

ZINC IN SOIL AROUND NON-FERROUS METALS SMELTER “MIASTECZKO ŚLĄSKIE”

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Komunikat

ZAWARTOŚĆ CYNKU W GLEBACH WOKÓŁ HUTY CYNKU „MIASTECZKO ŚLĄSKIE”

Huta Cynku „Miasteczko Śląskie” rozpoczęła produkcję w 1968 roku i od tego momentu wyraźnie oddziałuje na środowisko przyrodnicze, powodując m.in. znaczną kumulację metali ciężkich w powierzchniowej warstwie gleb wokół zakładu. Chcąc określić stopień skażenia gleb cynkiem, pobierano próbki gleb w ośmiu kierunkach świata z głębokości od 0 do 5 cm, w odległości odpowiednio: 10, 25, 50, 100, 150, 200, 250 m, aż do odległości 3000 m. Zawartość Zn oznaczano metodą AAS. Najwyższe średnie stężenie cynku w glebie stwierdzono w odległości około 50–100 m od emitora i związane jest to zapewne z wielkością cząstek opadającego pyłu.

Summary

The zinc and lead smelter “Miasteczko Śląskie” near Tarnowskie Góry started in 1968. In the last few years emissions of contaminants from the production process of Zn and Pb were reduced. But some of the elements remain accumulated in the upper layer of the soil.

Samples of the upper layer (0–5 cm) of the soil were taken along transects set with a compass in the following directions: N, NE, E, SE, S, SW, W and NW, starting from the smelter in the distances of: 10, 25, 50, 100, 150, 200, 250 m, and then every 250 m, up to 3000 m. The concentration of zinc was measured by conventional AAS method. The highest content of zinc in soil was found 50–100 m from the smelter. It was probably due to the grain-size composition of dust emitted by the smelter and to local content of heavy metals in the soil.

INTRODUCTION

Development of new industries in the last few decades caused great changes in the environment. The harmful influences are related to gaseous and dust emissions, which contain loads of heavy metals [9]. The metals are accumulated in soil and in plants [3, 8]. The highest accumulation is near the largest emitters, but the impact of pollutants was observed as far as 50 km away from the emission source. The highest accumulation of heavy metals was found in soil rich in organic matter (e.g. in forest soil). The metals are bound with organic compounds in the upper layer of soil and this could be the reason for its degradation, which could be irreversible [5].

The smelter "Miasteczko Śląskie" is one of the greatest emitters of heavy metals in Upper Silesia. The smelter opened in October 1968. Nowadays it produces about 50 000 t of zinc and about 75 000 t of lead smelted in Poland. One of the by-products is cadmium carbonate.

The aim of this study was to investigate the concentration of zinc in the upper layer of the soil, within a radius of 3 km from the non-ferrous smelter "Miasteczko Śląskie".

MATERIAL AND METHODS

The material was soil sampled from the upper layer (0–5 cm) at distances: 10 m, 25 m, 50 m, 100 m, 150 m, 200 m, 250 m, and further on in each 250 m up to 3000 m, in 8 directions: N, NE, E, SE, S, SW, W and NW of the zinc and lead smelter „Misteczko Śląskie”.

Soil was air dried, passed through a sieve (1 mm mesh) and extracted with 0.1N HCl [1]. After filtration, the concentration of zinc and lead was measured by conventional atomic absorption spectrometry (AAS). Each soil sample was prepared in 3 replications, and the results are presented as the arithmetic mean values. The quality of analytical procedures was controlled by using internal samples with known zinc content [4].

RESULTS AND DISCUSSION

Zinc is an essential element in the metabolic process of organisms. But elevated zinc content in soil is unfavorable for plants, animals and humans. Plants are tolerant to high concentration of zinc. Symptoms of toxicity, e.g. disturbances of growth and reduction of germination, appear when the Zn content is in the range of 100–600 µg/g dry weight [5]. Terelak *et al.* [9] have reported the Zn content in soil in Poland in the range of 0.5–2837.5 mg/kg (average 32.7 mg/kg). The contamination of the investigated area by industrial emission was stated by Karweta [6] who has found about 100 times increase in plant accessible zinc, in comparison with the results measured before the opening of the zinc and lead smelter.

