IMPROVING THE QUALITY OF ENVIRONMENTAL COMPONENTS IN THE VICINITY OF WASTE DEPOSITS

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Abstract: The research paper reflects the desire to integrate investigation methods with direct reference to the evaluation of the quality of environmental components in areas located in the vicinity of urban landfills. It is based on an assessment of ecological risk based on data obtained through field and laboratory investigations. Solid waste management is a current problem that unfortunately has not yet found a solution. Improper waste management can have undesirable consequences on the environment and perhaps even on human health. To limit the harmful effects on the environment, landfills must be designed and executed in such a way as to meet requirements whose main objective is to limit the pollution of air, soil and groundwater.
Key words: environmental risk, assessment of environmental components, waste management.

1. INTRODUCTION

Among the many environmental problems that threaten our planet, one major problem is, without a doubt, waste. Each of us, small or large, throws objects into our trash every day that no longer serve us, that are empty, broken or worn. Landfilling, in addition to being a rather expensive technological process, has another disadvantage: it pollutes the environment. The solution does not lie in storing them in vacant places, on green spaces or in parks, but in their selective collection and recycling.

This method allows valuable substances to be recovered for recycling. In general, because of the lack of facilities and poor operation, landfills are among the objectives recognized as generating impact and risk for the environment and public health. The main forms of impact and risk caused by urban and industrial landfills, in the order in which they are perceived by the population, are [1]:

• Landscape changes and visual discomfort;
• Air pollution;
• Surface water pollution;
• Changes in soil fertility and biocenosis composition on neighboring lands.

The national policy in the field of waste management must subscribe to the objectives of the European policy on the prevention of waste generation and aim at reducing the consumption of resources and the practical application of the waste hierarchy. The principle of preventive action is one of the principles underlying the OUG 195/2005 on environmental protection, with subsequent amendments and completions, and Directive 2008/98/EC on waste, transposed into national legislation by Law no. 211/2011 on the waste regime, presents the hierarchy of waste that "is applied as an order of priorities within the legislation and policy on the prevention of generation and management of waste, as follows: prevention, preparation for reuse, recycling, other recovery operations, for example energy recovery and disposal" [1,2].

The EU's approach to waste management is based on three major principles [1]:

• Waste prevention – a factor considered to be extremely important in any waste management strategy, directly linked to both improving production methods and getting consumers to change their demand for products (green product orientation) and to approach a lifestyle that generates reduced amounts of waste.

• Recycling and reuse – where waste is generated, encouraging a high level of recovery of component materials, preferably through material recycling. In this regard, several waste streams are identified for which material recycling is a priority: packaging waste, end-of-life vehicles, battery waste, waste electrical and electronic equipment.

• Improving final waste disposal and monitoring – where waste cannot be recovered, it must be disposed of in a safe manner for the environment and human health, with a strict monitoring programme.

Normally, waste disposal and recycling activity is expensive and complicated. However, in recent times, new technologies for both waste destruction and recycling are more efficient and sometimes even profitable [2]. Over the last few years, a conception has crystallized that starts from the idea that coordinated measures must be taken to combat the environmental problems posed by waste. It is understandable that the focus is not only on increasing and improving destruction capabilities, but also on finding new technologies that produce less waste [1, 2].

2. BASIC PRINCIPLES IN WASTE MANAGEMENT

The following principles have been agreed to be necessary to be considered in integrated waste management [2, 3]:

The principle of best available technique – it sounds like this: Best Available Technique Not Entailing Excessive Cost and says that the best techniques or methods that do not involve excessive costs will be used.

The principle of prevention – says that activities must be ranked according to importance, to avoid the appearance of waste, to minimize quantities, for reuse, for treatment by recovery or disposal.

The Polluter Pays Principle – aims, among other things, to make polluters responsible and who will bear the costs of waste management and environmental damage.

The principle of proximity – establishes that the treatment of waste should be done as close as possible to the place of production, and the transport is allowed and recommended only to processing capacities that have the necessary technology for treatment.

The principle of subsidiarity – which promotes decision-making at a lower level, based on uniform criteria, previously established at the highest level.

The principle of integration shows that waste management activities cannot be dissociated but are an integral part of the socio-economic activities that generate them.

The principle of care for the product - all those involved in the "life" of a product must assume responsibilities in order to reduce its impact on the environment; appropriate product design to ensure controlled recycling or storage of the product at the end of its useful life; active role of traders and consumers in ensuring the proper storage or recycling of a product at the end of its useful existence.

