PREVENTION MEASURES OF ENVIRONMENTAL RISKS GENERATED BY UNCONTROLLED STORAGE OF WASTES – A REVIEW

MIRELA DINCĂ[1*], GIGEL PARASCHIV[1], GHEORGHE VOICU[1], GEORGIANA MOICEANU[1], NICOLETA UNGUREANU[1], MIHAI CHIȚOIU[1]

[1]University Politehnica of Bucharest, Splaiul Independenței 313, Sector 6, Bucharest, 060042, Romania

Abstract: The issue regarding the negative impact on the human health and environment, as a result of waste storage by using improper methods remains of great actuality, especially with the increasing trend of the generated wastes quantity. The present paper aims to present the most efficient methods that can be used to reduce and prevent environmental risks caused by uncontrolled storage of agricultural waste. Will be treated theoretical aspects related to the actual state of waste management in the E.U. but also in Romania, methods of treating organic waste, as well as prevention measures of environmental risks.

Keywords: environmental risk, organic waste, anaerobic digestion

1. INTRODUCTION

The issue regarding the negative impact on the health of human and on the environment, as a result of waste storage by using improper methods remains of great actuality, especially with the increasing of the generated wastes quantity. European Union determination is internationally recognized concerning the environment protection measures and promoting sustainable development worldwide. The E.U. policy in this field has evolved gradually, from the implementation stage of minimal environmental protection measures, at an enhanced assumption of the environmental issues by complex and specific solutions [1].

For a variety of reasons, poor waste management practices and associated public health implications remain severely problematic in many developing countries a century and a half after the European sanitary revolution, despite increasing globalization [2].

The society generates high quantities of waste that represent a risk for the human health, environment and also on animal health. In order to prevent and control this risk, different methods of waste treatment are used. When choosing the method it must be based on minimum environmental impact, maximum safety, and also on valorization of the waste and final stage consisting in the recycling of the end products. One of the main aspect of the waste management policies is to reduce the quantity of waste disposed to landfills and to recycle the organic matter [3]. Mechanical–biological treatment of the organic solid waste is now the main strategy to reduce biodegradable municipal solid waste in Europe [4]. It consists of mechanical pre-treatment followed by an anaerobic or aerobic process, so that waste impacts are reduced. These processes have attracted attention because they produce stabilized waste that can be sold as fertilizer or disposed off in landfill, in which case it will have a minimum impact on the environment [5]. Thus, the composting process produces a harmless product

* Corresponding author, email: mirela_dilea@yahoo.com

that can be used as organic fertilizer, while the anaerobic decomposition (fermentation) produces biogas (renewable energy) and digestate (which, enriched with compost, results in a high quality fertilizer).

The issue regarding the negative impact on the human health and on the environment, as a result of waste disposal by using inappropriate methods and technologies remains topicality, especially in the context of sustained trend of increasing quantities of waste generated [6].

The aim of this study is to present, from an environmental point of view, different alternatives for the management of organic waste. Will be treated theoretical aspects related to the actual state of waste management in the E.U. but also in Romania, methods of treating organic waste (aerobic - composting-like process and anaerobic process), as well as prevention measures of environmental risks.

2. THE PRESENT SITUATION OF WASTE MANAGEMENT

2.1. At the European Union level

European Union determination is internationally recognized concerning the environment protection measures and promoting sustainable development worldwide. The E.U. policy in this field has evolved gradually, from the implementation stage of minimal environmental protection measures, at an enhanced assumption of the environmental issues by complex and specific solutions [1]. The European Commission proposed on December 2005 a new strategy regarding the recycling and prevention of waste taking a longer-term perspective in setting clear environmental objectives to around 2020. Along with the prevention of waste generation, the recycling and reuse are among the major policy challenges declared in the Sixth Environmental Action Plan adopted in 2002 [7].

The approach of E.U. in the waste management field is based on three main principles [8]:
- the prevention of waste - this factor is considered to be very important within any waste management strategy, directly linked to orientate the consumers to use green products and to address a lifestyle that generate small quantities of waste;
- recycling and reuse – if the wastes are produced, it is important to recover a high content of material components, preferably by material recycling;
- improving the final disposal of waste and the monitoring – if the wastes are not recoverable, they must be stored in a safe conditions for the human health and for the environment, with a severe monitoring.

Currently, at the level of E.U., the municipal wastes are treated by landfilling (49%), incineration (18%), recycling and composting (33%). In the E. U. there are significant differences between the Member States, varying from the situation of states where recycling is done to a small extent (90% storage, 10% recycling and energy recovery) to the states in which it holds an important place, the last option for waste disposal is storage (10% storage, 25% energy recovery and 65% recycling) [6].