In soil of the areas adjacent to the zinc and lead smelter "Miasteczko Śląskie", the zinc content in the upper layer of soil was in the range of 3.5 mg/kg–3184.5 mg/kg. The average at the investigated area of 65 km² was 611.2 mg of Zn/kg of soil.

The permissible content of zinc in arable soil is 250–300 mg/kg [5, 7]. In 62 of 144 sampling places the Zn level was higher. The most contaminated area was within a radius of 100 m from the source of emission. The explanation is the granulometric (Fig. 1) composition of the emitted dust [3]. Another possible reason for contamination of the area could be wastes from the opencast mining of zinc ore, which ended several years ago.

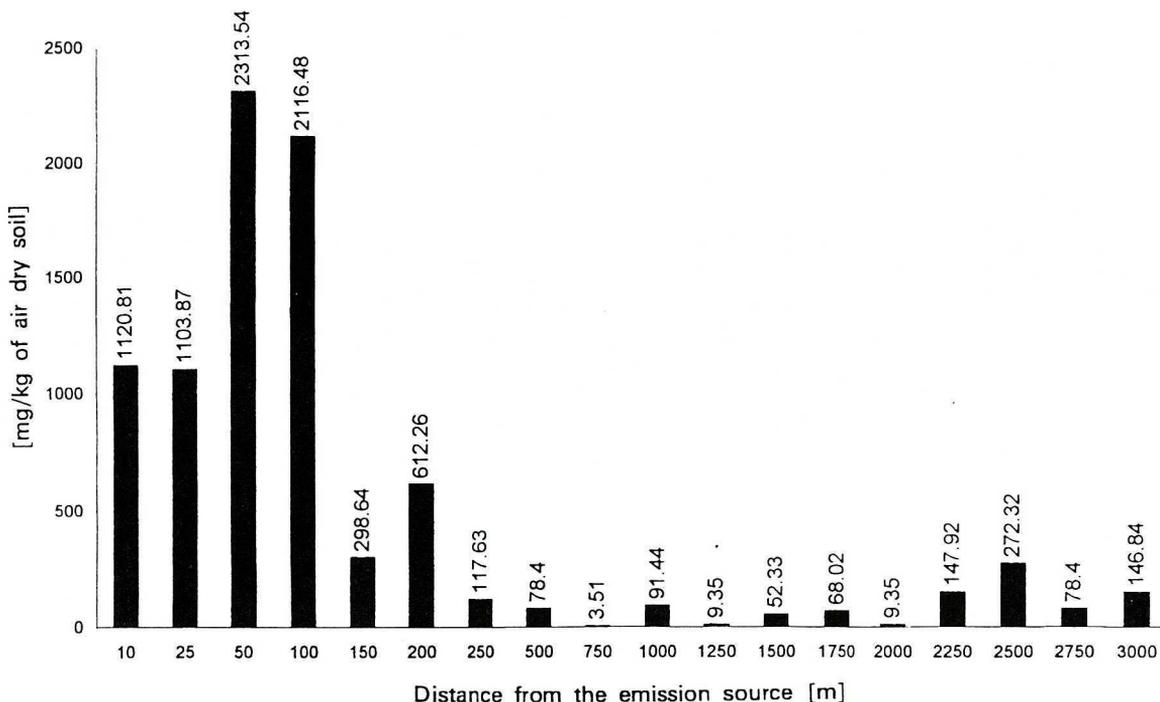


Fig. 1. Mean content of zinc in soil [mg/kg of air dry soil] around non-ferrous metals smelter "Miasteczko Śląskie"

The highest Zn content in soil was found west of the emitter (Fig. 2), where wastes from the zinc-oxide plant were dumped. Today the zinc-oxide plant is closed.

