OPTIMIZING OF COGENERATION UNIT INSTALLATION

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ABSTRACT

The work deals with usage of heat energy from cogeneration unit in a family house. It is focused especially on the use for family house's heating and warming of service water. Optimalization is made on existing cogeneration units. Heating energy is used for heating of the family house. In thermal circuit we will deal with optimization. It is a complete reconstruction of the thermal circuits in the family house.

1. INTRODUCTION

Cogeneration unit is located in the building adjacent to the family house. Cogeneration unit consists of Zetor internal combustion engine and asynchronous generator. Accumulation tank is used to accumulate heat energy. Exchanger is located in the accumulation tank. Exchanger is connected to the heating distribution in a family house. Accumulation tank is also a source of heat for house hot water. Cogeneration unit operates for more than ten years. We will try to optimize the cogeneration unit primarily for the use of thermal energy. Price of electrical energy does not cover operating costs of a cogeneration unit. For efficient operation of cogeneration unit it is necessary to use the waste heat energy.

2. COGENERATION UNIT MT45

We focus on basic parameters of a cogeneration unit. We determine the current technical status of the cogeneration unit. We focus on thermal circuit diagram and the possible ways of using waste heat in detail. We focus on various operational states of cogeneration unit in different seasons.

2.1. BASIC INFORMATIONE

We introduce basic parameters of a cogeneration unit. Cogeneration unit has the same internal combustion engine and generator as a cogeneration unit TEDOM MT45. Parameters in Table 1 are valid for natural gas with lower heating 34MJ/m3. Cogeneration unit has motor Zetor 1001.03 G. Asynchronous generator is the second part of machine unit. Cogeneration unit is home-made. Individual parts were purchased separately and then were assembled into one unit.

Type	MT 45
Electric power	45kW
Heater power	60kW
Fuel consumption	16.4m^3/h
Electrical efficiency	29.0%
Thermal efficiency	52.0%
Fuel efficiency	81.0%

Table 1: Parameters of a cogeneration unit

Cogeneration unit has an accumulation tank of the size of 5.6 m^3. Accumulation tank contains water with a volume of 5.4 m^{3}due to water expansion during temperature changes.

2.2. PROPOSED NEW HEAT CIRCLES

Thermal circuit was constantly changed. Thermal circuit was changed depending on the source of thermal energy. Thermal circuit was extended but its effectiveness was reduced due to frequent changes. The last source of thermal energy is cogeneration unit. During operation of existing thermal circuit was a problem with sufficient heating of a family house. Thermal circuit was thus reconstructed.

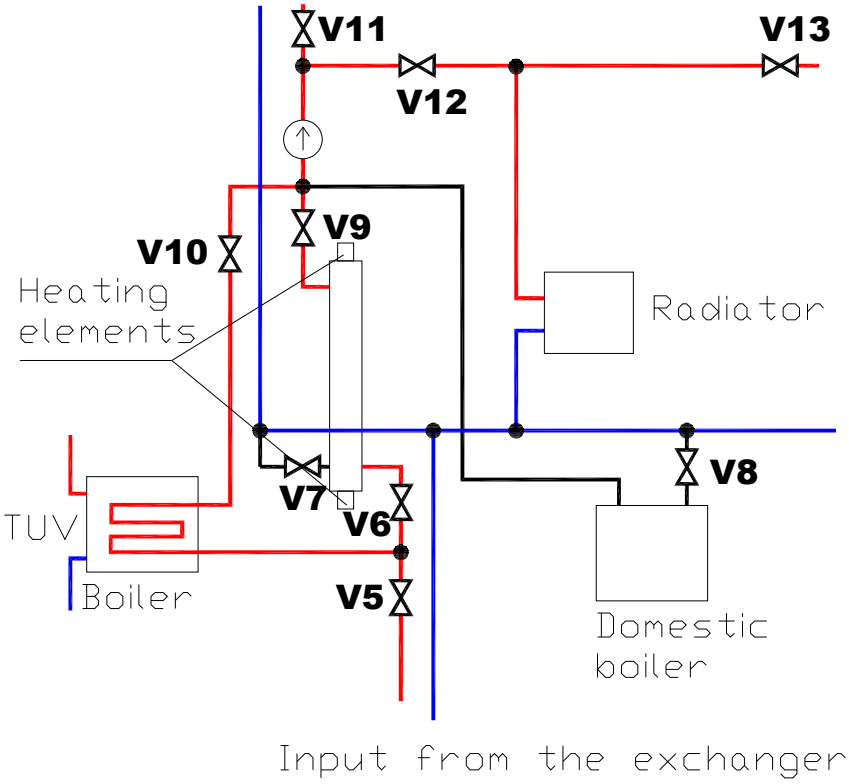

Figure 1: Diagram of a thermal circuit in a family house

3. OPTIMIZING THE OPERATION OF A COGENERATION UNIT

Simulation of a cogeneration unit is performed with the program Matlab-Simulink. Simulation is performed for winter operation, when the thermal energy consumption is greatest. Simulation was performed for an average winter day, when the cogeneration unit supplies heat into the accumulation tank. Losses are included in the calculation as constant. Heat consumption for heating is simulated by a fixed constant. Heat consumption for boiler simulates the curve, which corresponds to daily consumption.

