metal leached in mg/kg of dry matter in NEN 7343:1995 for L/S = 10 L/kg

Results

The main difference in these results is that sample A leaches Fe, Cu and Zn several times greater than sample B. For Pb, Cd, Ni and Mn the difference is not significant.

Availability test

PURPOSE:

Quantify the maximum amount of species that could be released to the environment during the lifetime of the material (Worst Case Scenario)

Experimental conditions	
Nº of extractions	2
1st extraction	
pH	7,0
L/S	50
2nd extraction	
pH	4,0
L/S	50
Cumulative L/S	100

Table 2 – Availability Test Experimental Conditions

Element	mg/Kg	% available
Mn	94	21,3
Ni	30	20,4
Fe	19	0,2
Cu	296	46,9
Zn	8 389	70,9
Pb	777	14,1
Cd	185	87,8

Table 3 – Results of the Availability Tes for sample B fly-ash

SEQUENTIAL EXTRACTION WITH ACIDIC SOLUTION

OBJECTIVES:

Extract heavy metals with an acidic solution (demineralized water acidified to pH=4 with HNO_3)

The possibility of improving extraction using low L/S ratios by acidification and recirculating the eluate several times was also considered

Experimental procedure:

The extract experiments were carried out on samples A and B using for each sample two acrylic columns (h=30,0cm; $Ø_{int}$=5,2cm) operated in upflow. The samples were carefully introduced into the columns in order to ensure good packing. The columns were weighted before and after filling them to determine the total mass of sample, and this value was corrected for moisture content (calculated in sub-samples after drying at 105 ± 5ºC).

For sample A two sequential extractions were performed. For sample B the solution was reintroduced continually in a closed circuit loop, and acidified to pH=2 (with HNO_3 1:1) before each passage.

Different L/S ratios were tested, ranging from 1.3 to 9 (for sample A) and 0.2 to 1.5 (sample B).

Conductivity and pH were registered.

Results:

	Mn	Ni	Fe	Cu	Zn	Pb	Cd
C.1 – E.1	0,04	0,03	1,64	5,01	30,52	128,37	0,63
C.1 – E.2	0,15	0,04	5,11	0,09	71,82	189,83	1,01
C.2 – E.1	0	0	0	0	0,83	7,55	0,02
C.2 – E.2	0	0	0	0,08	6,47	9,27	0,06

Sample A - Heavy metal in eluates (mg/l)

	Mn	Ni	Fe	Cu	Zn	Pb	Cd
C.3 – E.1	0	0,67	2,57	0,22	11,32	29,8	0,62
C.4 – E.1	0,23	1,58	0,6	0,26	12,03	8	0,09
C.4 – E.2	0,22	1,24	0,17	0,07	8,64	5,35	

Sample B - Heavy metal in eluates (mg/l)

C.i - column i, i=1 to 4

E.j - extract j, j=1 to 2

CONCLUSIONS

- Mobility of metals was very low meaning that in field conditions (simulated with NEN) most of heavy metals will be retained in fly ash and not easily released to the environment.
- Acidification and recirculation of solution lead to an increase of Mn, Ni, Cu and Zn in sample B leachate. However, this increase was not as high as could be expected looking at their content in fly ash. Fe, Pb and Cd decreased with sample B leachate recirculation as well as with sample A leachate due to the occurrence of precipitation reactions.
- These results indicate that partial extraction of some of the heavy metals present in fly-ash is possible. However the residue obtained is not so detoxified as expected. So, investigation will proceed.