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Environmental Impact of the Closure of Târgovişte – Aninoasa Solid Waste Dump

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Abstract

The production and accumulation of increasingly significant quantities of waste made it necessary to adopt some adequate policies and strategies in order to limit the negative impact of this waste on the environmental life and security. Our research approached the following problems: quality of the environmental factors, analysis of the size of the impact, evaluation of the potential impact on the environmental factors, evaluation of the global impact and post-closure monitoring of Târgovişte-Aninoasa solid waste dump. Taking into account the value of the global pollution index and the bonity grades for each environmental factor, we have noticed that, through the closure of the solid waste dump, the environment is affected within the allowable limits, the impact is low and local, and the effects of this project on the environmental factors are positive.

Key words: *waste dump, environmental impact, Târgovişte – Aninoasa*

JEL Classification: *Q51*

Introduction

The waste dump that is to be closed serves the municipality of Târgovişte and is situated outside the town (near the Aninoasa commune), with access to DN 71 on a specially arranged road, has been functioning since 1951, has a surface of 12.63 ha, and the total mass of the waste dumped here is estimated at 252,800 tons. The closure of this waste dump is regulated by the Governmental Decision HG no. 349/2005, according to which the existing dumps that are not environmentally friendly cease their activity and apply the legal operation and monitoring provisions concerning their post-closure surveillance.

We must mention the fact that, to carry out this impact project, we have used reports and calculations based on the gathering of samples out in the field by SC. GEOSTUD S.R.L. Bucureşti, on our demand, according to a contract concluded in this sense.

The theoretical considerations and the studies carried out in the respective area reflect the existing situation of the solid waste dump, namely: the dump is not controlled; no selective gathering procedure has been implemented so far; the hazardous wastes are dumped together with the urban wastes; there is no drainage system and no system for the gathering of the levigated mass; there appeared the waste self-ignition phenomenon, following the non-collection of the fermentation gases; there is no daily covering of the waste, which leads to the presence of unpleasant smell and there is no coherent operation and management system.

Air Quality

In order to estimate the *volume* of fermentation gases produced we took into account the total mass of the waste dumped, as well as the established emission factor of 213m^3 /t dumped waste, the result being of 198 Nm^3 /h, as the gas emission takes place on the entire surface of the dump (Table 1).

Table 1. Fermentation gas flow

Dump	Mass of the dumped waste (t)	Total gas volume (Nm^3)	Fermentation gas flow (Nm^3 /h) Year 2006
Târgovişte-Aninoasa	252,800	53,846,400	198

The estimation of the gas emission *content* took into account the fact that the dump is not covered and, consequently, the fermentation is mainly aerobic, leading to the production of carbon dioxide and of other gases whose nature depends on several factors, out of which we can mention: the organic components present in the waste, the temperature and humidity of the environment. The investigations carried out on the basis of analysis reports revealed higher values than the accepted limit for: sulfur dioxide, nitrogen dioxide, ammonia, and total dusts in suspension (Table 2).

Table 2. Gas emission content

Period of mediation	Parameter	Unit of measurement	Value determined	Limit value	Margin of tolerance
1h	Sulfur dioxide (SO_2)	mg/m^3	0.098	**0.35***	0.150 mg/m^3 until Jan. 1, 2004, then reduced by equal annual shares (%) to 0% until Jan. 1, 2007
1h	Nitrogen dioxide (NO_2)	mg/m^3	0.105	**0.2***	0.100 mg/m^3 until Jan. 1, 2005, then reduced by equal annual shares (%) to 0% until Jan. 1, 2010
30 min	Ammonia (NH_3)	mg/m^3	0.007	**0.3****	-
30 min	Total dusts in suspension	mg/m^3	0.124	**0.5****	-

* Order 592/2002 "Order of the Minister of Waters and Environmental Protection for the approval of the Norms concerning the limit values, threshold values and of the evaluation criteria and methods for nitrogen dioxide, dusts in suspension, lead, benzene, carbon monoxide and ozone emissions.";
** STAS 12574/1987 – "Air in protected areas – Quality conditions".

At the same time, there appear CH_4 concentrations, a fact that reveals an anaerobic fermentation of the waste dumped in the basis; the values of the determined concentrations are below the maximum allowed limits; yet, we should highlight the fact that the dump is not covered. At the

same time, the lack of a vegetal cover to protect the surrounding area favors the dispersion of the pollutants in the neighborhood and creates a state of obvious discomfort for the inhabitants who live nearby.

