RESEARCH CONCERNING THE PRESENCE OF POLYCHLORINATED BIPHENYLS IN GLINA AREA

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Abstract
Polychlorinated biphenyls (PCBs) have been placed on the list of persistent organic pollutants by the Stockholm Convention in 2001 because of their high persistence, the bioaccumulation along the food chain and high toxicity. An area of concern in terms of pollution by these compounds is the landfill Glina. This paper aims to do a study on the presence of polychlorinated biphenyls in Glina soils and in their migration on soil profile. Soil samples were collected from six depths on five profiles (between 0 and 100 cm). Measurement by gas liquid chromatography with specific detection (capture electron detector) and capillary column (with specific non polar stationary phase) showed that only one of the five profiles is significantly polluted with PCB compounds. Thus, PCB 52 (with four chlorine atoms in the molecule) and PCB 101 (with five chlorine atoms in the molecule), were found with values exceeding approximately ten times the alert threshold of 0,002 mg/kg. Also, the content of highly chlorinated isomers (PCB 138, PCB 153 and PCB 180) were just above the intervention threshold of 0,04 mg/kg. The total content of PCBs compounds are ranged between 0,1401 mg/kg and 0,422 mg/kg, thus exceeding the alert threshold values of 0,25 mg/kg, but not reach the threshold of intervention of 1mg/kg. Although PCB compounds are quite immobile compounds in soil, they were found in deeper soil layers. This is possible if these compounds have been present in soil for years or due to disruption of soil layers, common situation in urban soils.

Keywords: PCBs, urban soil, gas chromatography

1. INTRODUCTION

Polychlorinated biphenyls (PCBs) are highly stable industrial chemical products. PCBs have been used as industrial fluids, hydraulic and dielectric fluids for capacitors and transformer. Due to its high persistence and bioaccumulation along the food chain, PCBs have been widely identified in wildlife and human tissue. A total number of 209 theoretical PCB congeners exists and around 150 have been reported in the environment [1].
In the legislation of some European countries, including Romania, the monitoring of PCBs is prescribed as the quantification of a set of seven indicators (28, 52, 101, 118, 138, 153 and 180). These congeners have been selected on the basis of their presence at high concentrations in technical PCB mixtures and the environment.
PCBs are extremely persistence. They were put in evidence for the first time by the Swedish researchers which were studied the organochlorines pesticides in wildlife. The studies showed the presence of traces of PCBs in almost all samples tested, collected starting in North America and Europe and reaching to Arctica and Antarctica [2].
Due to all this reasons PCBs were included on the Persistent Organic Pollutants adopted by the Stockholm Convention in 2001.
An area of concern in terms of pollution by these compounds is the landfill Glina.

2. MATERIALS AND METHODS

From Glina area were collected soil samples from 5 profiles on 6 depths (between 0 and 100 cm).
PCBs analysis from soil samples was made by organic solvent extraction and gas chromatografic determination. Thus, air-dried soil samples were extracted in a water bath with 50 ml petroleum ether : acetone in a 2:1 ratio. Ethereal extracts obtained were shaken in a separatory funnel, first with solution 2% sodium sulfate to remove traces of acetone, then with 3 x 25 ml petroleum ether. Combined ether extracts were passed on a column of anhydrous sodium sulfate, necessary step to remove traces

of water. The eluate is concentrated in rotary evaporator until a convenient volume (1-2 ml).
Purification of samples was made by passing extracts on a column of Florisil, followed by elution with 6 ml hexane. The sample was then brought to a convenient volume by evaporating in a low current of air.
For separation and determination of PCBs it was used a fused silica capillary column type WCOT (wall coated open tubular) with methyl silicone non-polar stationary phase (OV-1). The instrument used was a gas chromatograph Carlo Erba model Mega 5380 equipped with capillary column injection, "on column" injector (which allows direct sample injection) and electron capture detector.
Experimental conditions used in gas-chromatographic separation of PCBs are:

- ''on column'' injector;
- volume of the sample1µl;
- capillary column, 50 m x 0,32 mm, film thickness 0,25µm with polydimetilsiloxan stationary phase (OV-1);
- capillary column was operated under programmed temperature: initial isotherm at 60°C for 1min, with 20 o/minute at 190°C, two minutes at 190°C, with 5°/minute at 240°C, three minutes at 240°C, with 20°/minut at 280°C, then the final isotherm four minutes at 280°C;
- Carrier gas: helium 1ml/minute;
- Make-up gas: nitrogen 40 ml/min;
- Detector temperature 300°C.

