THE INFLUENCE OF THE CITY WASTE STORAGE ACTVITY ON THE SOIL IN VALEA LUI MIHAI LANDFILL AREA

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Abstract

The purpose of the present study is the appreciation of the soil quality state in the landfill area to quantify the evolution of quality indicators in time.

In this purpose there were taken samples in considered points significant for the time evolution of the dump.

The results obtained indicate possible damage to soil and groundwater and provide evidences about the possibilities of further exploitation of the land.

Key words: landfill, pollution, soil acidification, alert threshold, intervention threshold, heavy metals.

INTRODUCTION

Valea lui Mihai waste dump was installed in 2000, on a land that initially functioned as agricultural land.

In the east, south-east part of the dump there is a lake, that formed during time through accumulation of technological used water, evacuated from the preserve Arovit manufacture (of which activity was stopped).

The designed capacity of the deposit is 40000 mc, the actual quantity deposited being estimated at 36000 mc.

According to HG 349/2005, concerning waste disposal, the deposit is an urban deposit, nonconforming, class b, with a stopping deadline of storage in 2017.

The purpose of this study is the assessment of soil quality status in the landfill area in order to be able to identify optimal opportunities for land use after the cessation of activity.

Analysis of local soil conditions

Valea lui Mihai plain in which the city with the same name developed, represents a high tabular plain, with altitudes from 130-140 m to 150-160 m (maximum altitude is on Creasta Lunga dune).

The principal elements of relief are the dunes and valleys, often of inter-dunes type. The dunes have the shape of smooth peak, long of 1-1.5 km, sometimes till 3 km, wide of 100-400 m, slope slide that vary between 5^0-10^0 and height of 5-20m. Their disposition is parallel on the NE-SV direction.

Valea lui Mihai plain occupies around 270 km^2 and it is covered with sands (Posea, 1997).

The dune's relief influences the other physical-geographical aspects too:

- sands are heating strong on summer time and are increasing the evaporation especially on the dune's mane;
- on the winter and summer time is being shattered easy;
- the rain water infiltrates rapidly, but ponds on the inter-dunes, where imposes a higrofil vegetation, swamp and gleyzation soils;
- on the dried sand are being developed psalm soils, with reduced humus, instructed and generally phreatic- wetted (water at 3-5 m).

A structural characteristic of the area dunes is the presence of some overlapped layers named ferruginous skyline (Benedek Z, 1969).

Their thickness varies from 2cm to 40 cm, their origin being explained by the infiltration of water rainfall that removed the ferruginous material from the soil to the deeper skyline.

Water economy of ferruginous sands is better because the water coming from rainfall stays a longer time in the root area system, and the roots unfold sides becoming much more developed. The ferruginous layers are richer in nutritious matter, stopping the ascendant movement of water, decreasing its evaporation, an important fact during the dry months of the summer.

Sand dunes with ferruginous surface have a better stability against the wind interaction.

A characteristic of the studied area is the mosaic aspect of the soil type disposition, highlighting next:

-in the west, south-west part of the storage are found easy soils, permeable, of open color;

- on the same diameter, to easth, the presence of phreatic water at low depth determined an ample process of gleyzation, that favorized the lake formation (Bilant Mediu, 2011).

Inside the active landfill, cannot speak of the soil presence in the soil and geochemical meaning of the term, at least at the surface layer. Through successive depositing of inorganic wastes, oily and biodegradable organic materials, the composition of the first layers was altered to increase the pollutant content(Călinoiu,2006).

Small and medium depth drilling one revealed that natural litho-logic sequence, consisting in compacted clay and different sands was modified by type uncontrolled depositing of urban and industrial waste over the years. This led to the formation of a filling layer of anthropogenic origin, porous consistency, and with relatively high permeability (Consiliul Judetean Bihor).

In the deposit are being storaged the next types of waste: organic waste 68%, textile waste 5%, plastic materials 10%, paper 5% and others 12%.

In present the dangerous waste as part of the household waste and assimilable waste from the household waste (HG 856, 2002) are not separately colected.

