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RESEARCH ON HOUSEHOLD COMPOSTING EQUIPMENT USED FOR PROCESSING ORGANIC WASTE

Gabriel NAE, *[1)] Florin NENCIU [1)], Valentin VLĂDUŢ [1)], Adriana MUSCALU [1)]

[1)]INMA Bucharest / Romania;
E-mail: gabi.nae83@yahoo.com

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ABSTRACT

Organic waste management is a great challenge for authorities in the context of the continuous increase of the quantities annually generated. When is brought to the municipal separation and treatment stations, the organic waste is highly contaminated and difficult to process, therefore one of the best management solutions is considered the treatment at source, using specialized household composting equipment. This paper proposes to analyze the main characteristics of household composters, emphasizing the advantages and disadvantages of this treatment technique.

INTRODUCTION

The collection and disposal of municipal solid waste is a major problem for the urban environment, given the continuous increase in quantities produced annually and the fact that all identified solutions for waste management must be financially sustainable, technically feasible, socially feasible, legally acceptable and environmentally friendly.

Conventional organic waste management procedures may involve at least one of the following methods: disposal at landfills, incineration, composting, or anaerobic digestion. Composting has advantages over other processes, due to lower operating costs, reduced environmental impact and, more importantly, the beneficial use of the final product, which can be applied to soils as a fertilizer.

The goal of reducing the amount of waste generated at source can be achieved by continuously improving the composting of organic waste in households. Biodegradable organic products comprise the major fraction of waste generated by households around the world. They consist mainly of kitchen waste and may comprise up to 50% (g / g) of total household waste (EEA and ETC-WMF, 2002).

In order to ensure proper management of this waste stream, it is necessary to implement effectively practices and schemes that promote sustainability and are based on the provisions and principles of environmental policy and legislation.

Compost is defined as a product obtained by an aerobic, thermophilic process of decomposition and microbial synthesis of organic substances in residual products, which contains over 25% relatively stable humus, consisting predominantly of microbial biomass and which is further subjected to poor decomposition, being stable enough not to overheat or cause odor or insect breeding problems, and has a C: N = 10-15 ratio. Regardless of its origin and nature, organic matter, evolves depending on the conditions of aeration and humidity, to a qualitatively new state, relatively stable to biodegradation,

characterized by a C: N ratio similar to humus.

We can therefore define composting as a method of managing the biological oxidation process that converts heterogeneous organic matters into more homogeneous ones, with smaller particles similar to humus. Composting is constituted by all the microbial, biochemical, chemical and physical transformations that organic, vegetable and animal waste undergoes, from their initial state until they reach different stages of humification, a qualitative state different from the initial one, characteristic of the newly formed product, called compost, (Ştefănescu et al, 2006).

Composting equipment can be used to carry out composting in both rural and urban areas. They vary in shape, size, color, based on the same process by which pro-composting is performed, but they may be different from a technical point of view. Some composters are in the form of a small basket and can be purchased relatively easily. There are also composters whose construction is much more complex and which, in addition to composting, also perform other functions that can bring various benefits. The use of composters can reduce composting time by up to 70%.

MATERIAL AND METHOD

The study aims to describe the main advancements made in the field of household composting, highlighting the most relevant discoveries proposed in recent years, both in scientific papers and patents.

The need to reduce the amount of organic material at the source is particularly important, considering that when arrives at urban processing stations recyclable waste is often highly contaminated, it can not be led to recycling but to incineration. Household solid waste management in is important for a variety of reasons, including the fact that waste storage becomes a limited final disposal option in many countries (Sterner et.al., 1998).

RESULTS AND DISCUSSIONS

The most common administrative measures a weight-based billing system for household waste taxation Sterner et. al. (1998) has been conducting research since 1998 on a monitoring and control system that might grant access to actual measured waste disposal data at the household level for several a given region.

The most important determinants of each individual household were the composting of kitchen waste, the living area, age and attitudes regarding the difficulty of recycling various materials. Another factor found is the usefulness of composting kitchen waste together with garden waste. This is very natural not only from the point of view of habit formation, but also from a chemical or technical point of view, and the reason is that is much easier to compost both types of waste together. Composts made only from kitchen waste tend to have an excess of nitrogen but low carbon compounds. This can create messy, smelly compost, but is easily corrected by adding garden compost material such as grass, leaves or twigs that are high in carbon and also provide a physical structure that increases air penetration and acts as a barrier that keeps flies away.

