04–2014
ISSN 2192-158X

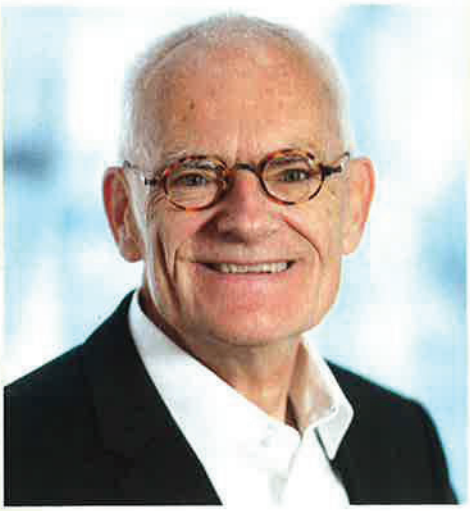
www.gas-for-energy.com

gas for energy

Magazine for Smart Gas Technologies, Infrastructure and Utilisation

IGRC 2014 summary

DIV Deutscher Industrieverlag GmbH



Reports

WHR innovative technogy – intelligent energies

by **Imrich Discantiny**

Renewable energy source technology solution is aimed to change the manner and system of flue gas processing, generated in the combustion process in heat plants, cogeneration units, power plants etc., which burn the gaseous fuel, primarily natural gas, or methane, biogas, geothermal gas, or other gaseous mixtures containing hydrogen. The solution proposes a more effective and non-traditional use of gaseous fuel for heating, the flue gases of which are processed in order to extract additional utilisable heat, with potential elimination of CO_2 from them.

The purpose of these solutions is to seek solutions aimed to achieve optimal enhancement of the whole boiler facility´s efficiency, to support the solution of existing environmental challenges, i.e. climate changes, reduce greenhouse gas emissions by 60 % until 2050, and to provide generation of „cleaner" heat and electricity in central heat production plants.

1. UP-TO-DATE TECHNOLOGY CONCEPTS

Generally known are the gas boilers that utilise condensation heat and operate in such away that the heating medium in the recurrent sleeve has a temperature that is sufficiently lower that the dew point, which is under regular combustion conditions less than 57°C. The temperature of the heating medium in the recurrent sleeve of the boiler should vary between 35 to 40°C. Such solution is not practicable in a central heating system, where the heat plant uses in the recurrent sleeve much hotter medium.

The well-known connection pattern used for introducing thermal condensers into the flue gases circuit has dis-

