INVESTIGATION OF SOIL POLLUTION WITH Pb AND Cd

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abstract: This paper presents some issues regarding the pollution of the soil on DN1 in Prahova district. Soil samples gathered in close vicinity of the road and at a 100 m distance from it have been mineralized and analysed regarding their content in hard metals Pb and Cd, using the spectropfotometric method of atomic absorbtion. Drawing points of the soil samples were on the line – entering Prahova district (Potigrafu locality), on Prahova Valley until leaving Prahova district (entering Braşov district). The results of the study are discussed based on the compliance index.

key words: pollution, lead, cadmium, compliance index, contamination degree

Introduction

Protection and improvement of the environmental conditions is a matter of great importance that affects the life of the people and economical development of the countries around the world. Environment protection complies with the needs and interests of peoples, and simultaneously represents a duty for every government [1÷3].

The present work deals with the study of the pollution degree of soils with Pb and Cd nearby DN1 from Prahova County, taking into consideration that automotive traffic in Prahova Valley is very high during any season.

The national road, DN1, crosses Prahova county between Potigrafu and the exit from Azuga, and it is one of the most used roads because Prahova Valley represents a very beautiful touristic attraction for both Romanian and foreign tourists.

Automotive traffic is a very important source of pollution for all environment components – water, air and soil. As pollutants, the first place is occupied by exhaust gases, containing several hundreds of toxic components. Depending on the type of the car, its technical condition, and the nature of the fuel, the volume, the nature and the concentration of the pollutants may vary. From the substances evolved into the atmosphere, the following are representative: carbon oxides, nitrous oxides, hydrocarbons, dust suspensions, and Pb. Apart from them, the composition of fuel and lubricants contain a series of substances as additives for quality improvement (antioxidants, anticorosives, surfactants, etc.) which can also contribute to environment pollution [4,5].

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Analele Universităţii din Bucureşti – Chimie, Anul XV (serie nouă), vol. II, pag. 15-19

Experimental Part

In order to evaluate the level of pollution with Pb and Cd of the national road no. 1, between Potigrafu and the exit of Azuga, samples of soil have been taken from the area of the indicators for entrance into the locality, nearby the road and at 100 m away from the road (marked with a), respectively, from the superficial layer, like this: 1. Potigrafu, 2. Ploiesti, 3. Baicoi, 4.Campina, 5.Comarnic, 6.Sinaia, 7.Busteni, 8. Azuga, 9. exit of the Prahova County.

The soil samples have been naturally allowed to dry, and then they have been milled and separated. 1g of sample has been treated with aqua regia, strictly according to the mineralization procedure [5]; the samples have been filtered and diluted to 100 cm^3 in calibrated flasks.

Determination of the content of Pb and Cd has been made by atomic absorption spectrometry, with a GBC Avanta Ver Model 2000 spectrometer. The absorbance of the standard as well as sample solution has been read to the following wavelengths: Pb – 217.0 nm; Cd – 228.0 nm [6]. Evaluation of the heavy metal content in soils was done based on the calibration curves, by counting the mass of the mineralized sample and the dilution.

Results and Discussion

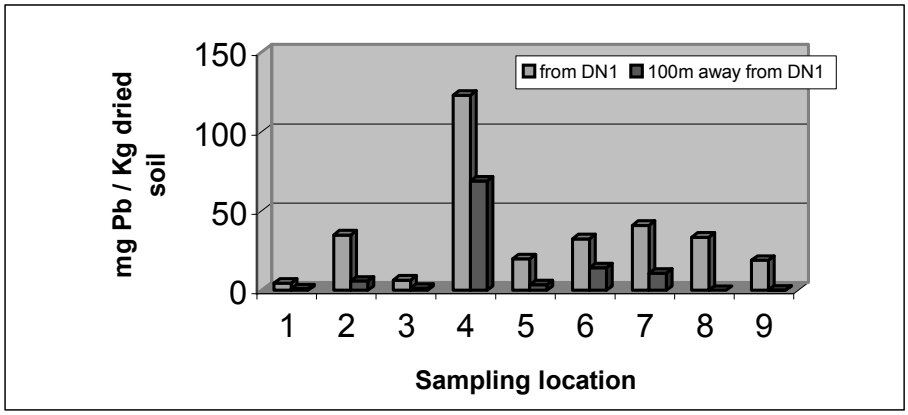

Fig. 1: *Pb concentration* [mg/Kg dried soil] *from various sampling locations.*

Graphical illustration of the correlation between Pb and Cd content and sampling sites is made in Figs. 1 and 2. From these data it can be seen that:

– Lead content (Fig. 1) of soils sampled from the area nearby the road, for every sampling location, is greater than the content of the samples taken at 100 m away from the road. The highest values have been recorded for Campina (sampling site no. 4), but also for the locations at the entrance of Ploiesti, in Sinaia, in Busteni, and in Azuga; the results exceed regular values of 20mg/kg of dried soil, according to law [7].

– In general, cadmium content (Fig. 2) of soils is below regular value of 1 mg/kg dried soil, with two exceptions: Baicoi and Azuga. Ones remark that these overlimit values are encountered only in the immediate vicinity of the road.

