Heat supply system computer laboratory stand development

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Abstract. The process of developing a virtual laboratory stand of automatic temperature control in the closed heat supply system is discussed in detail in the article. The virtual laboratory stand of the temperature control system can be easily replicated. It provides a significant reduction of material and time costs for its creation and maintenance. This distinguishes it from traditional laboratory equipment.

Hot water is necessary for hygienic and household needs. The water temperature varies from 50 to 70 degrees in this system. In a simple form, the local hot water-supply system is a water heating installation and a process piping that supplies heated water to the points of consumption [8].

Hot water systems are connected to the heating network through water-to-water heat exchangers. Several schemes are applied for the inclusion of heaters in two-pipe networks with simultaneous connection of heating and hot water supply systems: pre-wired, parallel, two-stage sequential, two-stage mixed, two-stage mixed with a flow limiter. Installation of storage tanks for load balancing hot is necessary in a number of cases. They are also used as a reserve in case of a break in the supply of coolant. Reserve tanks are installed in hotels with restaurants, baths, laundries, shower screens in production, etc. Therefore, the parallel circuit can be without a battery, with a lower storage tank and with a top storage tank.

The circulation pump installed on the supply line is present in the coolant supply circuit. A reserve pump of the same power is placed around the working pump in accordance with the rules.

This scheme uses the heat energy of the return line of the heating system, as well as the heat of the water flowing through the closed DHW circuit. This water is mixed with cold water from the water pipe. The mixture enters the second stage heat exchanger only after this. The PID controller regulates the outlet temperature due to the valve on the coolant supply line. The scheme allows you to significantly save, removing the excess load from the boilers and using the maximum heat available. It should be noted that filters are installed at the inlet to the heat exchanger. Reliable and durable operation of the unit depends on this. Sensors that are needed to monitor the flow, pressure and temperature in the system are also installed. The implementation of automatic alarm is due to them [1].

The modern education system contributes to the strengthening of student’s theoretical knowledge and acquiring the necessary skills in the chosen direction through laboratory work. The issue of purchasing equipment for laboratory work is acute in many universities. We have developed a virtual laboratory temperature control stand in the heat supply system in the modeling environment.
OmegaLand. Virtual stands provide an opportunity to model production processes and control the assimilation of knowledge. Spent on laboratory work time is reduced at the same time. This is due to the use of computer effects.

The task of creating a laboratory stand is very relevant for many universities. The task of creating a laboratory stand is very relevant for many universities. This makes it possible to equip all educational institutions, regardless of their geographical location and new training equipment. Also, it does not affect the economic effect of the purchase of equipment.

There are various software tools that allow you to create virtual stands. The OmegaLand simulation system was used to create this virtual stand [2].

Each OmegaLand product contains several "modules" and VMspace. Modules provide an independent function. VMspace is the mechanism for systematically connecting these modules.

For example, the visual Modeler dynamic modeling (VM) package. It classifies functional modules as basic functional modules, optional functional modules, and user functional modules. Basic functional modules include the necessary fundamental modules to build almost any application system. Optional functional modules may be selected depending on the task. Both basic and optional function modules are products of Omega Simulation [3]. User-defined function modules are provided and added by the user. The term "application" is used to indicate the software in the format of performance In OmegaLand. It includes functions as part of a real application system, while the term "module" is used to include mechanisms that also generate each application [4].

In addition, the exact models created in the Visual Modeler dynamic modeling program can be implemented into the OmegaLand system as applications. The process plant model thus created can be executed on its own in the process model module (that is, in the Visual Modeler). This was done during the development of the stand.

The virtual laboratory stand of the closed system of heat supply consists of a plate heat exchanger and its piping system.

The creation of the schema begins with adding components used in the technological process in the module Visual Modeler.

The ability to add elements to the diagram and enter initial parameters of the model is provided after adding components and creating the system.

Further, the addition and configuration of valves, sensors, heat exchangers, PID controller is carried out.

Creating and setting up a mnemonic that can be used in the simulator is made in the Graphic module. It is necessary to connect the valves with pipes, to supply sensors, pumps and PID controller...
in the appropriate places.

Discrete sensors and PID controller with valves should also be connected by a dotted line in accordance with the scheme of Visual Modeler [5]. The final view of the scheme, built in Graphic Builder, is shown in figure 2.

![Figure 2](image1.png)

**Fig 2. The final scheme of the process in Graphic Builder**

Linking icons to the Visual Modeler is the next step in creating a mimic.

As a result, the virtual laboratory bench shown in Figure 3, based on a two-stage heat exchanger strapping scheme, was created on the basis of a virtual process model.

![Figure 3](image2.png)

**Fig. 3 - Virtual laboratory stand layout**
The scheme consists of the heat exchangers E01 and E02, Pump01 pumps and spare pump Pump02, shut-off valves HV01, HV02, HV03, HV04, HV05, HV06, HV07, one control valve AV01, PID pid01, modules for the implementation of the logic of automatic protection and alarm Calc01, Calc02, Calc03, Calc04, mainCalc, flow sensors FI01, FI02, FI03, FI04, FI05, pressure gauges PI01, PI02, PI03, PI04, PI05, discrete sensor LS01, LS02, LS03, LS04, LS05, LS06, LS07, LS08, LS09, LS11, LS12, LS13, LS14, LS15, LS16.

Tap water comes from the ColdFeed inlet and is sent to the heat exchanger E01. There, it is initially heated by the heat of the mixture of the coolant that exits the heat exchanger E02 and the heat of the reverse heating flow that exits the ReverseHeating element. Further, water is mixed with the return flow of hot heating coming from HotWaterSupply. After that, water is sent for reheating to the heat exchanger E02 with the heat carrier coming out of the Heat element. After that, the heated water goes to the outlet, to the consumer. The PID regulates the flow of the heat transfer medium from the Heat element, changing the degree of openness of the AV01 valve, depending on the setpoint values. Discrete sensors receive a signal with sensors and costs.

Conclusions
The quality of education received by a student is determined not only by the level of theoretical training, but also by the ability to use the knowledge gained in practice. The student acquires practical skills through laboratory works and seminars, which are provided specifically in the curriculum. However, laboratory stands that involve physical modeling of the technological process, even in a simplified form, mean serious financial costs for their creation and maintenance in a working condition. In recent years, Information technology has been increasingly used, in particular in the organization of laboratory workshops. This is done to improve the level of practical training of scientific and technical specialists. The laboratory virtual stand presented in this article can easily be replicated, it provides a sign.

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