Composting of animal mortalities - Procedure and preconditions

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Keywords: composting, animal mortalities, green wastes, zeolite, circular economy
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Introduction

The management of large animal mortalities is a difficult procedure and of doubtful appropriateness, mainly because the methods used: a) are not environment friendly; b) are likely to disperse diseases to humans and animals; and c) do not promote the circular economy of livestock units.

On the other hand, the management of plant raw materials from gardens, parks and tree-lined streets is also difficult, due to their high lignin content and the lack of efficient management plans by local authorities. Therefore, in the most of the cases, green wastes are discharged unexploited to landfill sites, causing: a) rapid filling of landfills, as these materials account for almost 65% of the total discharged wastes; b) fire risk increase that can be also spread from landfills to residential areas; c) burden municipalities with fees, which are related to transportation, fuels for municipal trucks, routes to and from the landfill sites, machinery and vehicles damages; and (d) environmental and social impacts due to objections raised by residents when local authorities try to find new landfill areas.

This study aims to present a composting methodology of large animal mortalities by exploiting also green wastes from municipalities and natural zeolite as additives to the feedstock materials. The ultimate goal is to produce a safe and environment friendly product, appropriate to be applied to agricultural and forest ecosystems.

Materials and methods

The composting area was configured to meet all the requirements set by the EU Regulation considering also the Greek law about animal by-products. For this, a cemented floor was constructed along with a leachate collector (tank) where leachates from the compost piles were collected and reused. A fence was placed around the experimental area to protect the composts from the wildlife or any human activity as well as, three bait stations for controlling rats and mice around the fence. The mortalities were transferred to the area by special transporting carcasses vehicles. A refrigerator was also available for carcasses storage near the experiment place and a shower for the people who were involved in composting activities.

Three compost piles were prepared by adding materials in layers; the first layer was prepared using straw and was place over the cement floor (about 200 x 200 x 30 cm). Then a layer of green wastes about 1.5 m^3 was added consisting of prunings (from Xerophytic Mediterranean Vegetation such as Pistacia lentiscus, Robinia pseudoacacia, Cupressus sempervirens, Viburnum sp., Ligustrum sp., Laurus Nobilis, Pittosporum chinense, Eucalyptus globulus, Olea europea, Ceratonia siliqua, Nerium Oleander, Lavandula sp., Rosmarinus officinalis and Gaura sp) and also small amounts of soft plant tissues (i.e. leaves of Platanus orientalis, Pinus halepensis, Viburnum sp., Ligustrum sp., Laurus Nobilis, Pittosporum chinense, weeds residues, fruits and vegetable stems). These lignin-rich plant raw materials were collected and crumbled by a shredder. Thereafter, 2 sheep mortalities were placed parallel to each other on the green waste layer for each of the compost piles (approximately 50 cm above the floor), without being chopped or making additional incisions to their bodies, while none of vital organs or wool was removed. Finally, the mortalities were cover with approximately 3 m^3 of green wastes. The final dimensions of the compost piles were 2 m long, 2 m wide and 1.2-1.3 m high (ca. 5 m^3). Straw bales were placed around the piles (3 m long, 0.30 m wide and 1 m high) due to their excellent odor-absorbing potential, as well as deterring predators and scavenging animals. The compost piles were covered using compost-textile (Toptex) to protect them from rain and other environmental impacts. Toptex cover permits gases exchange between the compost and the atmosphere and also assists in maintaining compost temperature.

The three compost treatments were the following: a) Compost pile No1 was built by using two sheep mortalities and a balking agent of prunings and straw at the lowest layer, b) Compost pile No2 was built by using two sheep mortalities, a balking agent of prunings and straw at the lowest layer and also by adding zeolite (clinoptilolite with particle size 0.0-0.8 mm) up to 5%. Zeolite was added in layers below and above the mortalities, c) Compost pile No3 was built by using two sheep mortalities and a balking agent of prunings and straw at the lowest layer. However, at the end of composting and during the maturity phase of compost pile No3, an amount of zeolite equal to this added in compost pile No2 was added; then, the compost was incubated for three months.

