Buletinul Ştiinţific al Universităţii "POLITEHNICA" din Timişoara
Seria HIDROTEHNICA
TRANSACTIONS on HYDROTECHNICS

Tom 55(69), Fascicola 2, 2010

The Economical Risk Evaluation for a Municipal Waste Landfill from where the Heavy Metals are Drained into the Surface Water.

Doltu Cristina[1]

Abstract- Over time an important source of contamination of surface water is represented by the municipal waste landfills or other solid waste that do not comply with the rules of storage and that are located in major river beds of the watercourses. The surface water pollution with heavy metals resulting from these deposits has a destructive character on aquatic fauna and flora and through the process of bioaccumulation, on animals and people.

In this paper the author presents the ecological risk evaluation in the case of a potential heavy metal pollution of river Barlad, these metals deriving from the municipal landfill of the Vaslui County located near the riverbed.

Keywords- ecological risk evaluation, municipal waste landfill, heavy metals, the source-way-receiver analysis, bioaccumulation process.

1. INTRODUCTION

It is well known that any human activity has a wide range of positive and negative implications that can be felt in various areas. To combat the negative implications it is necessary to be achieved an ecological risk evaluation which is produced on the objective study.

The ecological risk evaluation is a process of identification and estimation of the damage produced to the ecological systems by various chemicals released into the natural environment. The evaluation is mainly intended to inform the responsible institutions both political and economical of the measures to be taken in order to stop or diminish the activities involved in pollutant emissions.

There is a wide range of different methodologies for risk evaluation, both quantitative and qualitative. The degree of risk depends on the nature of the impact on the receiver as well as the probability of this event to happen.

The risk calculation may be based on a simple classification system where the probability and severity of an event is classified descending, assigning them a random score as follows:

Probability classification	Gravity classification
3 = high	3 = majored
2 = medium	2 = medium
1 = low	1 = easy

Then, the risk can be calculated through probability factor multiplication with gravity factor to obtain a comparative number, like 3 (high) x 2 (medium) = 6. Greater the result is, higher will be the priority which will be accorded for risk control.

In this paper the author presents the ecological risk evaluation in the case of a potential heavy metal pollution of river Barlad, these metals deriving from the municipal landfill of the Vaslui County located near the riverbed.

2. THE LOCATION AND DESCRIPTION OF THE SOURCE OF POLLUTANTS.

The waste is a major issue in every European country, and quantities of waste are increasing. The legal and illegal waste sites disposal, scattered all over the Vaslui county territory and not only do not comply with the effective requests of the environment (base isolation, biogases and filtrates collection, wastewater treatment, groundwater protection and monitoring equipment).

These are potential sources of pollution generating the risk of contamination of the soil and also of the surface water and groundwater.

The Municipal Vaslui waste landfill is located near the river Barlad in the north-west of the city. The wastes deposited there are classified by activity areas like: industrial waste, construction waste, agrozootechnical waste, household waste, street waste (sweep garbage from the streets, garbage from the parks, public places, suspensions resulted from washing the streets), commercial waste, medical waste, special waste (explosives, toxic and radioactive substances).

[1] Technical University " Gh. Asachi" Iasi, Department of Civil Engineering, Bd. D. Mangeron 65, Iasi 700050, Romania Email address: cristinadoltu@yahoo.com

In the years 2005-2006 the amount of waste collected has increased rapidly reaching values of 174 662 m3/year, mentioning that household waste was collected also from the surrounding villages.

The table 1 shows the percentage evolution of the household waste composition during 2002 to 2005 in Vaslui county.

Table 1. The evolution of the household waste composition between 2002-2005.

