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STUDY ON WASTE WATER TREATMENT PLANTS

Mariana DUMITRU

Lucian Blaga University of Sibiu, 10 Victoriei Boulevard, 550024, Sibiu, Romania, Phone/Fax: +40-(269) 21.60.62, E-mail: mariana_dumitru2001@yahoo.com

Corresponding author: mariana_dumitru2001@yahoo.com

Abstract

Biogas is more and more used as an alternative source of energy, considering the fact that it is obtained from waste materials and it can be easily used in cities and rural communities for many uses, between which as a fuel for households. Biogas has many energy utilisations, depending on the nature of the biogas source and the local demand. Generally, biogas can be used for heat production by direct combustion, electricity production by fuel cells or micro-turbines, Combined Hest and Power generation or as vehicle fuel. In this paper we search for another uses of biogas and Anaerobe Digestion substrate, such as: wastewater treatment plants and agricultural wastewater treatment, which are very important in urban and rural communities, solid waste treatment plants, industrial biogas plants, landfill gas recovery plants. This uses of biogas are very important, because the gaseous emissions and leaching to ground water from landfill sites are serious threats for the environment, which grow bigger and bigger during the constant growth of some human communities. That is why, in developed European countries, the sewage sludge is treated by anaerobe digestion, depending on national laws. In our country too, in the last years, efforts were made in the direction of treating wastewaters and management of waste in general. This paper can be placed in this trend of searching new ways of using with maximum efficiency the waste resulted in big communities.

Key words*: *biogas, anaerobe digestion, wastewater

INTRODUCTION

One of the actual problems of mankind, beside the global warming, the quest for new fuels and reducing pollution, is the management of waste water. That is why in the last years, in the entire world appeared many wastewater plants. A wastewater treatment plant is a physical plant where various physical, biological or chemical processes are used to change the properties of the wastewater in order to turn it into a type of water that can be safely discharged into the environment or that is usable for a certain reuse purpose [5]. The treatment of wastewater belongs to the over-arching term sanitation, just like the management of human excreta, solid waste and storm water. By-products from wastewater treatment plants, such as screenings, grit, sewage sludge, other sludge, odorous gases are also treated in a wastewater treatment plant. [1] A wastewater treatment plant generally requires electrical energy to function, except for certain types of constructed wetlands, but they can also produce energy in the form of biogas if anaerobic processes are used. City wastewater collection and drainage systems called sewers became increasingly common through the 19-th century. The drainage from these sewers became known as sewage; and treatment of sewage evolved through the 20th century into a standardized sequence of primary treatment, followed by secondary treatment, and ending with disinfection. A typical municipal sewage treatment plant includes primary treatment, in order to remove solid material, secondary treatment to remove dissolved and suspended organic material, and disinfection to kill disease-causing micro-organisms. Larger municipalities often include factories discharging industrial wastewater into the municipal sewer system. Sewage treatment plants may be called wastewater treatment plants, when the standard municipal sewage treatment plant sequence of primary treatment, secondary treatment, and disinfection is presumed anaerobe digestion equate for treating the combined sanitary sewage and industrial wastewater collected by the sewer [7].

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Agricultural wastewater treatment for continuous confined animal operations like milk and egg production may be performed in plants using mechanized treatment units similar to those described under industrial wastewater [3]; but where land is available for ponds, settling basins and facultative lagoons may have lower operational costs for seasonal use conditions from breeding or harvest cycles.[8]

MATERIALS AND METHODS

The researches and observations were made in an ecologic landfill near Sibiu.

Anaerobe digestion is largely used for treatment of primary and secondary sludge, resulted from aerobic treatment of municipal waste water. The system is applied in many countries in combination with anaerobe digestion treatment systems, where the anaerobe digestion process is used to stabilise and reduce the final amount of sludge. Most engineering companies providing sewage treatment systems have also the capability to provide anaerobe digestion systems. In European countries, between 30 and 70% of sewage sludge is treated by anaerobe digestion, depending on national legislation and priorities [2].

The anaerobe digestion treated sludge effluent can be further used as fertiliser on agricultural land or for energy production by incineration. There are still countries where the effluent is disposed on landfill sites. As this practice can have negative consequences for the environment due leakage of nutrients to ground water and emissions of CO_2 to the atmosphere, it is therefore found in most European countries.