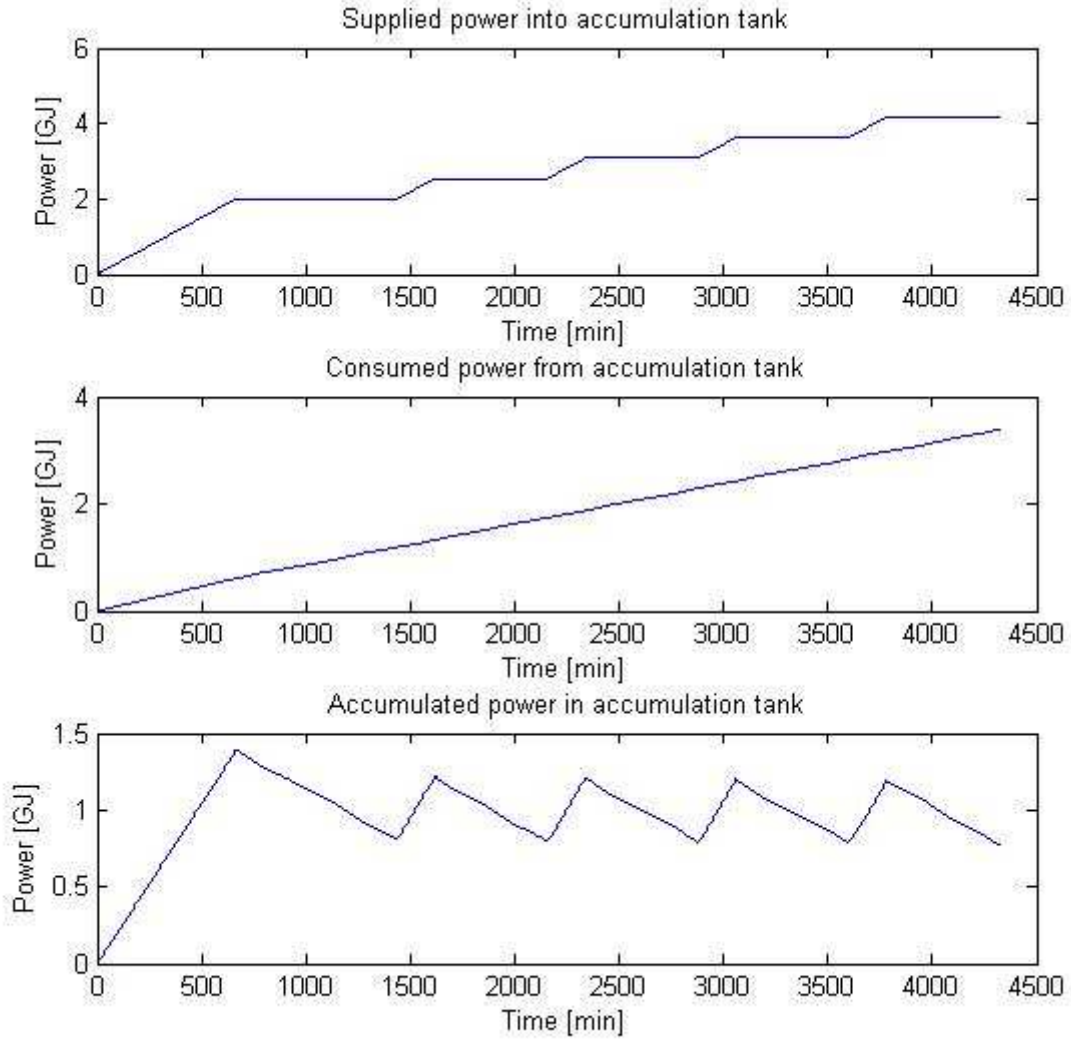

Figure 2: Accumulation tank in the winter

Individual heat powers of cogeneration unit are in the picture. The initial conditions at the storage tank are 30 ° C. Accumulation tank must be heated to operating temperature. Cogeneration unit shall be paid back only if we use produced heat. Thermal circuits can be operated only manually. Cogeneration unit must work during the large frosts a long time or we have to use electric heat for reheating thermal circuit.

Another option is to operate a cogeneration unit during the summer. Heat energy is consumed for heating of water. Cogeneration unit works only for a short time, or once in several days. For the simulation we chose every day operation for a short period. Other losses of heat energy are caused by losses in accumulation tank and by losses in heat circuits, which are connected to family house.

