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Factors which influence the qualification of the electricity production in high efficiency cogeneration for biomass combined heat and power plants

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Abstract

The high efficiency cogeneration is promoted across European Union by support schemes that are applied in order to achieve energy policy goals of sustainability, security of supply and improved competitiveness. The paper presents an analysis of the factors which influence the qualification of the electricity production in high efficiency cogeneration for the biomass combined heat and power plants. The correct identification of the energy from the consumed biomass and the delivered useful heat, it is decisive for the high efficiency cogeneration.

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Keywords: High efficiency cogeneration; support schemes; green certificates; renewable energy sources (RES); organic Rankine cycle (ORC).

1. Introduction

Combined heat and power (CHP) production or cogeneration is significantly more efficient than separate production. Cogeneration greatly reduces overall fuel use, leading to lower emissions. There are various market instruments used by governments of EU Member States to support electricity production from renewable energy sources and high efficiency cogeneration [1,2].

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The simultaneous conversion into heat and electricity of energy from renewable sources or the waste heat from different industrial processes is a solution to reduce greenhouse gas emissions [3]. If the primary energy source has a lower thermal potential, as is the case renewable energy sources [4,5], can be used organic Rankine cycle (ORC), for cogeneration both useful forms of energy: electricity and heat.

The support scheme of electricity production from the renewable energy sources (RES-E) in Romania, combines the mandatory quotas with the trading of green certificates (GC). Directive 2004/08/EC on the promotion of cogeneration and Directive 2012/27/EU on energy efficiency, established the political framework that allows the expansion of the cogeneration implementation in the Member States (Directive 2012/27/EU; Directive 2004/8/EC).

Currently, there are different support instruments in the EU to stimulate the production of electricity from renewable energy sources. Romania has opted for mandatory quota system and green certificates (GC). In the case of biomass, the support scheme provides 2 GC for each MWh delivered to the public network and additional 1 GC if the electricity is produced in high efficiency cogeneration.

2. Analysis of a cogeneration plant with ORC technology and biomass fuel

The principle thermal scheme of the cogeneration plant with organic Rankine cycle (ORC) and biomass fuel is shown in Figure 1. The technical characteristics in the nominal conditions of the biomass CHP are: electrical power 1.3 MWe and thermal power 5.4 MWth.

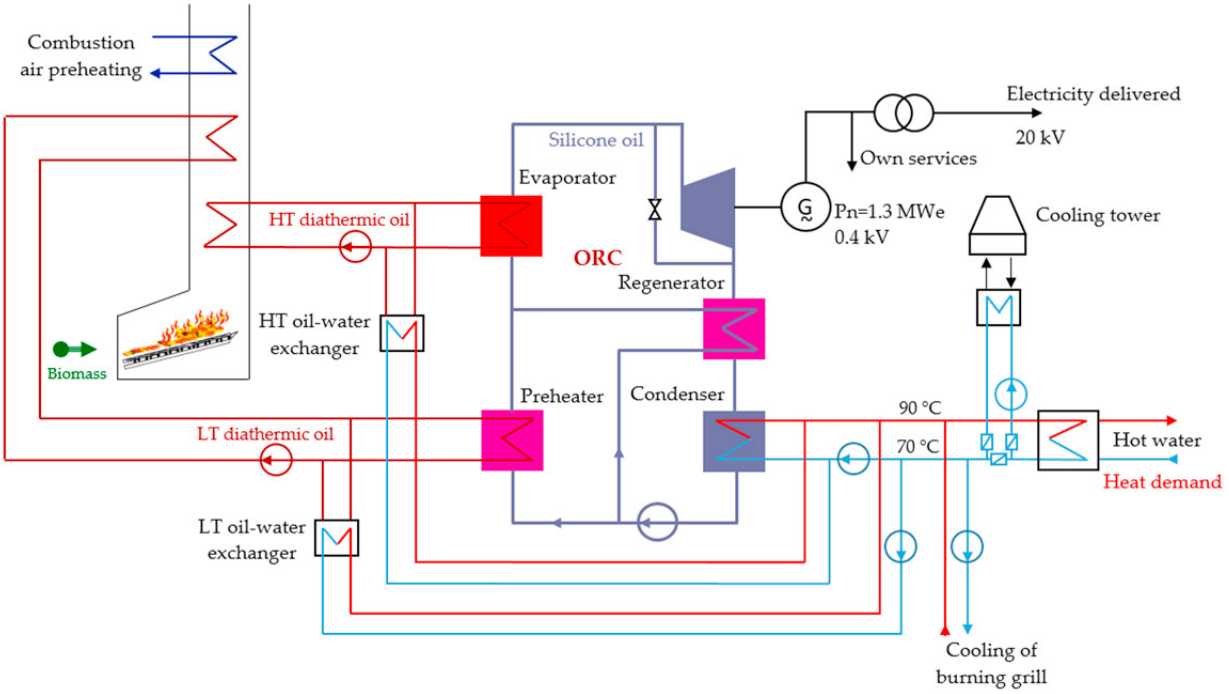

Fig. 1. The principle thermal scheme of the CHP unit with ORC technology.

The main fuel is the biomass (without burning fuel support) and it comes from the primary wood industrialization (wood chips, bark, sawdust) and biomass from agriculture (straw). Heat delivered by the cogeneration plant is mainly used for industrial purposes (dryers for wood) and a small part for heating administrative buildings and production.

The qualification of electricity production in high efficiency cogeneration for a cogeneration unit is based on the primary energy saving compared to separate production with alternative technologies in similar conditions and the same amounts of useful heat and electricity [6]: