STUDIES CONCERNING RECYCLING BY COMPOSTING ORGANIC WASTE IN TG-MUREŞ

Florica Morar
„Petru Maior" University of Tg. Mures
morar.florica@engineering.upm.ro

ABSTRACT

Recycling organic waste has become a matter of utmost importance for overall healthiness of the Earth, its volume largely interacting with the economic development. The problem tends to become a vital matter of survival for an entire society. In this context, recovery, recycling, physical-chemical treatment, composting or incineration are methods of waste processing, commonly used in most countries of the world. These measures are intended to both environmental protection and rational use and economically efficient. Based on the data regarding the municipal waste generated in Mures County, in previous years, and in Tg-Mures city, in 2007 were calculated the quantities expected to generate by the year 2038. Also, concerning the cleaning recovery it is proposed the pile composting method, being, from our point of view, more beneficial in the area. In conclusion, at county level but at city level too, there is still working to do, primarily in terms of awareness, not only the population but also the relevant, local bodies, of what means the cleaning recovery of the municipal waste.

Keywords: organic waste recycling, composting biodegradable organic waste, compost, aerobic fermentation, anaerobic fermentation.

1. Introduction

The terms "waste crisis", "consumer society" and "avalanche of waste" are some examples that illustrate the problems created by waste, facing the environment today.

It is undeniable that today we produce more waste containing recoverable materials. All the factors responsible of waste management must cope with this finding and to take responsibility.

Recycling organic waste has become a matter of utmost importance for overall healthiness of the Earth, its size largely conditioning the economic development. The problem tends to become a vital matter of survival of an entire society.

In the UE an U.S. countries, although it was adopted the idea that the deposit of waste on the ground or bury them in the basement is the least acceptable solution, however is still primarily used(70% in Europe, 60% in the U.S., and 38% in Japan).

Where storage areas are becoming more restrictive, increasingly more countries give up the classical solution of storage and support a cost-effective environmental management of waste. In this context, recovery, recycling, physical-chemical treatment, composting or incineration are waste processing methods commonly used in most countries of the world. These measures are intended both environmental protection and rational use and efficient in terms of economic activities.

Recycling organic waste and their use, primarily as an organic fertilizer, should be considered permanent in two ways: agriculture and environmental protection. Neglecting one of these sides has adverse repercussions over economy and social activities.

Therefore recycling organic waste should be made in a framework that allows precise control and judicious planning, while improving the qualities of fertilizer-amendment of the organic substances.

2. Biodegradable organic waste composting

At its essence, composting is a sum of microbial enzymatic processes physical and chemical, found in the interdependence that happen in the mass of organic residues under certain conditions (good aeration, optimum humidity, certain thermal values), resulting in obtaining a new product with properties distinct from the materials where it came from, called compost.

It is an aerobic fermentation process, the anaerobic processes being fermentative too, never decaying. This explains on the one hand, the formation of humus substances and on the other hand, the lack of odor that is released during putrefaction.

The effectors of this process are mostly bacteria, actinomycetes and to a certain stage, the fungi. In the process bacteria is involved and also the actinomycetes thermopilic, thermo-mesophilic and mesophilic from species living in soil, but also in the rumen of ruminants, and other aerobic-anaerobic mesophilic bacteria, whose decomposition function of dead organic material in simple organic compounds, partly participate in the synthesis of humus materials and partly converted into stable bacterial biomass[7]. They operate more intensively in the early stages, when they greatly multiply and allow to the end of the process, the multiplying the fungi that continue the decompositions, participating to the new substances synthesis, more complex, many of them precursors of humus (like fungal necromass). No aspect of any original material cannot be recognized in good and mature compost, because the concentration of the nutrients is another [6].

In the compost piles major biological, biochemical, chemical, physical changes take place, induced by the microorganism activity involved, due to changes in temperature a pH, which in turn produces essential changes in their structure during the composting process.

By composting pathogens germs are removed, unpleasant odors disappear and mixture of organic substances can be improved to optimal parameters for the fields that will receive fertilizer.

There are numerous studies showing that application of uncomposted organic fertilizer or processed by technologies known(anaerobic fermentation) produce and maintain the pollution of surface and groundwater and of the atmosphere, and sometimes(when accompanied by nitrogen fertilizers), including pollution of plants, animals and human consumption [3].

By composting fresh vegetable waste(e.g. waste from gardens and parks), most of the carbon is fixed as a form of humus compound infiltrating rapidly in the humus soil [9].