Material	Percentage %			
	2002	2003	2004	2005
Paper / cardboard	4,58	4,95	9,63	7,94
Glass	2,85	2,45	3,39	3,82
Metals	2,52	1,64	1,48	1,67
Plastics	8,37	2,88	6,15	7,1
Textiles	7,13	6,87	8,74	4,51
Biodegradables	70,60	61,45	52,06	55,36
Inerts	1,5	10,58	8,17	5,06
Other	2,45	9,18	10,38	14,54
TOTAL	**100**	**100**	**100**	**100**

In the coming period, until 2020, it is expected an increase of the amount of waste resulting from expanding the sanitation services to rural areas (with an index of production of 0.3-0.4 kg / Pearson/ day, exclusively agricultural and fermentable waste) and the index in the big cities will be 1.1-1.4 kg / Pearson/ day.

Also the gross wastes tend to be a problem on a short and medium term and the sludge from wastewater treatment stations must be carefully monitored and managed in terms of quantity and composition.

2.1 The quantitative and qualitative evaluation of household and street waste.

a) The quantitative and qualitative evaluation of household waste.

The household waste is very heterogeneous, their composition showing large variations from one village to another, depending on the season, degree of urban development and civilization, or of the food profile.

To establish the quantity of household waste generated by the population is required a percentage characterization of the waste composition.

The average daily volume of household waste is determined by the relationship:

$$Qmed/day = N \cdot Im \cdot 0{,}001 \quad (t/day) \quad (1)$$

where:

N – is the number of people;

Im – is the average index of household waste production (kg / Pearson / day).

This index is determined by measuring and recording static the villages or assimilating the indexes of other villages with the same size, dimension and degree of comfort, etc.

In The table below is presented the average index of production of household waste that was registered in different countries. It can observed that in Canada, U.S., France is registered a relatively high index of household waste generation.

Table 2 the average index of household waste production registered in different countries.

The country	The average index of household waste production. I_m (kg/loc/day);
France	0,8
England	0,75
Germany	0,55
Switzerland	0,41
Italy	0,55
Netherlands	0,74
Brazil	0,64
U.S.A	0.94
Canada	1

In our country, for global calculation can be considered Im= 0,6 - 1,4 kg/Pearson/day in the cities and Im= 0,3 - 0,7 kg/Pearson/day in rural areas.

According to data provided by the Regional Agency for Environmental Protection Vaslui the average index of production of household waste in the county is Im = 0,9 kg/Pearson/day.

The average amount of waste produced in the city is:

$$Qmed/day = 70884 \cdot 0{,}9 \cdot 0{,}001 = 63{,}79 \ (t/day) \quad (2)$$

The average annual quantity of waste is determined by the relationship:

$$Qmed/year = Qmed/day \cdot 365 \quad (t/year), \quad (3)$$

resulting in a quantity of 23,285.394 (t/ha) of municipal waste produced in Vaslui County.

Following the calculations it was established that the Vaslui city population generates almost 64 t/day of household waste and approximately 19000 t/year, the biggest quantity being generated by the people living in block apartments, compared to the people living in village houses and with a lower index of household waste production (0,3 kg/person/day).

b) The qualitative and quantitative evaluation of street waste.

The Street waste have in the composition the following things: dust and soil at a rate of 60-80%, leafs and wood -5-8%, paper and paperboard, debris from construction sites (debris, masonry, stone) 3-5%,the dejection from traction animals and other waste from shops and markets 0,1- 0,2%.

To determine the amount of waste street calculation uses the following relationship:

$$Q_S = S \cdot I_S \quad \text{(t/day)} \tag{4}$$

where:

QS – daily quantity of waste collected from the street (tons / day);

S – cleared streets surface (ha);

IS – street waste production index in t / ha / day; indicating that it depends on the nature of the street clothing (Table 3), settlements development degree, number of inhabitants.

Table 3. Waste generation index value depending on the nature of the street dressing.

The nature of the street dressing	Operation	I_S (t/ha/day)
Asphalt street clothing	The sweeping of sidewalks and roadway	0,10 – 0,25
Paving roads with sand embroidered	The sweeping of sidewalks and roadway	0,15 – 0,20
Streets paved with river rocks	The sweeping of sidewalks and roadway	0,18 – 0,25

After calculations based on the Is, it results a total volume of waste street:

$$Q_{tot} = 21{,}39 \text{ (t/day)}, \tag{5}$$

And the annual quantity of waste street:

$$Q_{s\,Year} = Q_{tot} \cdot 365 = 7807{,}35 \text{ (t/year)} \tag{6}$$

3. THE POLLUTANT DESCRIPTION AND THE DETERMINATION OF ITS EXPOSING WAYS.

3.1 The Characterization of heavy metals which is found in municipal landfill waste.

The heavy metal is any metallic chemical element, which has a relatively high density and is highly toxic or poisonous.

In municipal waste landfills the most common heavy metals are: mercury, lead (plumb), cadmium, copper.

The mercury is the only metal that is found in all of the three major mediums - water, soil and atmosphere. The mercury sources are natural and also artificial from human activities. Mercury is used mainly in chemical industry in the manufacture of paints, paper, of pesticides and fungicide, pharmaceuticals, disinfectants. The metallic mercury is also used in some household products, as barometers, thermometers and fluorescent light. Mercury contamination has a global character and affects both terrestrial environment, as well as the water environment.

The lead (plumb) is a highly toxic metal and is used by many industries. The lead (plumb) is resulted from industrial enterprises production lines and from the combustion engines of the vehicles (being added in the gas as an explosion moderator). It reaches the atmosphere with the exhaust gases of combustion engines and from the atmosphere it reaches the soil and water, where is absorbed by plants accumulating in the roots, the leaves and from where it is taken by the animals that feed with the plants. This metal is toxic to humans causing an intoxication called saturnism.

Cadmium is a metal with a strong toxic action on organisms. It enters in the body through food and through the body surface accumulating selectively in different tissues, increasing the temperature and decreasing the salinity. The cadmium concentration in freshwater is higher than in sea. Because cadmium accumulates in organs and has a fairly long period of semi-elimination (10 -30 years), using very small amounts of fish soaked with cadmium through a long period of time can lead to severe poisoning with cadmium. It enters in the environment primarily through the soil because it can be found in fertilizers and pesticides.

The Copper production increased in the last decade and therefore increased the amount of copper in the environment. Most copper compounds are deposited on the sediments in the water or on soil particles. The soluble compounds of copper represent a major threat to human health. Typically, water-soluble copper compounds can be found in the environment after the removal following the application in agriculture.

3.2 The effects of the pollutant and the way of exposure.

In Romania is still not very well pointed out the selective storage of the wastes and also the rules of storage are not respected.

For this reason, in the Vaslui municipal waste are reaching beside household wastes (biodegradable waste) also no degradable wastes (car batteries, cans, jars, lids, thermometers, cans of drinks, chemical fertilizers and results from animals, debris from construction, CFL lamps, alkaline batteries, alkaline batteries, rechargeable batteries, packaging's for medical products, packaging machinery oils, other hazardous waste packaging, etc) which contain a large amount of heavy metals. Thus, there is an increased risk of contamination of river water Barlad which heavy metal.

The effects of this pollutant, once reached in the river water, are very harmful causing degradation of water quality, fish deaths and disappearance of all aquatic organisms and aquatic flora. Through the process of bioaccumulation the heavy metals reach both agricultural crops as well as in the body of the animals and subsequently in humans.

Once in the human body they produce the atrophy of nervous cells in the cerebellum, with symptoms of numbness of the lips and tongue, gums porosity, deafness, worsening eyesight, kidney disease, lung disease, anemia, abortion, decreased fertility in men, stomach pain, bone fractures, cancer, etc.

.

4. THE ANALISYS OF THE SOURCE-WAY-RECEIVER RELATIONSHIP REGARDING THE RISK OF POLUTING THE BARLAD RIVER WITH HEAVY METALS.

The analysis of the source-way-receiver relationship is presented in Table 4.

Table 4. The matrix of source-way-receiver analysis.

The type of pollutant	Source	Way	The nature of the danger.	Receiver	Reaching the source, way, objectives	The risk importance	The intervention necessity.
Heavy metals (mercury, lead, cadmium, copper)	The municipal waste landfill of the Vaslui city.	The migration of pollutants in storm water	phytotoxic, toxic, cancer.	River Barlad (surface water)	YES	Medium	YES
		The migration of pollutants in storm water		Aquatic wildlife of the river Barlad	YES	High	YES
		The migration of pollutants in storm water		Aquatic flora of the river Barlad	YES	Medium	YES
		Bioaccumulation process		Crops	NO	Low	NO
		Bioaccumulation process		Animals	YES	Hig	YES
		Bioaccumulation process		Human health	YES	Medium	YES

In Table 5 is determined the risk of pollution and its severity.

Table 5. The risk calculation/ the risk quantification.

RECEIVER	REACHING THE SOURCE, WAY, OBJECTIVES	THE RISK CALCULATION/THE RISK QUANTIFICATION.	PROBABILITY CLASSIFICATION	GRAVITY CLASSIFICATION
River Barlad (surface water)	YES	6-high risk	3-high	2-medium
Aquatic wildlife of the river Barlad	YES	9- very high risk	3-high	3-majore
Aquatic flora of the river Barlad	YES	4 – medium risk	2-medium	2-medium
Crops	YES	2- low risk	1-low	2-medium
Animals	YES	9- very high risk	3-high	3-majore
Human health	YES	6- high risk	2-medium	3-majore

The calculations revealed an increased risk of heavy metal pollution of the water in the Barlad River.

5. CONCLUSIONS

The methodology that is suggested in this paper highlight the importance of completing an ecological evaluation of the contamination risk of surface waters.

The calculations revealed an increased risk of heavy metal pollution of the water in the Barlad River and the impact of this pollution on the environment.

Therefore appropriate measures must be taken to combat this pollution like: respecting the European rules of storage, selective waste collection, positioning deposits in remote areas of major river beds and making frequent assessments of environmental risk of pollution both soil and water groundwater or surface water.

REFERENCES

[1]. *Andreia Petcu*, (2004) „Tehnologii pentru reducerea emisiilor de metale grele ale instalatiilor marine de ardere", Bucuresti.

[2] *Brandusa Robu, Matei Macoveanu*, (2010) „Environmental evaluation for sustainability", Ed. Ecozone, Iasi.

[3]. *Cismaru Corneliu, Gabor Victor,* (2004) "Gestiunea deşeurilor solide", Editura Performantica, Iaşi.

[4]. *Institutul Național de Cercetare, Dezvoltare în Ingineria Mediului (ICIM)* (2002) " Strategia națională de gestiune a deşeurilor" , Bucureşti.

[5]. *Mihai Manoliu, Cristina Ionescu,(*1998) " Dezvoltare durabilă şi protecția mediului" , Editura HGA, Bucureşti.

[6] *Principles of Characterizing and Applying Human Exposure Models,* Word Health Organization, Geneva, 2005.

[7]. *Popa Maria, Ileana Ioan, Kadar Manuella*, (2002) „Studii privind metodele electrochimice utilizate pentru analiza metalelor grele in zonele poluate", Târgu Jiu.

[8] *Thomas E. McKone,* (1999) „The Rise of Exposure Assessment among the Risk Sciences: An Evaluation Through Case Studies, Inhalation Toxicology, 11:611-622.

[9].****http//www.cjvaslui.r*o – Plan Județean de gestionare a deşeurilor menajere în județul Vaslui.

[10].*** *http//deseuri-online.ro.*

[11].****http://www.ecoimm.ro/resurse/ordin-nr-184-din-21-septembrie-1997*

[12].*** *http://www. ecologicamb.ro*

[10.]****http://facultate.regielive.ro/proiecte/agronomie/impactul poluarii cu metale grele a zonelor agricole-159443.html*