Water Quality

Generally speaking, it is considered that water pollution represents a degradation of its physical, chemical and biological qualities, induced directly or indirectly by human activity; as a result, the water becomes unsuitable for normal use to meet the needs it used to before the degradation occurred (Gâştescu P., 1988).

It has been noticed that the underground waters in the area have suffered the impact of Târgovişte-Aninoasa waste dump activity, while the surface waters are not submitted to this kind of impact, as the rivers and rivulets in the neighborhood are far enough from the dump area.

The investigations based on analysis bulletins for the underground waters sampled in several different points show that the values of the indicators under analysis are below the maximum allowable quantities (CMA) mentioned by all the legal norms that are now into force (Table 3).

Table 3. Sample S1 according to the analysis bulletin no. 187

Features	**Values obtained**	**CMA**	**Indicators**	**Values obtained**	**CMA**
Appearance, color, smell, taste	clear	acceptable	CCO – Mn (mg O_2/dm^3)	-	5.0
Turbidity (degrees SiO_2)	0	<=5	Sulphides and sulfuretted hydrogen (mg/dm^3)	-	0.10
pH at 20^o	7.3	6.5-9.5	Residual free chlorine (mg/dm^3)	-	0.50
Conductivity (µS/cm)	2900	2500	Fixed residuum at 105^o C (mg/dm^3)	898.0	1200
Hardness (measured in German degrees): ○ Total ○ Permanent ○ Temporary	 39.2 13.72 25.48	 minim 5 - -	Temperature (^{o} C) - -	20 - -	- - -
Alkalinity	p = 0 m = 9.1				

There is, however, a possibility that during the periods of heavy rain, the torrents created may wash the waste dump area and reach the nearby soil, even the nearby rivulets, transporting large quantities of solid flow, as well as particles in suspension.

Soil Quality

Human activities contribute to the acceleration of soil degradation through inadequate use, removal of natural vegetation, frequent use of heavy machines and equipments, inadequate crop rotation or excessive use of chemical fertilizers (Bălteanu, D., Alexe Rădiţa, 2001).

In the present case, large areas of waste dump are not covered; along with domestic waste several other types are deposited, as follows: vegetal waste, waste coming from demolitions, textile and plastic waste, wrapping, mud, rubber and other types of industrial waste. As far as the nature of the pollutants is concerned, there are: organic matter, heavy metal compounds,

greases and oils, inorganic matter, car batteries, other types of industrial waste and toxic substances resulted from waste fermentation (levigated from the waste dump).

In order to determine the soil pollution level we compared the values obtained during the investigations carried out on the spot, followed by laboratory analyses, with the reference values mentioned in the legal norms concerning the soils with less sensitive use (Table 4). So, we identified higher values than the maximum allowed values for Cu, Zn, Pb, Cr and Cd, while the value overpassing the allowed limit for Ni suggests the fact that the soil might be polluted with galvanization mud or other types of industrial mud.

Table 4. Sample S4 according to the analysis bulletin no. 202/40

Parameter	Unit of measurement	Value determined	Normal value	CMA	
				a.t.*	i.t.**
pH	pH units	7.4	-	-	-
Conductivity	S/cm	749	-	-	-
Cadmium	ppm	2.9	1	5	10
Copper	ppm	54.6	20	250	500
Chrome	ppm	31	30	300	600
Manganese	ppm	650	900	2000	4000
Nickel	ppm	22	20	200	500
Lead	ppm	41	20	250	1000
Zinc	ppm	288	100	700	1500
Oil products	ppm	114	100	1000	2000

* a.t. – alert thresholds for less sensitive soils
** i.t. –intervention thresholds for less sensitive soils

Taking into account the analysis of the environmental factors' quality, we can see that the closure of the waste dump will lead to the mitigation of the present pollution process, and from the landscape viewpoint, seeing the desolating images it provides at present, the impact will be an extremely positive one.