Since the metal content of domestic waste and other types of wastes that fall into the category of urban waste is about 4%, it is expected that some of these metals to be included in the composition of the soil, subsoil and groundwater(Sabău C., Domuța C., Berchez O., 2002).

Household waste and those assimilated thereto contain a high percentage of biodegradable organic matter. By depositing them directly on soil the later acidification occurs, following the development of fermentation processes and implicitly one generates acidic compounds (CO_2, acetic acid, fatty acids, H_2S, NH_4+, etc.) (Chiş S., 2003).

The final products of the organic decomposition, interacting with meteoric waters, are being trasformed in salts, especially chlor, nitrates and sulphates and become sources of pollution for the depth soil and phreatic water.

MATERIAL AND METHODS

In order to quantify the effects of waste disposal activities on soil and subsoil quality samples were taken at depths of 0.2 m and 0.4 m, at 3 points considered significant for the evolution of the dump (Vica□, 2010):

- P1, dump point located outside dump, in the vicinity of the enclosure limit, situated at about 10 m from the dump entrance (witness sample) in a perimeter formed from alluvial sediments, sandy with a granulation of 0.2 mm.;
- P2, point located within the maneuver space, where waste is no longer deposited, the soil being rocky-sandy, mixed with detritus mineral-organic, specific dumps and diverse stages of decomposition of the waste dumps.
- P3, point located in the active part of the dump, on the slope of the interior part, in the east part of the dump, the soil being appropriate in what means texture with P2, with the mention that storage wastes are in an advanced stage of decomposition.

Soil sample prelevation was made by manual drilling with a pedological probe (Bilanț de mediu, 2011).

The analyzed indicators were: pH, P-mobile, K-mobile, N-$NO_{3,}$ Humus, C org, N total, Report C/N, Oil Report, $CaCO_{3,}$ Zn, Pb, Cu, Cr, Mn, Fe(Domuța, 2002)).

The samples were initially dried, after which they were analyzed using the following methods:

- ISO 1146498 potentiometer for pH;
- Gravimetric, according to STAS 12607-88 for petroleum residue;

- Spectrophotometry of atomic absorption for heavy metals.

RESULTS AND DISCUSSIONS

The obtained results are being presented in table 1:

Table 1

Evaluated Indicators	P1, dump point located outside dump (blank)		P2, point located within the inactive dump		P3, point located in the core of the active dump	
	0-20	20-40	0-20	20-40	0-20	20-40
pH	7,15	6,45	7,80	7,55	7,75	7,95
P-mobil ppm	70	40	104	744	223	168
K-mobil ppm	80	70	570	330	720	490
$N-NO_3$ ppm	2,3	1,8	9,5	5,5	28,3	31,5
$N-NH_4$, ppm	7,0	0,9	1,2	6,0	19,5	18,3
Humus %	0,49	0,27	1,85	3,43	1,55	1,15
C org %	0,284	0,162	1,073	1,989	0,899	0,667
N tot %	0,037	0,022	0,097	0,193	0,088	0,064
Raport C/N	7,68	7,38	11,06	10,31	10,21	10,42
Rez.petrolier ppm	1520	1740	2280	1580	1400	1580
$CaCO_3$ %	0,0	0,0	5,15	3,62	5,45	3,58
Ni ppm	4,7	3,0	25,9	22,2	6,0	8,3
Pb ppm	11,7	1,2	41,0	40,5	6,3	8,2
Cu ppm	5,2	2,6	36,7	13,9	5,9	9,5
Cr ppm	7,1	3,8	27,6	30,8	9,4	12,5
Cd ppm	0,0	0,0	0,03	0,04	0,0	0,0
Fe ppm	3589	2827	13282	8893	4013	6773

Concentrations of pollutants in soil have been reported to: blank, normal values, alert thresholds and interventions thresholds, as set by the Order no. 756/1997 of M.A.P.P.M. on soils for sensitive use, considering that a possible use of these lands might be agricultural land.

