

THE ASSESSMENT OF POLLUTION IN THE AREA OF TURNU MAGURELE AFFECTED BY FERTILIZERS PLANT

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The fertilizer industry related to the whole chain of production, storage, transport and use causes a potential pollution of air, water, soil and vegetation. A local sampling monitoring network was developed around Turnu Magurele fertilizer plant in Romania. Samples of mosses, soil, tree leaves and crops were analyzed by neutron activation analysis for more than 35 chemical components. This paper reports the distribution of 39 trace elements in the moss-biomonitor *Hypnum cuppresiforme* used to study atmospheric deposition in the examined area. The results obtained evidence for a local pollution of the area exposed to the emissions of the phosphate fertilizer local industry, following a gradient along the Danube River wind rose profile. The vegetation input of trace elements from soil is compared with inputs from atmospheric deposition, and these inputs were evaluated in relation to the vegetation content. The study established that cadmium, strontium and rare earths are the major elements as regards fertilizer input.

Key words: fertilizers plant, environmental pollution, monitoring strategy, specific pollutants

1. INTRODUCTION

During the last decade, the fertilizer industry have made substantial progress in the monitoring of environmental impacts that may occur at the point of production and throughout the distribution system. The environmental effects facing the fertilizer industry have increased in recent years and now include such matters as climate change and ozone depletion.

This study was realized in the frame of the project “ Epithermal neutron activation analysis (ENAA) and monitoring strategy used for the workplace monitoring and occupational health studies at the Turnu Fertilizer Plant, Romania”, under the auspices of the Centre of Environmental Protection from “Politehnica” University.

The intensive production of phosphorus fertilizers always introduce the risk of contamination of the local ecosystem with specific pollutants (i.e. As, Cd, Cr, Cu, F, Fe, Mo, Ni, REEs, Sb, Sr, Th, U, V and Zn), by their emission into the atmosphere, or by depositing the raw material or byproduct nearby the plant or by the overflow of tailing discharges in water resources.

The objectives of this investigation were: (1) elaboration and validation of a local network monitoring according to the geographical position of fertilizers plant, (2) evaluation of the pollution caused by fertilizers plant in the surrounding areas

(including the atmospheric pollution, soil and plant contamination) and (3) study of the relationship between the atmospheric deposition of specific pollutants and their content in plants.

2. EXPERIMENTAL

2.1. Study area, sample collection and analytics

The Turnu Phosphate Fertilizer Plant in Romania is located along the left bank of Danube River (km 596.3), 5-km southern of the TURNU town. The collection of environmental samples was carried out both inside the factory (technological shops) and its surrounding. Table 1 shows some of industrial technological procedures and byproducts obtained at Turnu Phosphate Fertilizers Plant.

In this paper we'll present only the research conducted in the areas enviroing the plant (15 x 15 km²).

Table 1.

Some of industrial technological procedures and related byproducts obtained at the Turnu "Mineral Fertilizers" Plant

No.	Industrial process	Byproducts type
1	Phosphate fertilizers production by nitric acid attack	NP ¹
2		NPK ²
3	Phosphate fertilizers production by sulphuric acid attack	TSP ³
4		DAP ⁴
5		Purified H ₃ PO ₄

^{1,2} - Nitrophosphate type

³ - Diammoniumphosphate

⁴ - Triplesuperphosphate

The sampling campaign was performed in November 2000 year and included the following environmental sample types: (1) 16 soil samples of 1-2 kg each were collected from semicircular areas around the plant at different distances from it - 0.5 km, 1 km, 3 km, 5 km, 7 km, 10 km, and 15 km, respectively, (2) 4 moss samples were collected from 4 cells according to the Table 2, respectively, of a local network (16 x16 km²), (3) leaves of different trees such as ash (*Fraxinus*), birch (*Betula*), acacias (*Robinia pseudacacia*) and poplar (*Populus*), as well as potatoes (peel and pulp), carrots (leaves and pulp), and ears of corn (sheaths, cobs, and grains) were collected in zones at the same distances from the plant as soils (between 0.5 and 15 km).

Table 2.

The geographical data of the four Hypnum cupressiforme moss samples

Code	Moss species	Site	Latitude	Longitude	Altitude
11	HC	Turnu Magurele	43°45' 18	24°53' 24	~ 58
12	HC	Scarisoara	43°58' 48	24°36' 05	~ 100
13	HC	Calmatuiu	43°57' 36	24°53' 24	~ 50
14	HC	Bogdana	43°57' 10	24°06' 23	~ 90

The samples were analyzed by neutron activation analysis and we determined at least 35 constituents in all sample types. A detailed description of all analytical procedures for the determination of trace pollutants in soil and plant material is given in [3].

3. RESULTS AND DISCUSSION

The downwind profiles of specific pollutants released by fertilizer Turnu plant were examined (Fig. [1-2]). Rare earths present a weak gradient along the windrose profile. U and Th show a deep gradient along the downwind direction (i.e. along the Danube river), reflecting the dispersion of the pollutants up to a distance of 20 km far from the plant. The trace metal atmospheric deposition showed not a gradient along the wind rose direction.

