MOBIGAS – TECHNOLOGY FOR SOLID ORGANIC WASTE TREATMENT TO PRODUCE COMPOST/HUMUS AND GENERATE ALTERNATIVE ENERGY

HINTERBERGER S.

Müller Abfallprojekte GmbH, 4675 Weibern, Hauptstraße 34, Austria
E-mail: stephan.hinterberger@m-ut.at

ABSTRACT

MobiGas is a technology which combines composting and digestion process to treat all kinds of solid organic waste to produce compost/humus and to generate alternative energy. The organic waste treatment technology consists of 1 control module, up to 10 process modules and bio filter equipment and was established to treat organic waste amounts of 1.000-5.000t per year in decentralised regions like islands and rural areas.

All modules are designed as a container system to increase modularity and transportability, which allows regional treatment of organic waste and the possibility of active reaction to changing waste amounts. The technology has the following objectives and ambitions:

- humus production out of all kinds of organic waste material, to increase the topsoil/humus proportion and avoid land erosion;
- decentralised humus allocation (65% of Europe shows a rural settlement structure) out of small waste quantities including reduction of transportation costs and emissions; humus utilisation to substitute chemical fertiliser and close natural circuits (e.g. phosphorus, carbon) to increase resource efficiency; advance recycling management to guarantee an optimal use of resources
- reduction of environmental impacts, greenhouse gases (CO_2, CH_4, N_2O,..), odour and dust emissions
- renewable energy production to substitute fossil fuels as energy carriers and without competing with food industry (limitation of cultivated area and biomass leads to a competition food vs. energy); organic waste is still unused
- to comply with European directives and standards (e.g. Landfill Directive, Waste Framework Directive, Thematic Strategy on the Prevention and Recycling of waste, Directive on Renewable Energy Sources, Climate aims 20-20-20)

Keywords: solid organic waste, alternative energy, emission, Peripheral fermentation technology

1. Introduction

Anaerobic degradation is a very cost-effective method for treating organic wastes be-cause the formed biogas can be used for heat and electricity production and the digestate can be recycled to agriculture as a secondary fertilizer. Various process types are applied and state of the art which differ in material, reaction conditions and in the form of the used reactor systems. The introduction of anaerobic digestion has shown that organic wastes are a valuable source for energy and nutrients. Anaerobic waste treatment is done today in biogas plants on middle farm scale as well as on large industrial scale with the best beneficial and economic outcome. Through the development of new anaerobic treatment technologies based on small scale the recycling rate of organic waste should be increased.[1][2]

[1] Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste

[2] Climate aims 20-20-20; 20% reduction in EU greenhouse gas emissions from 1990 levels; raising the share of EU energy consumption produced from renewable resources to 20%; 20% improvement in the EU's energy efficiency

2. Small scale dry fermentation technology

2.1. Technology MobiGas

The organic waste treatment technology consists of 1 control module, up to 10 process modules and bio filter equipment. All modules are designed as a container system to increase modularity and transportability, which allows regional treatment of organic waste and the possibility of active reaction to changing waste quantities (e.g. the tested prototype consisted of 1 control module, 3 process modules and 1 bio filter module). The modules are manufactured in compliance to be transported with normal trucks. In addition the process modules are connected to the control module with an exhaust air line and a control cable via Plug Play, which are the only fix installed components of the technology on site.

Figure 1: MobiGas technology: 1 control module and 3 process modules

Control module

The control module equipped with visualization and remote control is mainly responsible for monitoring the process flow of the individual process modules and provides in-formation about the operating condition of the system. It is divided into two areas, an engineering room and biogas storage. The engineering room contains:

- Control cabinet with visualized remote control
- Exhaust air and gas distribution valves and pipes with technical equipment
- Gas measurement equipment
- Power generation

Process module

The organic waste material is processed in the process modules, which contain all basic system elements for processing: percolate storage and pumps, blower, ventilation pipes and floor heating system. The process modules equipped with heat insulation clad with metal plating, possess a fill capacity of 58m³/module. The process modules are designed to treat all kinds of organic waste.

3. Treatment process

In the process solid state material like organic waste, heavy fraction of municipal solid waste (MSW), bio waste and residual materials out of food industry is treated to pro-duce humus to particular national conditions and energy.[3] The process proceeds under controlled and closed conditions in 3 consecutive phases:

- The first phase (duration 1-3 days) works under aerobic condition after filling up the process module with input material and closing it gas-proof. The substrate in the process module is aerated until a defined level of temperature because of microbial self-heating

[3] The Waste Framework Directive (WFD) of 17 June 2008 .The aim of the WFD was to lay the basis to turn the EU into a recycling society. One of the main features of WFD is the European Waste Hierarchy.

is reached. The generated exhaust air charged with odor and dust emissions is purified using bio filter equipment.

- The second phase (4-6 weeks) starts with the addition of percolation water, which is responsible for the required water content in the substrate and the faster be-ginning of the anaerobic activity. The biogas production starts during few hours after the second phase was started. The biogas is used to generate energy in form of electrical and thermal power by diverse power generation technologies. End of the anaerobic phase starts with the forced ventilation of the substrate.
- The third phase (1-5 days) of the process works under aerobic condition again. The system measures the concentration of oxygen and the temperature level in the process module to secure that the process is working according to default for the quality of the end product; aims of this phase can be the sanitation or the dehumidification of the substrate. The generated exhaust air charged with odor and dust emissions is again purified using bio filter equipment.

4. Implementation and operation

4.1. Implementation

For the implementation of the technology, infrastructure including hard surface for the container, manipulation surface, connecting pipes and lines and drainage has to be established. On the following pictures the infrastructure works e.g. construction of the container and manipulation surface, are shown.

Figure 2: Construction of infrastructure; container & manipulation surface

After checking the installation surface and mounting the container fixings, the delivery of the containers has to be made. The containers, control & process modules, are un-loaded and set up. Subsequently the installation of the supply channel for the pipes & lines connecting the modules each other is started.

After installing the pipes and lines a pressure test of gas & heating pipes is done and a functionality test of the modules including control unit is made.

4.2. Operation

The technology is developed to treat all kind of solid organic waste, like organic, waste, heavy fraction of municipal solid waste, bio waste and residuals out of agro and food industry. Before treatment of such wastes, it is necessary to prepare the input material regarding the following topics:

1) Preheating the fresh input material during cold period, the temperature of the input material is very important for starting the digestion process. Therefore it is necessary to preheat the fresh input material during cold periods to speed up the process. A very simple method is to prepare the input material in a pile using the natural self-heating process from the material e.g. compost pile.

2) Mixing the input material with digestate and structure material - to inject the bio waste with methane- producing bacterium. To guarantee an ideal biogas production it is important to find an ideal mixture with input material, structure material and digestate.

Figure 3: Implementation of MobiGas technology in composting plant