

# Evaluation of Environmental Impact Generated by Waste Deposition into a Romanian Urban Landfill

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**Abstract:** The deposition of urban wastes is a technological process that can negatively influenced the environment quality. The evaluation of air, water and soil quality during the waste deposition activities has a great importance to express the pollution level into the area of deposition and proximity. In Moldova area, the waste deposition is done directly on the soil and subsoil, in special area at the extremity of the town, surface named urban/municipal landfill. The impact of waste deposition process on the environment is assessed using the well known methods (e.g. pollution global index etc.).

**Keywords:** waste, deposition, landfill, assessment/evaluation of environmental impact, global pollution index

## 1. Introduction

In the context of sustainable development, the waste management plays an important role, waste deposition being not only a potential pollution source but also an important source of raw secondary materials and energy.

The choosing of priorities in this sector of activities depends of the economical or/and environmental consequences that are or not in agreement with the environmental policies and technological, economical and consumption policies.

The actual tendencies concerning the wastes take into consideration two aspects (Atudorei and Pănescu, 2002):

- the reduce of waste volume;
- environmental pollution risk.

The modern strategy of waste management includes a hierarchy of waste management options where the first accent is focused on the prevention of waste production. This is followed by the promotion of recycling and reuse activities and, after, the optimization of final waste deposition and waste safety.

The waste management strategy indicates as principles of waste management the following:

- recovery from the generated wastes, separation and selection of recycling materials and energy recovery;
- prevention of waste production by "clean" technologies, reuse and changes into the behaviour of producer and customer;
- controlled deposition together with the reducing of deposited waste quantity and strict standards of deposition conditions.

In the last years, a lot of important reglementations and legislative acts have been approved as proposals of Environment Ministry or/and disposals of Roumanian Government as directives for wastes and special directives for dangerous wastes, reglementations for urban/municipal waste control, technical standards for waste incineration or municipal/urban waste deposition (e.g. Law 426/2001 for waste management, GD 155/1999 for waste mangement

control and european waste catalogue, GD 128/2002 for waste incineration, GD 162/2002 for waste deposition, directive 1147/2002 for post closing waste deposition etc.).

The implementation of the waste legislation imposes reliable data of:

- waste production and characteristics together with the waste treatment facilities;
- waste management;
- minimization of changes for the deposition area/place;
- establishment of recycling routes and opening of market for recycling materials.

For an acceptable/legal waste management is necessary the evaluation of environment impact generated by waste deposition and, after that, improvements of waste deposition conditions and technologies. Also, it is imposed the application of waste separation/selection at the generation source, improvement of recycling efficiency and accordance of priorities for the route followed by different wastes and promotion of final deposition safety.

The legislative acts/norms of waste management must be followed by the adoption or acceptance of the EC special directives for waste packing, incineration, control and reuse of deposition area in the case of closing and, also, a general directive concerning the civil awareness for the damages and actions against the environment (\*\*\*) Guide to assess the enviroment impact for a controlled landfill, 1990).

The environment quality (air, water, soil) into the urban waste deposition area must be monitorized. Also, the evaluation of environmental impact generated into the urban waste landfill must be quantified using an adequate evaluation method.

In this paper is assessed a case study for a roumanian urban waste landfill (e.g. Botoșani town).

The environmental impact is necessary to be evaluated sometimes immediately and other times for long period in accordance with the national legislation and procedures. The assessment of an environmental impact in the case of urban waste landfill (not dangerous waste

deposit) must contain the field, objectives, adopted policy, evaluation of fond situation together with the impact assessment of the major and sensible environment components. It must be take into account aspects as the long period impact, the post closing deposit management and the policies for long period area use. For the characterization of the urban waste landfill, it is necessary to distinguish three important aspects:

- the kind of wastes: What wastes were or are deposited, in what quantities and what forms ? What are the discharge used techniques ? Also, what new waste must be studied through analysis of prelevated samples ?
- the chemical implicated products: What are the compounds presented into the wastes ? In what forms and concentrations ? The subsoil conditions: What type of materials are components of the landfill subsoil ?
- the monitoring systems (control systems); for examples, the kind of existent layer that covers or not the waste landfill and the type of exfiltration systems and surface outflows.

The urban waste landfill is a deposit of non-dangerous wastes from population and non-dangerous assimilable wastes from economic agents or company.