Wastewater treatment plants

In wastewater can be found the following [9]:

- Suspended solids (physical particles that can clog rivers or channels as they settle under gravity)

-Biodegradable anaerobe digestion organics, which can serve as "food" for micro-organisms in the receiving body. Microorganisms combine this matter with oxygen from the water to yield the energy they need to thrive and multiply; unfortunately, this oxygen is also needed by fish and other organisms in the river. Heavy organic pollution can lean aerobe digestion to "de anaerobe digestion zones" where no fish can be found; sudden releases of heavy organic anaerobe digestions can lean anaerobe digestion to dramatic "fish kills".

- Pathogenic bacteria and other disease causing organisms These are most relevant where the receiving water is used for drinking, or where people would otherwise be in close contact with it;

- Nutrients, including nitrates and phosphates. These nutrients can lean anaerobe digestion to high concentrations of unwanted algae, which can themselves become heavy biodegradable digestion organic materials. Treatment processes may also neutralize or remove industrial wastes and toxic chemicals. This type of treatment should ideally take place at the industrial plant itself, before discharge of their effluent in municipal sewers or water courses.

There are three levels of waste water treatment: primary, secondary, and tertiary.

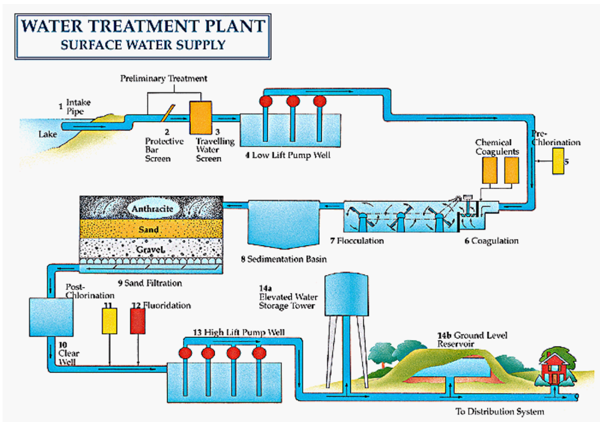

Fig. 1. The processes in a water treatment plant
Source: [6]

Wastewater treatment processes

Wastewater treatment processes are designed to achieve improvements in the quality of the wastewater [6]. In fig. 1 we can observe the flow processes in a wastewater treatment plant, which includes the 3 phases of treatment.

The three treatment processes are the following:

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Primary or mechanical treatment is designed to remove gross, suspended and floating solids from raw sewage. It includes screening to trap solid objects and sedimentation by gravity, to remove suspended solids. This level is sometimes referred to as mechanical treatment, although chemicals are often used to accelerate the sedimentation process. Primary treatment can reduce the impurities of the incoming wastewater by 20-30% and the total suspended solids by some 50-60%. Primary treatment is usually the first stage of wastewater treatment. Many anaerobe digestion advanced wastewater treatment plants in industrialized countries have started with primary treatment, and have then anaerobe digestioned other treatment stages, as waste water anaerobe digestion has grown, as the need for treatment has increased, and as resources have become available.

Secondary or biological treatment removes the dissolved organic matter that escapes primary treatment. This is achieved by microbes consuming the organic matter as food, and converting it to carbon dioxide, water, and energy for their own growth and reproduction. The biological process is then followed by anaerobe digestion in aditional settling tanks, to remove more of the suspended solids. About 85% of the suspended solids can be removed by a well running plant with secondary treatment. Secondary treatment technologies include the basic activated sludge process, the variants of pond and constructed wetland systems, trickling filters and other forms of treatment which use biological activity to break down organic matter.

Tertiary treatment is simply anaerobe digestion traditional treatment beyond secondary. Tertiary treatment can remove more than 99 percent of all the impurities from sewage, producing an effluent of almost drinking-water quality. The related technology can be very expensive, requiring a high level of technical know-how and well trained treatment plant operators, an anaerobe digestiony energy supply, and chemicals and specific equipment which may not be available.