Analyzing the values of the analyzed indicators one notice the following:

1. Oil residue indicator:
   - At all sampling points, residual oil content exceeds the normal value as it follows:
     -in P1 of 15.2 times, respectively of 17.4 times;
     - in P2 of 22.8 times, respectively of 15.8 times;
     -in P3 of 14 times, respectively of 15.8 times.

- At all sampling points, residual oil content exceeds CMA for sensible soils as it follows:
  - in P1 exceeds the alert threshold with 8.7 times and the one of intervention with 1.74 times;

- in P2 exceeds the alert threshold with 11.4 times and the one of intervention with 2.28 times;
- in P3 exceeds the alert threshold with 7.9 times and the one of intervention with 1.58 times;

- At all sampling points, residual oil content exceeds CMA for less sensible soils as it follows:
  - in P1 exceeds the alert threshold with 3.48 times;
  - in P2 exceeds the alert threshold with 4.56 times and the one of intervention with 1.14 times;
  - in P3 exceeds the alert threshold with 3.16 times;

-the highest exceeds are being remarked in the case of sample P2, at 20 cm depth.

2. Cd Indicator

- there are no exceeds of the normal values, the Cd content of the sampling points from P1 and P3 being situated under the detectable limit of the work method.
- detectable values through the applicated work method were registered in the case of P2.

3. Pb Indicator

- there are no exceeds of the normal values, the Cd content of the sampling points from P1 and P3;
- samples taken from P2 present exceeds of normal values of 2 times;

4.Cu Indicator

- there is being remarked an exceed of the normal value, of 2 times, in the case of sample P2 at a 20 cm depth.

5. Cr Indicator

- there are no exceeds of the normal values, in none of the points;

6. Fe Indicator

- is not accordingly to Order No. 756/1997;

-in the case of the sample taken in the maneuver area of the dumpis being remarked a substantial increase in the Fe content (of 4 times), from the witness sample, respectively from the active area of storage.

7.K and P mobile indicators, N_{nitric}, $N_{amoniacal}$, $N_{total,}$ $C_{organic}$, C/N that characterize the content of organic combinations of soil present a continuous increase of the values from the witness sample at the sample which comes from the active area of storage.

8. The content of humic acids of samples P2 and P3 present increased values in report with the blank, normal process under the aspect of the nature activity of storage the household waste.

CONCLUSIONS

Analysis of soil samples reveals the following:

- Active storage area has the highest content oil residues, Pb, Cu, Cd, due to the accidental losts of tanker products;
- In the case of Cu indicators one noticed the exceeding of the normal range in the active area, phenomenon explained by:
  - The high presence of the chemical element in a big variety of products, that become waste;
  - The versatility of the shapes of this soil element;
  - The increase of the metal concentration during time, due to the concentrating factor in soil;
  - The existance of a possible natural fund rich in copper, of the studied area;

This stage represents the combined effect of some cumulation of causable factors, between which the most relevant are:

- The quantity, respective the high variety of storage waste;
- In all this period there was no selection of the waste;
- The poor drainage of the leachate;
- Producing during time accidental pollution through drain tanker products from transport waste truck.

Recomendations

For a better identification of optimal possibilities of valorification of afferent dump field we recomend:

- Monitoring the quality soil according to hydric regime area, as well as the dinamic of the quantity of waste storaged, so there can be an annual of at least 2 sampling campaigns (Sabău N.C., 2002);
- Quantity appreciation of the level of rainfalls and correlation of the obtained data with the evolution of quality parameters of soil (Vicaş et.al., 2010);
- Elaboration of measure plan in order of finding optimal alternatives of field valorification (Vicaş, 2011);

Taking into account the soil particularities of the studied field, in the waste dump valorification variant as a agricultural field (Berca, 1998) is being recomended:

- Annual cultures that value the superficial layer of the soil (Vicaş, 2009);
- Making plowings with 40 cm depth, that transfer the salty layer in depth:
  - avoiding cultures that necesit irrigation;

- Establishment of the nature and the quantity of necesary amendments to correct the ph values from easy acid (witness sample) to neutral.

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