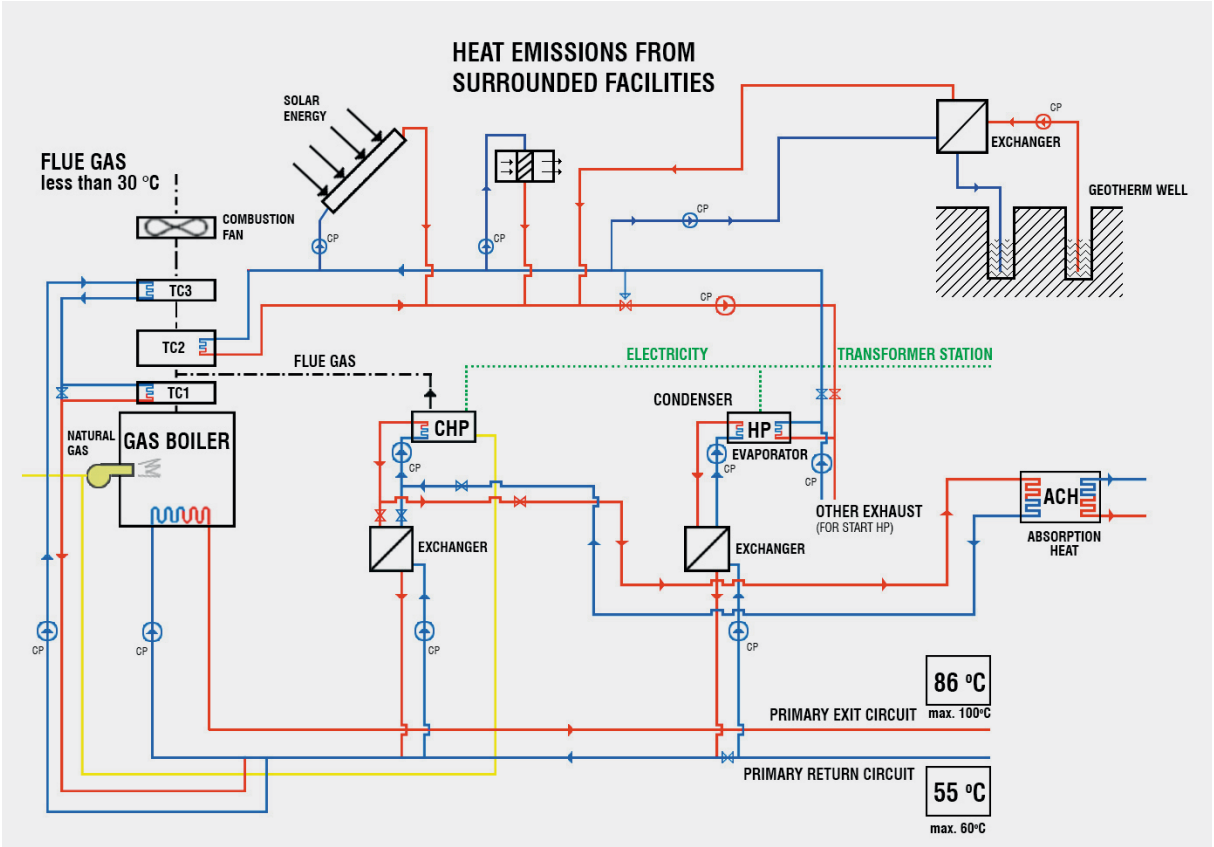


Figure 1. Scheme.