Principle of autonomy - waste management decisions must be taken at the lowest administrative level in relation to the source of generation.

The principle of integration - waste management activities are an integral part of the socio-economic activities that generate them.

The principle of prioritization of options - prevention of waste production, reduction of the amount of waste produced, reuse of materials, recycling of waste, in conditions of economic efficiency, energy recovery of waste: composting of organic waste, incineration of combustible waste; controlled waste storage.

Modern waste management also provides [3]:

• Separating waste by type (paper and cardboard, textiles, metals, plastic, glass, wood, etc.),

• Assessing local or regional conditions,

• Finding the best disposal solution for each type of waste, so that the final resulting waste quantities are minimal.

3. WAYS OF INVESTIGATING THE QUALITY OF ENVIRONMENTAL COMPONENTS IN THE VICINITY OF WASTE DEPOSITS

It is unanimously recognized that a separate approach to the assessment of soil or groundwater pollution would not be correct and

would limit the achievement of an objective assessment because there are close links between these building blocks of the geological environment. A sustainable environment can be defined as: "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs". To achieve a more comprehensive assessment of water resources, it is recommended to bring together experts with different specializations to collect, evaluate and analyze the data necessary for the assessment. Water is the common geological element present in almost any geological structure, in different varieties of existence and manifestation.

Traditionally, water monitoring for chemical pollutants and assessment of ecological status is limited to surface water concentrations, where the main target is water quality and the risk of eutrophication. A high spatial variability of pollutant concentrations is found at the interface between groundwater and surface water. This situation is due to the characteristics of the pollution sources, the variability of hydraulic conductivity. Groundwater is the most important resource of domestic, industrial water and used in agriculture in many countries in the world. The geological structure through the variety of minerals and rocks of different particle sizes, through the presence of pores, their arrangement or other circulation paths, generates the water circulation through interconnection.

The hydrophysical characteristics of the land define their behavior in relation to all forms of groundwater and associated fluids. The hydrophysical characteristics include those of the semi-permeable and impermeable lands that condition the phenomena of communication of aquifers by drainage and contribute to the completion of hydrodynamic balances of hydrostructures.

The lithological constitution of the aquifers determines the structural characteristics of the porous space in which the groundwater is collected and moved.

To characterize the structure of the porous space of the aquifers, two fundamental parameters are used: porosity and permeability. The quantity and quality of groundwater and associated fluids are responsible for the speeds at which they move:

- The quantity of fluids present in the pores of aquifers lands is expressed through humidity and the degree of saturation;
- The quality of the fluids present in the porous space of the aquifers is described by means of physical parameters (temperature, density, viscosity, etc.) And chemical parameters (concentration in inorganic or organic elements).

Following the physical configuration of the geological environment, it is found that the presence of pollution in a certain area generates important risks at the level of the entire system. The most eloquent example is the following: if the soil is subjected to the aggression of pollutants, such as the non-compliant storage of municipal waste, the underground aquifers present the risk of being polluted/contaminated by the transfer of the pollutant from the soil surface to the depth, a displacement on a vertical component.

Conversely, if an aquifer is contaminated with a polluting substance, most of the time, over time, it can also lead to soil contamination by vaporization and capillary rise of groundwater. Even though such connections are evident between all elements of the environment, soil, subsoil, geological formations, and groundwater form a distinct physical and relational system outlined in the structure of the geological environment. Particularly important for maintaining the ecological balance is the ability of the soil to form a buffer against various pollutants.

The geological environment is the host of extremely dense human activities on the surface of the earth and in the shallow area below it, but increasingly rare at depths of hundreds or thousands of meters, which negatively affect, destroy, consume or pollute the geological environment, inducing negative local, zonal or even regional effects on it.

The pollution of the geological environment represents the modification of the physical, chemical and biological properties of the geological environment, restricting the properties of use of its constituent elements (soil, geological formations, groundwater aquifer,

deep aquifers). According to HG 1408/2007 on the methods of investigation and evaluation of soil and subsoil pollution, the following are defined: Assessment – any method used to measure, calculate, model, forecast or estimate the presence of a pollutant in the geological environment; Investigation – the process of identifying the presence of pollutants in the geological environment, their spatial delimitation, establishing their concentration, as well as their relationship with the mineral matrix and the structure of the geological environment.

The pollution of the geological environment (Fig. 1) has water as its main transport agent, on its entire global circuit: in the atmosphere (vapors and precipitations), at the level of the topographic surface (surface flow), in the depths of hydrostructures (underground flow).