## 2. Waste deposition technology and effects on environment

The urban waste landfill into a roumanian district (e.g. Botoșani town) is managed by a specialized economic company named S.C. „URBAN SERV” S.A. Botoșani.

The urban wastes collected from population or different economic agents have different composition that varies into each town. The technological process of urban deposition on landfill involves the next steps:

- municipal wastes collection from population and business owners;
- transportation of the collected wastes;

- deposition of collected wastes.

The collection and prestockage at the waste generation source were performed into special spaces, into different receivers or ecologic containers. These are directly transported or discharged periodically into special transportation vehicles, in closed system. These spaces are closed to block of flats or other buildings and permits the access of vehicles inside.

From the data base of S.C.”URBAN SERV” S.A. Botoșani for the urban and industrial assimilable wastes, the main components are: paper, blue-print paper, plastics, textiles, glass, ceramics, mettalic bodies, foods or other vegetable products, ashes etc., structural composition that together with humidity and caloric power influences the waste quality.

The average composition of collected wastes was not established by adequate or indicated analysis but was estimated after weighing and precollection.

The average composition of urban wastes includes: 14 % paper and blue-print paper; 3 % glass; 1.5 % plastics; 4 % textiles; 4 % mettalic bodies; 42.5 % organic materials; 31 % other wastes (inert materials as soil, ashes, woods, leaves).

The quality of urban wastes depends of people and economic companies number (e.g. Botoșani has 128 586 people/2003 (that corresponds to 0.825 kg waste / citizen x day) and 171 economic companies/institutions), collection points (e.g. 73 waste collection points in Botoșani from population and 171 waste collection points from economic companies/institutions) and varies every year (for example: 70 422 m<sup>3</sup> municipal wastes from population and other municipal services in 2002 and 108 706 m<sup>3</sup> in 2003).

The receivers or ecological containers were placed into the proximity of the fixed collection points (in some collection points was started the selective precollection for recycling facilities) and discharged two days per week into the districts with blocks of flats and one day per week for individual residence or codomains.

TABLE 1. Municipal wastes collection and destination into Botoșani town

No.	Type of collected wastes	Weighing (t)	Quantity of collected wastes (t)	Valorification	Disposal/ quantity (t)
1	Municipal wastes from: - population; - assimilable from business owners (industry, commercial units, institutes) - preselected wastes (textiles, paper, blue-print paper, aluminium, iron, plastics etc.)	No / estimation	40 616 ( $\square=0,5$ t/m <sup>3</sup> ) 3 435 ( $\square=0,5$ t/m <sup>3</sup> )	No/only plastics in some schools	Landfill (soil) / 40 616 3 435
		Yes / weighting	1 193.93 ( $\square=0,5$ t/m <sup>3</sup> )	Yes	1 193.93
2	Wastes from municipal services: - street cleaning; - market cleaning; - park, garden, green spaces	No/ estimation	1 018 ( $\square=0,3$ t/m <sup>3</sup> ) 960.8 ( $\square=0,3$ t/m <sup>3</sup> ) 1 194.9 ( $\square=0,3$ t/m <sup>3</sup> )	No	Landfill (soil) / 1 018 960.8 1 194.9
3	Wastes from building or construction materials	No / estimation	15 274 ( $\square= 2$ t/m <sup>3</sup> )	No	Landfill (soil) / 15 274
4	Wastes from hospitals	No	-	No	-
5	Other wastes (inerts, dangerous wastes etc.)	No	-	No	-

The deposition of urban non-dangerous wastes is made according with the traditional technology:

- wastes are discharged from transportation vehicles and deposited on landfill into a layer having 1.5-2 m height;
- the new wastes are deposited only after the temperature of the layer above was decreasing to the temperature of the natural soil after the aerobic fermentation;
- the wastes are periodically compacted for avoiding the high air gaps that facilitate the self ignition and so, the burning of landfill;
- the waste layer are periodically covered with soil or other inert materials (sands) with 10-30 cm height.

The waste deposition is made through frontal advancement, in this case the landfill is formed on a perpendicular surface upon the filling direction.

Each new layer must be started in the same place as the first for an equal exposure during the atmospheric rains.

