PRELIMINARY ANALYSIS ON THE SOIL POLLUTION. CASE STUDY ON THE HISTORICALLY IN DEJ-NORD

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Abstract

The soil pollution as a result of the industrialization in the communist and current period leads to the deterioration of quality of the soil from the old industrial platforms, seldom fallen into disrepair and in precarious stage of decontamination. The purpose of the current study is to analyse degree of pollution of the soils with heavy metal in the area of Nord Dej industrial platform, in the location of the former Cellulose and Paper Enterprise and Artificial Fibers Enterprise. In order to reach this goal, we conducted field analysis and series if soil profiles, using Hydra Joy 3 equipment, which allowed us to extract soil caps from a significant depth. We used ISO 10530:1992 in order to make an analysis of the chemical properties of the soil, based on the soil profiles extracted, and (ICP-MS) EPA 6020B: 2014 to determine the existence of Cadmium, Lead, Chromium, Copper and Zinc. The highest concentration was found for Nickel, but there are other elements such as Cadmium or Zinc with high values in the studied area.

Key words: *soil pollution, heavy metals, soil profiles, chemical analysis*

INTRODUCTION

Human industrial activities, as well as the continuous extension of urban areas leads to an increase in soil pollution, endangering human health. It is acknowledged that substances such as Cadmium, Lead or Mercury have no biological functions and are therefore toxic for human health. (Senila et al., 2008, Constantinescu, 2008, Levei et al., 2009, Nedelescu et al., 2017).

Several sources of heavy metals which are polluting the soils are represented by human activities such as: mining (Cd, Cu, Ni, Pb, Zn), foundries (Cd, Pb), lamination (Ni, Cd, Pb), plastics industry (Cd, Zn, Pb, used as polymeric stabilizers), chemical industry (using Pb, Ni as electrode catalyst), wood industry (Cr and Cu). In the vicinity of the factories, these before-mentioned elements have been seldom identified as water and soil pollutants. (EPA, 1996, Flora and Ioanoş, 2000, Suciu et al., 2008, Moldoveanu, 2014).

Currently in Romania there is a number of 1393 contaminated and potentially contaminated sites inventoried at the moment. In the administrative territorial unit of Dej, the historic site of Dej-Nord stands out as a representative example from the point of view of soils polluted due to industrial activities, more specifically the location of the former S. C. Cesarom S.A. Dej, in the industrial area from the north-eastern side of the city of Dej, on the lower terrace of Someş river. (Fig. 1).