Analysis of the Size of the Impact

The method of assessment of the impact on the environment comprises several stages of synthetic estimations, based on quality indicators that can reflect the general condition of the environmental factors under analysis. The quality of an environmental factor or element is estimated by transforming the qualitative aspects into quantitative measurements. So, in relation with the effects' size we can determine indicators of quality (Iq):

$$Iq = 1/ \pm E \quad (1)$$

where $\pm$ E is the size of the effect determined using the evaluation matrix.

The determination of the effects by quantitative measurements (E) allows for their combination and reconciliation on a scale of the following type:

- + positive influence
- 0 zero influence
- - negative influence.

For the quantitative evaluation, the quality indicators of each environmental factor at a given moment are placed on a bonity (manageability) scale, with the awarding of grades expressing how near or far from an ideal state they are (Table 5).

Table 5. Bonity scale for Iq

Bonity grade	**Iq = 1/± E; E ≠ 0**	**Effects on the environment**
10	Natural environment	○ -environment not affected by the activity
10 ÷ 9	Iq = (0 ÷ 0.25] E>0	○ environment affected within the allowable limits level 1 ○ the positive effects are significant (the sum of the positive effects is significant) ○ -the activity generates a positive impact
9 ÷ 8	Iq = (0.25 ÷ 0.5]	○ environment affected within the allowable limits level 2 ○ -the positive and negative effects compensate each other ○ -the activity generates a low impact
8 ÷ 7	Iq = (0.5 ÷ 1]	○ environment affected within the allowable limits level 3 ○ -the negative effects can be measured ○ -the alert threshold is reached
7 ÷ 6	Iq = -1 E<0	○ environment affected over the allowable limits level 1 ○ -the negative effects are significant ○ - the intervention threshold is reached
6 ÷ 5	Iq = (-1.0 ÷ -0.5]	○ environment affected over the allowable limits level 2 ○ - the negative effects cause discomfort to the forms of life
5 ÷ 4	Iq = (-0.5 ÷ -0.25]	○ environment affected over the allowable limits level 3 ○ the negative effects are obvious ○ -the impact is important
4 ÷ 3	Iq = (-0.25 ÷ -0.025]	○ -degraded environment – level 1 ○ -the effects are damaging for long periods of exposure
3 ÷ 2	Iq = (-0.025 ÷ -0.0025]	○ degraded environment – level 2 ○ - the effects are damaging for medium periods of exposure
2 ÷ 1	Iq = under -0.0025 environment inadequate for life forms	○ degraded environment – level 3 ○ - the effects are damaging for short periods of exposure

Evaluation matrix for the environmental impact

The potential interactions or reactions between the effects of the project concerning the closure of the waste dump on the environmental components are measurable as "size of the effects ±" using the matrix method. Based on the effects (± E), we obtain the indicators of quality (Iq), according to which we find out the grades of bonity (Gb) for each environmental element.

The value of the grades of bonity (Gb) indicates the extent to which the assessed environmental factor is affected (Table 6).

Table 6. Evaluation matrix for the environmental effects

Actions of the waste dump closure project	**Effects on the environment**						
	Under-ground waters	**Sur-face waters**	**Air**	**Soil and under-ground**	**Bio-diver-sity**	**Landscape & cultural patrimony**	**Social & eco-nomic environ.**
The influence of the place where the dump is situated on the environment: ○ phreatic water level ○ the extent to which the area is affected	-	0	-	+	0	+	+
The assurance of the demands	+	+	+	+	+	+	+

in point of construction for the closure of the dump ○ the system of covering ○ used water/gas storage and treatment							

Table 6 (cont.)

Level of pollutant emissions in underground & surface waters and in the air: ○ systems for storing the emissions; ○ protection for the vegetation	+	+	+	+	+	0	0
Influence of the monitoring activity on the functioning of the protection systems for minimizing the environmental risk	+	+	+	+	0	0	+
Social & economic effect	0	0	0	0	0	0	+
Size of the effects	+2	+3	+3	+4	+2	+2	+3

Evaluation of the Potential Impact on Environmental Factors

The measurement of the potential impact of the waste dump closure project on the natural environment in the area where it is situated relies on the analyzed elements, on environmental factors concerning the pollutant-generating sources, the estimated impact and the condition of the natural environment. We calculated:

The environmental factor WATER
E UNDERGROUND WATER = + 2
I Q UNDERGROUND WATER = 1/ + 2 = + 0.50
Gb UNDERGROUND WATER = 8

Analyzing the bonity scale it results that: the environment is affected within the allowable limits level 2; the positive and negative effects compensate each other; the activity generates a *low impact*.

