

System of unattended order of fuel biomass to automatic boiler room

MARIUSZ CYRANKOWSKI, JACEK WILKOWSKI, JAROSŁAW GÓRSKI, KAROL SZYMAŃSKI, PIOTR PODZIEWSKI, BARTOMIEJ SZYSZKO

Faculty of Wood Technology, Warsaw University of Life Sciences - SGGW

Abstract: “*System of unattended order of fuel biomass to automatic boiler room*”. The purpose of the paper was to design and build a model of the device being able to automatically control the level of biomass in the storage tank of the boiler room. The device measures in the real time the level of biomass and after reaching the preset alarm level, sends order to the supplier.

Keywords: biomass, automation, measurement probe, telemetry module

INTRODUCTION

For centuries, people have used solar energy stored by photosynthesis in chemical bonds. The first fuel was wood, then more calorific and high-performance fuels, such as coal and oil, began to be used. However, for some time now because of the fight against carbon dioxide emissions, the cellulosic fuels come back into favor. Their use is conducted in two ways - in cogeneration in the largest power plants and as a primary fuel in municipal district heating plants and private boiler rooms. (Gradziuk et al., 2002)

While one can dispute about the ecological and economic justification of cogeneration, it seems that the use of renewable wood mass of all types on local markets is beneficial. The previously conducted modernizations of municipal heating plants give very good results. As an example one can present two modernizations of two objects in Kępice commune in Pomorze district. In the year 2000 a boiler room in Kępice was commissioned, used from 1981. One has replaced the coal boilers with the total power of 3,5 MW with wood biomass boilers with the power of 4 MW. The costs of heat gain have decreased from 528,7 thousand to 366,5 thousand. The situation is similar in Biesowice. Coal boilers with The costs of fuel purchase have dropped from 99,933 thousand to 41,000 thousand. The environmental fees are also five times lower.

All currently mounted heating systems are equipped with fully automatic control of the combustion process, from the fuel supply to the control of the amount of air necessary for optimal combustion of the fuel. The final aspect that requires automation is the process of supplying warehouses of the boiler rooms with heating fuel. The designed and presented system allows for the creation of fully automated and unattended boiler room. The only thing for man is to realize the order sent by the system, or to provide the required amount of biomass to the warehouse. However, this operation also will be limited to pneumatic handling of pellets or installing a special container with wood chips from local suppliers.

MATERIALS AND METHODS

The basic assumption was a system for biomass of loose character of wood origin, i.e. wood chips of forest and agro origin and machining waste. The system is dedicated for use in heating installations of central heating and hot water with a power of a few megawatts, e.g. in public buildings. It is also possible to adjust the device for operation in boiler rooms of single family houses.

General design assumptions of the prepared system:

In order to design an optimal and universal configuration of the system, the following assumptions were made:

- Possibility of operation with various types of tanks (size, shape, performance technology);
- Remote reporting on the state of the storage material at preset levels;
- Ability to check inventory by "querying" the measuring equipment;
- Small size of the finished device;
- Ease of installation;
- The system allows the application of sensor lights instead of the depth finder;
- The ability to expand the system with additional functions.

Power supply

An element which requires a direct supply is the telemeter module. It may use the voltages from 9 to 30 V DC. Other elements, i.e. depth finder and indicator are supplied from the current loop 4-20 mA. For the system supply one has selected the power supply MDR-20 with an output voltage of 24 V DC. It is a modern industrial power supply suitable for mounting on DIN rail. Its biggest advantage is the built-in protection against overload, short circuit, an increase in tensions and overheating. This is important because of the use of the electronics.

If there would be a need to supply the system with an alternative source it is possible to use a module with battery that is loaded with a solar panel or wind turbine.

Digital indicator Shimaden SD16

The indicator is an ancillary element of the system. It is mounted in the housing of the cabinet so that the display is visible from the outside. Indicator is connected to the 4-20 mA loop with the depth finder and after scaling it will display a percentage scale level in the tank. This makes it possible to read the level without "querying" the telemetry module. It is also possible to program two alarm thresholds that can be connected to the binary inputs of the telemetry module.

Depth finder Vegapuls 62

For the project execution one has used the depth finder Vegapuls 62 by Vega. It is a pulse radar dedicated to bulk materials. Its most important feature is the biggest signal strength on the market, which is particularly important in measuring wood-based materials with very low dielectric constant. These devices are also characterized by simplicity of installation and programming, durability and availability of Ex version - approved for use in hazardous areas (dust). When programming the finder, one selected the type of measured medium and type of tank, one can also identify and save the constant arising interferences e.g. due to the construction of the tank, which the finder will later ignore during measurements.

In assumption, the Finder cooperates with D100 antenna with a length of 100 mm, which guarantees the highest quality of measurement.

GSM Inventia MT-021 module

Due to the design assumptions, data, in this case, of reports on the level of biomass must be carried out wirelessly and over long distances. This suits the needs of telemetric module, being able to send this information via SMS or e-mail via the GSM network. An important information is the fact of use of GSM network, so the investor does not need to build additional communication network, and access to a cellular network exists throughout the country. In the proposed device, one uses telemetry module from Polish company Inventia. Telemetry Module MT-021 with built-in GSM modem is a device dedicated to the

needs of remote monitoring, diagnostics and remote control of objects using data packet (GPRS), text messaging (SMS), e-mail or calling. Remote access to the resources of the module is feasible using standard Modbus RTU protocol or using a free communication controller MTDData Provider.