The economic incentives, although important, are not the only driving force, because people are willing to invest more time on the waste management when obtaining compost.

Other studies have addressed the use of some technical plants that have been processed for biofuels production, and all the amounts of waste generated by processing were directed to compost production. Among the analyzed crops, very good results in obtaining high quantities of both biofuel and quality compost were Jerusalem artichoke and

some mixtures of fruits and sugar sorghum extract (Nenciu et. al, 2020).

Following a 3-year research on small-scale composting of biodegradable household waste, home composting is recognized for its contribution to reducing the disposal of household waste in landfills. Home composting was measured in a two-year monitoring study involving 64 homeowners by Smith et al., (2009). The total annual average of waste placed in a standard 290 l basket was about 370 kg per household. The average relative mass inputs of kitchen waste, paper waste and garden waste were between 29.2% and 69%, A survey of the study indicated that about 20% of households were engaged in home composting, this corresponded to an overall recycling / diversion rate equivalent to 20% of biodegradable household waste. Encouraging and expanding participation in household composting schemes has major potential benefits by providing a low-cost approach to managing and facilitating the sustainable recycling of biodegradable organic waste. However, the processing and stabilization of waste in small-scale composting systems has received little scientific investigation or optimization to increase its effectiveness in the treatment of biodegradable waste. The results in the field demonstrated the efficiency of composting household products as substitutes for peat balms or untreated soil, the production being superior in the case of using household compost. This research program quantitatively assessed the potential diversification of biodegradable household waste from landfilling by composting at home, biodegradation of waste in small-scale composters, bioaerosol emissions, vector attraction and end use of compost. Home composting also plays a significant role in diverting household waste from landfill, and the results of this study fully support proposals to include home composting in local government performance targets, (Smith et al., 2009).

Another research focused on understanding the effectiveness of household compost bins as a waste management technique for household waste. In this research, 70 household samples were randomly selected and a survey was conducted using a questionnaire to understand the attitudes of the community towards home composting and to identify the problems associated with the use of a composting container. During the survey to analyze compost parameters, two compost samples were collected from the top and bottom of the compost bins. The color, odor, and texture of the compost samples were visually tested, and the pH was measured using a calibrated pH meter. Moisture content and bulk density were measured in the oven (dry method). The sieve test procedure was used to measure the size of the particle variation. According to the results of the survey, it showed that the most used type of waste was kitchen waste, which is about 97% and about 66% of landfill owners add waste to the landfill once a day. Also, the most common problems associated with the use of the compost bin that people faced were related to leachate (19%), odor (13%) and worm problems (10%).

After analyzing the questionnaire, it turned out that some of the owners of compost bins are not aware of the compost bin. They also do not have much knowledge about this technology. Therefore, in order to get better results, it is important for people to be informed about the importance of using compost bins, to identify the effectiveness of compost bins as a solution for biodegradable household waste taking into account the ideas of compost bin owners and by analyzing the composition compost, (Lekammudiyanse et. al., 2009).

In practice, a variety of composting equipment for household use are known, each of which has advantages and disadvantages arising from: size, practicability, construction simplicity, degree of automation, composting

process and certain features of the equipment. Our goal was to analyze the characteristics and usefulness of household equipment for composting in people's own homes, while emphasizing that composting at home can bring many benefits that support sustainable agriculture.

A study investigating the performance of food waste composting was conducted using a simple, small-scale household composter. Three composting tests were performed using food waste and wood chips in 10 L plastic baskets through different filling schemes. This study evaluated the operating strategies and efficiency of the waste composting process by feeding small household composters (10 liters) that could be installed in any environment. In various tests, the composters were filled in batch and semi-continuous composting systems. Wood chips (used as structural material) were inserted into nature or reintroduced after the composting cycle to improve aeration and moisture control. To facilitate natural aeration and drainage of any leachate during the composting process, the compost bins were drilled with holes 0.6 cm in diameter on the sides. The composting process was monitored for 63 days in Process 1, 42 days in Process 2 and 39 days in Process 3, for a total of 144 operating days. In all tests, the temperature of the compost material varied between 26.7 ° C and 46.2 ° C throughout the process. The advantages of this type of composter consist in the small size that offers the possibility of installation in places where space is limited, low purchase cost and widespread availability in supermarkets. Stabilization of food waste is feasible in simple and small composters, and in situations where there is no production of cutting waste, wood chips can be used and reused in subsequent composting cycles without compromising the efficiency of the process. The daily manual return of the mixture in the first week after the addition of food waste is effective in maintaining the aerobic process and preventing the formation of leachate. Finally, improvements are needed so that thermophilic temperatures can be reached to guarantee the microbiological quality of the compost. However, the adoption of longer composting periods may allow the natural degradation of pathogenic microorganisms (Vich et. al., 2017).