Billett *et al.* [2] has found a statistically important correlation between the zinc content in the upper layer of soil and the distance from the emission source. A similar correlation ($p < 0,001$) was found in the described investigation.

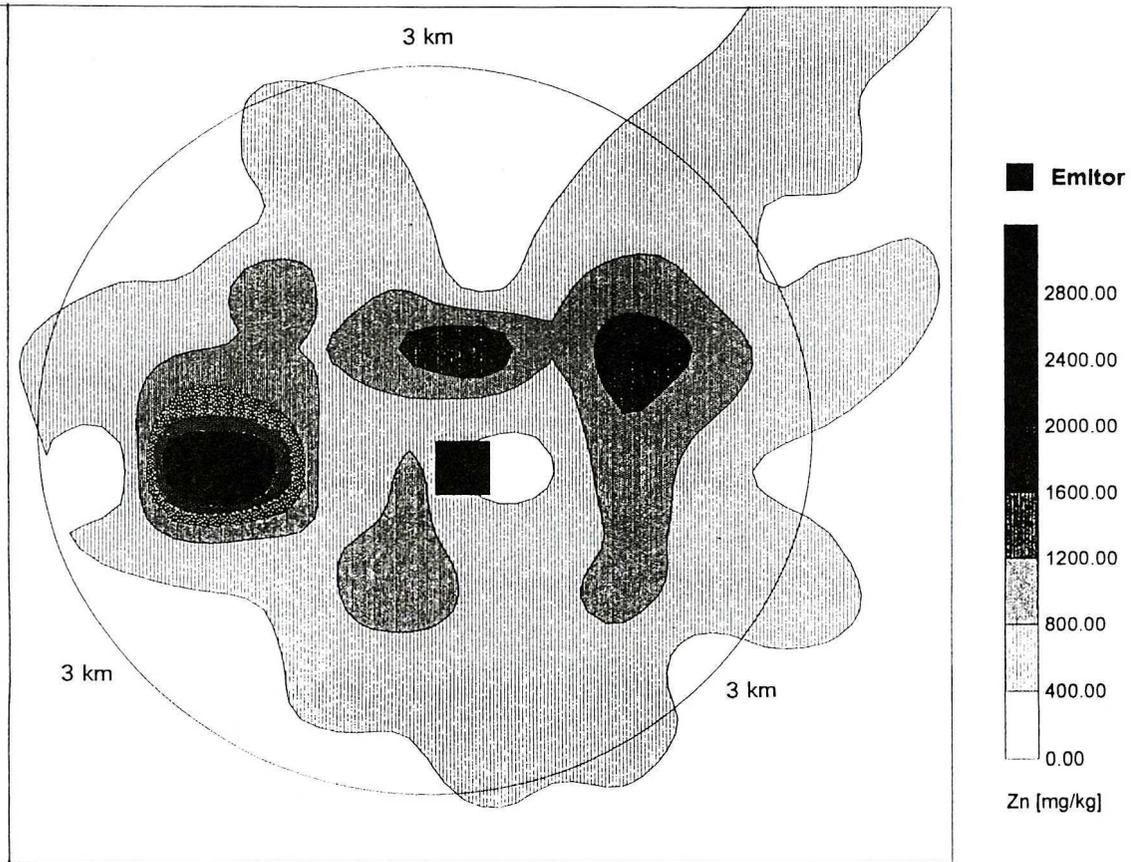


Fig. 2. Distribution of zinc [mg/kg] in the upper layer of soil in areas adjacent to non-ferrous metals smelter "Miasteczko Śląskie"

CONCLUSIONS

1. The most contaminated soil was within a radius of 100 m from the emission source.
2. The highest content of zinc was found west of the smelter where wastes from the zinc-oxide plant were dumped.
3. The concentration of zinc in soil of the area adjacent to non-ferrous metals smelter.

„Miasteczko Śląskie” after 32 years of zinc and lead smelting is above the safety limits and could be hazardous to living organisms.

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