

## **THE USE OF BIOGAS ENERGY FROM MUNICIPAL SOLID WASTE LANDFILLS AS A STEP TO REMOVE THE GREENHOUSE EFFECT IN THE THIRD MILLENNIUM**

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In the last half century a trend to the enhancement of the greenhouse effect, global by nature, has been observed. This has led to a need for a solution to a problem of energy saving and environmental pollution decrease, which causes more efficient use of traditional energy resources, as well as the research of others, preferably renewable and inexpensive energy resources.

The main greenhouse gas of the atmosphere is water vapor, which traps 60% of heat radiation of the Earth. Approximately 40% is trapped by other gases, more than 20% is comprised of carbon dioxide.

This 40% includes biogas - gas derived from the methane fermentation of biomass. It consists of methane - 55-75%, CO<sub>2</sub> 25-45%, with a slight touch of H<sub>2</sub> and H<sub>2</sub>S. After biogas undergoes refinement from CO<sub>2</sub>, we get biomethane. Biomethane is a complete analogue of natural gas, different only in origin. This type of fuel, as far as efficiency concerned, is in no way inferior to already well-known alternative solutions, such as biodiesel and ethanol.

Biomethane is produced virtually out of nothing. Municipal solid waste (MSW), the remains of living creatures, plants and even urban sewage can be used to produce biomethane. Being independent as an alternative source of world energy from the markets of fossil fuels, such as natural gas, coal, oil, and covering many other above enumerated advantages, it is of interest to European and American developers and politicians as regards the engines that use biomethane today.

Currently, two main ways of energy recycling of MSW are being intensively developed – burning and burying with biogas getting. Waste burning requires expensive refinement systems, therefore, landfill MSW dumping is more widespread and rational. The main advantages of the burial are simplicity, relatively low money and labor costs, more safety. Biogas released during the decomposition of municipal waste contains up to 60-75% of methane. 100-200 m<sup>3</sup> of biogas can be formed during the decomposition of one ton of solid waste. Depending on the content of methane the lowest heat of the combustion of the landfill biogas is 18-24 MJ/m<sup>3</sup> (about half of the heat capacity of natural gas).

It should be noted that if biogas is not extracted from landfills, the methane, produced during the interaction with oxygen, becomes a mixture, which sometimes leads to explosions and fires at landfills, which not only causes additional harm to the environment, but also constitutes danger to people.

In Ukraine, in urban areas the production of MSW is about 10 million tons annually. Over 90% of solid waste is transported to 655 landfills and dumps, 140 of them are suitable for the production and use of gas from a landfill. The potential of gas from landfills in Ukraine makes up about 400 million m<sup>3</sup> per year, which can almost be compared to the potential of the United States.

The utilization of biogas at landfills requires the landfill designed with engineering in mind (the creation of an insulating screen, gas wells, gas collection system, etc.).

The implementation of this project is based on an embedded computer system. It can be divided into two parts: Hardware and Software. The software part, namely, the SCADA (from Engl. Supervisory Control And Data Acquisition) system performs control functions of management process and provides a convenient man-machine interface. The SCADA System usually consists of the following subsystems: a human-machine interface, a supervisory (computer) system, remote terminal units, programmable logic controller and communication infrastructure. Hardware consists of a controller which directly controls executive mechanism and eBox-3310A-MSJK, which is optimally suitable for embedded computer systems with high requirements for reliability and compactness due to its properties.

Since the process of waste decomposition takes many decades, landfills can be regarded as a stable source of biogas. The emission of biogas from landfill to landfill, depending on the amount of mass, can range from several tens of liters / s (small landfills) to several m<sup>3</sup> / s (large landfills). The scale and stability of producing, location in urban areas and low cost of production make biogas one of the most promising sources of energy for local needs. At the same time the major task of environmental protection in urban areas such as providing the purity of air and prevention of groundwater pollution is solved.

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