The methodology and results of testing the performance of a system for the production of high quality compost from biodegradable household waste separated at source led to the development of a prototype system for simultaneous separation and composting of organic waste from the household, then evaluated through a pilot application to selected households. The specific characteristics of the selected households were identified, recorded and evaluated through household visits, interviews with households and the completion of questionnaires that were specially prepared for this purpose. The prototype system is based on continuous mechanical mixing, aerobic degradation and DOKW stabilization. Its inner volume is about 126 l, while its total volume is about 128 l (height: 65 cm and diameter: 50 cm). It consists of four separate compartments, as follows: feeding, composting process, compost collection and removal, leachate collection and removal. The capacity of the cylindrical composting compartment is 66 l, it receives organic when the shaft is rotated and the material is present in the feed compartment.

The prototype system has significant advantages compared to other available household composting systems, because it has unique features such as: separate feeding system which minimizes odors in the composting compartment during the supply of fresh organic material; the composting compartment (reactor vessel) which is isolated from the feeding system, thus avoiding the mixing of fresh organic material with the composted material; relatively low manufacturing cost. The main problems

encountered during the use of composters in households were: the presence of odor, difficulty rotating the shaft, clogging of the leachate collection valve, generation of large quantities of leachate, clogging of the ventilation holes of the internal grill and the presence of insects. These problems occurred in the first cycle (5 weeks) due to the fact that the households were not familiar with the use of composters, but with a good collaboration from them the problems were solved later. The compost that was produced in the households was characterized by high quality, as confirmed by the results obtained from the analyzes performed on the level of pH, humidity, organic carbon content, nitrogen content and C / N ratio, (Papadopoulos et. al., 2009).

Within some patents, various composting equipments have been proposed at home, each of them has certain common characteristics, but also some particularities that differentiate them, as follows:

Construction of a composter for domestic use in the processing of vegetable waste generated has the main advantage that it can extract excessive moisture from the mixture, continuously reducing the volume of raw material processed and allows the disposal of a larger amount of waste that would have been thrown in the landfill. The novelty of the composter is a condensing tower, which is connected to an exhaust fan that will remove excess moisture by condensing vapors and transporting them through a pipe in a storage tank. In this basin, the leachate that will accumulate at the bottom of the composting basin, which will be gravitationally oriented, will be led to reduce energy consumption. The system is equipped with a filtration system and an unpleasant odor reduction system equipped with a dispenser is used. Its construction has a modular shape, so you can work faster and prepare several batches simultaneously (Wu, 2014).

A composting container, intended to receive solid materials, generally of plant origin, and / or liquids, to allow them to decompose in such a way as to produce natural plant protection products, also called liquid manure or compost. The equipment offers the advantage of a composting container by facilitating all or part of the operations to be performed.

The innovative features of the equipment are represented by a stirring means suitable for stirring the contents of the tank both manually and electrically, from outside the container preferably with the container closed, it comprises a mechanical device, such as a mobile whip, capable of sweeping, at least partially, the inner volume of the tank and a filter means for filtering the contents of the tank suitable to be placed inside the tank. The construction of the equipment is simple, can be made of any material, has smooth surfaces and free shapes (Lancien, 2018).

A device for the recovery and composting of household waste. is characterized in that at least one sorting processing chamber is provided in the ground, in which a feed crushing mechanism with feed and a scrap metal recycling mechanism are provided which are arranged in the sorting processing chamber, classification of the water storage tank, the water treatment mechanism and the framework used to support each of these mechanisms. The structure of the invention is simple, reasonable and ingenious, convenient to use, can classify household waste, can separate and collect recyclable waste, such as ferrous metals, plastic bags, glass, etc. and it is beneficial to avoid wasting resources; it also circulates water. Use is conducive to saving water resources, (Zhaoyang, 2018).