The moldavian landfill is not completely enclosed with fence of minimum 2 m height. During the deposition on landfill, the urban wastes were decomposed by fermentation processes (aerobic or anaerobic process) in two steps: acidogenesis and methanogenesis.

The whole surface of landfill is not covered and can be considered as fixe pollution source because of the gaseous emissions generated into the aerobic/anaerobic fermentation process. The gaseous emissions generated by the waste decomposition are not captured as biogas for energetic uses and so, can be felt by the persistent smells with negatively effects on health of human bodies or vegetation.

Into the gaseous emissions are presented important quantities of CO<sub>2</sub>, H<sub>2</sub>S, SO<sub>x</sub>, NO<sub>x</sub>, CO, CH<sub>4</sub>, solid particles etc.

On the landfill, there were no air depollution equipments or safety covering systems of landfill surface. There were no measurements of gaseous flow or pollutant concentrations into atmosphere to balance the air emissions. So, the main air pollutants together with the meteorological conditions (e.g. temperature, pressure etc.) must be monitorized.

The urban landfill has no systems to control the exfiltrations or to treat the landfill leachate. In these cases, the subsoil quality will be defined on the basis of geology and local soil characteristics. During exploitation, the landfill is covered with temporary layer and before closing with a final layer of soil or clay with or without vegetations.

The soil can be acidified (more than 42.5 % biodegradable products) by the organic and inorganic acids (e.g. acetic acid, grease acid, H<sub>2</sub>S etc.) generated into the fermentation process and a lot of toxic compounds can be introduced in subsoil and so appears soil and subsoil pollution. Also, the subsoil has a loessian layer that kept the pollutants that penetrate from the landfill and not permit the contact with ground waters. But, some of these toxic compounds reach to the ground waters and affect their quality as water resource.

Almost all of the landfill from Moldova region have more than 60 % of their filling capacity occupied.

We were done some measurements of the pollutant concentrations in air, ground waters, soil and subsoil and also nearly surface waters (upstream and downstream of Teascu river) for Botoșani landfill.

The quality indicators for wastewaters and leachate were sometimes monitorized by the service of water mangement „Prut river”. Also, the ground water quality is monitorized two times per year (the landfill having 4 drilling well to collect the ground water samples).

At the Botoșani landfill does not exist potential sources of noise. The only noises are generated by the compacting processes and transportation.

### 3. Assessment of environmental impact

The environmental impact of waste deposition on a urban landfill is evaluated by the global pollution index.

The assessment of environment quality into the area of urban landfill is done for air, water and soil quality.

The method consists into synthetic appreciations based on quality indicators of each environmental component (surface water, ground water, leachate, air and soil) and after, correlation based on graphics and assessment by global pollution index.

For each environmental factors is proposed a record that quantifies the pollution of the component expressed by a bonity scale.

The bonity scale is appreciated through records from 1 to 10, 10 representing the non affected natural state and 1 represents an irreversible and major deterioration of the studied environmental components (Macoveanu, 2005).

It has to be remarked the fact that this method is mainly based on subjective appreciations and therefore the experience of evaluators is very important.

Some legislative acts/norms must be taken into account (e.g. Government Ordinance no.1146/2002 for surface waters, Drinking Water Law no.458/2002 for drinking water quality, Government Ordinance no.188/2002 for approval of technical norms for wastewater quality 001 and 002/2002, Government Order no.462/1993, Government Order no.592/2002 for air quality together with Standard 12574/1984, Government Order no.156/1997 for soil quality).

The proposed bonity scale for the environmental components: surface water, ground water, air and soil are presented into tables 3, 4, 5 and 6. To characterize the surface water quality are evaluated chemical oxygen demand (COD), biochemical oxygen demand (BOD), amonia, nitrogen, sulphate, residues, phosphorus. For ground water are evaluated COD, amonia, nitrogen, sulphate, residues and extractible substances.

To characterize the air quality are evaluated SO<sub>x</sub>, NO<sub>x</sub>, CO, CO<sub>2</sub>, non-methane volatile organic compounds (NMVOC), CH<sub>4</sub> and dust. For soil are evaluated total organic compounds (TOC), extractible compounds, pH and phenolic compounds.

The global pollution index ( $I_{GP}$ ) is expressed as following:  $I_{GP} = \frac{S_i}{S_r}$  where:  $S_i$  – area of the ideal state of environment and  $S_r$  – area of the real state of environment.