2.2. At the national level

The priority objectives of waste management in Romania are the prevention or reduction of waste production and their degree of hazard and reuse, waste recovery through recycling, recovery or any other process to obtain secondary raw materials or the use of waste as an energy source.

The Directive 1999/31/EC regarding the waste landfill has as main objectives to establish procedures, measures and guidance to prevent the negative effects on the environment, reduction of surface water pollution, of groundwater, soil and air.

During 2008, Romania adopted the National Strategy for Sustainable Development to align our country to the E.U. sustainable development [9]. The development of integrated waste management systems is an objective of this strategy. Also, within of the Strategy are presented the following objectives relating to waste management:
- ✓ will be reduced up to 2.4 million tons the annual quantity of deposited biodegradable waste;
- ✓ is provided a recovery of useful materials from packaging waste for recycling or incineration with energy recovery;
- ✓ reducing the number of historically contaminated sites in at least 30 counties;
- ✓ the creation of 30 integrated waste management systems at regional / county level.

The national policy on waste management should subscribe European policy goals of waste prevention and aim to reduce resource consumption and practical application of the waste hierarchy.

The principle of preventive action is one of the principles underlying the Government Emergency Ordinance no.195/2005 regarding environmental protection and the Directive 2008/98/EC on waste, transposed into national law by the Law on waste no.211/2011 present the waste hierarchy which "applies as order of priorities under legislation and policy for the prevention of waste generation and waste management, such as: prevention, preparation for re-use, recycling, other recovery, eg energy recovery and disposal" [8].

In Romania, where efforts have been made and significant investments were made to align with the communautaire acquis, the situation evolving rapidly, but the main method of waste disposal is still represented by the storage. In the structure of municipal waste from Romania, the largest spread are household waste (about 81%), while street waste and construction and demolition waste have about the same percentage (10% and 9%). Over 90% of municipal waste collected is disposed of in landfills [10].

3. METHODS OF ORGANIC WASTE TREATMENT AND WAYS TO PREVENT ENVIRONMENTAL RISKS

High quantity of animal manure produced today and the organic waste is a continuous pollution risk with a negative impact on the environment, if not managed optimally. To prevent emissions of greenhouse gases and leaching of nutrients and organic matter to the natural environment it is necessary to adopt the optimal measures [11].

When the organic wastes are untreated or inappropriate managed, they become a major source of air and water pollution. Leaching of nutrients, such as nitrogen and phosphorous, evaporation of ammonia and contamination of pathogen are some of the major threats.

According to Steinfeld et al. [12], the animal production industry generates 18% of the overall green house gas emissions and 37% of the methane. If handled properly, the animal manure becomes a valuable resource for renewable energy production and a source of nutrients for agriculture.

In the following are presented the main methods of treating organic waste as well as the ways to prevent environmental risks by adopting these measures.

3.1. Aerobic fermentation (composting method)

Composting of organic waste and using the compost for agricultural purposes is a quickly growing and viable option to manage the organic waste [13, 14]. The method of composting has been found to be the best organic waste management strategy. Curently, composting can be done in open spaces, using non-polluted organic waste collected from parks and gardens, with no need for air supply, or in enclosed spaces, in order to accelerate the process and to avoid disturbing odours. In the latter case, waste is previously grinded, sieved and homogenized.

Advantages and prevention measures of environmental risks

Composting provides the environmental benefit of reducing waste from landfill sites, and health benefits by reducing the survival and spread of pathogens in waste. Furthermore, the end product is a valuable soil fertilizer [15]. The main advantages and prevention measures of environmental risks of composting technology are the following:

- ✓ ensures environmental protection near livestock rearing and also in the whole area in which it applies;
- ✓ it replaces a bulky product, with high humidity, heavy to carry, with a concentrated product, easily transportable, odorless, free of pathogens, easy to store;
- ✓ the compost is a product able to reduce the deficit of organic matter and micronutrients in agricultural soils;
- ✓ the use of compost as a soil fertilizer or growing medium has significant environmental benefits. Besides reintegration nutrients in the soil and thus favoring the reduction of chemical fertilizers used, compost biodegradable waste is no longer reach to the ecological deposit.

The greenhouse gases from composting have a low contribution to the global warming because this practice is not yet widespread. Biofilters in the enclosed composting facilities remove odor emissions [16].

The diagram from Figure 1, presents the working phases for a composting plant that processes, in common, municipal solid waste and sludge from urban waste water treatment plants [14].