As municipal organic waste resulted after sorting (separation of metals, glass, plastics) are biodegradable, but when cellulosic residues predominate (paper, cardboard, wood, sawdust) is desirable as these, when dried or semi-humid to be sorted and burned – with production of heat, because their speed of fermentation is excessive, the material overheating and going directly into the mineral state.

When this is not possible, technically speaking, they can be composted, but the household waste will be mixed with other waste, richer in nitrogen, being preferred in the food industry (meat and milk).

Theoretical and practical aspects of this process have been brought, in the modern era, by Rudolf Steiner (1920) and depth later by its illustrious disciples and E. Pfeiffer and Howard (1937-1943). The process is however, much older. Even if it was not scientifically based, in Asian civilizations was well known and appreciated.

It is discussed increasingly about industrial composting, which involves taking a large amount of organic waste (from different industries or industrial animal farms) and their rapid transformation (2-3 months), by an excessive mechanical ventilation and sometimes with the help of microbiological starters, in compost, or rather a certain kind of compost, immature, raw, highly mineralized, and unstable. Note that, as Gray and Biddlestone, composting takes place in four phases: mesophilic or mesothermal phase, thermopilic phase, cold and dark phase, maturation phase. In industrial composting actually are used the first two phases (mezzo and thermopilic), and not the following two (cold and dark phase and maturation phase).

A good, mature compost should be about 50% organic matter (mranita has 5-12%), pH 7-8, containing 0.2 to 4% N, predominantly organic and a C/N = 10:1 report, weed seeds should be degerminated, bacterial load with pathogen agents as small as possible, the material is semi-humid, brittle, flows well, has a blackish brown color and pleasant smell of fresh earth.

3. Projection of biodegradable municipal waste generation

Looking at the share of biodegradable waste in municipal waste (situation provided in the Master Plan for the Integrated Waste Management System in February 2009) concluded that it is 62%, the value subscribes within the UE (finals survey in September 2008, by European Environment Agency), most European countries have a value share of biodegradable waste in municipal waste between 60 and 70%.

Due to the weight of biodegradable waste in municipal waste, we proposed in our study to suggest a method of treating this waste, efficient and also clean.

4. Composting technique in furrows (piles)

In order to reduce biodegradable municipal waste in storage can be applied a simple technique called composting in furrows or piles. This consists in shaping the trapezoidal furrows that are periodically turned and moistened to accelerate the aerobic fermentation process.

The furrows dimensions (height, width at the base and top) can be estimated taking into account the specifications of typical return machines on the market. Therefore, a cross section of the swath as shown in Figure 1 can be taken for an estimated calculation. Before placing the organic materials on furrows, ferrous materials must first be removed by passing under a magnetic tape and then mixed with organic mass which is called green or filler fraction, a class of organic materials with low decomposition (pieces of wood, cleaning materials from trees, chips), which creates an internal structure in the furrows, promoting aeration.

Assuming that 50% of household waste and 13% of commercial waste generated daily in Tg-Mures are organic matter and assuming that 15% of these can be collected at source on long-term (2015), the station must be sized so as to face a total of 110,000 tons/year compostable waste.

110000 t/year x 49, 92% + 17000 t/year x 12,73%] x 15% = 7812 t/year

Considering that without automatic ventilation, the entire fermentation time necessary to stabilize the organic matter is 18 weeks, the mass and volume of compost permanently required in station will be:

7812 t/year x 18/52 = 2704 tons
2704 t/0,6 t/m^3 = 4506 m^3

Given a minimum volume reduction during the fermentation process of 30%, the needed volume would be:

4506 m^3 x 0,7 = 3154 m^3

The composting area can be designed to include this volume. Therefore, being given a trapezoidal cross section of the swath and the length and the spaces between the furrows shown in Figure 1, the projected area has capacity for:

105 m x 9 (rows) x 4,3 m^2 = 4063 m^3 > real needed volume 3154 m^3.

Figure 1. The length and spaces between furrows
L – Length of furrows; l – Width of furrows; 1, 5 m – the distance between furrows

But more furrows can be added within the same building by reducing the space between the furrows.

Of course it is necessary to design a sorting and composting station (SSC), which must have in its composition:

- ✓ Sorting line of organic matter;
- ✓ Composting area;
- ✓ Sorting line of packing waste;
- ✓ Auxiliary facilities;
- ✓ Shipping area;
- ✓ Workshops;
- ✓ Offices;

The process could stars with the chopping green fractions to be mixed with organic waste selected at source. Proportion must be a green waste volume to 2-3 volume of organic waste. This proportion is only indicative and should be adjusted to achieve an initial report C/N between 20 and 25.