A kitchen waste composting machine, which includes an inlet chamber arranged from upstream to downstream: an inlet chamber for the introduction of food waste and an inlet port; a fermentation chamber, which is used for fermenting kitchen waste. It also refers to a method of processing kitchen waste with a household waste composting

machine, which includes: a first stage, which involves collecting and sealing kitchen waste; second stage, spraying the fermentation broth into sealed kitchen waste and controlling the temperature to about 37 ° C in an oxygen-free environment; In the third step, the solid part and the liquid part of the organic fertilizer are separated to obtain solid fertilizer and liquid fertilizer. The advantages of this composting machine are that it can ferment and decompose kitchen waste to obtain organic fertilizers, recycle kitchen waste and turn waste into compost; separates solid and liquid. The screen of the filter in the component can separate the solid part and the liquid part of the organic fertilizer produced to obtain solid fertilizer and liquid fertilizer. The solid fertilizer is left on the filter screen for use, and the liquid fertilizer falls into the container for the liquid for use, (Wu et. al., 2018).

An automatic kitchen waste composting machine, which includes a feeding chamber, a fermentation chamber, a primary chamber for liquids, waste, a secondary chamber for liquid waste, a storage chamber, a transport channel and a controller . The invention has a simple design and use. It has a good safety and environmental performance, a high degree of automation and saves labor, material resources and reduces the costs of urban management of the classification, transport and burning of kitchen waste as solid waste. By setting up two liquid tanks residual, not only can perform the treatment of kitchen waste with high water content, but also facilitates the cleaning of the composting machine. The diffuser guarantees the fermentation and the fertilizing effect of the material. By using the screw conveyor and the two primary and secondary liquid tanks, users can introduce kitchen waste in real time and perform gradient fermentation of the material (Tao, 2019).

An automatic device for composting fruit and vegetable waste, equipped with a seven-way passage, an engine, a main composting chamber, an odor processing unit and a fermentation liquid storage room. has a feed hole located in the device, one end of the seven-character auger is connected to a shaft pulley, the shaft pulley is connected to a motor by a belt, and the other end of the auger is provided with a transverse blade . Using this device for composting, the resulting vegetable waste can be degraded to 70-80% of the original, obtaining the reduction effect. One of the main advantages of the device is the automation of pre-treatment processes, such as mixing and crushing fruit and vegetable waste, thus solving the problems of manual crushing and uneven crushing of existing compost buckets for household use (Zhang et. al., 2019)

A household waste composting device comprising a composting barrel, an outer layer cover plate movably connected to the top of the composting barrel, an inner layer square where the cover plate is fixedly connected to the inside of the composting barrel and thus an outlet is formed in the right side wall of the composting barrel. The utility model has the advantages of increasing the daily practicability and solves the corrosion of the fermented product on the inner wall of the barrel, the outlet has the role of eliminating carbon dioxide generated during the anaerobic fermentation process, avoiding the danger of expansion and explosion of the fermentation barrel. The outlet adopts a curved design to prevent contamination by bacteria and impurities. The outer and inner lid are made of transparent vacuum glass, so that the fermentation situation can be observed without opening the barrel lid and have a certain insulating effect. The bottom of the fermentation barrel is equipped with wheels to facilitate the movement of the fermentation barrel (Wang et. al., 2019)

A household composting device, which includes a barrel body in which the upper part of the cylinder body is provided with a feed inlet and the lower part is provided with a discharge outlet. It is also provided with a support, a storage

fermenter and a mixing mechanism and benefits from a compact general structure and a small size which makes it recommended to be placed under the kitchen countertop or integrated with the kitchen countertop. The main advantage of the device uses heat released during aerobic fermentation of kitchen waste to produce hot water, which satisfies the demand for hot water in a part of a family's kitchen and saves electricity by using electric water heaters. for water heating. The principle of operation of the household composting device consists in introducing kitchen waste into the fermentation barrel through the feed hole and into the fermentation hole, and the handle leads to the opening and closing of the release door through the pin and trough. (Liu et.al., 2019).

A household waste composting device that belongs to the field of waste treatment equipment. This type of equipment has a number of advantages: uniform distribution of materials on each layer of the material tray, overturning and constant updating; the equipment has an aeration device at the bottom to ensure the effect of ventilation of the entire device; the composting time of household waste is regulated by adjusting the rotational speed of the shaft; the thermal insulation layer provided on each layer of the device ensures the uniformity of the composting temperature of the material and can overcome the defect of the uneven temperature inside and outside the pile of household waste. The device has a high stabilization rate of composting, a short composting time and a low consumption of composting energy, thus significantly reducing the cost of operating the composting of household waste under the premise of ensuring the effect and efficiency of composting (Feng H. et.al., 2019).

