

## Section 02. Geotechnical Systems Stability

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### **Biomass Gasification State Analysis and Prospects of its Application in Ukraine**

Impetuous application of energy resources will trigger a sharp price increase in coming decades that will result in their gradual exhaustion of minerals. Internal reserves in the alternative energy basis are required to improve this situation with natural energy resources, the majority of which are non-renewable. There are two types of fuel which is used in energy production: non-renewable and renewable, i.e. inexhaustible. Coal, oil, oil sand, natural gas, heavy oil, associated petroleum gas, etc. belong to *non-renewable mineral resources* and such fuel as wood, straw, energy crops, municipal solid wastes, bio - and landfill gas are considered *renewable* ones. Today a share of renewable energy sources in the global energy resources amount approximately up to 13%.

Bioenergy, the main raw material of which is wood biomass (87 %), sets up 77 % of this energy. Biomass is referred to as an organic substance of vegetable or animal origin, which can be used as an alternative source of energy.

A share of renewable energy, according to the World Energy Recourses Report in 2016 amount to 11 %, and to 2030 it should be 22 % according to the optimistic indicators. The annual growth of biomass in the world is estimated at 200 billion tons of dry-mix, which is energetically equal to 80 billion tons of oil. One of the biomass sources are forests. At the added-value wood processing, 3 to 4 billion tons is waste, which is 1.1 – 1.2 billion tons of oil in energy equivalent.

At the bioenergy biomass potential Ukraine is far ahead of all other countries of the European Union, including such developed countries as France, Germany, Spain and the UK. The problem is only in the use of own energy potential, especially outdated approaches to its application. According to the official expert statistics for 2014, the theoretical potential of biofuel in Ukraine makes up 50 million tons of coal equivalent, where technical is 36.23 million tons and economically useful is 27.27 million tons. Though, based on the current level of overall primary energy consumption in Ukraine (180 million tons of coal equivalent in 2016) economic potential of biomass can satisfy for about 15 % of the total need of Ukraine in the energetics.

The most effective technologies of biomass application in bioenergy are the direct combustion, gasification, anaerobic fermentation, etc. In general, energy from organic wastes is obtained through *the physical, thermochemical or microbiological methods*.

*Physical method* is based on producing energy by combustion organic wastes.

*Thermochemical method* is based on the use of the gasification process.

The most popular is *microbiological method* of biogas production in the world that is anaerobic fermentation. Undoubtedly the most promising is thermochemical method of obtaining energy from biomass based on the gasification process. The variety of obtaining products in gasification process is much wider in comparison with physical or microbiological methods of obtaining energy.

In general, *gasification* is thermochemical conversion of fossil fuels into combustible gases by incomplete air oxidation (oxygen and steam) at high temperature. It is possible to gasify almost any fossil fuel, thereby product gases are obtained. Product gases could be used as fuel not only for producing thermal energy in everyday life, but also in various industrial processes. With a wide use of biomass gasification technology, fossil fuels can be significantly saved.

Despite of all positive aspects of *biomass gasification*, a high cost of obtaining alternative energy is one of the significant disadvantages. The reason for high costs can be explained by the fact that nowadays alternative energy sources are not developed yet and do not have mass distribution. That is why essential investing in them is more, sometimes even much more than in traditional one.

Moreover, there are some other obstacles which prevent wide development of this technology in Ukraine. Mostly they are low productivity of biogas plants due to the discrepancy between the qualitative parameters of biomass, transportation of biomass over long distances and restrictions in the preferences granting to reduce CO<sub>2</sub> emissions.

A large amount of researches in the underground coal gasification technology has been conducted at the Department of Underground Mining in the National mining university for the last 20 years. These investigations together with other alternative technologies are aimed at reducing the consumption of expensive natural gas.

Combining the borehole underground coal gasification with the proposed biomass gasification technologies is a quite promising trend in the alternative energy development.

Firstly, it will provide an opportunity to reduce the cost of purchasing expensive surface gasification equipment, because all thermo-chemical processes will occur under the ground simultaneously with coal gasification in place of its occurrence.

Secondly, the advanced technology of underground coal gasification was developed on a qualitatively new level within a closed sustainable cycle in order to solve the problem of ecological purity of this process.

To implement the proposed technology of biomass with coal gasification in Ukraine, it is necessary to make only certain adjustments to the existing technological schemes, where crushed biomass is fed into the gas generator through the controlled pipeline within the gasification channel, where its conversion into combustible gases is occurred. This will give an opportunity to get more energy and solve organic waste recycling problem in some regions of Ukraine.