During the composting phase, anaerobic microorganisms degraded the carcasses, releasing fluids and odorous gases such as hydrogen sulfide and ammonia, which were diffused into the bulking agent and degraded by aerobic microorganisms to odor-free carbon dioxide and water. The aerobic process produced considerable heat, causing the temperature of the compost pile to rise. The active bacteria in both the aerobic and anaerobic zones are heat-tolerant. However, the heat extinguished common viruses and bacteria that may be presented in the carcasses. The composting process lasted 150 days. Temperature, moisture and O_2 content were monitored periodically. The temperature increased up to 55ºC. At the end of the maturity and incubation phase some resistant bones (e.g. skull parts, teeth) were visible, but they were soft and easily crumbled by hand.

Results and discussion

During composting animal mortalities with the method described, no odors were observed, and no scavengers approached the compost piles. At compost pile No2 in which the feedstock mixture contained zeolite up to 5%, higher temperatures were measured during the entire composting process.

In the Mediterranean region a significant obstacle for utilizing lignin-rich green wastes in composting is their low moisture content (approximately 4.5%), especially after the xerothermic climate period of the year. Therefore, in order to achieve the optimum moisture content for composting (40-60%), frequent piles wetting was necessary. For this, 30 hours of drip irrigation within a period of 3 days was proved to be the most effective practice for watering compost piles built from green wastes belonging to Mediterranean vegetation. As regards piles aeration, it was observed that turning was needed after the 100th day of composting. This resulted in piles temperature increase to 40-50ºC during a period of 20 days. During turnings no flesh and odors were observed. In Fig. 1 the temperature diagrams for the three piles can be seen as well as the schedule of turnings and watering.

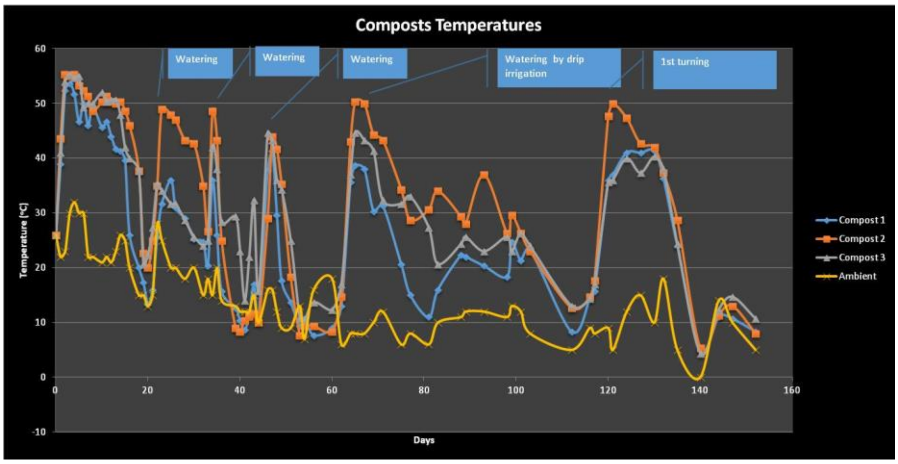

Figure 1. Temperature diagrams of the three compost piles-turnings and watering schedule

Conclusions

Composting animal mortalities by exploiting green wastes (lignin-rich plant raw materials) from municipalities and zeolite (clinoptilolite) under the Mediterranean climate conditions could be an effective and environment friendly method to manage mortalities and green wastes, as well as to promote circular economy of livestock units. Watering by a drip irrigation system is the best way to increase the moisture content of the piles to the optimum levels. One turning after the 100th day of the composting procedure is recommended. Straw bales placed around the compost piles and the green waste ensures an odorless procedure, as well as deterring scavenging animals from carcasses. Specific and strict preconditions for the composting area and the procedures implemented must be applied to protect human and animals' health, the environment and also to ensure the production of safe composts.

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