THE BIOGAS PROCESS AND THE MAINTAINABLE MANAGEMENT

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Abstract

All in all, biogas production meets the principles of the 'maintainability system' in a way that instead of fossil resources, it uses bio mass produced by plants (either from plants, or the manure of the animals consuming the plant, or the food remains from the animal)yearly for energy production, and decreases the energy dependency of several countries. Economic conditions also improve by processing materials that cannot be or hardly can be utilized, so the raw material cost may decrease to a minimal level. However, it can be stated that the implementation of such plants is hindered not by the risk of operation, but by the difficulty of raising the high amount of money required for the investment (Bai, 2005). Besides the above mentioned ideas, it is also advantageous that no more carbon-dioxide is produced in the process than the amount plants absorb by photosynthesis from the air. The by-products of the process get into the natural cycle as manure. Moreover, it is also beneficial that waste produced continuously by mankind are made harmless, so the environmental load decreases, as well as the bio gas plant to be built provides jobs and/or preserves workplaces.

Key words: biogas, maintainability, waste pile gas, environmental protection

INTRODUCTION

The concepts of maintainable development and management were created by recognizing that mankind has polluted its environment. Towards the end of the 20th century conferences around the world dealt with stopping this process: mankind has polluted water, the soil, the air and sinks into its own waste. As a result, the terms of maintainability were described: „Sustainable development is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs." (*Láng, 2003).* According to the renewed Gotheborg Strategy, it involves environmental, economic and social processes.

So it is important that all the things we do must match nature's cycles, preserve its vulnerable balance. In other words, we should not use more raw materials (energy) than the amount which may be supplied on the long run (because it renews, or we can renew it). Thence maintainability depends mainly on our power resources. Unfortunately, at present our world uses more raw materials than the amount the principle of maintainability tolerates *(www.wikipedia.org).* Many researchers have estimated the energy resources of the world in many different ways, considering a lot of different assumptions, and they believe this amount may be sufficient for the time period below (Table 1).

Table 1.

The duration term of the world's energy resources

Mineral oil	43 – 67 years
Gas	64 – 50 years
Coal and lignite	200 – 1500 years
Uranium	40 – 500 years

Source: Füsti-Hargitai (2007)

The most visible process is the disappearance of mineral oil and natural gas. Moreover, the application of them (burning) includes the emission of CO_2 which was bound by plants through photosynthesis for many thousands of years. The increase of the CO_2 level in the atmosphere at this rate causes changes in the climate affecting the world, some of whose results can be experienced even presently.

Besides the principles mentioned above, it is also very important to create a production process of new solutions according to the present economic situation in a way so that they should be competitive with other methods, as well as they should provide a proper income and social situation for those who deal with it.

It can be observed that environmental protection, economic and social principles are in a tight connection and form a 'maintainability system'.

MATERIALS AND METHODS

Biogas producing processes

Biogas is a kind of gas with methane content emerging during the anaerob (oxygen free) resolution of organic materials. Raw materials may include any organic, for instance, agricultural (diluted dung, plant pieces), processing industry (tinned food factory, slaughter house wastes) or communal (food remains, sullage) waste. Several processes have been developed according to the type of waste, but all of them share a common feature, namely, gas with a methane content of 50-60% is produced by bacteria in a fermenter, at a controlled temperature, in anaerob (oxygen free) conditions *(H. Schulz – B. Eder, 2005.)* which is cleaned, stored then utilized (Chart 1). The gas may be used for producing heat or electricity, or quite often for the combination of the two. The process turns the waste innoxious and produces valuable, fermented organic manure.