E SURFACE WATER = + 3
I Q SURFACE WATER = 1/ + 3 = + 0.33
Gb SURFACE WATER = 8.65

Analyzing the bonity scale it results that: the environment is affected within the allowable limits level 3; the positive and negative effects compensate each other; the activity generates a *low impact*.

The environmental factor AIR
E AIR = + 3
I Q AIR = 1/ + 3 = + 0.33
Gb AIR = 8.65

From the bonity scale it results that: the environment is affected within the allowable limits level 3; the positive and negative effects compensate each other; the activity generates a *low impact*.

The environmental factor SOIL + UNDERGROUND:
E SOIL + UNDERGROUND = + 4
I Q SOIL + UNDERGROUND = 1/ + 4 = + 0.25

Gb SOIL + UNDERGROUND = 9

From the bonity scale it results that: the environment is affected within the allowable limits level 1; the positive effects are significant (the sum of the positive effects is significant); the activity generates a *positive impact*.

The environmental factor BIODIVERSITY+ LANDSCAPE
E BIODIVERSITY + LANDSCAPE = + 2
I Q BIODIVERSITY + LANDSCAPE = 1/ + 2 = + 0.50
Gb BIODIVERSITY + LANDSCAPE = 8

Analyzing the bonity scale it results that: the environment is affected within the allowable limits level 2; the positive and negative effects compensate each other; the activity generates a *low impact.*

The environmental factor SOCIAL + ECONOMIC
E SOCIAL + ECONOMIC = + 3
I Q SOCIAL + ECONOMIC = 1/ + 3 = + 0.33
Gb SOCIAL + ECONOMIC = 8.65

Analyzing the bonity scale it results that: the environment is affected within the allowable limits level 3; the positive and negative effects compensate each other; the activity generates a *low impact.*

Evaluation of the General Impact

In order to simulate the pollutants' synergic effect, we have built an ideogram using the grades of bonity obtained. Thus, the ideal state was represented graphically using a circular surface, with equal rays having the value of 10 units of bonity. By uniting the points resulted from placing on the diagram the values expressing the real state, we obtained an irregular geometric figure, with a lower surface, inscribed in the regulated geometric figure of the ideal state (Figure 1).

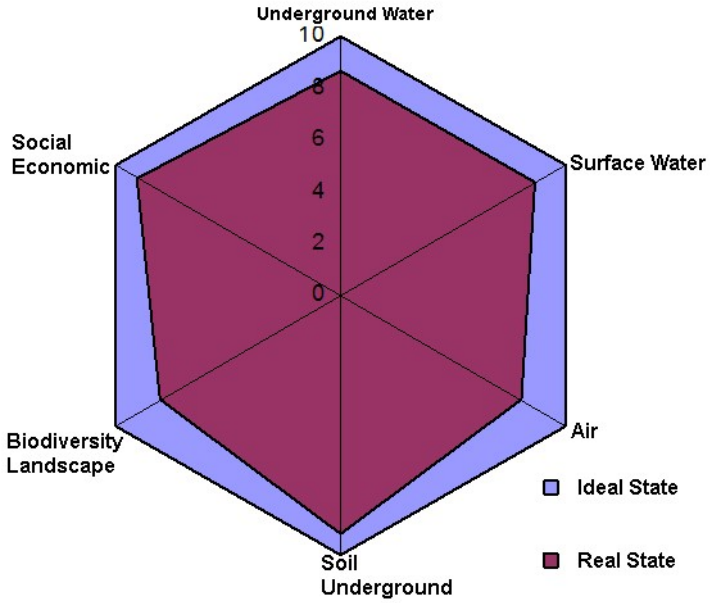

Fig. 1. General impact

The general pollution index (GPI) results by dividing the surface representing the ideal state (Si) to the surface representing the real state (Sr):

$$GPI = Si / Sr \quad (2)$$

We established an evaluation scale for the values of the GPI, from which it is obtained the impact on the environment, namely the effect of the activity on the environmental factors:

GPI = 1 –natural environment no affected by the human activity;
GPI = 1 ÷ 2 – environment submitted to the effect of human activity within the allowable limits;
GPI = 2 ÷ 3 – environment submitted to the effect of human activity causing a state of discomfort to the forms of life;
GPI = 3 ÷ 4 – environment affected by human activity disturbing the forms of life;
GPI = 4 ÷ 6 – environment seriously affected by human activity;
GPI over 6 – degraded environment, improper for the forms of life.

