

BIOGAS PLANT IN ROKYTNE – WAYS TO IMPROVE ITS WORK-FLOW

IRYNA VASKINA, ROMAN VASKIN, MAREK JELINEK

Sumy State University (Sumy, Ukraine), Czech University of Life Sciences (Prague, Czech Republic)

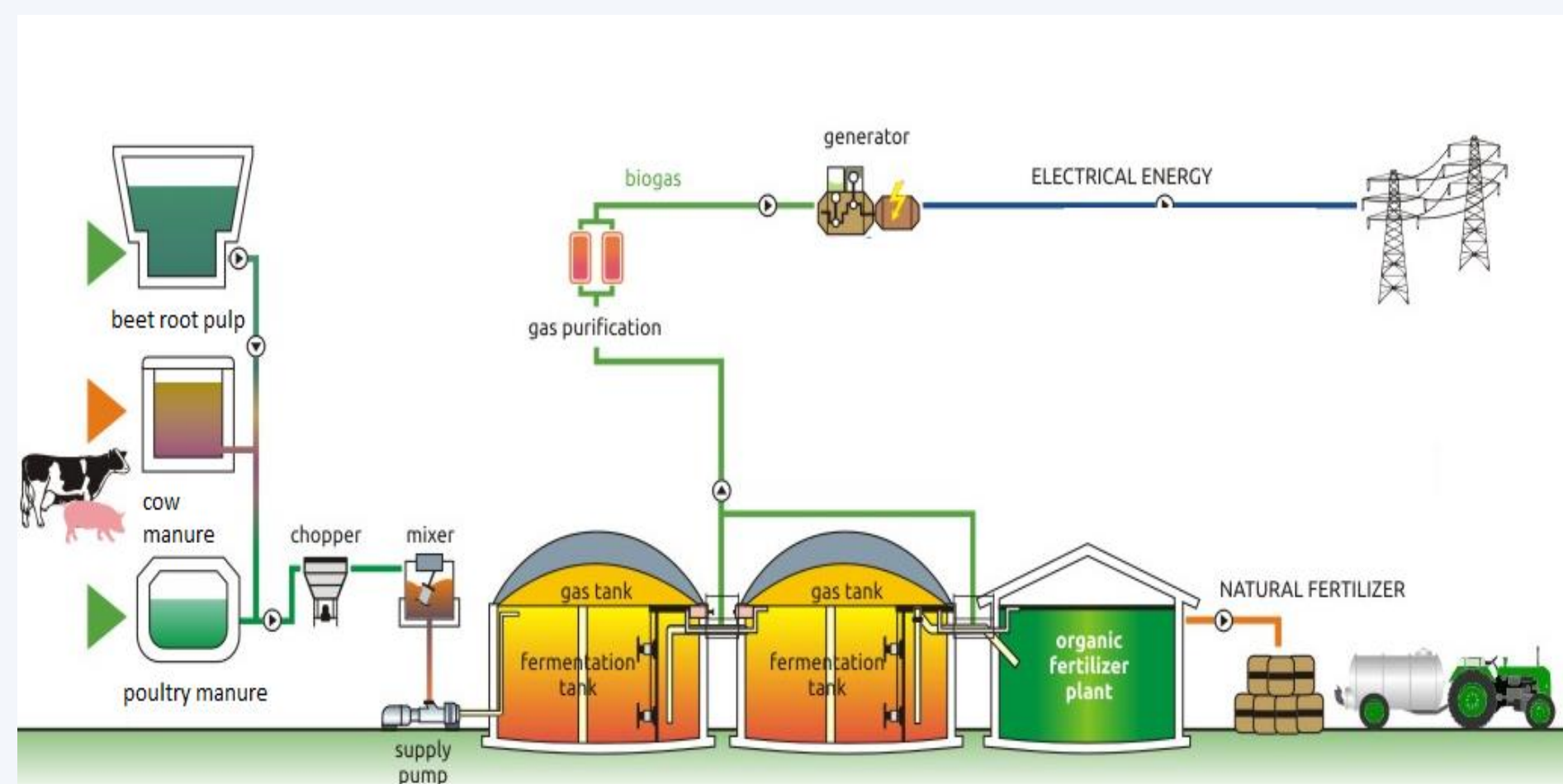


Introduction

Biogas is renewable source of energy and development of its production is one of the priority directions of the state policy of the European countries. Rokytne Sugar Factory (Kyiv region) built a complex for the production of electricity from biogas in 2014.