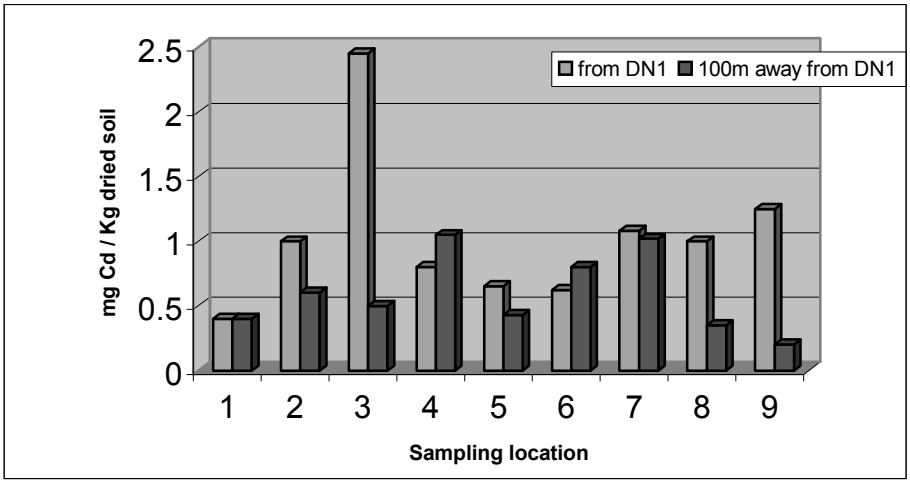

Fig. 2: *Cd concentration* [mg/Kg dried soil] *from various sampling locations.*

In order to evidence the degree of pollution with Pb and Cd in soils on DN1, the compliance index I_C – the ratio between the observed concentration of Pb and Cd in samples and the maximum accepted limits – has been determined. The pollution degree in each sampling location has been established based on the value of I_C. The types of soil contamination, as function of the compliance index, are [8]:

$I_C < 0.7$ – insignificant pollution (PN);

$0.7 < I_C < 1.0$ – potentially significant pollution (PPS);

$1.0 < I_C < 5.0$ – significant pollution LEVEL 1 (PS1);

$5.0 < I_C < 10.0$ – significant pollution LEVEL 2 (PS2).

Table 1. Correlation between compliance index and location of sampling for Pb

Locality	sample no.	[Pb] mg/kg dried soil	I_C [Pb]/20	Contamination type
Potigrafu	1.	4.55	0.23	PN
	1a	1.01	0.05	PN
Ploieşti	2.	34.90	1.74	PS1
	2a	5.85	0.29	PN
Băicoi	3	6.50	0.32	PN
	3a	1.40	0.07	PN
Câmpina	4	122.90	6.10	PS2
	4a	68.90	3.40	PS1
Comarnic	5	19.80	0.99	PPS
	5a	3.50	0.17	PN

Table 1. (*continued*)

Locality	sample no.	[Pb] mg/kg dried soil	I_C [Pb]/20	Contamination type
Sinaia	6	32.50	1.62	PS1
	6a	14.30	0.71	PPS
Bușteni	7	41.00	2.05	PS1
	7a	10.90	0.54	PN
Azuga	8	33.50	1.67	PS1
	8a	0.00	0.00	PN
Ieşire Jud.	9	19.00	0.95	PPS
Prahova	9a	0.30	0.01	PN

Table 2. Correlation between compliance index and location of sampling for Cd

Locality	sample no.	[Cd] mg/kg dried soil	I_C [Cd] / 1	Contamination type
Potigrafu	1	0.40	0.40	PN
	1a	0.40	0.40	PN
Ploieşti	2.	1.00	1.00	PPS
	2a	0.60	0.60	PN
Băicoi	3	2.45	2.45	PS1
	3a	0.50	0.50	PN
Câmpina	4	0.80	0.80	PPS
	4a	1.05	1.05	PS1
Comarnic	5	0.65	0.65	PN
	5a	0.43	0.43	PN
Sinaia	6	0.62	0.62	PPS
	6a	0.80	0.80	PPS
Bușteni	7	1.08	1.08	PPS
	7a	1.02	1.02	PPS
Azuga	8	1.00	1.00	PPS
	8a	0.35	0.35	PN
Ieşire Jud. Prahova	9	1.25	1.25	PS1
	9a	0.20	0.20	PN

By analysing data the following can be observed:

The Pb content of soil samples taken from DN1 in Prahova County show a significant pollution level 1 (PS1) in Ploiesti, Sinaia and Azuga. The pollution level in Campina is significant pollution 2 (PS2). At 100m away from the road there is insignificant pollution, with two exceptions: Campina and Sinaia.

The Cd content of the analysed soil samples reveals that in Baicoi, Campina, Busteni and at the exit of Prahova County the concentrations exceeds normal level. Higher concentrations are recorded for soil samples taken from the vicinity of the road, which demonstrates that Pb and Cd pollution is due to the road traffic, as in [9].

Conclusions

Experimental determination of the content of Pb and Cd in soil samples taken from DN1 and from 100m distance away from the road, in Prahova County, between Potigrafu and Azuga, reveals the fact that the highest Pb pollution is recorded at the entrance in Campina,

followed by Ploiesti, Sinaia and Azuga, and Cd content is highest at the entrance in Baicoi, followed by Busteni and the exit of Prahova County.

The fact that Pb and Cd concentrations are smaller in soil samples taken at 100m away from the road proves that these pollutants are evolved from the exhaust gases of the cars going to Prahova Valley, a touristic attraction with intense traffic in all seasons.

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