ACTA ENVIRONMENTALICA UNIVERSITATIS COMENIANAE (BRATISLAVA)
Vol. 19, Supplement (2011): 164–168 ISSN 1335-0285

THE INFLUENCE OF ZN-PB FLOTATION WASTE & SLAG ON PLANTS-SOILS SYSTEM

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Abstract: *Metallurgical industry presents a serious hazard to the environment. In spite of many technological advances and attempts to smelter influence on surrounding areas, the degree of pollutant emission and the decline of environmental quality is particularly evident in the soils-plants system. In the area surrounding the biggest metallurgical mills in Poland, samples of flotation waste and slag, as well as surface samples of the soil and plants were collected, and contents of: Zn, Pb and Cd were determined. The influence on plants-soils system within the most immediate surrounding of the above mentioned waste disposals are described.*

Keywords: flotation waste, slag, plant, soil, Zn, Pb, Cd

INTRODUCTION

Metallurgical industry presents a threat to the environment (Haiyan, Stuanes 2003; Sawicka-Kapusta 2007). In spite of many technological innovations and attempts of limiting their influence on surrounding areas the degree of pollution and the decline of environmental quality is particularly evident in the soils-plants system (Dueck 1986; Bell, Treshow 2002; Gracia et al. 2000; Kabata-Pendias, Mukherjee 2007; Manninen et al. 1995).

METHODOLOGY

In the area surrounding the biggest metallurgical factory (production 76 000 tons Zn/a.) located west of Krakow (Poland) samples of floatation waste and slag, as well as surface samples of soil and plants (typical species of grass and birch) were taken. In the samples collected Zn, Pb and Cd contents were determined, and influence on plants-soils system from the most immediate surrounding of stockpiles of this wastes were described. Elements extraction was done by the EPA-3051 (for soils and wastes) and the EPA-3050 procedures (for plants material).

RESULTS AND DISCUSSION

Flotation wastes constitute 57 % of the extracted ore mass. The annual flotation waste amount reaches 1.4 mln ton. They contains: 0.52 – 3.94 % of Zn, 0.13 – 1.13 % of Pb and 32 – 149 mg/kg of Cd (fig. 1). Concentrations of: Zn (0.03 – 10.2 %), Pb (0.02 – 5.48 %) and Cd (2 – 700 mg/kg) were measured in slag. Waste from smelting installation is stored nearly the mills. Metals are leached form waste by rainfall or are wind transported. In this way metals are accumulating on top-soils or/and they are included into surface waters (Adriano et al. 1997; Bylińska 1998; Wiąckowski 2000).

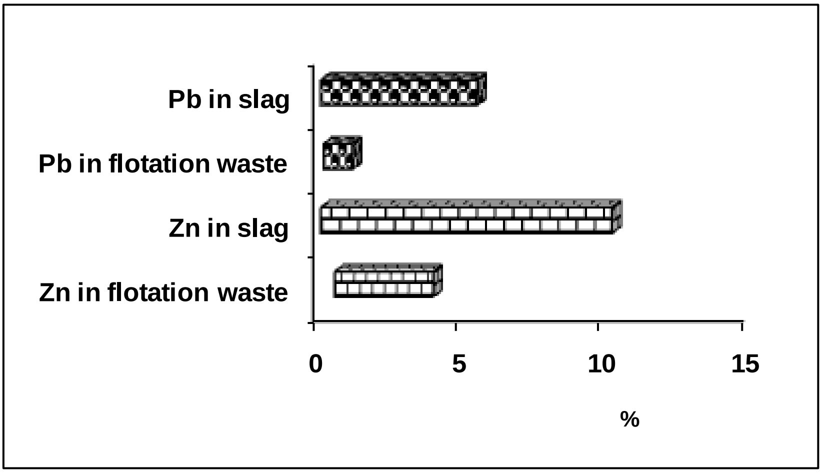

Fig. 1: Contents of Pb and Zn in wastes

The water extracts of flotation wastes contain up to 6.86 mg/dm^3 Zn, 0.42 mg/dm^3 Pb and up to 0.08 mg/dm^3 Cd. Leachates from wastes, which contain up to 1460 mg SO_4^{2-}/dm^3 provide a serious hazard. Leachates from the slag contain: 14.5 mg/dm^3 Zn, 2.52 mg/dm^3 Pb and 0.18 mg/dm^{3}Cd.

Contents of trace metals in top soils depends on the concentrations of them in the bedrock and in the continental dust, transported by the wind. High concentration of metals in soils could be an effect of high geochemical baseline (Kabata-Pendias, Pendias 1999; Maciak 2003; Migaszewski, Gałuszka 2007). The total concentration of the examined metals in the soil changes from 2.0 to 8.2 % of Zn, 0.08 to 0.6 % of Pb, and 49 to 214 mg/kg of Cd (tab. 1). These values prove strong contaminations of this area.

To determine a reason of high metal concentration in soil samples were have been collected within 5cm interval in vertical profiles and contents of Zn, Pb and Cd were measured (fig. 2).

