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DIGITAL MODEL OF HEATING SYSTEM FROM "GREEN ENERGY"

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Abstract

One of the ways to reduce the pollution of nature is to increase the share of "green" alternative energy and more efficient technologies in the field of its extraction and using in the household as heating. The application of the best technology, available from industry, can substantially reduce the generated waste and significantly improve its recycling or utilization.
In this article, with the creation of the digital model is shown correlations in terms of more rational use of different types of "green energy" from RES.
The main idea in the application of various types of renewable energy is the opportunity to reduce greenhouse emissions and their generation.

***Key words**: RES, green energy, digital models, process simulating.*

INTRODUCTION

The method of modelling represents by itself a complex process of research, including in observation, experiment, analysis, synthesis and etc. The essence of the method consists in the fact that the study of the object is done with the help of devices (machines, stands, appliances etc.), replicating its behaviour and, consequently, transferring the results of the model to the original.
The modern theory of similarity and modelling is the connecting link between the theoretical and experimental methods for the study of natural phenomena. In a broad sense, she provides a certain approach to planning research, processing and summarizing experiment data, and predicting the behaviour of the subject under study (Stanev, 2003; Komitov, 2003).
A basic concept in modelling is the term "model". In the modern science of modelling he is simplified system, with substantial material or abstract character, which reflects the distinct but important properties of the target object, called the "original".
From this definition it follows that with the help of the models the researchers can study specific phenomena and processes occurring in the original. The research (theoretical or experimental) itself is done on or through the model. Therefore, the value of modelling as a scientific method consists in the fact that the researchers studied the original, representing a complex system, through simpler and more accessible for research object, reflecting the most important and the most characteristic features of the original. In fact this is the reason why today modelling in all its variations is used as a primary method of scientific knowledge (Stanev, 2003; Komitov, 2003).
In order to obtain certain correspondence between the model and the original, the conditions for physical modelling should be chosen in a special way. The degree and character of similarity between the model and the original is accomplished by "criteria of similarity".
The necessary and sufficient conditions for the lines of the model and the original are based on several important principles, known as theorems of similarity (Komitov, 2003).

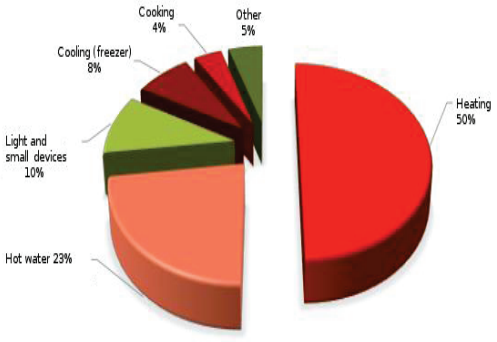

Figure 1. Household energy consumption

The analysis of energy consumption shows (Figure 1) that most of the household expenses are those for heating (50%) and hot water (23%). These costs are over 70% of all household expenses. Of utmost importance is the type of energy, equipment and efficiency of the system (Mitkov, 2017).
The research on heating systems requires a serious resource. Therefore, the idea of getting a digital model is quite attractive.
The reverse task of the theory of modelling is used.
It can influence and to set different modes, such as keep track of the status of the object in different working modes without the presence of a real original.
Subsequently, the digital model can be realized with specific real elements.