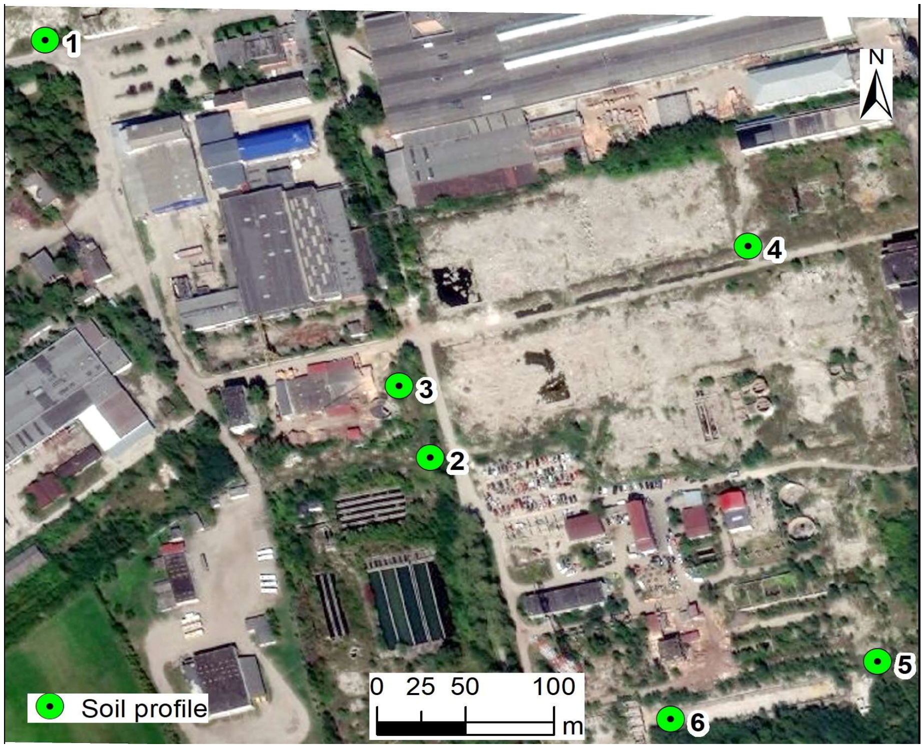

Fig. 1. The geographical position of the studied area

The industrialization of the city of Dej, initiated in the 50s and maintained until the 90s, turned the northern part of the city into an industrial area, with emblematic enterprises such as: The Enterprise of Cellulose and Paper (CCH) and The Artificial Fibers Enterprise (IFA) (Cimpoieșu et all., 1995, Pop, 2012). Between 1994-1998, the enterprise became SC Someș, but, due to the more modern requirements of the market and poor management, was closed down in 1998.

Previous studies labelled the location as a contaminated site due to historical pollution with heavy metals, mud and solid waste from the technological process of obtaining cellulose and paper, on a surface of approximately 10,000 mp. The total surface of SC CESAROM SA extended to 182,863 m^2, out of which 75,536 m^2 were occupied by built surface, 1,865 m^2 occupied by technological networks, 60,250 m^2 by transport routes and the rest of 45,212 m^2 remained unoccupied. Chlorinated Solvents were identified in previous studies in the river and in the soil (Sidonia et al., 2009), and the toxic effects were registered in the environment (in plants, animals and humans) (Stanescu et al., 2016).

MATERIAL AND METHOD

In order to achieve the main objective of the present study, the first stage of the analysis we analysed the historical data we found regarding the location of the polluted areas.

To identify the stratigraphic successions, field operations were conducted and we collected soil samples, as well as samples from the water bed, dependent on financial support, on their dispersed placement in all compass directions taking into account the possibility of multiple sources of pollution. A Hydra Joy 3 equipment with a diesel engine of 100CP and a downforce and extraction of 3500 kg was used to conduct the drilling.

In order to collect the groundwater samples, we used PVC tubbing (Ø = 70 mm), PVC covers, and the water was collected with a bailer with a diameter of Dn = 40 mm, volume V = 1 l, which allows the loading of a column of 0,97 m of water, including the layer covering the same surface on the water surface. The samples of underground water were collected after pumping the water from the drilling column here times. These works were executed to the depth of interception of the layer considered to be the basis, cca. 7 m deep from the platform's elevation (Matei and collab. 2020).

After sampling the soil evidence, specific chemical analyses were conducted, on these samples as well as on the ground and underground water. We determined the content of sulphides applying ISO 10530:1992, and (ICP-MS) EPA 6020B: 2014 to determine the elements: Cadmium, Lead, Chromium, Copper and Zinc.

RESULTS AND DISCUSSION

After analysing the data in the company's archive, we identified the main sources of pollutants for water and soil: Carbon disulphide (CS_2) which appears in the area of chemical preparation (xanthogenate method, dissolution, maturation), the spinning area (spinning, treatment), waste water treatment station, the area of recovering the carbon disulphide (CS_2) and storage of the carbon disulphide (CS_2); Hydrogen sulphide (H_2S) which is a result in the chemical preparation are (xanthogenate method) and the spinning area; Sodium hydroxide (NaOH) resulting in the chemical preparation area (alcalicellulose, xanthogenate method) and the spinning area; Sodium hypochlorite (NaOCl) was used in the spinning station; Sulphuric acid (H_2SO_4) appears in the spinning baths and in the dedicated storage; Ammonium (NH_3) used in the freezing station; Hydrochloric acid (HCl) used in the treatment of pure water as well as waste water treatment.