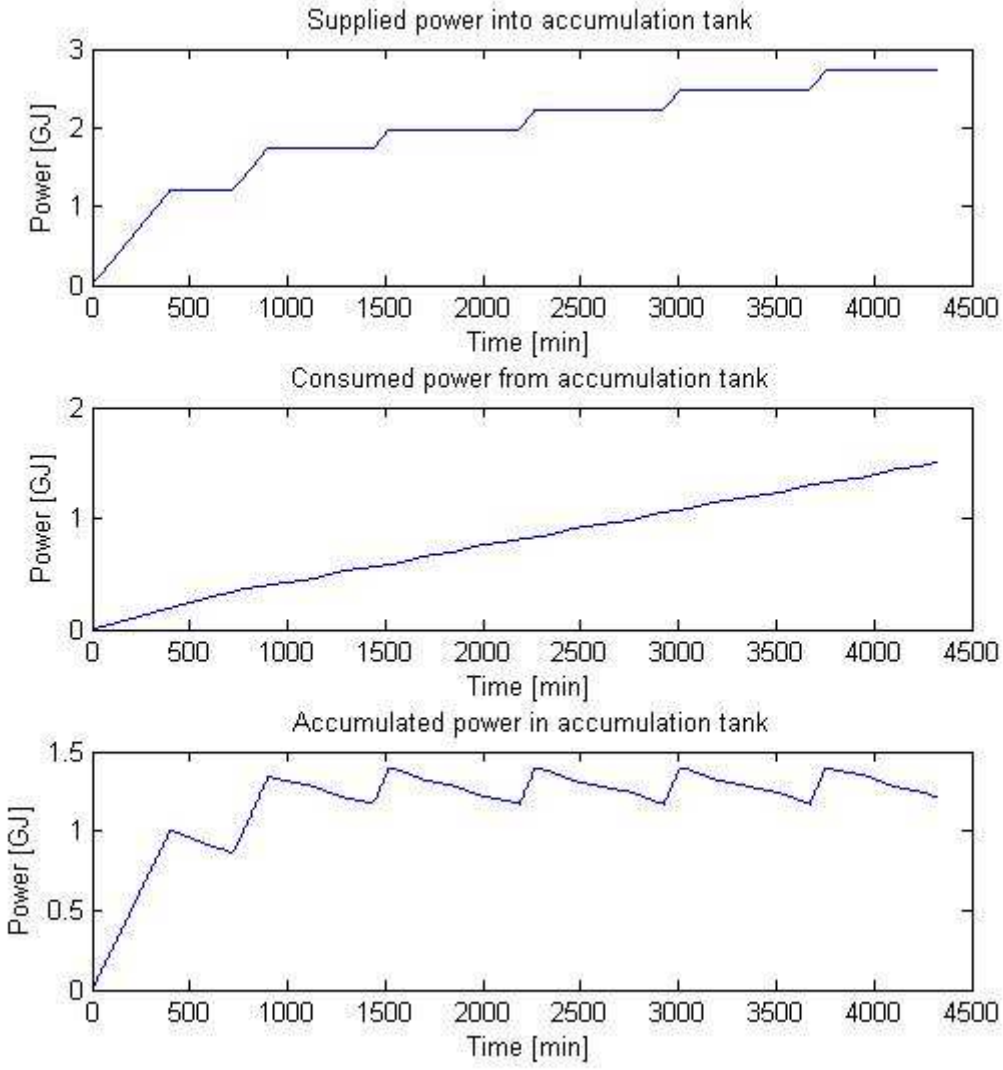

Figure 3: Accumulation tank in the summer

In the figure we can see heat characteristics in accumulation tank. There is shown that the cogeneration unit is operated for short time periods. Amount of supplied heat is smaller, then in winter period. Another advantage during the summer operation lies in the ability of using heating elements for heating, which are located in boiler room of the family house and cogeneration unit can be shut down.

4. CONCLUSIONS

The aim of the optimization was to increase the ability of regulation of heating circuits from cogeneration unit and to insert the boiler into the circuit. Within the optimization we

inserted heating elements into the circuit to have a backup source of thermal energy. Optimization was performed because of changing the operation of cogeneration unit. In previous operation was this cogeneration unit used primarily for produce of electrical energy. Heat energy was used ineffectively for heating of the family house. With decrease of redemption price of electrical energy, produce of electrical energy stops to be valuable. By this reason there was realized the reconstruction with the aim of better use of heat from the cogeneration unit.

After optimization of thermal circuit we have a better use of thermal energy. Accumulation tank insulation is better, because the family house consumption sufficiently cools the accumulation tank. Thanks to the optimization of a cogeneration unit it can be operated for shorter time. Reducing of operating time slightly reduces heating costs. The total financial cost of reconstruction was 1,120 EUR. This amount counts only material costs and stainless steel tank (520 EUR) for house hot water.

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