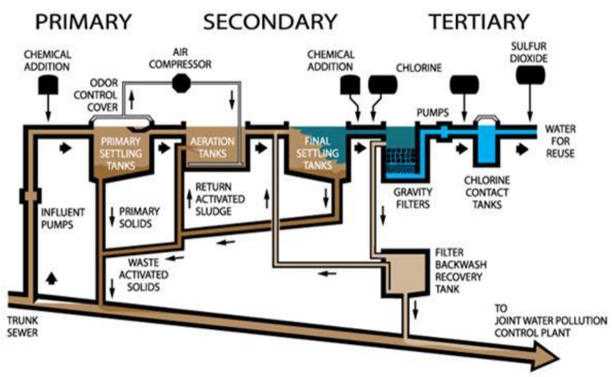

Fig. 2. The three phases treatment for wastewater
Source: www.lacsd.org

An example of a typical tertiary treatment process is the modification of a conventional secondary treatment plant to remove phosphorus and nitrogen.

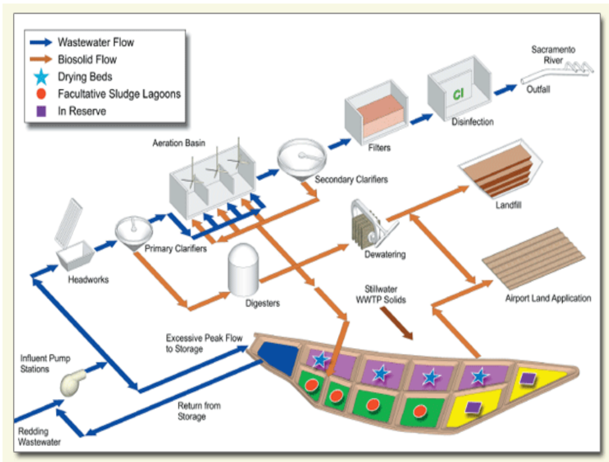

Fig. 3. The wastewater process flow in a wastewater plant
Source: www.clearcreekplant.com

Disinfection, usually made with chlorine, can be the final step before discharge of the effluent. However, some environmental authorities are concerned that chlorine residuals in the effluent can be a problem in their own right, and have moved away from this process. Disinfection is frequently built into treatment plant design, but not effectively practiced, because of the high cost of chlorine, or the reduced effectiveness of ultraviolet ranaerobe digestioniation where the water is not sufficiently clear or free of particles.

Waste water purge

The wastewater resulted from waste fermentation in the storage is drained through collector shafts in the lowest tank, from where are pumped in the 3 leaching tanks and then in the own purging station. This purging station uses as purging technology the reversed osmotic procedure.
The purging technology consists of:
The collected levigate through the draining and control system is guided in the 3 compartments tanks, from where it is pumped in the purging station following the technological flow.

Fig. 4. Purge technology
Source: www.imtgmbh.de

Municipal solid waste treatment plants
In many countries, municipal solid waste is collected as mixed stream and incinerated in large power plants or disposed on landfill sites. This practice is actually a waste of energy and nutrients, as most of the organic fraction could be source separated and used as anaerobe digestion feedstock. Even bulk collected wastes can be further processed and used for biogas production.
In recent years, source separation and recycling of wastes received increasing attention. As a result, separate fractions of this plant are now becoming available for more anaerobe digestion advanced recycling treatment, prior to disposal. The origin of the organic waste is important in determining which treatment method is most appropriate. Kitchen waste is generally too wet and lacks in structure for aerobic composting, but provides an excellent feedstock for anaerobe digestion. On the other hand, woody wastes contain high proportions of lingo-cellulose material are better suited for composting, as pre-treatment is necessary in order to be used for anaerobe digestion.