The degradation or deterioration of the quality of the geological environment represents all the phenomena and processes that damage the geological environment, except for the natural phenomena of erosion, landslides, salinity, etc., phenomena that also affect the quality of the geological environment.

Uncontrolled or improperly stored household and industrial waste also leads to soil pollution. The inadequate household waste deposits led to the pollution of the subsoil by the infiltration of leachate into the geological formations located in the bed of the landfill. The inadequate industrial and extractive industry waste deposits (dumps, tailings ponds, ponds, etc.) have led to an intense pollution of the geological formations in which they are located.

Groundwater pollution. Water quality is a priority problem worldwide, and the only source of unpolluted water is groundwater reserves.
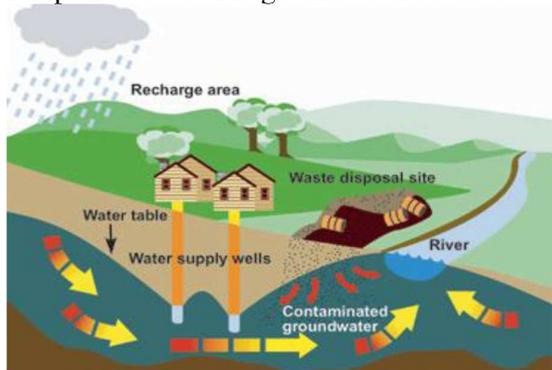

Fig. 1. Schematization of the pollution of the geological environment.

Thus, maintaining this reserve is a vital condition for any state. Groundwater is a good source of drinking water due to the purifying properties of the soil. The phenomenon of pollution also occurs in the case of groundwater, although it is more protected than surface water. Groundwater pollution makes it impossible to use the aquifer for very long periods of time.

The management of pollution problems of the geological environment and especially of groundwater, involves:
1) Collecting and processing information;
2) Building and using forecasting models;
3) Checking the way in which the forecast is made.

The collection and processing of information involves:
- Identification of the system;
- Recording of numerical information;
- Structuring non-numerical (qualitative) information;
- Optimization of information and control.

European and national policy is based on the 'waste hierarchy', which sets priorities for waste management at operational level: first, the prevention or reduction of the quantities of waste generated and the reduction of its hazardousness are encouraged, the reuse and only then the recovery of waste through recycling, and other recovery operations, such as energy recovery. At the bottom of the hierarchy is waste disposal, which includes landfilling and incineration. The transition to a circular economy is also a priority at Member State level. In the circular economy, the value of products, materials and resources is maintained in the economy for as long as possible and waste generation is minimized. The transformation of waste into resources is one of the main elements that underpin the circular economy.

4. MEASURES TO PREVENT WASTE GENERATION

The first strategic objective is to reduce the amount of household and similar waste generated. The target related to this objective is a reduction in the amount of waste generated by 2025, compared to 2017, by at least 10%, respectively the reduction of the household and

similar waste generation indicator from 228 kg/place in 2017 to 204 kg/place in 2025. Thus, considering the existing situation as well as the available instruments, to ensure the achievement of this objective, of reducing the quantities of household and similar waste generated, five sets of measures are proposed:

1. Implementation of the economic tool "Pay for what you throw away"
2. Support and development of existing actions regarding individual composting of biowaste
3. Halving the amount of food wasted by 2025
4. Preventing the generation of printed paper waste
5. Introduction in the school curriculum for pre-university education of topics related to the prevention of household waste.

Measure 1 Support and development of existing actions regarding the individual composting of biowaste

Targeted waste: biowaste from private households

Target sector: consumption.

Description of the measure: the purpose of individual composting is to reduce the amount of biowaste generated by private households by treating and recovering them on their own premises (yards, gardens). Considering the conditions for the application of this measure, first of all in terms of the necessary space, the related actions target households in rural areas. Through the projects on Integrated Waste Management Systems (IMS) financed by SOP Environment, it was planned to purchase approximately 1 million individual composting units to be distributed to the population (approximately 30% of households have entered or will come into possession of a UCI).

Thus, this program focuses on supporting and developing the measures already implemented by improving first, all the way in which individual composting is carried out and finally, by raising awareness among users.

Measure 2 Halving the amount of food wasted by 2025 report to 2017

Waste concerned: Food waste from household and similar waste.

Target sector: Distribution and consumption.