The system does not need an additional computer for proper operation. The MT-021 communicates directly with the depth finder, the alarm thresholds are programmed in the memory of the module. It is even possible to reprogram the module via SMS.

The purpose of the model is to show the possibility of informing about the change in biomass level. The 100% and 80% markers refer to the filling of the tank and can provide information for the administrator to accept the delivery. The programmed level at which it should place an order for delivery is 40%. In fact, this level should be estimated on the basis of the size of the tank, the planned consumption, completion date, etc. The level of 10% is the alarm informing about the lack of delivery and allows manager of the boiler room to react in time. The electrical wiring diagram is shown in Figure 1.

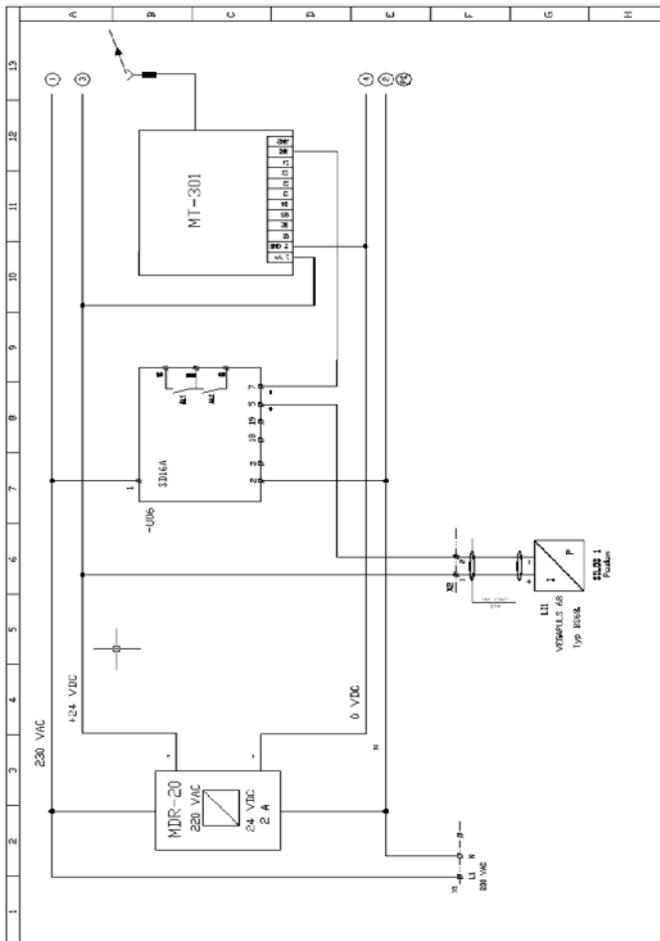


Figure 1. Electrical wiring diagram

Programming of the measurement system elements

Programming of the depth finders by Vega is possible using two methods:

- PLICSCOM module fixed directly to the finder, enabling manual configuration of the device thanks to context menu.
- VEGACONNECT module and PACTwear program allow to connect the finder to a computer via USB or RS232 and program the same parameters as by PLICSCOM.

CONCLUSIONS

This project constitutes a part of a general trend of modernization and introduction of modern technologies for the construction and operation of buildings, both residential and utility. The public awareness of the need for proper thermal insulation of buildings, more efficient use of heat sources and energy efficiency is increasing. This optimization is achieved, inter alia, by automating most of the processes involved.

The designed device can soon become a part of a larger system of energy production from renewable sources. Focusing on the use of locally available biomass resources provides opportunities for the development of farms producing the raw material. Prevalence of the local biomass use will actually make it a source of green energy by eliminating unnecessary transporting it over long distances - which is a source of additional CO₂ emissions and significantly interferes with the final balance of emissions.

REFERENCES:

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Streszczenie: *“System bezobsługowego zamawiania biomasy opalowej do automatycznej kotłowni”*. Celem pracy było zaprojektowanie i zbudowanie modelu urządzenia, będącego w stanie samoczynnie kontrolować poziom biomasy opalowej w zbiorniku magazynowym kotłowni. Urządzenie mierzy w czasie rzeczywistym poziom biomasy i po osiągnięciu zadanego poziomu alarmowego wysyła zawiadomienie do dostawcy.

Corresponding authors:

Mariusz Cyrankowski, Jacek Wilkowski,
Jarosław Górski, Karol Szymański,
Piotr Podziewski, Bartomiej Szyszko
Faculty of Wood Technology,
Warsaw University of Life Sciences - SGGW
159 Nowoursynowska St.
02-776 Warsaw ,Poland
e-mail mariusz_cyrankowski@sggw.pl
e-mail: jacek_wilkowski@sggw.pl
e-mail: jaroslaw_gorski@sggw.pl
e-mail: karol_szymanski@sggw.pl
e-mail: piotr_podziewski@sggw.pl