The main purpose of it – is waste utilization for energy needs.

Biogas plant (BGP) in Rokytne's feedstock includes sugar beet pulp, cattle and poultry manure.



BGP's Work Flow

Biogas is produced in 4 reactors with total volume of 14,400 m³ and in 2.2 MW of electric energy is produced in two generators. Electricity is sold to the national power grid.

The plant was designed to dispose of sugar production waste (sugar beet pulp) in conjunction with the disposal of animal waste (cow manure, chicken litter).

Methods

The methodology of systemic and multicriteria decision analysis was used. Data was collected during a visit to the BGP in Rokytne (on September 2019). The process of BGP's operation was studied and its potential problems identified.

References

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Results

The disadvantages of the design stage:

- Long-term access to **raw** materials was not calculated. The plant was designed to dispose of sugar production waste (sugar beet pulp) in conjunction with the disposal of animal waste (cow manure, chicken litter). To date, the sugar plant doesn't work and the biogas plant is forced to buy raw materials throughout Ukraine. Mostly it use cow manure and chicken manure. This makes it impossible to predict the productivity of the plant.
- There was no ways to utilize **heat**. It is not reflected in the profitability of the plant. Thermal energy is mainly released into the atmosphere. Only a small portion is used to preheat fermenters in cold season.
- **Nitrogen loss** from the final product (sediment). The sediment obtained in the fermentation process is rich by nitrogen. It can be used into as a nutrient in liquid form. In the separation of sediment, nitrogen remains in the liquid phase and does not fall into the solid degistate used in the fields.

Disadvantages at the stage of operation:

- **Low productivity by methane**. The part of methane in biogas is only 45-50%. (also biogas contains 25% CO₂, about 20% H₂S). It is very low level of methane. When using a waste of such composition, the methane content should reach 60-65%.
- **High H₂S content** - about 20%. Hydrogen sulfide interacts with water to form sulfur oxides, which are released into the air. There, by interacting with water vapor, they can form sulfuric and sulfurous acids and fall down as acid precipitation. At the plant, the treatment of sulfur is carried out by the method of adding air to the fermenter, which stimulates the activity of sulfur bacteria. Judging by the proportion of hydrogen sulfide in biogas, no effective decomposition of sulfur-containing compounds occurs.
- Lack of a system for **purification** of flue gas from generators. This gas contain carbon oxides, sulfur oxides and nitrogen oxides. Even if its levels don't do not exceed the standards it is important to reduce air pollution.
- Large volume of liquid waste that removed to the **filtration fields**. The nitrogen contained in the waste in soluble form (NH₄). So most of all doesn't enter the solid phase during separation. On the filtration fields the nitrogen is mostly evaporated.

Discussion

Excess heat. Heat is partly used in the cold season to heat the fermenters. 60-80% of heat is still lost to the atmosphere. It is advisable to use this heat:

- for drying grain by agribusinesses
- for greenhouses to grow vegetables
- convert heat to electrical energy by a cogeneration unit to (estimated cost € 18,000).

Poor methane productivity has such reasons:

- low raw material potential (cow manure). In order to increase the productivity of raw materials, it is advisable to mix animal manure with plant material (silage, energy plants).
- insufficient mixing of the waste in the fermenter. This leads to a decrease in the effectiveness of methane-forming bacteria. It's necessary to monitor the normal operation of the mixers.

High Hydrogen sulfide content

Filters, absorbers and other equipment can be used to clean sulfur compounds. It needs the extra costs.

Lack of a system for purification of flue gas from generators. Catalysts, filters can be installed to purify the generator exhaust gas from sulfur, nitrogen and carbon oxides.

Nitrogen loss

Using the technology of the introduction of harsh fertilizers in the fields.

Filtration fields require the removal of the ground beneath them, as well as causing an unpleasant odor around. Therefore, it is necessary to reduce its area. It is necessary to detail study the content of the liquid phase of the waste (because it contains valuable nitrogen) and to consider its use as a liquid fertilizer.

Conclusion

Implementation of such measures will increase productivity of the Rokytne BGP and therefore financial profit. This given cash has been used for decreasing the man-made impact of BGP on environment.

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