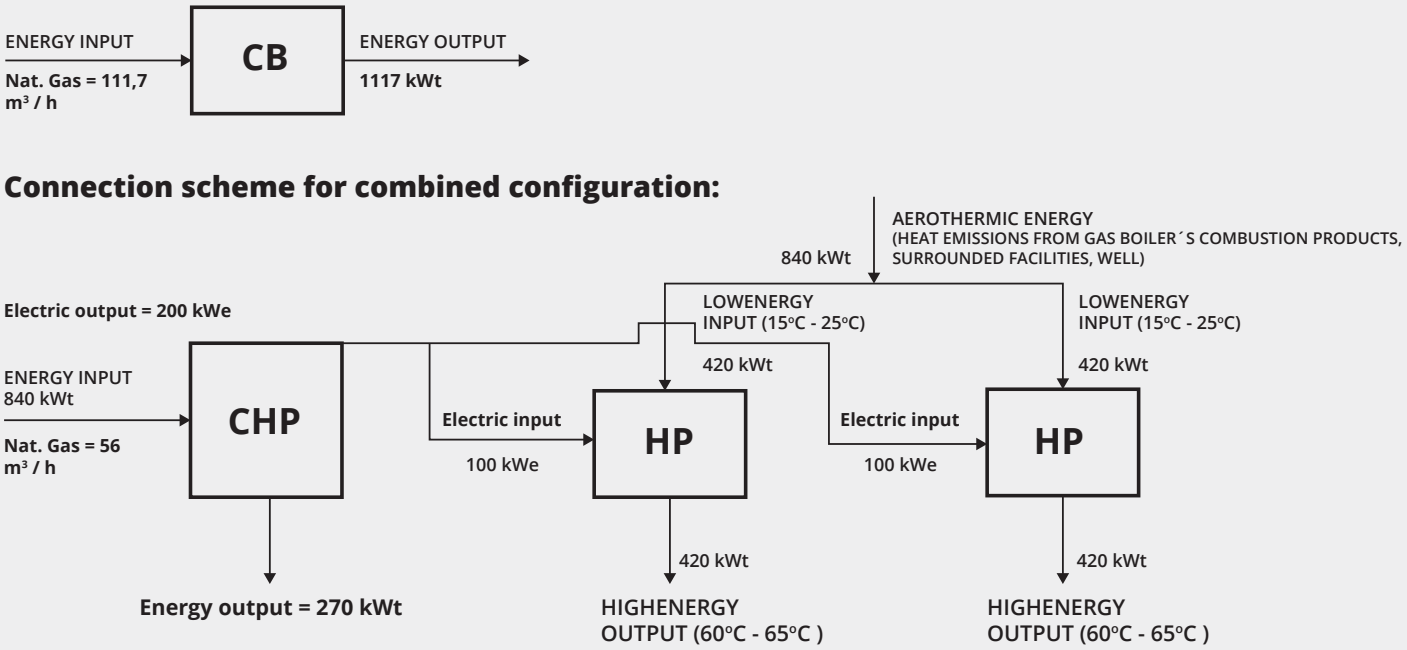


Figure 2. Comparative Diagram of Natural Gas Consumption: Comparing the economic efficiency of a system, combining CHP simultaneously with heat pumps versus gas-fuelled condensing boiler:

Savings:
Incoming energy (NG) savings .....55,7 m^3/hr
Annual (8000 hour operation): 445.600 m^3 NG, approx. 147,000 Eur/Year.

advantage in that flue gases could not be cooled below the temperature in the recurrent sleeve. The partial condensation starts already at the flue gases temperature less than 70°C, however the effective use of the specific latent heat starts only at the temperature below the dew point. The more effectively we achieve the cooling of the flue gases with more intensive course of water vapour condensation, the more residual heat we can utilise.

It is necessary to find a solution that allows at different, and even higher temperatures in the recurrent sleeve, cooling down of the flue gases and uses them for heating, whereas at the same time a higher degree of flue gases cooling would allow effective separation of CO_2 .

The shortcomings of the existing technology concepts are substantially eliminated by the method of processing of flue gases that are generated through burning the gaseous fuel in the heat source.

2. WHR TECHNOLOGY

The boiler room circuit layout shows clearly that the heat from thermal condenser goes to the heat pump, where it efficiently heats the heating medium in the recurrent sleeve. The heat source – cogeneration unit produces electricity, a part of which is subsequently used to run the heat pump.

The flue gases that emerge through burning of the gaseous fuel, after leaving the thermal source in thermal condenser (TK1-TK3) are cooled to the temperature that is lower than the dew point of flue gases, and at the same time lower than the temperature of the heating medium recurrent sleeve. The thermal condenser cooling circuit is not directly connected to the heating medium recurrent sleeve.

This cooling is permanent, and it is accompanied with a high degree of water vapour condensation that causes drying of vapours. The process has two mutually combinable advantages – it releases heat and at the same time it makes possible the elimination of CO_2 from died flue gases. The CO_2 separator device could be connected downstream from condenser TK2.

The thermal condenser is a specific type of heat exchanger, which is modified in order to cope with aggressive condensate, precipitated from flue gases. In the flue gases circuit the thermal condenser is connected as a heat source for heat pump (or for CO_2 separator), which is owing to its high effectiveness COP value (3.8 -4.5) an important component enhancing the energy efficiency of the whole technology system to 115 %.

Within the absorption unit (AU), connected to the cogeneration unit heat circuit, takes place efficient trans-

formation of produced heat (made in cogeneration unit) into cold (6 – 12 °C) at the temperature mode 90/70 °C, where the waste water (40°C) could be used to preheat the incoming water in the production of warm service water.

Unused volume of flue gases is pushed by the flue gas fan in dry condition (approximately 30°C) into the chimney, since the condensing stage removed the condensed H_2O with high amount of NOx emissions into sewage.

The fields of application of WHR technology include central heating sources (boiler rooms, heat exchanger plants), water treatment plants, industry sectors with a permanent heat/cold offtakes (e.g. steelworks, etc.), wellness centres, swimming pools, geothermal springs, schools, hospitals, administrative buildings, institutions, etc.

Achieved benefits of WHR technology are: lower consumption of incoming medium with lower costs, profit from production and consumption of electricity, overall reduction of required maximum system output (approximately less by one gas boiler capacity), permanent utilisation of condensation heat from gas boiler flue gases, separation of NOx from flue gases , reduction of generated volume of CO_2 emission quotas by approximately 14 %, enhanced energy efficiency of the technology up to 115%.

Pay-back period depends on an existing system, industry sector, heat and electricity consumption. Based on 4-year-operating experience in the heat production plant operated by our partner company COMtherm, Komárno (Slovak Republic) the pay-back period does not exceed 4 years.

Literature

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[2] *MacKay, D. J.C.* : Sustainable Energy - Without the Hot Air(2008)

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