During the period the enterprise operated, frequent overruns of the waste water treatment station effluents were recorded for: sulphates (SO_4); Hydrogen sulphide (H_2S), sulphides, Sodium (Na), fix residue, Zinc (Zn).

In the field trips it was determined that all installations, machineries, equipment, industrial pumps and engines were disused, dismembered and capitalized. Also, all the buildings related to the production facility, the dispersion chimney from recovering the Carbon disulphide, the buildings from CET with smoke chimney, the warehouses and raw material and finished products storages were demolished without a systematic procedure.

The tanks from the treatment stations were demolished, but the components of the waste water treatment are still in the field, containing water and chemical substances.

The big storage of Carbon disulphide (C106 – an underground building with 8 concrete tanks where 2 metal containers with CS2 were immersed) were demolished.

On the field only remained concrete tanks with rainwater. The oxidation tank, unused since 1986, is demolished and full of rubble; on the whole location, with the exception of access roads, treatment and waste water treatment station, there is waste originated from construction materials and equipment such as: brick, rubble, mineral wool, electric cables and other waste. Around the former platform for washing rich gases, the facility for recovering Carbon disulphide and the platform of draining there are Rasching rings made of plastic and ceramics.

Fig. 2. The area of the spinning section and chemical preparation

Fig. 3. The area of chemical preparation (fire pumps, water tanks, electric station)

Fig. 3. The treatment area

Fig. 4. The storage of sulphur

To analyse the degree of pollution of the soils, we used thresholds of alert and intervention of the pollutants: Cd, Cr, Cu, Ni, Pb, Zn (Table 1).

Table 1

Statistical data on soil pollution on Dej site

Element			***Cadmium (Cd)***	***Chromium (Cr)***	***Copper (Cu)***	***Nickel (Ni)***	***Lead (Pb)***	***Zinc (Zn)***
	Normal values		*1*	*30*	*20*	*20*	*20*	*100*
Alert threshold	*Types of usage*	*Sensitive*	*3*	*100*	*100*	*75*	*50*	*300*
		Less sensitive	*5*	*300*	*250*	*200*	*250*	*700*
Intervention threshold/ Types of usage		*Sensitive*	*5*	*300*	*200*	*150*	*100*	*600*
		Less sensitive	*10*	*600*	*500*	*500*	*1*	*1500*
Sample 1			*0.01*	*0.25*	*0.43*	*1.06*	*0.17*	*14.4*
Sample 2			*<0.005*	*0.47*	*0.51*	*1.01*	*0.08*	*6.9*
Sample 3			*0.06*	*0.26*	*0.6*	*2.49*	*0.11*	*7.35*
Sample 4			*0.08*	*0.85*	*3.6*	*8.35*	*0.24*	*11.1*
Sample 5			*0.01*	*0.35*	*0.36*	***17.1***	*0.16*	*9.6*

(according to Order 756/1997)

Overruns of the normal levels can be observed for Nickel, as well as in the case of samples 4 and 5.

It is notable that these substances move from the surface to the underground through dissolution and absorption, causing imbalances, migrating to the root system of the plants, reaching the fruit (cereals, especially corn, fodder and leguminous plants incorporate the highest part of heavy) and thus the animal and human system. The effect can be diverse, affecting the photosynthesis in case of plants, and the circulatory, cardiac and digestive system in case of humans. (Coman et al., 2010).

CONCLUSIONS

The negative effects observed on the environment as a consequence of using such chemical substances and lacking measures of adequate storage and decontamination of toxic substances are felt and acknowledged locally and this led to the decision of conducting detailed analysis regarding the concentration of toxic substances in the soil and groundwater.

The results of sampling the soil and water of the 6 profiles highlights the degree of pollution of the soil from the old industrial platforms of Dej-Nord, thus requiring more attention in order to invest in decontaminating the sites and reintegrate the terrains in the agricultural circuit, according to the recommendations given after the bonitation study of the farming land in the Someș area from the Cluj-Napoca – Dej sector (Matei et al., 2020) a study which took into consideration the degree of soil pollution from this sector.

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