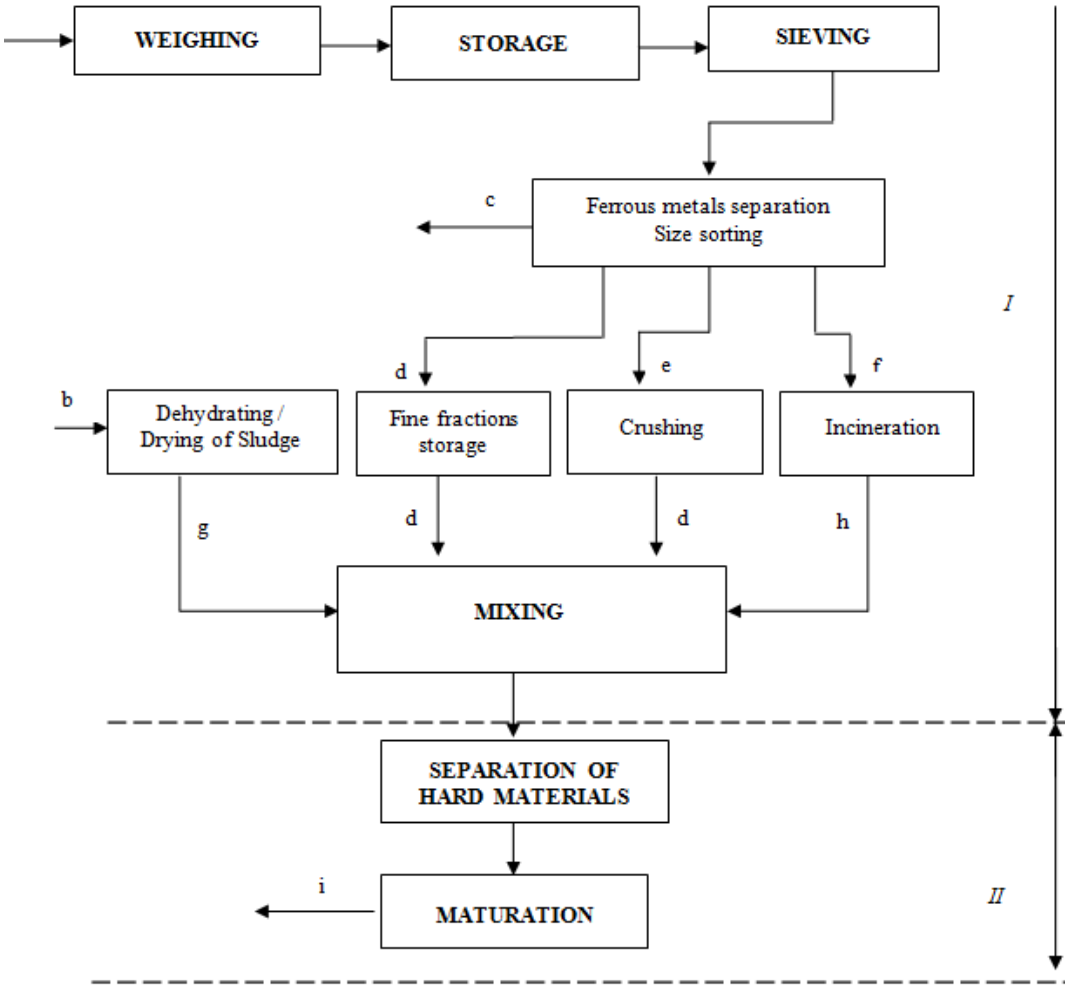

Fig. 1. Working phases at a composting plant [14]:
I – Preparation of raw materials; II - Maturation (production of raw compost)
a – fresh solid waste; b – sludge and waste waters; c – ferrous pieces; d – fine fractions; e – medium size waste; f – coarse fractions; g – dehydrated sludge; h - ash; i – raw compost.

3.2. Anaerobic digestion process

The process of anaerobic digestion represents a biochemical process, by which complex organic substrates (vegetal biomass, animal manure, organic waste, wastewater and sludges from sewage system) are degraded, in the absence of oxygen, to the stage of biogas and digested by various types of anaerobic bacteria [17].
Anaerobic digestion has been implemented for years as a means for the stabilization of sewage sludge, but, during the past years anaerobic digestion technologies have been expanded to emphasize treatment and energy recovery from many other types of wastes including animal wastes, source-sorted household wastes, organic industrial wastes and industrial wastewater [3].