Tab. 1: Content of Zn, Pb and Cd in plants and soils surrounding the Zn-smelter in Bukowno compared to the reference site, Poland

Type of sample		Zn (%, mg/kg)		Pb (mg/kg)		Cd (mg/kg)	
		Min.	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**
soils	Top-soil (0 – 20 cm)	2,0 %	8,2 %	852	5979	45,9	214,9
	Control site	*57*	*149*	*55*	*88*	*2,5*	*6,2*
plants	Grasess	844	5241	118	1565	10,5	90,8
	Control site	*48*	*72*	*10*	*14*	*0,1*	*0,1*
	Leaves of birch	805	5131	58	555	6,7	40,1
	Control site	*208*	*751*	*9*	*12*	*0,5*	*1,1*

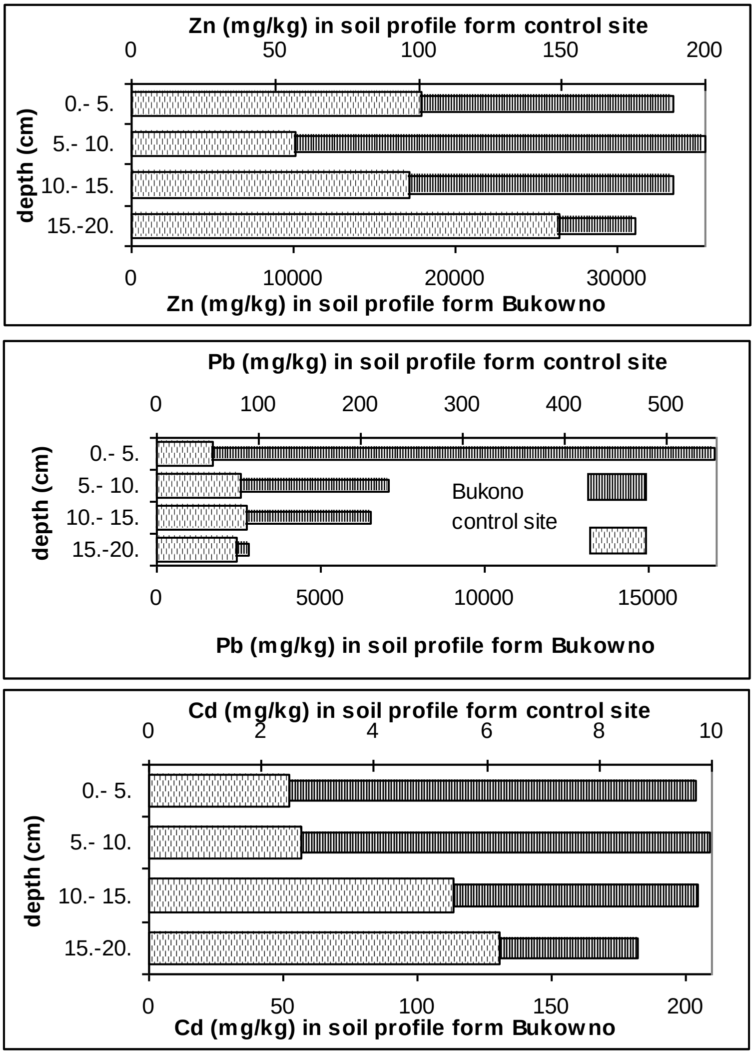

Fig. 2: Concentrations of Zn, Pb and Cd in soil profile form Bukowno and control site

A distinct decrease of metals concentrations with increasing the depth were observed in Bukowno area. Opposite pattern is observed in the control site. The highest contents of Zn and Cd were determined in soil level at the 15 – 20 cm depth, while the surface top (depth of 0 – 5 cm) shows significantly lower readings.

This tendency could be explain by uptake of dissolved elements by roots systems of plants (Guha, Mitchell 1966; Huettl 1989).

In plant's material, collected at variable distance to Zn-smelters, the Zn, Pb and Cd were determined (tab. 1). In birch leaves the following metal contents has been determined (mg/kg): Zn up to 5131, Pb up to 555 and Cd up to 40. In grasses the content of Zn, Pb and Cd were above 10 – 15 % higher, then respective the concentrations in birch samples. Probably it is an effect of differences between the length of roots system of two species of plants. Birch uptake the mineral solution form deeper soil-levels then grass.

Comparing the metals concentrations in grass and birch collected in control site (without of industrial emission or influence of metallurgy wastes) we can observe a significant differences (tab. 1). In samples form control site the concentration of measured metals are 4 to 5 times lower, then in Bukowno area.

CONCLUSION

1. Waste disposals of metallurgy industry have significant influence on the surrounding area. Waste dumps provide mobile of metals, such as: Zn, Pb and Cd.
2. Despite of knowledge about negative influence of smelter waste on soils-plants system, we can observed extensive farming in many local gardens.
3. Two species of plants: birch *Betula pendula* and grass *Agrostis capillaries*, used in research show that, they can be use as biomarkers (or bioindicators) during environmental research, to recognize a degree of soils contamination by Zn-smelter's.

ACKNOWLEDGEMENTS

This study is a part of the AGH – University of Science and Technology research project no. 11.11.140.447.

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