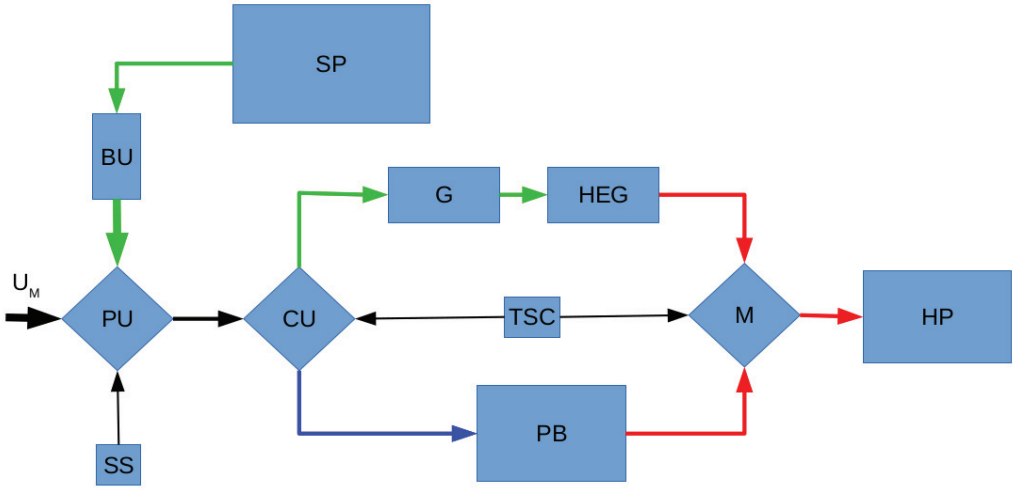

Figure 2. Principle scheme of digital model for heating system from „green energy":
SP -solar panels; BU -battery unit; PU -power unit; U_M -mains voltage; SS -solar sensor; CU -control unit; G -HHO generator; HEG -heat exchanger for HHO gas; PB -pellet boiler; M –mixer; TSC -temperature sensor of coolant; HP -heating part (radiators)

MATERIALS AND METHODS

The basis of the current digital model is the power source.
Under the Paris Agreement and the commitments of our country to protect the environment is recommended this energy source is renewable.
The model provides usage of two types of RES - waste from agricultural production and solar energy, from which produced the combustion gas.
The main elements of the current model (Figure 2) are:

- energy sources for heat generation - basic and auxiliary;
- power energy sources - solar panels with battery unit and mains voltage;
- control circuits - for the power supply and the heating source with sensors;
- consumers.

The principle of this model is as follows:
The HHO gas is the primary heat energy source in the system. It is derived from water molecules, therefore it belongs to the energy from RES. HHO gas is obtained by electrolysis in a special generator (cell), which converts the molecules of water in a convenient to use gas, according to Figure 3.
It contains two parts of gaseous hydrogen and one part of oxygen in a certain volume (modification of the physico-chemical and energetic state of water, changing the connections between the isotopes of hydrogen and oxygen (Mitkov, 2017).

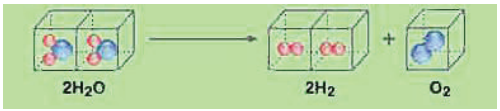

Figure 3. Structure of HHO gas

When burning, the heat is released and warmed up the coolant. The temperature in the combustion of HHO gas is high.

For receive the gas is used HHO generator (G). The generator works on the principle of electrolysis. The base for obtaining of the generator's electrolyte is KOH. The generator itself, when supplied with electric voltage, converts the water's molecules and releases flammable gas. The quantity of the gas depends on the size of the platters of the generator and the power of current. After it is mandatory should be install a water filter and the gas is fed to the burner of the gas for burning and heat generation.

The burner is mounted directly on the heat exchanger (HEG). The heat exchanger is necessary for receiving a good heat exchange between the heat from the combustible gas and the coolant. In such systems, usually the heat coolant is water with a temperature of about 60°C.

The alternate (second) version of heat source is heating boiler on pellets.

It complements the work of the primary energy source and if necessary, replaces it. The waste of agricultural productions is collected from the field and processed in the form of pellets on known technologies. Already the finished energy product shall be submitted to the pellet boiler (PB). In it, they burn and give heat to the heat exchanger built into the pellet's boiler. For the process, the pellet boiler is equipped with a pellet burner operating in the maximum efficiency mode. Thanks to it, the heating process is automated. It can work at a specific time or in accordance with a specified program to maintain the temperature of the coolant to the heating system.

One of types for system power supply is realized through the solar panels and the battery unit. The energy that results from solar radiation is captured by solar panels (SP). They are made from organic polymers or semiconductor's nanocrystals. The solar panel works on the principle of the photoelectric effect. Usually they work in the range of 24-48 V. In the specific case the operating voltage is of 24 V. With connecting of two panels is achieved a nominal current of 20 A. The energy obtained this way is a clean green energy, which, however, should be used and stored in an appropriate manner. The solar panels, sell in the market, are equipped solely with inverter for the connection.

For storage and smoothing the pulsations of obtained energy, is used the battery unit (BU). When there is sunshine, solar panels charge the battery unit. In need of power they supply electricity to the consumer.

The other type of power supply is mains voltage. It is realized through a standard voltage U_M - 220 V. If necessary, it is consumed energy from the electricity network, necessary for the maintenance of the heating system in the operating position.

One of the control circuits is the power supply unit (PU). It is aimed to determine when to use network power supply or solar panels. By priority, the main power supply is from solar panels, and in a bit of sunshine and low supply voltage from battery unit, it is switched to network power.

In order to determine the intensity of the light, to the control circuit of the power supply unit is installed the solar light sensor (SS). At low light intensity, usually in the dark of the day and in cloudy weather, the value of the sensor gives the power unit reason to switch to network power.

Another control circuit is that of the control unit (CU). It keeps track of priority of used energy sources-HHO gas or pellets and switches the operation mode. If necessary, the control unit can exclude completely one of energy sources or mutual complement them. To be able to carry out its management functions, the control unit takes the signal from the power supply unit and monitor the temperature of the coolant through the temperature sensor (TSC).

Depending from the values of temperature sensor, the different energy sources are switched and their work is managing.

The third control circuit is that of the mixer (M). It has the aims to switch the coolant to the working heat exchanger. In the mixer it is summing of heat from the two energy sources and is controlled by the temperature sensor. If

necessary or low temperature, the mixer can ensure coolant circulation in the loop of energy sources to produce a determined temperature. In this case, the system does not give up heat.

To realize the system is needed a heat consumer. The last link in this system is the heating part (HP). It consists of a pipe network and heating radiators, attached to it. The making method of heating part is irrelevant to the system. The heating part is a consumer of the produced heat energy. It can be maintained a number of other consumers, such as buffer tank and boiler for hot water.

On the basis of the proposed digital model, it has been developed a model (in "MATLAB SIMULINK" environment) to illustrate the work of the system and to simulate of different working modes.

CONCLUSIONS

The proposed digital model is an adequate one for a heating system of "green energy" type. The proposed model fully reflects the work of the system.

In the proposed model are used two types of alternative renewable energy sources. The system considers the joint use of the two types of energies.

REFERENCES

Komitov G.G., Stanev L.G., Staneva G.L., 2003. Konstruktivno-tehnologichni osobenosti na mashina za izpitvane na triene i iznosvane pri vazvratno-postapatelno dvizhenie. Proceeding of scientific paper. Vol (1), Forest research institute, Sofia, pp. 423-428.

Mitkov I., Komitov G.G., 2017. Possibilities of using HHO generator as renewable energy for buildings heating. Proceeding of University of Ruse-2017. Volume 56, book 1.1, Ruse, pp. 73-78. Stanev L.G., Komitov G.G., 2003. Otnosno nyakoi harakterni osobenosti pri modelirane na procesa na triene i iznosvane pri vazvratno-postapatelno dvizhenie. Manufacturing engineering and technology no 2/2003, Technical University-Varna, pp. 160-162.

Stanev L.G., Komitov G.G., 2003. Otnosno nyakoi harakterni osobenosti pri modelirane na procesa na triene i iznosvane pri vazvratno-postapatelno dvizhenie. Manufacturing engineering and technology no 2/2003, Technical University-Varna, pp. 160-162.