Advantages and prevention measures of environmental risks

Biogas production by anaerobic fermentation process and its use provides many socio-economic benefits, but also environmental, both to the whole society and for the farmers directly involved in this activity, such as [17]:

- ✓ renewable energy source;
- ✓ reduced emissions of greenhouse gases and reduce the global warming;
- ✓ contribution to the alignment to the European Union requirements for energy and environmental protection;
- ✓ reduction of biodegradable waste by turning them in the form of biogas and digestate (excellent fertilizer for agriculture);
- ✓ reducing the odors from livestock but also from other organic waste;

✓ significant additional source of income for the agricultural sector.

Anaerobic digestion has a limited impact on the environment, which is related to the biogas production itself: risk of odours, solved by burning odorous components in the exhaustion air or other odour treatment techniques and risk of explosion, solved by utilisation of explosion-proof equipment [18, 19].

In Figure 2 are presented the stages of anaerobic treatment, with biogas and digestate production [18].

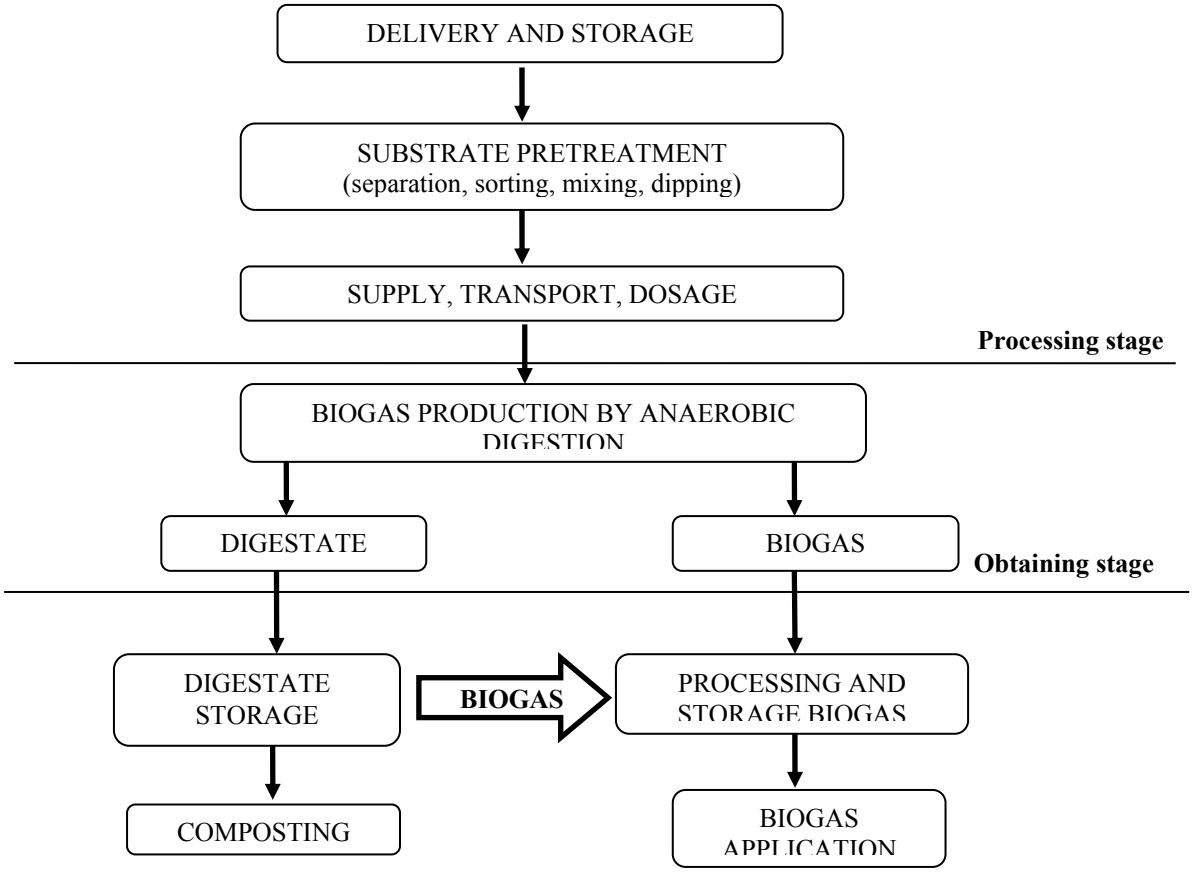

Fig. 2. The stages of anaerobic treatment, with biogas and digestate production [18].