The literature (Macoveanu, 2005; Negrei, 1999; Rojanschi, 1997) proposes for different values of  $I_{GP}$  the following assessment of environmental impact (Table 2).

TABLE 2. The values for pollution index

$I_{GP}$ values	Effects / real situation
$I_{GP} = 1$	Natural environment, not affected by industrial/human activities
$1 < I_{GP} < 2$	Environment modified by industrial/economic activities within admissible limits
$2 < I_{GP} < 3$	Environment modified by industrial/economic activities generating discomfort effects
$3 < I_{GP} < 4$	Environment modified by industrial/economic activities generating distress to life forms
$4 < I_{GP} < 6$	Environment modified by industrial/economic activities, dangerous for life forms
$I_{GP} \geq 6$	Degradated environment, not proper for life forms

TABLE 3. Evaluation scale for surface water (bonity scale)

Bonity scale	Water category	COD (mg/L)	BOD (mg/L)	Ammonia (mg/L)	Nitrogen (mg/L)	Sulphate (mg/L)	Residues (mg/L)	Phosphorus (mg/L)
10	Drinking water	< 5	< 3	< 0.05	< 4	< 80	Fond	< 0.2
9	Category I	5	3	0.05-0.20	< 4	< 80	Fond	0.2-0.25
8	Category II	5-10	3-5	0.20-0.30	4-13	80-150	200-500	0.25-0.3
7	Category III	10-20	5-10	0.30-0.6	13-26	150-250	500-1000	0.3-0.5
6	Category IV	20-50	10-25	0.6-1.5	26-66	250-300	1000-1300	0.5-0.8
5	Category V	50-100	25-30	1.5-2.0	66-75	300-500	1300-1500	0.8-1
4	Stage 1 of degradation	100-150	30-50	2.0-3.0	75-85	500-700	1500-1700	1-2
3	Stage 2 of degradation	150-300	50-100	3.0-4.0	85-95	700-800	1700-1800	2-3
2	Wastewater stage 1	300-400	100-500	4.0-5.0	95-100	800-900	1800-2000	3-4
1	Wastewater stage 2	> 400	> 500	> 5.0	> 100	> 900	> 2000	> 4

TABLE 4. Evaluation scale for ground water (bonity scale)

Bonity scale	Water category	COD (mg/L)	BOD (mg/L)	Ammonia (mg/L)	Nitrogen (mg/L)	Sulphate (mg/L)	Residues (mg/L)	Extractible (mg/L)
10	Drinking water	< 5	< 3	< 0.05	< 4	< 80	Fond	< 1
9	Category I	5	3	0.05-0.20	< 4	< 80	Fond	1-3
8	Category II	5-10	3-5	0.20-0.30	4-13	80-150	200-500	3-5
7	Category III	10-20	5-10	0.30-0.6	13-26	150-250	500-1000	5-10
6	Category IV	20-50	10-25	0.6-1.5	26-66	250-300	1000-1300	10-15
5	Category V	50-100	25-30	1.5-2.0	66-75	300-500	1300-1500	15-20
4	Stage 1 of degradation	100-150	30-50	2.0-3.0	75-85	500-700	1500-1700	20-25
3	Stage 2 of degradation	150-300	50-100	3.0-4.0	85-95	700-800	1700-1800	25-30
2	Wastewater stage 1	300-400	100-500	4.0-5.0	95-100	800-900	1800-2000	30-35
1	Wastewater stage 2	> 400	> 500	> 5.0	> 100	> 900	> 2000	> 35

TABLE 5. Evaluation scale for air (bonity scale)

