

BIOMASS USAGE IN CHP UNITS

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ABSTRACT

This article deals with overview of biomass usage in combined heat and power units (CHP). The aim of the paper is to explain fundamentals of CHP units and heat and power generation with these units. Article deals also with basic requirements for connecting these blocks into power grid and differences in operation between decentralised CHP units and centralised power plants. In beginning of article the authors devote about basic principles of extraction fuel from biomass and with processing of biomass.

1. INTRODUCTION

One of base goals of energy policy SR is usage of renewable energy sources. The biggest potential of usage these sources in Slovakia has biomass. It uses almost any substance of biological origin for generation of thermal power or electric power. Combustion of pure biomass has advantages, that they does not pollute the environment, because low amount of carbon dioxide which is created by combusting is equal to amount which can same plants absorbs by their grown. In Slovakia is possible to obtain 40 453TJ by year from biomass and that is 46% of whole potential of renewable sources. [2]

Biomass is plant matter such as trees, grasses, agricultural crops or other biological material that can be used as a solid fuel, or converted into liquid or gaseous forms, for the production of electric power, heat, chemicals or fuels. Figure 1 clarifies the bio-energy chain from biomass origin to energy usage. [1]

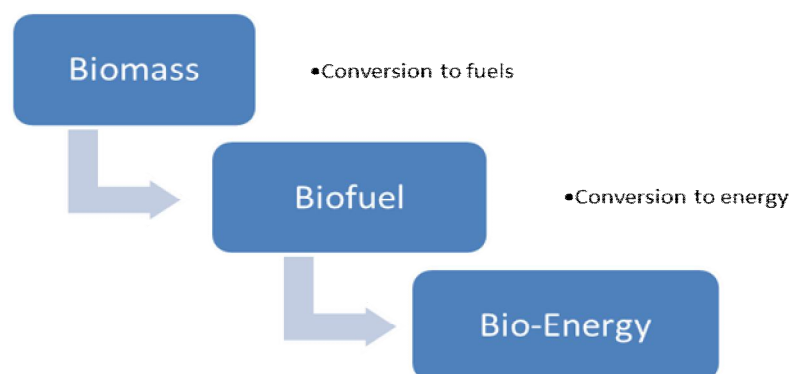


Figure 1 – Bioenergy chain [1].

Biomass energy, one type of renewable energy, is important from two perspectives: firstly, from the perspective of climate change and energy; and secondly, from viewpoint of a recycling society. Biomass energy is superior to other forms of renewable energy sources in its ease of storage and transportation. Promoting the use of biomass energy has potential to mitigate climate change, offer a sustainable energy supply, and achieve a sustainable and recycling social system for the future. [1]

2. PROCESSING OF BIOMASS

2.1. Types of biomass

By origin we can divide biomass to three groups:[2]

- Forest biomass – firewood (lops, roots, bark, sawdust)
- Agricultural biomass – cereal straw, animal excrements etc.
- Communal waste – solid combustible waste, landfill gas, sewer gas

2.2. Conversion technologies for power generation

Biomass conversion is about converting solid biomass into form that is usable for energy generation. Biomass conversion technologies can be divided into:

- Biological conversion (technologies of extraction and trans esterification)
- Chemical conversion (uses microbiological action to convert biomass material into usable fuel)
- Thermo-chemical conversion (involve heat treatment of the biomass)[1]

These methods are used to convert solid biomass feedstock into a form usable for energy production, because solid biomass can be utilised in direct combustion methods only. Figure 2 presents the main ways for power generation based on bio fuel. It starts from grouping of conversion technologies and resulting in technological alternatives for power generation. [1]