Description measure: At European and national level, an increasing amount of food –

according to several estimates, up to 50% – is lost along the food chain, starting from primary production, food processing, distribution, to the consumption stage - restaurants, public catering units, households, turning into waste. Thus, a significant amount of food, although perfectly edible, is treated as waste in the context in which food waste produces both ethical and environmental problems, as well as economic and social costs.

Measure 3 - Prevention of the generation of printed paper waste.

Targeted waste: Non-packaging paper waste
Targeted sector: consumption.

Description of the measure: this measure has as its main objective the reduction of the generation of office paper as well as of printed and distributed advertising materials free of charge According to the existing data, in 2014 224 kg/person/year of household and similar waste were generated. Considering that 12.4% of the handling and similar waste is paper and cardboard waste and that 50% of this is represented by packaging waste, the result is a generation indicator of 14 kg/person/year of non-packaging paper and cardboard waste. Printed advertising materials are estimated to represent about a third of the total non-packaging paper and cardboard waste.

5. MONITORING THE EFFICIENCY OF WASTE STORAGE SYSTEMS

Passive testing consists of daily on-site observations to validate system performance and correct problems as they may occur. Continuous data are obtained on soil moisture status, percolation and interflow, runoff and erosion, precipitation, wind speed and direction, relative humidity, solar radiation, air and soil temperature. Periodic measurements also cover vegetation cover, biomass, leaf surface index and species composition.

Active testing includes the addition of additional precipitation to hydrologically stress different cover systems. The water applied using the sprinkler system is tested for flow rate and uniformity of application. All water is distributed through electronically controlled flow meters where the discharged quantities are

controlled and measured. This system can apply amounts of water that simulate precipitation in the worst case. All other measurements in this precipitation regime are the same as those described above for passive monitoring.

The equation of the water balance used is:

$$E = P - I - R - D - DS \tag{1}$$

where: precipitation plus applied water, if applicable (P), surface runoff (R), lateral drainage (D), evapotranspiration (E), soil water storage (S) and percolation or infiltration (I) are the six equilibrium variable waters. Except for "E", quantities for all other variables in the water equilibrium equations are obtained with monitoring systems.

Evapotranspiration is then determined by solving the water balance equation for "E". All measurements are made with automatic monitoring systems to provide continuous data. Manual backup systems are available for use in the event of a failure at one or more of the automated systems and/or to verify the accuracy of the automated systems.

Time domain reflectometry (TDR) and an associated data acquisition system (Fig. 2.) are used to provide a continuous record of soil moisture status at different planes, locations, and depths within each cover profile.

Each TDR probe has been individually calibrated to achieve the highest possible degree of accuracy. PVC pipes were strategically installed in the covers to be used as ports to allow the use of frequency domain reflectometry as a backup.

Runoff and erosion: Runoff and erosion are measured on an event-by-event basis "Surface runoff" is collected with a gutter system located at the base of each slope component of each covering. The collected water is directed to instruments that analyze the quantity and to the data acquisition system.

Percolation and interflow: Groundwater flows are measured. Lateral drainage from each drainage layer is collected using systems located at the base of each slope component of each cover. The water is directed to instrumentation that quantifies it. The tool is linked to a data acquisition system to continuously record flow events. Both percolation and interflow are routed through drains to the flow monitoring system. Measurement redundancy is built into the system to reduce the likelihood of losing data in the event of equipment failure or loss of power, as well as to verify the correctness of the results obtained.

The measured values for each landfill test area are from January to December. Percolation vs. precipitation is shown in figure 3, and surface runoff versus precipitation is shown graphically in figure 4.
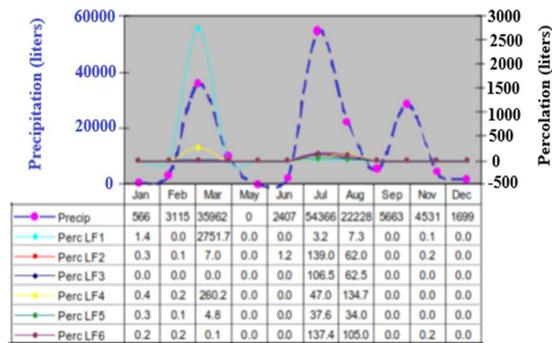

	Jan	Feb	Mar	May	Jun	Jul	Aug	Sep	Nov	Dec
Precip	566	3115	35962	0	2407	54366	22228	5663	4531	1699
Perc LF1	1.4	0.0	2751.7	0.0	0.0	3.2	7.3	0.0	0.1	0.0
Perc LF2	0.3	0.1	7.0	0.0	1.2	139.0	62.0	0.0	0.2	0.0
Perc LF3	0.0	0.0	0.0	0.0	0.0	106.5	62.5	0.0	0.0	0.0
Perc LF4	0.4	0.2	260.2	0.0	0.0	47.0	134.7	0.0	0.0	0.0
Perc LF5	0.3	0.1	4.8	0.0	0.0	37.6	34.0	0.0	0.0	0.0
Perc LF6	0.2	0.2	0.1	0.0	0.0	137.4	105.0	0.0	0.2	0.0

Fig. 3. Percolation vs. Precipitation.

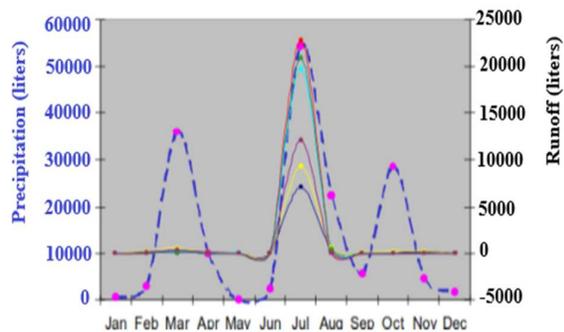**Fig. 2**. TDR Tester and Data Logging Equipment.

Fig. 4. Surface runoff versus precipitation.

Essentially, the value of efficiency quantifies how well the coatings prevent moisture from precipitation from seeping into the landfilled waste.

Depending on the physical and mechanical characteristics of the materials, appropriate quality performance should be established, as appropriate. A layer of geosynthetic material performs the function of filtering when it allows the circulation of water or other liquids in the direction perpendicular to its plane. An effective filter must be as permeable as possible for water, but at the same time retain as many solid particles as possible.

In design, the provisions regarding the retention criterion have a predominantly empirical character and consist in establishing conditions regarding the pore sizes, in relation to the granularity and physical condition of the soil in contact with the filter.

The efficiency condition to be met by the geosynthetic material used as a drainage element is that the water pressure in this material should be as low as possible in relation to the pressure applied by the earth layer. Geosynthetic materials can be used as vertical drains to accelerate the consolidation of soil layers.

6. CONCLUSIONS

The international issue of waste is a very vast one, the planet's population is constantly growing, new technologies develop new and new materials, and waste from them represents a constant challenge in choosing waste management methods, so that life on Earth takes place in a healthy environment. Solid waste management is a current problem that unfortunately has not yet found a solution. Improper waste management can have undesirable consequences on the environment and perhaps even on human health.

Solid waste management highlights that it is a major current problem due to the rapid increase in the volume of waste generated by human activities, urbanization and industrial development. The main aspects that make solid waste management a challenge are the increase in the amount of waste, the lack of adequate infrastructure, the negative impact on the environment, the impact on public health.

Eco-friendly landfills are currently the only way to dispose of waste. To limit the harmful effects on the environment, they must be designed and executed in such a way as to meet requirements whose main objective is to limit the pollution of air, soil and groundwater. Since some waste can pollute more than others, it is imperative that the components of ecological landfills fulfill functional roles, and the materials and installations necessary to carry out their construction are of superior quality.

The "active" testing activities will allow data collection under extreme and accelerated conditions. This information will allow those responsible for developing landfill cover design guides to have a considerable basis for the transition from classic to innovative designs.

Urban landfills have a significant impact on the quality of the environment. Without proper management and monitoring measures, they can lead to air, water and soil pollution, affecting biodiversity and public health. It is essential to implement modern waste management technologies and continuously monitor environmental quality to minimize these impacts

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Imbunătaăţirea calităţii componentelor de mediu în vecinătatea depozitelor de deşeuri

Lucrarea de cercetare reflecta dorinta de a integra metode de investigare cu referire directa la evaluarea calitatii componentelor de mediu din zone situate in vecinatatea depozitelor de deseuri urbane. Are la baza evaluarea riscului ecologic pe baza datelor obtinute prin investigatii de teren si laborator. Managementul deşeurilor solide este o problemă actuală care din păcate încă nu şi-a gasit o rezolvare. O gestionarea necorespunzătoare a deşeurilor poate avea consecinţe nedorite asupra mediului şi, poate chiar şi asupra sănătăţii omului. În scopul limitării efectelor nocive asupra mediului înconjurător, depozitele de deşeuri trebuie proiectate şi executate astfel încât să răspundă unor cerinţe care au ca obiectiv principal limitarea poluării aerului, solului şi apei subterane.

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