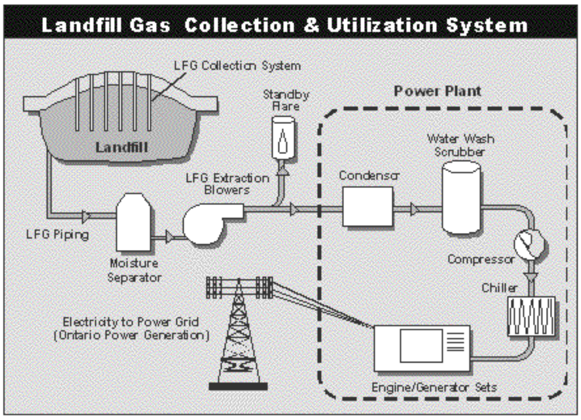

Fig. 5. Landfill gas collection system
Source: www.icleiusa.org

Utilisation of source separated organic fraction of household waste for biogas production has a large potential and several hundred anaerobe digestion plants, processing organic fraction , are in operation around the world. The aim is to reduce the stream of organic wastes to landfills or even to incineration and to redirect them towards recycling [4].

RESULTS AND DISCUSSIONS

All important cities and even some rural communities have landfills, because the management of waste is another big problem with which all communities are confronted. Landfills can be considered as large anaerobic digestion plants with the difference that the decomposition process is discontinuous and depends on the age of the landfill site. Landfill gas has a composition which is similar to biogas, but it can contain toxic gases, originating from decomposition of waste materials on the site.

Recovery of landfill gas is not only essential for environmental protection and reduction of emissions of methane and other landfill gases but it is also a cheap source of energy, generating benefits through faster stabilisation of the landfill site and revenues from the gas utilisation.

Due to the remoteness of landfill sites, landfill gas is normally used for electricity generation, but the full range of gas utilisation, from space heating to upgrade anaerobe digestion to vehicle fuel and pipeline quality is possible as well.

Landfill gas recovery can be optimised through the management of the site such as shredding the waste, re-circulating the organic fraction and treating the landfill as a bioreactor. A landfill bioreactor is a controlled landfill, designed to accelerate the conversion of solid waste into methane and is typically divided into cells, provided with a system to collect leachate from the base of the cell.

The collected leachate is pumped up to the surface and redistributed across the waste cells, transforming the landfill into a large high-solids digester.

Industrial biogas plants

Anaerobic processes are largely used for the treatment of industrial wastes and waste waters for more than a century and anaerobe digestion is today a standard technology for the treatment of various industrial waste waters from food-processing, agro-industries, and pharmaceutical industries. Anaerobe digestion is also applied to pre-treat organic industrial waste waters, before final disposal. Due to recent improvements of treatment technologies, diluted industrial waste waters can also be digested. Europe has a lean aerobe digestion position in the world, regarding this application of anaerobe digestion. In recent years, energy considerations and environmental concerns have further increased the interest in direct anaerobic treatment of organic industrial wastes and the management of organic solid wastes from industry is increasingly controlled by environmental legislations.

Industries using anaerobe digestion for wastewater treatment range from:

-Food processes: for example vegetable canning, milk and cheese manufacture, slaughterhouses, potato processing industry

-Beverage industry: for example breweries, soft drinks, distilleries, coffee, fruit juices

-Industrial products: for example paper and board, rubber, chemicals, starch, pharmaceuticals

Industrial biogas plants bring about a number of benefits for the society and the industries involved:

-Anaerobe digestion value through nutrient recycling and cost reductions for disposal

-Utilisation of biogas to generate process energy

-Improved environmental image of the industries concerned, through environmental friendly treatment of the produced wastes

It is expected that the environmental and socio-economic benefits of anaerobe digestion, complemented by higher costs of other disposal methods, will increase the number of applications of industrial biogas in the future.

CONCLUSIONS

Beside the well known uses of biogas, which was the subject of our previous researches, we studied another uses of biogas and anaerobe digestion substrate, such as: wastewater treatment plants and agricultural wastewater treatment, solid waste treatment plants, industrial biogas plants, landfill gas recovery plants.

In this paper we have presented the purging technology applied in this particular waste storage compared to that required in the literature on this domain. Utilisation of separated organic fraction of household waste for biogas production has a large potential and several hundred anaerobe digestion plants, processing organic fraction are in operation around the world.

These ecologic landfills which are now placed near the big towns and which represents the main material for biogas plants, can also be placed near rural communities, contributing to the future rural development, especially in our country.

The researches concerning wastewater belong to a large sphere of researches which have big benefits to the environment and to urban and rural communities, which aim to manage wisely water use, because water is a valuable natural resource, which deserves our full attention.

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