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Further Treatment of Sewage Sludge through Composting Process Using "Agile System"

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Abstract: The aim of this study is to show the possibilities of further treatment of sewage sludge produced by waste water treatment plant, as a byproduct which is one of the main ingredients of made compost. The compost facilities built near town of Ferizaj in Kosovo treats about 5 m³ sewage sludge daily and other organic porous material such is cardboard, waste food, chopped wood, straw etc. using "agile system" which is able to produce the compost ready-to use to the soil within 6-9 weeks. Such of compost is used to prevent land erosion and improves water holding capacity and at the same time serves as a fertilizer for the plants.
Kosovo is generated about 2 million kg trash on daily bases, where 30-35 percent of that is organic (biodegradable) matter, which could be as a solid base for building new capacities of composting facilities.

***Key words**: Compost, sludge, organic matter*

Introduction

Compost is the product of a managed process through which microorganisms break down plant and animal materials into more available forms suitable for application to the soil. Compost must be produced through a process that combines plant and animal materials with an initial C:N ratio between 25:1 and 40:1 There are two types of making compost: open windrow that requires oxygen supply by turning by hand or by machine and agile system using "Gore-Tex" semi permeable membrane. The Agile system comes ready to use in a container. The system uses Gore-Tex to cover the pile, which helps keep out the elements and regulate the temperature. It also helps hold in the needed moisture and the oxygen supply is replenished by using a computer monitoring system, which monitors heat and oxygen. When peak oxygen levels fall, a black tube under the compost pumps in air and stops when the desired level is reached.

Operation of AGILETM-system

The composting facility is divided into six different operation areas

I. Delivery area for waste
II. Mixing area
III. Biological treatment (composting)
IV. Screening area
V. Storage product (compost)

The area of the composting facility is covered with a combined seal consisting of a geo-textile membrane below the gravel and cay soil lies beneath the membrane. The supply area is situated in assigned place of the composting facility and is divided into two fields. In the area of (approximately 200m²) wet organic waste fractions such as food waste and sewage sludge is

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delivered to the collection site by truck that dumps the sludge onto the mattress of wood chips. Dry waste fractions such as shredded cardboard / paper and scrap wood for the production of woodchips are delivered to the delivery area.. The area between the individual collecting facilities in the eastern part of the facility is used as mixing area. In this area the different waste fractions are mixed and homogenized with structural material such as woodchips and shredded cardboard/paper in proportion of 3:1

By adding wood chips and shredded cardboard / paper as structural materials sufficient porosity in the material is created to ensure the best possible flow through of the wastes with fresh air during the biological treatment stage. Additionally, shredded cardboard / paper delivered from the recycling area absorb a certain amount of the free water. Wood chips are produced from scrap wood.

The carbon and nitrogen ratio (C/N) is essential for a good composting progress. The most ideal values for the C/N ratio are 25/1 to 30/1. The proportion of carbon should be comparatively strong; the rotting process decelerates, as micro-organisms are severely restricted in building up their body substance and reproducing them due to the lack of nitrogen. As a result, rotting efficiency remains at a low level. However, too much nitrogen is also not ideal. Although rotting proceeds much faster in this case, only a very small amount of stable humus compounds emerge which again results in a loss of nitrogen. For this reason it is important to observe the correct mixing ratio of the base materials when mixing individual waste fractions. Sewage sludge for instance has low carbon content. The desired mixing ratio can be optimized simply by adding shredded cardboard / paper as a carbon provider. Mixing of individual waste fractions is accomplished by a tractor powered mixer. This machine can take on 4.5 ton batches of material. It consists of two vertical mixing screw conveyors and one discharging transport belt.

Picture 1. Discharge of the mixed Fraction

During the mixing procedure the proportions of the different waste fractions given as examples in Table 1 are mixed. After having finished the homogenization procedure, the material is transported out of the Mixer via the discharging transport belt and individual "mixtures" are blended once again by means of a wheel loader. If necessary, plastic parts are sorted out again manually. Then the material is placed on the windrows by means of a wheel loader.

Table 1. Mixing proportion of compost ingredients

Mixing proportion – option 1	**Mixing proportion – option 2**
1 bucket shredded cardboard	1 bucket shredded cardboard / paper
1 bucket oversize product after screening > 20 mm	1 bucket oversize product after screening > 20 mm
½ bucket fresh wood chips	½ bucket fresh wood chips
1 ¼ bucket food waste	1 ½ bucket sludge
mixing time approximately 15 min	mixing time approximately 15 min

The AGILETM system supplied by COMP-ANY GmbH performs biological treatment of the homogenized material. For this purpose the material is heaped up by a wheel loader to approximately 1.80 meter high and approximately 5.0 meter wide trapezoidal windrows which are covered with a semi-permeable "Gore-Tex" membrane.