Bonity scale	Air category	NOx mg/m <sup>3</sup>	Dust mg/m <sup>3</sup>	CO mg/m <sup>3</sup>	VOC mg/m <sup>3</sup>	SO <sub>x</sub> □g/m <sup>3</sup>	CH <sub>4</sub> mg/m <sup>3</sup>
10	Natural quality	0-0.020	0	< 3	0-20	0	Abs.
9	Clean air - stage 1	0.020-0.150	0.0-0.04	3-4	20-50	0.0 - 0.02	0-0.2
8	Clean air – stage 2	0.150-0.750	0.04-0.06	4-6	50-150	0.02 - 0.05	0.2-0.5
7	Affected air- stage 1	0.750 - 7	0.06-0.08	6-10	150-300	0.05 - 0.2	0.5-1
6	Affected air- stage 2	7 -75	0.08-0.1	10-15	300-700	0.2 - 0.4	1-5
5	Polluted air – stage 1	75 -350	0.1 – 0.16	15-20	700-1000	0.4 - 0.8	5-10
4	Polluted air – stage 2	350-550	0.16 –0.25	20-50	1000-3000	0.8 - 1.5	10-15
3	Degradated air - stage 1	550-700	0.25 - 0.8	50-75	3000-5000	1.5 - 4	15-20
2	Degradated air - stage 2	700-750	0.8 –2.0	75-100	5000-10000	4 - 8	20-50
1	Not breathable	>750	> 2.0	> 100	> 10000	> 8	> 50

TABLE 6. Evaluation scale for soil (bonity scale)

Bonity scale for soil	pH	TOC mg/Kg soil	Extractible compounds, mg/kg	Phenolic compounds, mg/kg
10	6.8-7.2	< 3	< 100	< 0.02
9	6.8-6.4 and 7.2-7.8	3 - 3.2	100 – 500	0.02 – 0.15
8	6.0-6.4 and 7.8-8.0	3.2 - 3.4	500 – 1000	0.15 – 0.75
7	5.8-6.0 and 8.0-8.2	3.4 - 3.6	1000 – 2000	0.75 – 1
6	5.6-5.8 and 8.2-8.8	3.6 - 3.8	2000 – 3750	1 – 5
5	5.4-5.6 and 8.8-9.2	3.8 - 4	3750 – 5000	5 – 10
4	5.0-5.4 and 9.2-9.8	4 - 4.5	5000 – 6250	10 – 20
3	4.7-5.0 and 9.8-10	4.5 - 7	6250 – 7500	20 – 30
2	4.2-4.7 and 10-12	7 - 10	7500 – 10000	30 – 40
1	< 4 and > 12	> 10	> 10000	> 40

#### 4. Experimental data

The magnitude of environmental potential pollution generated by waste deposition into the Botoșani landfill was established based on the analysis of:

- specific air pollutants from the gaseous emissions using an automatic OLDHAM MX 21 Plus analyzer and equipment for determination of solid suspended particles;
- specific water pollutants from surface water (upstream and downstream of Teascu river) and ground water (4 drilling organized at the basis of waste landfill);

- specific soil pollutants from 6 soil samples from landfill area (at 5 cm and 30 cm depth) and one soil sample (reference soil) from 7 km far from the landfill area (Cotnari-Botoșani national route).

The quality indicators have been analyzed by standardized methods, according to Government Acts.

The experimental results are presented in Tables 7-12. The quantification of environmental impact was performed by the global pollution index. The records for each environmental component assessment (surface water, ground water, air and soil) were accorded taking into account the experimental data of the physico-chemical analysis.

TABLE 7. The characteristics of surface water (Teascu river)

No	Quality indicator	Upstream landfill	Downstream landfill	Order 1146/2002, Quality II
1	pH	7.170	7.143	6.5 – 8.5
2	Total suspended solids, mg/l	96	111	-
3	Turbidity (FTU)	37	48	-
4	COD, mgO <sub>2</sub> /l	17.35	17.48	10
5	BOD, mg/l	2.36	2.12	5
6	Nitrate, mg/l N-NO <sub>3</sub>	0.375	0.375	3
7	Nitrite, mg/l N-NO <sub>2</sub>	0.44	0.37	0.06
8	Phosphate, mg P/l	1.076	1.017	0.2
9	Sulphate, mg/l	371.86	384.62	150
10	Hardness, °G	11.2	11.1	-
11	Extractible substances, mg/l	17	38	-
12	Chloride, mg/l	49.7	42.6	100
13	Residues, mg/l	372	568	500
14	Amonia, mg/l	10.5	10	0.3
15	Sulphide and H <sub>2</sub> S, mg/l	0.213	0.638	nothing

TABLE 8. The characteristics of ground water (drilling no.1-4)