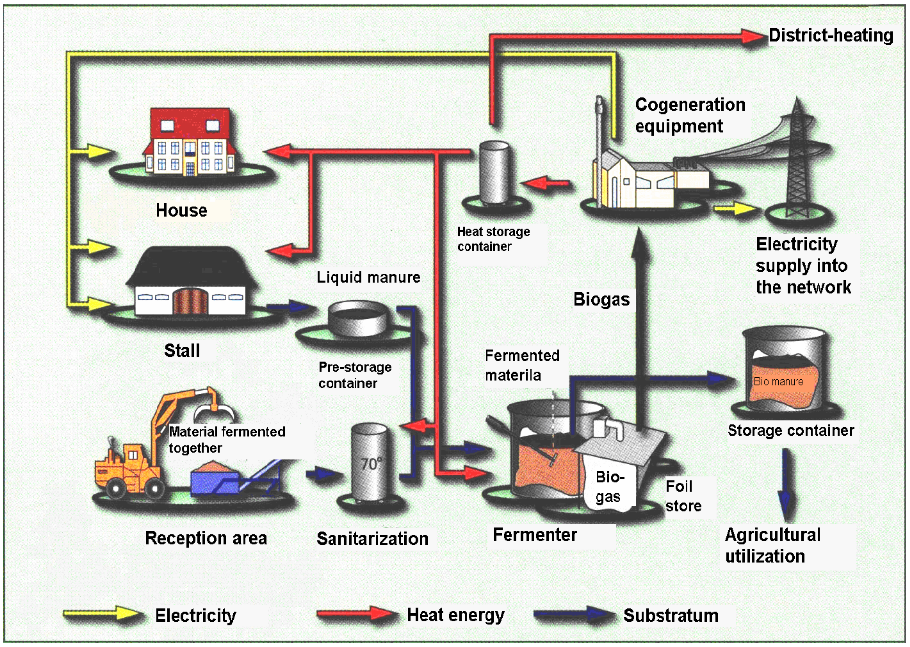

Fig. 1. The process of bio gas production
Source: www.erneuerbareenergien.saarland.de

The simplest way of grouping technologies applied in agriculture is according to the fact whether the process is recurring or continuous, or to the water content of the material treated (*Grasselli, 2004).*

In the damp (semi-liquid) process, the starting raw material (usually liquid manure) makes transmission with a pump possible due to its low (2-10%) dry material content. The fermented end product can be emitted as liquid manure (with or without a phase resolution). The process can be recurring (the filling up and dejection of the fermenter are periodic) or continuous (the filling up and dejection of the fermenter are continuous) or with storage (the filling up is continuous, the liquid manure remains in it until dejection). During continuous production a separated storage container is required for the fermented manure, while in the case of the recurring process, a pre-storage container is necessary. During the continuous (liquid' process, raw material is placed into the fermenter once or several times, so biogas production and the material flow are balanced.

The recurring 'semi-dry' equipment use a process when the mixed bio mass with a high (17.5-25%) dry material content is filled into the fermenter (e.g. with a grub), then its is sealed and leave it to ferment for a certain period of time. The stages of fermentation follow each other at the same place. After the start of methane production, the gas yield increases first, then after the peak, it begins to fall. At the end of the process, the fermented material is dejected just as the organic manure. To provide the continuity of the gas yield and the operation, several fermenters with recurring operation are built in a plant.

According to the temperature of the microbiological resolution and required time period we can distinguish mesophil (35±2 °C, 25±5 day) and thermophil (56±5 °C, 15±2 days) processes. *(Kalmáriné et.al., 2007)* With the temperature increase of the process, the gas yield and the technological heat consumption of the process grow. It is possible to ferment materials in more phases, with mesophil pre- or post fermentation, as well as with the combination of thermophil main fermentation. The thermophil process is suitable for saniterisation on its own, however when processing dangerous waste (slaughter house waste, carcases), a separate heat treatment (at 70°C) is also used.

The application opportunities of the products emerging from the biogas process

The methane content of the biogas may be used for heating in 100%, with gas engine electricity production in 30-40%. However, if we get back the waste heat emitted in the cooling water of the engine and the exhaust gases (related energy production, cogeneration), besides obtaining the more valuable energy form, the total energetic efficiency rate may exceed the 80%. The energy utilization is more complete if the differences in the seasonal heat production are taken into consideration, and the waste heat is used for cooling with an absorbing cooling machine (trigeneration). This way, for instance, the cooling demands of processing plants, cold-stores as well as hospitals, public institutions can be met, (The solution with the most promising advantage may be that heat consumers with a big area are concentrated at one site, for instance into an agrarian industrial centre).

For further utilization methods, extra cleaning is required, namely, that the CO_2 content of the bio gas must be extracted to make its methane content similar to natural gas quality. This way it can be transmitted into the gas network which is suitable for decreasing the import dependency on a national level.

The cleaned biogas (‘biogas’, ‘bio methane’) can be utilized in a compressed form in transportation as a fuel. Engines using methane show an advantageous emission rate.

A valuable by-product of the process is the ’bio manure’ produced. It is a more efficient soil improving material than untreated manure because it has a better carbon-nitrogen rate, so the plants can absorb nitrogen more easily. Bio manure (with dejecting liquid manure) can be spread directly on plants even in the growth stage.

Another utilizable product of the process is the CO_2 content of 30-40% of the biogas. If it is separated during the gas cleaning process, it can be used for CO_2 fertilization of greenhouses.

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