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STUDY ON THE TRANSPORT SYSTEM OF FEEDSTOCK IN AGRICULTURAL BIOGAS PLANTS

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Abstract

The human energetic necessities are frequently exceeded by the energetic potential of plants, but the present technologies use only a small part of biomass to be used for transforming it in energy. Even so, the energy obtained from biomass obtained from agriculture, forests and waste can be significant. In this respect, biogas is an important biofuel and biogas plants represent a good resource of energy, which can be used both in rural and urban communities. The paper refers to the first stage of an agricultural biogas plant, transport, delivery and storage of feedstock. Thus, stackable feedstock like grass, maize silage, manure with high straw content, vegetable residues, must be transported from a storage facility, such as a bunker silo to the digester feeding system. This is usually done by loaders or tractors and the feedstock is fed into the digester using different transporting systems, which are analysed in this paper.

Key words**:** *biogas plant, feeding system, feedstock, transport*

INTRODUCTION

Biofuels are fuels produced from biomass. This is the biodegradable mass from products, waste from agriculture, including vegetal and animal substances, the forest sector and industrial and urban waste [11].

The European Union adopted in 2003 a provision in order to impose the using of biofuels and other alternative fuels. Thus, the provision 2003/30/EC imposes that European countries must reach a certain target of using biofuels in the transport section.

In Table 1 are presented the shares of some alternative fuels which are and must be used in future years in European Union.

Table 1. Planned ponderance of alternative fuels

	2005	**2010**	**2015**	**2020**
Biofuels	2 %	6 %	7 %	8 %
Natural gas	0 %	2 %	5 %	7 %
Hydrogen	0 %	0 %	2 %	5 %
TOTAL	2 %	8 %	14 %	20 %

Source: [6]

The most effective way of producing biogas is through biogas plants, which are more and more used in all countries of Europe.

Agricultural biogas plants operate with four different process stages:

1.Transport, delivery and storage of feedstock

2.Biogas production

3.Storage of digestate, eventual conditioning and utilisation

4.Storage of biogas, conditioning and utilisation [4]

From these 4 stages which operate a biogas plant, in this paper we will study the first stage: transport, delivery and storage of feedstock. Stackable feedstock like grass, maize silage, manure with high straw content, vegetable residues must to be transported from a storage facility such as a bunker silo to the digester feeding system [3]. This is usually done by loaders or tractors (Figure 1, 2 and 5) and the feedstock is fed into the digester using a screw pipe transporting system, like the one shown in Figure 3.

The feed-in system includes a container, where stackable feedstock is poured by tractor, and a transport system, which feeds the digester. The transport system is controlled automatically and consists of scraper floors, walking floors, pushing rods and conveyor screws.

MATERIALS AND METHODS

In this study we analysed the transport devices and machines which are used in a biogas plant. These are loaders, conveyor screws and

feed-in systems. Scraper floors and overhead push rods are used to transport feedstock to the conveyor screws. They are capable of transporting nearly all stackable feedstock, either horizontally or with a slight degree of inclination, and are therefore used in very large, temporary storage containers.

Photo 1. Loader with maize silage
Source: [10]

RESULTS AND DISCUSSIONS

In the transport system of a biogas plant, beside loaders are very often used conveyor screws (Photo 3 and Fig.1.), because they can transport feedstock in nearly all directions. The only condition for using these screws is the absence of large stones and other physical impurities.

Photo 2. Loader feeding maize silage into a container
Source: [10]

The conveyors screws assure a continuously movement, so that the feeding of the digester can be done easily and continuously. In order to improve its functioning, it is recommended that coarse feedstock should be crushed, in order to be gripped by the screw and to fit into the screw windings.

Photo 3. Conveyor screws, ready for installation
Source: [10]

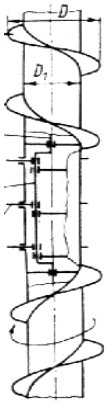

Fig. 1. Conveyor screw
Source: [7]

Beside conveyors screws presented above, in biogas plants are also much used wash-in shafts for feeding the digesters.
Feeding solids to the digester through wash-in shafts or sluices, using front or wheel loaders, allows large quantities of solids to be delivered any time, directly to the digester (Fig.2.).

Photo 4. Frontal loader
Source: [7]

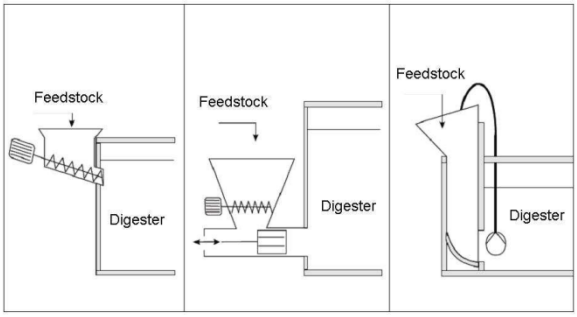

Fig. 2. Wash-in shaft, feed pistons and feed conveyors system for feedstock insertion into the digester
Source: [2]

In Fig. 2 are presented 3 cases of feeding the digester, through wash–in shaft, feed pistons and feed conveyors.
In the case of using feed pistons (Fig.2.), the feedstock is inserted directly into the digester by hydraulic cylinders, which push the feedstock through an opening in the wall of the digester. This ground level insertion means that the feedstock is soaked in the liquid content of the digester, reducing the risk of floating layer formation. This system is equipped with counter rotating mixing rollers, which transport co-substrates to the lower horizontal cylinders and, at the same time, crush long fibre materials [2].
Feeding co-substrates to the digester can be done by using feed screws or conveyor screws (Photo 5).

Photo 5. Feed-in system for silage
Source: [1]

In this case, the material is pressed under the level of the liquid in the digester, using plug screws. The method has the advantage of preventing gas leaking during feeding. The simplest way to do it is to position a dozer on the digester, so that only one insertion screw is necessary. For feeding the screw, temporary storage containers, with and without crushing tools, are used [4].
From the components of the transport systems in a biogas plant presented above: front or wheel loaders, conveyor screws, wash-in shafts, feed pistons and feed conveyors, each of them has its importance and place to be used, depending on the circumstances, because each of them has its own advantage. Thus, the loaders are used for transporting feedstock to the conveyor screws, conveyor screws are very often used because they can transport feedstock in nearly all directions and wash-in shafts allows large quantities of waste to be delivered any time, directly to the digester.

CONCLUSIONS

A biogas plant is a complex installation, which is more and more used in rural areas as an alternative of classic energy.
From all the components of a biogas plant: transport, delivery, storage and pre-treatment of feedstock, biogas production and storage of digestate, we concentrated in this paper over the transport of feedstock, because this stage has a big importance in functioning of a biogas plant.
We analysed the transport of vegetable residues from a storage facility to the digester feeding system. This is usually done by loaders or tractors. It was also analysed the feed pistons, feed conveyors screws and wash-in shafts, showing the importance and advantages presented by each of them.
All these systems of transport used in biogas plants are finally meant to improve the efficiency of obtaining biogas.

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