3. RESULTS AND DISCUSSION

The results obtained indicate that just one of five profiles analyzed are significantly polluted with polychlorinated biphenyls.
Thus, profile 1 is polluted with highly chlorinated isomers: PCB 153, PCB 138 (with six chlorine atoms in molecule) and PCB 180 (with seven chlorine atoms in molecule). The contents are relatively low, less than 0,0041 mg/kg for PCB 138, ranging from 0,0006 mg/kg and 0,0055 mg/kg for PCB 153, and less than 0,0078 mg/kg for PCB 180. So, the concentrations of the three isomers detected exceed normal values in some cases but are below the alert threshold.
The total content of PCBs range from 0,0006 mg/kg and 0,0174 mg/kg, so the concentration values are within the normal range *(Figure 1)*.
The results interpretation was performed by the Order no. 756/1997 [3].
The second profile is characterized by the presence of for isomers, namely: PCB 101, PCB 138, PCB 153 and PCB 180. The range of concentrations for each isomer is:

- 0,0014 – 0,0075 mg/kg for PCB 138;
- 0,0011 – 0,0100 mg/kg for PCB 153;
- 0,0010 – 0,0077 mg/kg for PCB 180;
- 0,0058 – 0,013 mg/kg for PCB 101.

It can therefore see that the concentration values exceed normal threshold, but they are below the alert thresold. Also, the total PCBs concentration is ranged between 0,0033 and 0,031 mg/kg, so it is within the normal range *(Figure 2)*.

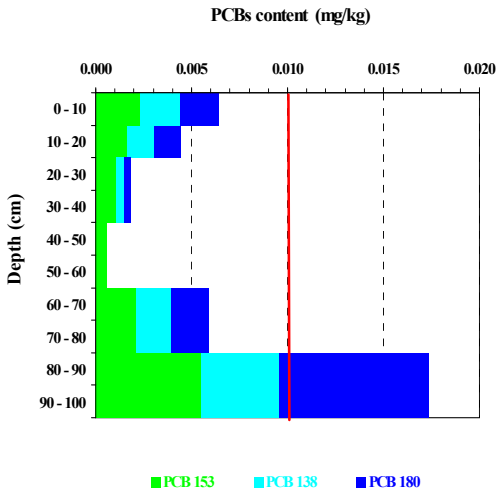

Figure 1. Polychlorinated biphenyls in Glina soil (profile 1)

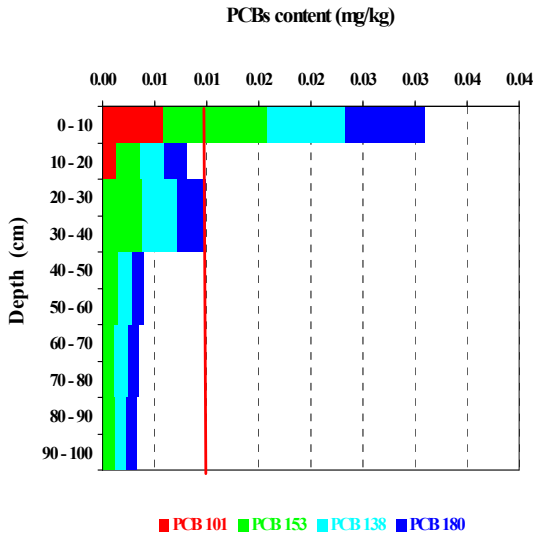

Figure 2. Polychlorinated biphenyls in Glina soil (profile 2)

Very interesting is the case of profile 3, where it can be observed a significant pollution with PCB compounds (*Figure 3*). The level of the concentrations determined in this case is two orders of magnitude higher than in the other profiles. In this profile compounds with lower degree of chlorination as PCBs 52 (with four chlorine atoms in the molecule) and PCB 101 (with five chlorine atoms in the molecule), are put in evidence with values which exceed of about ten times the alert threshold of 0,002 mg/kg. Also, the level of highly chlorinated isomers (PCB 138, PCB 153 and PCB 180) is just above the threshold of intervention of 0,04 mg/kg.

Concerning the total content of PCB compounds the concentrations are ranged between 0,1401 mg/kg and 0,422 mg/kg, thus exceeding the alert threshold values of 0,25 mg/kg, but not reaching the threshold of intervention of 1mg/kg.