No	Quality indicator	Drilling 1	Drilling 2	Drilling 3	Drilling well 4	Law no. 458/2002 (drinking water)
1	pH	7.634	8.191	7.622	8.190	6.5-9.5
2	Total suspended solids, mg/l	32	37	20	17	-
3	Turbidity (FTU)	31	27	16	1	< 5
4	COD, mgO <sub>2</sub> /l	11.73	17.20	35.29	1.09	5
5	COD, mgO <sub>2</sub> /l	1.91	3.71	1.81	0.96	-
6	Nitrate, mg/l N-NO <sub>3</sub>	0.25	5.48	14.21	108.9	-
7	Amonia, mg/l	0.25	5.48	14.21	108.9	0.5
8	Nitrite, mg/l N-NO <sub>2</sub>	0.028	0.050	0.025	0.181	-
9	Phosphate, mg P/l	0.114	abs	0.065	abs	-
10	Sulphate, mg/l	3758.23	6852.3	1735.33	244.19	250
11	Chloride, mg/l	145.55	418.9	3493.2	53.25	250
12	Sulphide and H <sub>2</sub> S, mg/l	0.21	0.64	0.62	abs	100
13	Hardness, ° G	75.6	95.48	161.28	21.95	5
14	Extractible substances, mg/l	95.5	15.5	45.5	19.5	-
15	Rezidues, mg/l	6024	11764	9860	958	-

TABLE 9. The characteristics of landfill leachate

No	Quality indicator	Leachate
1	pH	5.15
2	Total suspended solids, mg/l	553
3	Turbidity (FTU)	461
4	COD, mgO <sub>2</sub> /l	9916.67
5	BOD, mg/l	722.21
6	Nitrate, mg/l N-NO <sub>3</sub>	27.13
7	Nitrite, mg/l N-NO <sub>2</sub>	1425
8	Phosphate, mg P/l	95.12
9	Sulphate, mg/l	662.59
10	Extractible substances, mg/l	242
11	Amonia, mg/l	218.4
12	Chloride, mg/l	4544.0
13	Residues, mg/l	3232

TABLE 10. The characteristics of emissions into air

No	Source	Noxe type	Concentration (hour), mg/mc	M.A.C. (mg/mc) Order no. 592 / 2002
1	Prelevation point E1	- CO <sub>2</sub>	0.2	-
		- CO	10	10
		- COV	52	-
		- NO <sub>x</sub>	10	0.2 (0.1-tolerated limit)
		- SO <sub>2</sub>	2	0.35
		- CH <sub>4</sub>	0	-
		- H <sub>2</sub> S	0.4	-
		- NH <sub>3</sub>	2	-
		- dust	4	0.5
2	Prelevation point E2	- CO <sub>2</sub>	0.1	-
		- CO	5	10
		- COV	36	-
		- NO <sub>x</sub>	3	0.2 (0.1-tolerated limit)
		- SO <sub>2</sub>	1	0.35
		- CH <sub>4</sub>	0	-
		- H <sub>2</sub> S	0.2	-
		- NH <sub>3</sub>	3	-
		- dust	5.5	0.5
3	Prelevation point E3	- CO <sub>2</sub>	0.8	-
		- CO	11	10
		- COV	70	-
		- NO <sub>x</sub>	11	0.2 (0.1-tolerated limit)
		- SO <sub>2</sub>	2	0.35
		- CH <sub>4</sub>	0	-
		- H <sub>2</sub> S	0.1	-
		- NH <sub>3</sub>	2.5	-
		- dust	5	0.5



No	Source	Noxe type	Concentration (hour), mg/mc	M.A.C. (mg/mc) Order no. 592 / 2002
4.	Prelevation point E4	- CO <sub>2</sub>	0.1	-
		- CO	3.5	10
		- COV	28	-
		- NO <sub>x</sub>	4	0.2 (0.1-tolerated limit)
		- SO <sub>2</sub>	2	0.35
		- CH <sub>4</sub>	0	-
		- H <sub>2</sub> S	0.2	-
		- NH <sub>3</sub>	2	-
- dust	6	0.5		
5.	Prelevation point E5	- CO <sub>2</sub>	0.3	-
		- CO	12	10
		- COV	65	-
		- NO <sub>x</sub>	10	0.2 (0.1-tolerated limit)
		- SO <sub>2</sub>	2	0.35
		- CH <sub>4</sub>	0	-
		- H <sub>2</sub> S	0.2	-
		- NH <sub>3</sub>	2	-
- dust	4.5	0.5		
6.	Prelevation point E6	- CO <sub>2</sub>	0	-
		- CO	1	10
		- COV	6.5	-
		- NO <sub>x</sub>	1	0.2 (0.1-tolerated limit)
		- SO <sub>2</sub>	0	0.35
		- CH <sub>4</sub>	0	-
		- H <sub>2</sub> S	0	-
		- NH <sub>3</sub>	0	-
- dust	6	0.5		