The calculation of the general pollution index (GPI) results from the diagram which was built using the values of the grades of bonity (Gb UNDERGROUND WATER = 8, Gb SURFACE WATER = 8.65, Gb AIR = 8.65, Gb SOIL + UNDERGROUND = 9, Gb BIODIVERSITY+ LANDSCAPE = 8, Gb SOCIAL + ECONOMIC = 8.65) namely:

Si = 244;
Sr = 214;
GPI = 244/214 = 1.14.

Taking into account this value of the GPI of 1.14, according to the principles established in the evaluation scale we can see that the activity proposed, namely the closure of the urban waste dump of Târgovişte-Aninoasa, affects the environment within the allowable limits, the impact is low and local and the effect of this project on the environmental factors are positive.

Postclosure Monitoring

In compliance with the legal provisions in force, the operator of the waste dump has to ensure the post-closure monitoring for a period of at least 30 years; this period can be prolonged if during the carrying out of the monitoring program it is noticed that the dump is not yet stable and can present risks for the environmental factors and for human health. In case negative environmental effects are noticed, the operator of the waste dump is obliged to inform the competent environmental authority. The parameters that need to be monitored are those included in the legal provisions, including meteorological data, data on the emissions, on the underground waters and on the body of the dump. At the same time, in case the alert thresholds specified by the environmental authorization are crossed, it will be necessary to urgently inform the competent authority, and this authority will determine the steps that need to be taken in order to prevent the deterioration of the environmental condition in the area.

Conclusions

The impact study concerning the closure of Târgovişte-Aninoasa urban solid waste dump has determined us to suggest the closure of this dump, especially now after the approval of the project of the local authorities called “Reabilitarea colectării, transportului, tratării şi depozitării controlate a deşeurilor solide din judeţul Dâmboviţa” (The rehabilitation of the gathering, transport, treatment and controlled storage of the solid waste in Dâmboviţa County), worth 26,054,000 euros, financed by the ISPA program, concerning the building of an ecological dump in the same area until the end of the year 2009.

This project’s main objectives are: to protect people’s health, to improve the landscape conditions in Dâmboviţa County by increasing the population’s comfort in this area and the attractiveness of this area for tourists and by reducing the use of resources by sorting out and recycling the waste.

The research carried out has shown that, for the future, we need to have in view both to increase the population's awareness concerning the impact produced by the human activity on the environment and to extend the participation of the local community, of the NGOs and of the economic agents in solving of the environmental problems, demands stipulated as well in the Community Action Program concerning the Environment for the period 2001-2010, entitled: "Mediu 2010: viitorul nostru, alegerea noastră" (Environment 2010: Our Future, Our Choice).

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Impactul închiderii depozitului de deşeuri solide urbane Târgovişte-Aninoasa asupra mediului

Rezumat

Producerea şi acumularea unor cantităţi din ce în ce mai mari de deşeuri a impus adoptarea unor politici şi strategii adecvate pentru limitarea impactului negativ al deşeurilor asupra vieţii şi securităţii mediului. Depozitul de deşeuri ce urmează a fi închis deserveşte municipiul Târgovişte şi este situat în afara oraşului (lângă comuna Aninoasa), cu acces la DN 71 pe un drum special amenajat, funcţionează din anul 1951, are o suprafaţă de 12,63 hectare, iar masa totală a deşeurilor depozitate este evaluată la 252.800 tone. Cercetările efectuate se referă la următoarele probleme: calitatea factorilor de mediu, analiza mărimii impactului, evaluarea impactului potenţial pe factori de mediu, evaluarea impactului global şi monitorizarea postînchidere a depozitului de deşeuri solide Târgovişte-Aninoasa. Luând în considerare valoarea indicelui global al stării de poluare şi notele de bonitate pe factorii de mediu se constată că, prin închiderea depozitului de deşeuri solide, mediul este afectat în limite admisibile, impactul este redus şi local, iar efectele proiectului asupra factorilor de mediu sunt pozitive.