In the case of profiles 4 and 5 contamination with PCBs is low (*Figure 4 and Figure 5*).

The studies regarding the mobility of PCBs on the soil profile show that these compounds are found in different soil layers. Thus, for profiles 1, 4 and 5 PCB isomers content decreases from the surface to 60 cm, then increases slightly. In profile 2 the level of concentration decreases from the surface to 30 cm, increased to 40 cm and then decreases. Regarding profile 3, the concentration of PCBs increased from the second surface to depth and then decreases. So it is possible that PCB compounds leach on the soil profile because for years are present in soil, or because of the disruption of soil layers, common situation in urban soil.

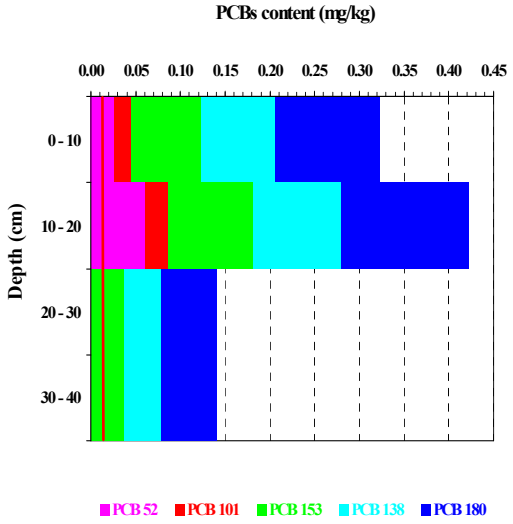

Figure 3. Polychlorinated biphenyls in Glina soil (profile 3)

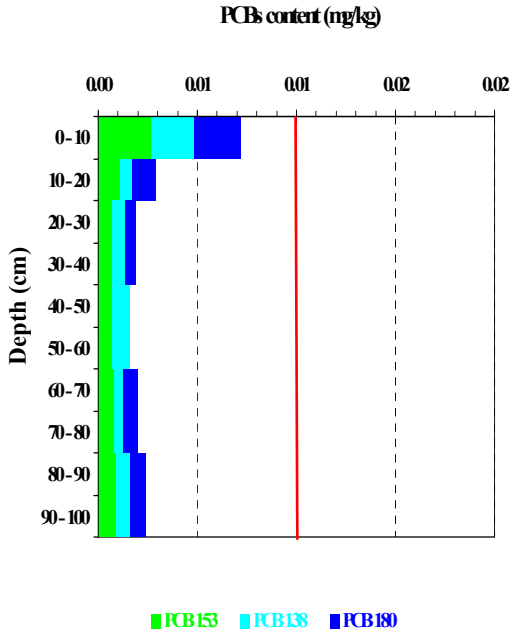

Figure 4. Polychlorinated biphenyls in Glina soil (profile 4)

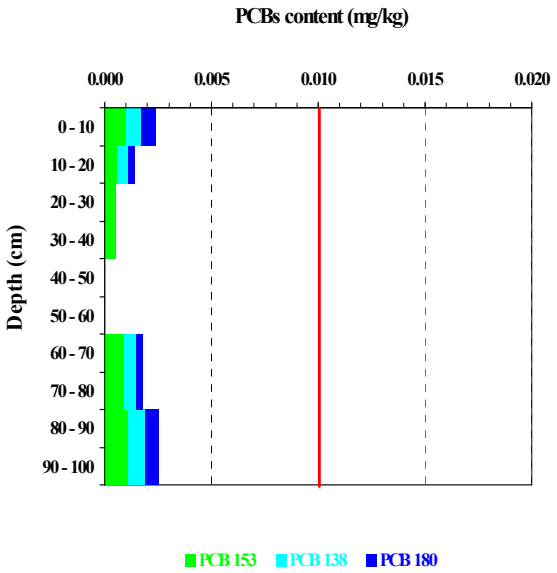

Figure 5. Polychlorinated biphenyls in Glina soil (profile 5)

4. CONCLUSIONS

- Glina area is polluted with polychlorinated biphenyls. One of the soil profile contain PCBs concentrations which exceed even the intervention threshold.
- The most frequent isomers are the highly chlorinated (PCB 138, PCB 153 and PCB 180) which are also the most persistent in the soil.
- Studies regarding the mobility of these compounds on the soil profile indicates that in some cases the levels are higher on the second or third deep of soil profile. This phenomenon can be explained by the fact in the case of urban soils, layers are disturbed.

5. REFERENCES

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