# *ЭКОЛОГИЯ, ОХРАНА ТРУДА, ПРОМЫШЛЕННАЯ БЕЗОПАСНОСТЬ*

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## MAIN DIRECTIONS TO INCREAS BIOGAS PRODUCTION FOR ORGANIC WASTES MANAGEMENT

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*Main analysis of efficiency of biogas production from organic waste in the frame of pretreatment are presented in the article.*

Biogas technologies today are one of the promising fields of renewable energy to provide solutions for both energy-related and environmental tasks. The biogas production is a well-known technology that brings many benefits, both economic and environmental because biogas is a renewable energy source that comes from cheap and environmentally friendly recycling of organic waste and it lowers the greenhouse gas emission. The biogas production is also a sanitation process that reduces pathogen microorganisms in organic waste, removes odours and flies and produces an organic fertilizer that brings economic benefits for the farmers. The availability at low costs and ability to use the broad spectrum of feedstocks makes biogas a very usable fuel that can be used to produce heat, steam, electricity, hydrogen or even as a transportation fuel [1].

According to the information of the Department for Energy Efficiency of the State Standardization Committee of the Republic of Belarus, the country has 18 operating biogas plants with a total installed capacity of over 26 MW. The most plants have electric power up to 2 MW, which ensures better efficiency in solving the tasks of their effective use. In particular, they are mostly using animal waste as raw materials for biogas production. Six plants work on landfill gas.

Biogas is produced in a process known as anaerobic digestion (AD). The AD is a process during which complex organic matter is decomposed by diverse types of microorganisms through a series of metabolic stages (hydrolysis, acidogenesis, acetogenesis and methanogenesis) in the absence of oxygen. The result of the AD process is two main products: biogas and digestate. Biogas is a mixture of

$CH_4$ (50 – 70 % (v/v), $CO_2$ (25 – 50 % (v/v)), $H_2S$ (0 – 5000 ppm (v/v)), $NH_3$ (0-500 ppm (v/v)), $N_2$ (0 – 5 % (v/v)) and traces of water vapour [2]. Digestate is the decomposed substrate full of macro- and micronutrients which can be applied on the soil as a fertiliser due to its good homogeneity and C/N ratio, nutrient availability and significantly reduced odours.

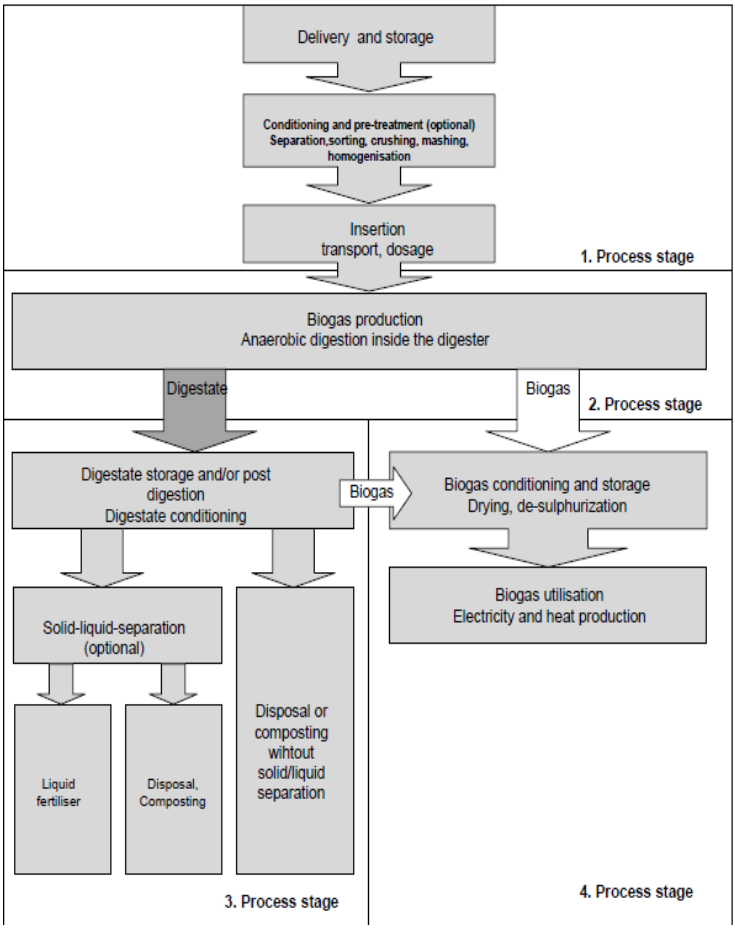


Fig. 1 – Process stages of biogas plant

The first process stage (storage, conditioning, transport and insertion of feedstock) includes the storage tank for manure, the collection bins, the sanitation tank, the drive-in storage tanks and the solid feedstock feeding system.

The second process stage includes the biogas production in the biogas reactor also referred to as the digester.

The third process stage is represented by the storage tank for digestate and the utilisation of digestate as fertiliser on the fields.

The fourth process stage (biogas storage, conditioning and utilisation) consists of the gas storage tank and the CHP- unit (combined heat and power generation).

Efficiency of operating biogas plants in Republic of Belarus is quite law. Some pretreatment methods may be used in the aim to increase biogas production efficiency:

1. Physical pretreatment methods do not use chemicals or microorganisms. The main functions of physical pretreatment of raw material are to increase the surface area and size of the pores, rupture the structure of the biomass, and decrease the crystallinity [3].

2. Chemical pretreatments are widely used with lignocellulosic biomasses and are generally viewed as satisfactory. It is generally less expensive and is faster and more efficient at increasing the degradation of complex organic waste materials. Commonly used chemical pretreatments are acid, basic, oxidation, ionic liquid, and organosolv processes [4].

3. The biological pretreatment of biomass to increase biogas production in anaerobic digestion mostly uses fungi, microbial consortium, and enzymes. Pretreatment with the microbial consortium is performed by microorganisms selected from natural environments whose substrate is the lignocellulosic biomass [4].

4. Enzymatic hydrolysis is another biological pretreatment. Pretreatment by enzymatic hydrolysis may provide an alternative to energy-demanding thermal and mechanical pretreatments and to chemical pretreatments because enzymes are safer compounds than chemicals [4].

5. Combined pretreatment is a combination of several pretreatment types described above. For example, plant substrate can be crushed (mechanical pretreatment), exposed to the effect of acid solution (chemical pretreatment), placed in an autoclave (mechanical pretreatment) and hydrolyzed by fungi and enzymes (biological/enzymatic pretreatment).

**References**

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## ИСПОЛЬЗОВАНИЕ БИОГАЗОВЫХ ТЕХНОЛОГИЙ ДЛЯ ПЕРЕРАБОТКИ ОРГАНИЧЕСКИХ ОТХОДОВ

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*В работе определены энергетические, экологические и агротехнические аспекты использования биогазовых технологий для переработки органических отходов*

Рост объемов производства и потребительской способности приводит к увеличению образования отходов. Ежегодно в Республике Беларусь образуется более 1400 наименований отходов с широким спектром морфологических и химических свойств. В данной работе рассмотрена группа органических отходов, к основным видам которых относятся: отходы животноводства; отходы растениеводства; отходы очистки и подготовки вод; отходы перерабатывающей промышленности (сахарной, целлюлозно-бумажной и др.).

Существенным источником образования органических отходов в республике являются сельскохозяйственные и перерабатывающие предприятия. Они обеспечивают страну продукцией, а также занимают лидирующие позиции по объемам экспорта. Выращивание сельскохозяйственной продукции (растениевод-