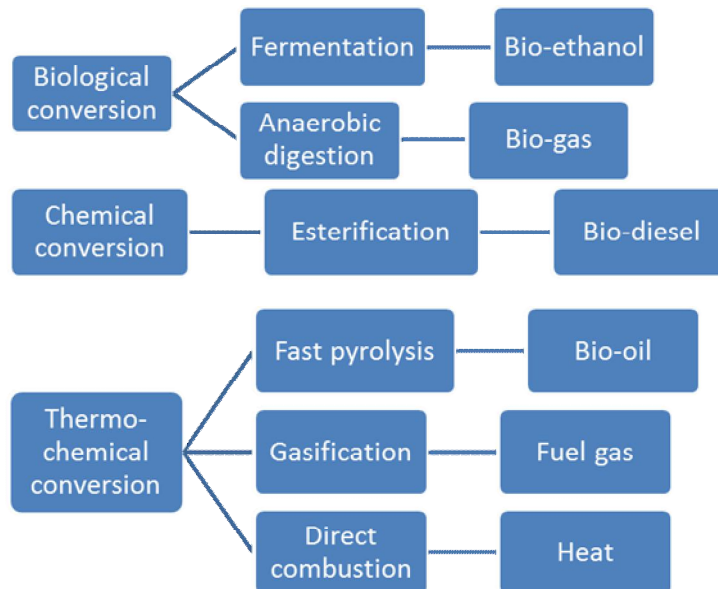
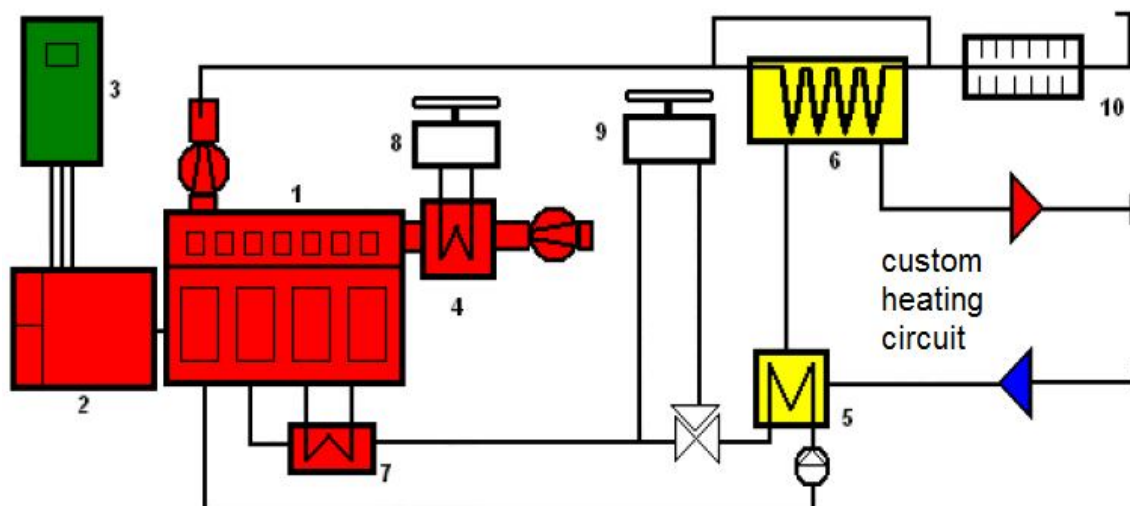


Figure 2 – Overview of main technological routes [1].

3. CHP UNIT FOR BIOMASS USAGE

Combined heat and power generation unit (CHP) can produce heat and power in same time. As a fuel can be used natural gas or bio gas. Except CHP units based on gas combustion engines, can be for process of combined production of heat and power used also other technologies. For devices with higher installed power are often used turbines. Less used are technologies based on organic rankine cycle or steam engine [2][3][5].

CHP units are suitable for distributed generation. Power of these units can be from 10 kW to few MW. Chemical energy of biogas is changed in CHP unit to 30% of electric power and to 50% of heat. It's important to mention, that from this reason is important to use this units only for combined generation. By optimal consumption of generated electric power and heat we can obtain efficiency of these units over 80%. On figure 3 is shown scheme of CHP unit. [2][4][6]



1 - block of combustion engine, 2 - electric generator, 3 - electric switchgear with control system (connection to power grid), 4 – intercooler of filling mixture, 5 – exchanger water/water, 6 – exchanger fumes/water, 7 – oil cooler, 8 – Cooling fan, 10 – Silencer

Figure 3 – The principal scheme of the cogeneration unit [2].

4. COOPERATION OF CHP UNIT IN POWER GRID

CPH unit can be connected to power grid by installed power in 0.4kV, 6.3kV and 22kV voltage level. Building of these units needs optimization of connection requirements, because of elimination of negative influences for operation of distribution system. Power plants or heat plants with CHP units are decentralised sources because of requirement of placement nearby heat circuit. In agricultural field of use of these units it isn't problem, because heat circuit is placed around CPH unit. But in urban areas for example, these unit must be placed as close as possible to heat circuits. In this case can be problem exactly with electric part of CHP unit, because of connecting these sources to power grid.[2]

5. CONCLUSIONS

One of biggest advantage of biomass is that can be obtained not only by targeted production of crops, but also like waste of livestock production, wood production and many other agricultural types of production. Biomass can be processed for specific use by some ways, such as biological, chemical and thermo-chemical conversion. So we can obtain fuels like bioethanol, biogas, biodiesel, bio oil and fuel gas. Every this product can be used in specific device like fuel and so we can get optimal efficiency of device.

One of possibility how we can utilize fuel products from biomass is combined heat and power unit. Advantage of these units is high efficiency up to 80%, which can be obtained by combined heat and power generation. This is also one of disadvantages, because usage CPH unit only like source of electric power is ineffective. So CPH unit must be placed near by some heating circuit where can be this heat energy used. These units are thus suitable for heat plants, where heat circuits are located nearby heat plant.

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