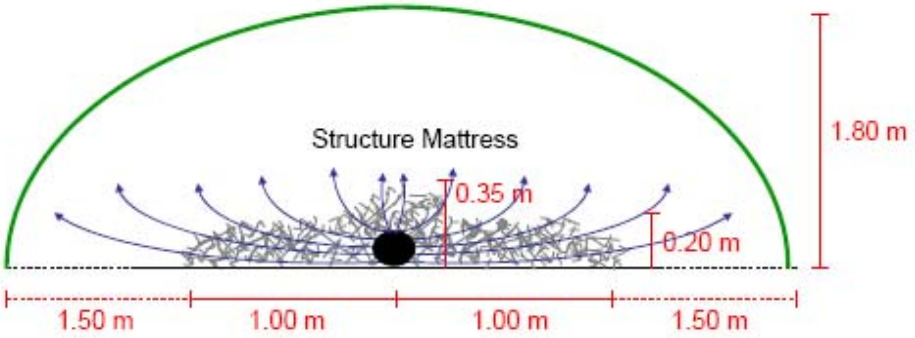

Figure 1. Construction of the Structure mattress under heap

Picture 2. Design of the Structure Mattress

Picture 3. AGILETM system for biological Treatment

The treatment time for this intensive rotting stage is three weeks. During this phase the temperatures inside the covered pile are ranged from 60 to 70 ^{0}C. After this stage the material is taken up again and transported to the maturing process. It is treated biologically for another three weeks. After six weeks of treatment in the AGILETM system, the windrows are uncovered and samples are taken. The biologically stabilized material is then processed mechanically by means of a wheel loader in a star screen with a length of approximately 1.0 meter.

Picture 4. Screening Area

Picture 5.Compost Storage

Here the compost fraction is separated from the structural material (split cut approximately 20 mm). The compost fraction is stored temporarily in the assigned part of the facility until it is processed further, and the overflow fraction (as structural material) is mixed with the fresh waste. In order to minimize flying papers and plastic parts during the screening procedure, the area surrounding the open screening surface has been netted. The screened overflow fraction (as structural material) is mixed once again with the fresh waste and the compost fraction is stored temporarily on the area near the access road until final utilization.

Materials and Method

The samples are taken at the and of 6 weeks of composting process (three weeks of intensive phase and another three weeks of curing phase) composting the finished compost is tested in its own laboratory for following parameters: pH, moisture, maturity index and pathogen test,

Sampling

Eight representatives were picked from sampling sites in a pile of compost. Divided the pile into eight sections (four per side) (see Figure 1).

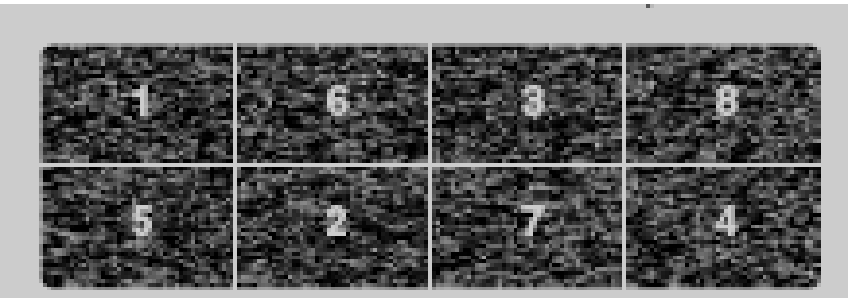

Figure 2. Sample collection positions

Thrust a spade shovel vertically into the middle of each section of the pile to a depth of 30–60 cm. and with the help of partially unwrap the sterile scrapers and use it to scrape off the top 2.5 cm of material from the cleared section of the pile. Than unwrapped one sterile spoons and scoops a sample from the scraped area. The sample was placed in a sterilized Whirl-Pak®* Bag. After sample is collected it proceeds to the lab to be tested for following parameters

Results

Results of weekly testing are given in Table 2.

Table 2. Results of analyses performed at process control laboratory

Parameter	Result	Unit	Standards
pH	7.93	-	6-9
Moisture	50.37	%	50-60 %
Maturity index	7	-	6-8
Pathogen	337	MPN Fecal coliform/ g dry weight	< 1000 class A > 1000 class B

In addition once a year one composite sample is taken for heavy metals test and is sent outside of Kosovo (in Hungary) for testing. Results of all performed analyses are given in the following Table 3.

Table 3. Concentration (mg/kg) of heavy metals in finished compost

Parameter	Result	Unit	Standards
Arsenic	<5	mg/kg	41
Cadmium	1.70	mg/kg	39
Chromium	15.0	mg/kg	1200
Copper	58.0	mg/kg	1500
Lead	7.0	mg/kg	300
Mercury	0.65	mg/kg	17
Nickel	13.0	mg/kg	420
Selenium	<5.0	mg/kg	36
Zinc	501	mgkg	2800
Total N Kjeldahl	4650	mg/kg	n/a

Discussion

Due to results on both tables we can freely say that finished compost is completely in compliance with standard requirements and can be applied in all areas with no limitation. This kind of compost prevent land erosion, than increase water holding capacity in soil, increase soil temperature etc.

Conclusion

The burning of trash causes a lot of problems due to having high content of organic wet matter. So making compost in this way is a good solution to get rid of organic waste (sludge). Another advantage of the Gore-Tex system is that it keeps birds and other pests from digging in the heaps for food waste. The system also keeps the odor of the decaying organic material locked inside, while the open windrows make the area smell like a barnyard. Another advantage is that all pathogens and weeds are destroyed of high temperature (up to 70 ^{0}C) during the composting process. During the cold, wet winter months, the Gore-Tex system's compost piles have been keeping good temperatures (ranging from 60 to 70 degrees Celsius) for three weeks, while the open windrows start their decline shortly into the second week.

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