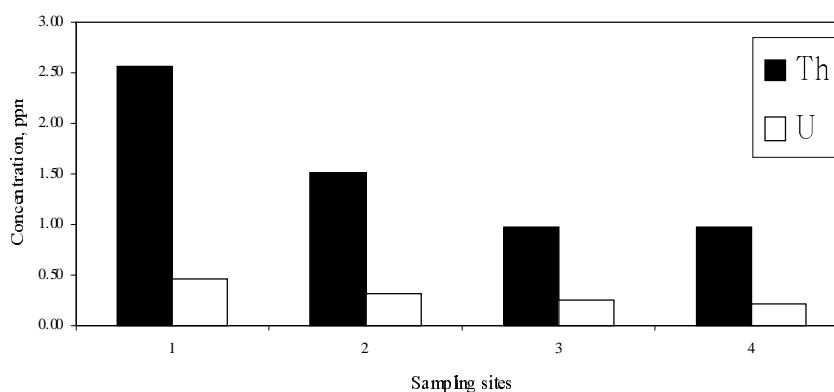


Fig. 1 - The uranium and thorium gradients along the wind rose profile

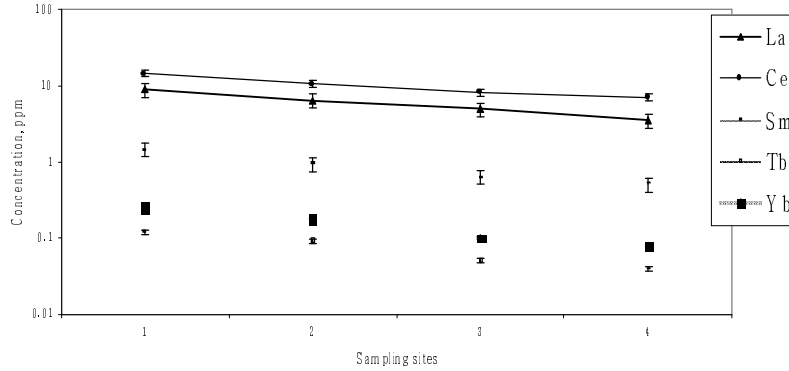


Fig. 2 - The rare earth behaviour along the wind rose profile

The relationships between the enrichments of trace elements from soil are compared with enrichments from atmospheric deposition in tree leaves (Fig. [3]). The definitions of the enrichment factors are the following:

$$EF_{\text{leave(soil)}} = (X/Sc)_{\text{leave}} / (X/Sc)_{\text{soil}} \tag{1}$$

$$EF_{\text{leave(moss)}} = (X/Sc)_{\text{leave}} / (X/Sc)_{\text{moss}} \tag{2}$$

$$R = EF_{\text{leave(moss)}} / EF_{\text{leave(soil)}} \tag{3}$$

The ratio between the two enrichment factors R defines the input released by the fertilizer manufacturing. In the Fig. [3] the pollutants of higher risk for vegetation can be seen (i.e. the highest R). They are the specific pollutants Sr, Cd, La, Ce, Sm, Tb, Yb, U and Th, emitted into the air by fertilizer industry.

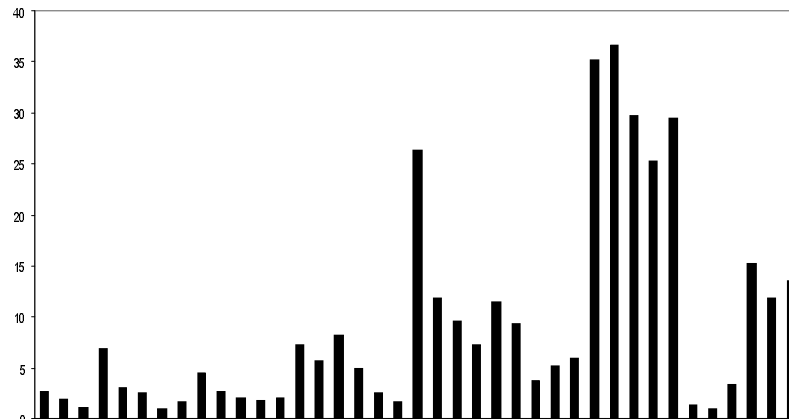


Fig. 3 - The elemental input realized in tree leaves by fertilizer plant (R ratio)

4. CONCLUSIONS

Cd, Sr and REEs are the highest risk pollutants for vegetation. The tree leaves collected in the survey proved their capacities as biomonitors of elemental atmospheric deposition. The atmospheric deposition of specific pollutants presents a weak gradient along the Danube River. The pollution caused by the monitored fertilizer plant has a strict local character, approaching the background level at 15-20 km far from the plant.

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