4. CONCLUSIONS

The concern for environmental risks reduction, sustainable development and use of renewable energy sources, have gained important valences in recent years, fact that led to adopt significant measures in the country, among which are found the process of anaerobic digestion and the composting process.

Rapid urbanization has created a major challenge with regard to waste management and environmental protection. However, the problem can be ameliorated by turning organic waste both into compost, for use as an agricultural fertilizer, and into biogas.

From the economic point of view, composting, in addition to the role to produce fertilizer, is a method for neutralizing the organic waste. Anaerobic digestion process of animal manure provides some agricultural, environmental and socio-economic benefits throughout reduction of odors and inactivation of pathogens, higher fertilizer quality of manure, and last but not least production of biogas, as renewable fuel, for several utilizations.

European directives relating to renewable energy production, reduction of greenhouse gas emissions and sustainable waste management are based on the commitment of Member States to implement appropriate

measures to reach them. Production and use of biogas from anaerobic digestion has the potential to meet all three targets, simultaneously.

Acknowledgements
The work has been funded by the Sectoral Operational Programme Human Resources Development 2007-2013 of the Ministry of European Funds through the Financial Agreement POSDRU/159/1.5/S/134398.

REFERENCES

[1] Stănescu, R., European Union policies guide - no. 4, Environmental Policy, 2012.
[2] Konteh, F.H., Urban sanitation and health in the developing world: reminiscing the nineteenth century industrial nations, Health & Place, vol. 15, no. 1, 2009, p. 69 – 78.
[3] Ahring, B.K., Perspectives for anaerobic digestion, Advances in Biochemical Engineering/Biotechnology, vol. 81, 2003, p. 1 – 30.
[4] Scaglia, B., Adani, F., An index for quantifying the aerobic reactivity of municipal solid wastes and derived waste products, Science of the Total Environment, vol. 394, 2008, p. 183 – 191.
[5] Adani, F., Tambone, F., Gotti, A., Biostabilization of municipal solid waste, Waste Management, vol. 24, 2004, p. 775 – 783.
[6] http://www.mmediu.ro/ National Waste Management Strategy Strategia, Ministry of Environment and Forests (17.05.2014).
[7] EPC, The European Parliament and the Council of the EU, Decision no 1600/2002/EC of the European Parliament and of the Council of 22 July 2002 laying down the Sixth Community Environment Action Programme, Official Journal of the European Communities, 10.9.2002 (17.05.2014).
[8] http://www.mmediu.ro, Ministry of Environment and Climate Change, Waste Management (17.05.2014).
[9] National Strategy for Sustainable Development of Romania - Horizons 2013-2020-2030, Bucharest 2008, Available at http://www.anpm.ro/upload/3912_SNDD%20-%20rom.pdf. (17.05.2014).
[10] http://www.anpm.ro (17.05.2014).
[11] Holm-Nielsen, J.B., Al Seadi, T., Oleskowicz-Popiel, P., The future of anaerobic digestion and biogas utilization, Bioresource Technology, vol. 100, 2009, p. 5478 – 5484.
[12] Steinfeld, H., Gerber, P., Wasenaar, T., Castel, V., Rosales, M., de Haan C., Livestock's long shadow. Environmental Issues and Options, Food and Agriculture Organisation (FAO) of United Nations, 2006.
[13] Drechsel, P., Kunze, D., Waste composting for urban and peri-urban agriculture - closing the rural–urban nutrient cycle in Sub-Saharan Africa, Wallingford, UK: CABI Publishing, 2001.
[14] Păunescu, I., Paraschiv, G., Installations for waste recycling, AGIR Publishing, Bucharest, 2006, p. 60.
[15] Hassen, A., Belguith, K., Jedidi, N., Cherif, A., Cherif, M., Boudabous, A., Microbial characterization during composting of municipal solid waste, Bioresource Technology, vol. 80, 2001, p. 217 – 225.
[16] Zafar, S., Zafar, S., Kumar, S., Composting technology – An overview, The Journal of Municipal Solid Waste Profesionals, May/June 2006.
[17] Al Seadi, T., Rutz, D., Prassl, H., Kottner, M., Finsterwalder, T., Volk, S., Janssen, R., Biogas – Handbook, University of Southern Denmark, 2008, p. 7 - 19.
[18] Popescu, I., Pilot plant for biogas production – Sieni, Maramures, Report on environmental impact, July 2013.
[19] Al Seadi, T., Good practice in quality management of AD residues from biogas production, Report made for the International Energy Agency, Task 24- Energy from Biological Conversion of Organic Waste. Published by IEA Bioenergy and AEA Technology Environment, Oxfordshire, United Kingdom, 2001.