When carrying out the composting process, an important role is played by a series of elements selected from the different composting equipment analyzed (fig.1), which influence the process.

In the case of simple compost bins, natural aeration and drainage of leachate during the composting process can be facilitated by drilling compost bins with holes 0.6 cm in diameter on the sides.

Unpleasant odor can be reduced by using a composter that has a separate feed system that, by isolating the composting compartment from the feed system, avoids mixing fresh organic material with composted material, or by a filtration system that is equipped with a system reduction of odor unpleasant equipped with a dispenser.

Humidity control can be achieved by using the composter equipped with a condensing tower that is connected to an exhaust fan, it will remove excess moisture by condensing vapors and transporting them through a pipe in a storage tank, thus continuously reducing the volume. of processed raw material.

Shaking the contents of the tank in a composter can be carried out electrically from the outside of the container with the container closed. It comprises a mechanical device, such as a movable whip, capable of sweeping, at least in part, the inner volume of the tank and a filtering means for filtering the contents of the tank suitable for placement inside the tank.

To avoid wasting resources you can use a composter that achieves water circulation, which is favorable for saving water resources, it also includes a water treatment mechanism that involves an absorption treatment tank, disinfection treatment tank and a tank of resorption treatment that are connected in order. Also the heat released during aerobic fermentation of kitchen waste to produce hot water can be used to meet the hot water demands of a part of the kitchen and to save electricity consumption by using electric water heaters to heat water.

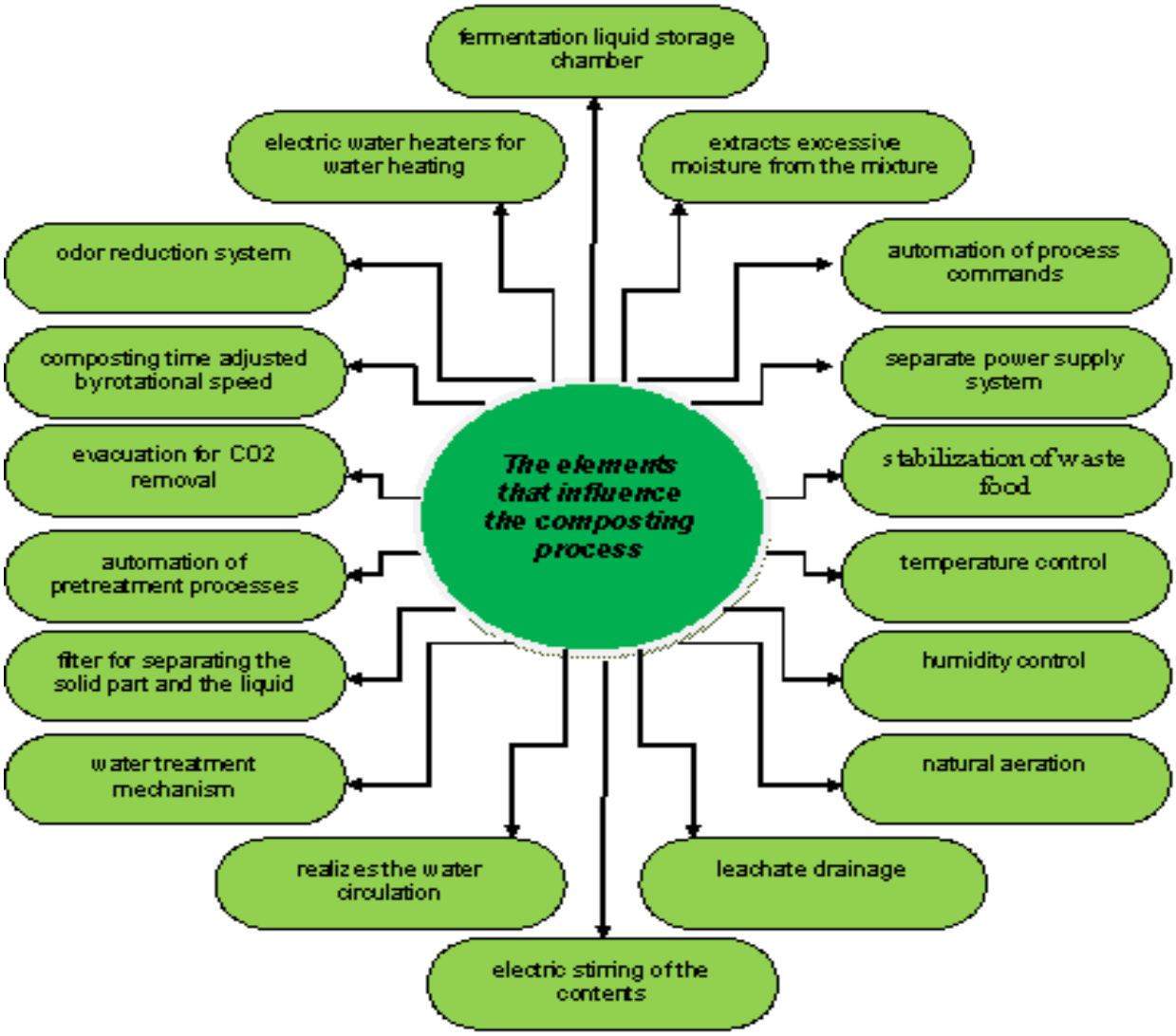
Using a composter that involves automating process orders saves labor, material resources, and reduces classification management costs. It is also possible to control the temperature in