Once the mixture is ready, the front loader has to carry it to the furrows area; placing the material on an area previously released by the returning equipment. The frequency of return depends on the pH and the swath's temperature, but as an approximate formula, it can be achieved on the third day and then 1-3 times a week. Also, water must be added to the swaths to ensure continuity to the biological reactions, maintaining humidity levels of 40-50%.

The furrows temperature should be kept at 50-55°C during the first day and 55-60°C by the end of the process. Obtaining a temperature above 60°C normally means that the process is shifted from aerobic to anaerobic conditions, which can slow down the reactions and produce unpleasant odors. If the temperature rises above 60°C in the furrows, they must be returned to maintain reasonable temperature values. The furrows must be maintained between 60 and 70°C for 24 hours to remove the existing pathogens.

Usually, the whole process takes about 10-15 days for completion, and main indicators that show the stability of the final compost is the pH which must have constant value 8 and ambient temperature 5-10°C. In addition, other tests may be performed to determine whether the process is complete: the activity of breathing after four days, CCO, iodine-starch test.

When maturation occurs, the compost is taken to the rotating sieve to separate green waste and reuse it in the process, because the materials are normally limited.

It should be noted that the composting process depends on the weather of the area and the characteristics of composted materials. This means that the process must begin to work with the recommendations provided in this section, but a careful and continuous monitoring of the variables, such as C/N ratio, pH, temperature, humidity, must be made for fine operating conditions such as frequency return, the necessary irrigation, the period of composting and mixing proportion.

Periodically, laboratory tests on the final sample have to be conducted to determine its composition and the viability of its use for agriculture and landscaping in accordance to EEC Directive 2092/91.

5. Conclusion on reducing the environmental impact of waste

Implementation of an integrated waste management in urban areas can be achieved by setting the following objectives:

- ✓ elimination of uncontrolled storage;
- ✓ selective collection of industrial waste disposed at municipal landfills by industrial operators;
- ✓ increase the waste recycling;
- ✓ reducing the quantities of industrial waste disposed at municipal landfills by industrial operators;

✓ reducing quantities of biodegradable waste, using an economic and environmentally method;

✓ Stimulating the production that generate small quantities of organic waste;

References

[1]. **Amirante, P., Leone, A., Caliandro, L., -** 2004 – Quility compost: composting, agronomic phytopathological and legislative aspects. Informare Agrario, 60(13), 49-53, Italia.

[2]. **Anashu, S., Satyawati, Sh., -** 2003 – Effect of microbial inocula on mixed solid waste composting, vermicomposting and plant response. Compost Science and Utilization, 11(3), 190-199, India;

[3]. Axinte, Stela, Agafitei, Alina, Axinte, Lorica, Chiriac, C., - Cercetari privind tehnologia de compostare a reziduurilor organice dintr-o ferma agricola complexa. In lucrarile simpozionului " Disaster and Pollution Monitoring", 2004, Iasi, Romania;

[4]. Barth, J., - 2005 – Conditii necesare pentru tratarea biologica in UE: experienta, legislatie, directive. Reteaua europeana pentru compost ECN;

[5]. Favoino, E., s.a., - 2003- Optimizarea si evaluarea costurilor pentru schemele de colectare a desurilor biodegradabile, Ed. Cerbeta, Italia.

[6]. Ionescu, Al., Jinga, I., Stefanic, Gh., -1985- Utilizarea desurilor organice ca ingrasamant. Ed. Ceres, Bucuresti.

[7]. Ionescu, Gh., Ionescu, Viorica, - 2005- Materii organice ale solului si durabilitatea ecosistemelor. Rev. Cereale si Plante Tehnice, nr. 9, Bucuresti, Romania.

[8]. Micle, V., Neag, GH., - 2009 - Procedee si echipamente de depoluare a solului si a apelor subterane, U.T.PRESS, Cluj-Napoca.

[9]. Oomah, B.D., Mazza, G., Kenaschuk, E.O.-1992- Cyanogenic compounds in flaxseeds. Journal of Agric. And of Chemistry, vol. 40, Canada.

[10]. Pfirter, A., Hirscheydt, A., Ott, P., Vogtmann, H. -1981- Composting-an introduction to the rational use of organic waste. Migros, Aargau, Switzerland.

www.apmms.ro

www.cjms.ro