TABLE 11. The characteristics of soil (5 cm depth)

No sample	Soil prelevation	pH	TOC %	Extractible substances, mg/Kg soil	Gases and vapour, %	Phenolic compounds, mg/kg
1	S1	8.317	0.91	2200	0.380	0.72
2	S2	7.921	2.09	240	2.26	1.35
3	S3	7.909	6.26	190	3.08	2.14
4	S4	7.881	6.87	210	0.49	2.22
5	S5	7.747	6.18	440	1.48	1.82
6	S6	7.864	0.45	500	2.83	0.32
7	Reference sample	7.12	1.2	135	1.730	0.73

TABLE 12. The characteristics of soil (30 cm depth)

No sample	Soil prelevation	pH	TOC %	Extractible substances, mg/Kg soil	Gases and vapour, %	Phenolic compounds, mg/kg
1	S1	7.970	0.45	330	1.01	0.45
2	S2	8.068	2.75	1780	0.60	0.82
3	S3	8.045	4.41	220	3.703	1.98
4	S4	7.877	9.19	420	0.67	1.79
5	S5	7.802	5.11	300	2.59	1.41
6	S6	7.790	0.42	170	2.93	0.20
7	Reference sample	7.22	1.08	130	1.921	0.52

The quality of surface water is evaluated by the following records:

COD: 7  
BOD: 10  
Amonia: 1  
Nitrogen: 10  
Sulphate: 5  
Residues: 7  
Phosphorus: 4

The evaluation record for surface water is: 6.29

The quality of ground water is evaluated by the following records:

COD: 7  
Amonia: 1  
Nitrogen: 7  
Sulphate: 1  
Residues: 1  
Extractible substances: 1

The evaluation record for ground water is: 2.83

The quality of air is evaluated by the following:

SO<sub>x</sub>: 4  
 NO<sub>x</sub>: 6  
 CO: 7  
 VOC: 8  
 CH<sub>4</sub>: 10  
 Dust: 2

The evaluation record for air is: 6.17

The quality of soil is evaluated by:

TOC: 3  
 Extractible compounds: 9  
 pH: 8  
 Phenolic compounds: 6

The evaluation record for soil is: 6.50

The Fig.1 described the ideal and real state for each environmental compounds and permitted the calculation of the ideal and real area,  $S_i$  and  $S_r$ .

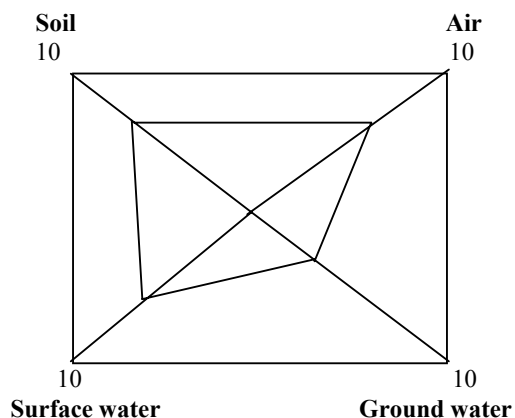


Figure 1. Graphic representation of environment evaluation  
 $S_i=200 \text{ cm}^2$ ;  $S_r= 58.1259 \text{ cm}^2$ .

The  $I_{GP}$  value is of 3.44 and corresponds to the situation of „environment modified by economic activities generating distress to life forms”.

## 5. Conclusions

The method of global pollution index was applied for a preliminary assessment of environmental quality. There were analysed the main pollutants that are generated from the waste deposition activities on urban landfill of Botoșani town.

The experimental data were obtained by standard analysis methods of the quality indicators, methods internationally approved (ISO).

The assessment of environmental impact was performed for air, soil, surface and ground water.

The value of  $I_{GP}$  is of 3.44 and corresponds to ”an environment modified by economic activities generating distress to life forms”.

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