an oxygen-free environment, and the solid part and the liquid part of the organic fertilizer are separated by the filter screen from the composition. Automating pre-treatment processes such as mixing and crushing fruit and vegetable waste solves the problem of manual and uneven crushing of compost material, and the presence of a fermentation liquid collection chamber is beneficial because the liquid can be used as plant fertilizer.

The composting time of household waste can be regulated by adjusting the rotation speed of the shaft within the composter, which leads to a high stabilization rate of composting, a short composting time and a low consumption of composting energy, thus significantly reducing the cost. operation of household waste composting under the premise of ensuring the effect and efficiency of composting.

The anaerobic fermentation process generates carbon dioxide. To avoid the danger of expansion and explosion of the fermentation barrel, the composter with evacuation can be used which adopts a curved design to prevent contamination of bacteria and impurities.

Figure 1**- *The element that influence the composting process***



CONCLUSIONS

The paper aimed to analyze equipment used in the field of composting of household waste, evaluating the main positive and negative characteristics as appropriate, given that composting is the best method of recovery of organic waste, having advantages over other processes, due to lower costs. operation, the reduction of environmental pollution and, more importantly, the beneficial use of the final product, which can be used as a balm for soil or fertilizer.

The main advantages of composting equipment vary from one piece of equipment to another. For small composters (10 l) with a simple construction the advantage is the small size that offers the possibility of installation in places where space is limited, low acquisition cost and availability of large-scale procurement, but this equipment needs improvement so as to reach thermophilic temperatures. to guarantee the microbiological quality of the compost.

Composting equipment with a more complex construction has different advantages depending on the particularities of each as follows: separate feeding system which minimizes odors in the composting compartment; extracts excess moisture from the mixture, continuously decreasing the volume of raw material processed; stirring means suitable for stirring the contents of the tank both manually and electrically; can classify household waste, can separate and collect recyclable waste; solves the corrosion of the fermented product on the inner wall of the barrel; uses the heat released during aerobic fermentation of kitchen waste to produce hot water; overturning and constant updating and aeration to ensure the effect of ventilation.

Automatic composting machines have good safety and environmental protection performance, a high degree of automation and save labor.

The main common problems encountered during the composting process were related to leachate, unpleasant odor, problems with flies and worms, but these problems can be overcome by using balanced composting schemes and the correct use of composting equipment.

The paper aimed to expose some important aspects regarding home composting, which involve several factors for the composting process directly at the source, whose necessity is useful to avoid contamination of organic waste in separation and treatment plants, given that biodegradable organic products comprise the major fraction of waste generated by households around the world.

The article analyzed several studies on the behavior, knowledge and availability of people to use composting equipment. The results show that some compost basket owners are not sufficiently informed about the usefulness of the compost bin and do not have much knowledge about this technology. The main finding was that economic incentives, although important, are not the only driving force, people are willing to invest more time in composting than can be motivated simply by savings on the waste management bill. It is therefore important for people to be informed about the importance of composting, the use of compost bins as a solution for biodegradable household waste. Awareness of the use of composting equipment requires the implementation of a national program, supported and implemented by local authorities that includes schemes and composting equipment to support sustainable agriculture.

Following the analysis of household composters, a series of elements were selected that influence the composting

process and that may be the basis for the future design of a new experimental model of household composter that incorporates the most efficient solutions.

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