DKVR Boiler Control System: Variable Frequency Drives and the MIK-51 Controller

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Variable frequency drives combined with a controller can noticeably reduce the electricity consumed by boiler drives and save gas. Below is a brief overview of a project to upgrade DKVR and DE boilers, in which the gas–air ratio is controlled by a MIK-51 controller made by Microl LLC.

About the project

In 2007, seven DKVR and DE boilers were automated at the Brovary heating network under a program of Ukraine's Ministry of Housing and Utilities. The work was carried out by ADVES, the official distributor of Emotron AB. Instead of replacing the boilers with new imported ones, the existing boilers were upgraded: their efficiency was raised to 90–92.5 %, and no design work was needed because the boilers' process equipment was not changed. The old control system was kept as a backup and integrated into the new one, so it can be made the main system again at any time.

The new boiler control system provides:

- an optimal linear gas–air ratio in all boiler operating modes;
- a defined light-off sequence;
- an automatic operating chart;
- maintenance of the set furnace draft.

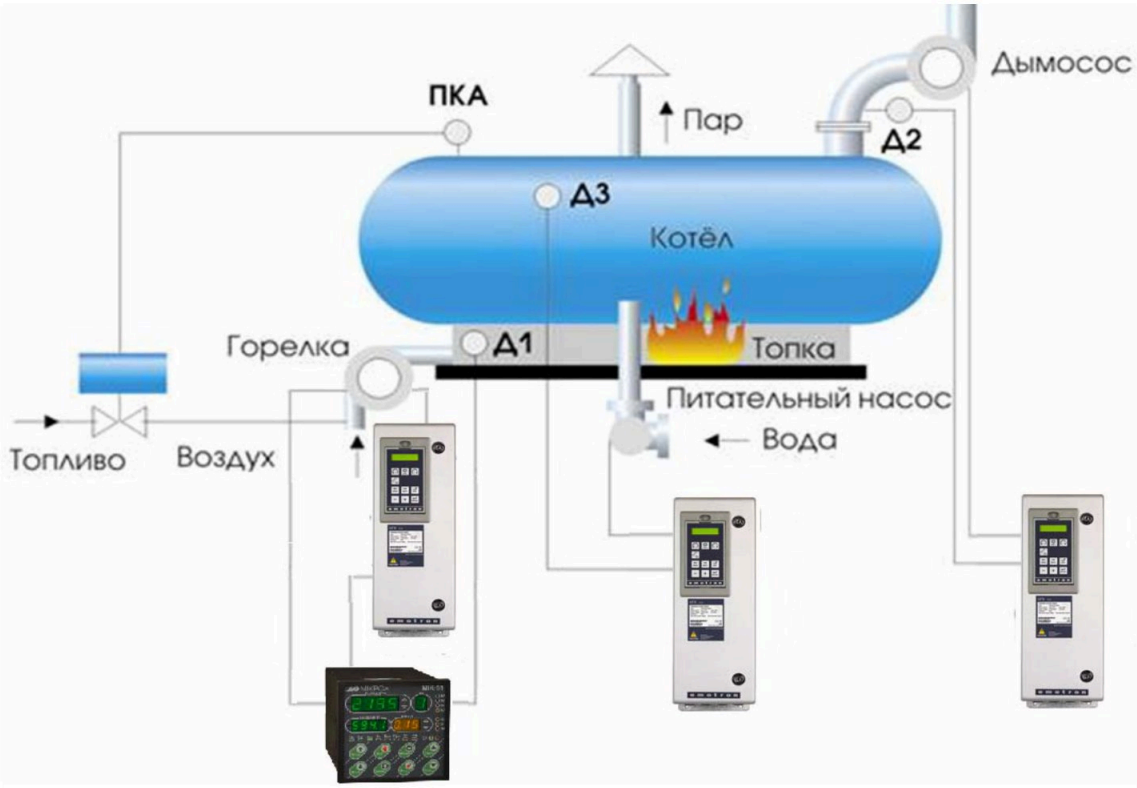


Fig. 1. Block diagram of the boiler control system

Equipment

The fans and the induced-draft fan are driven by Emotron FDU series frequency converters designed specifically for fan and pump applications. They run reliably on supply networks with poor power quality and use scalar control, which is fully sufficient for this application.

The gas–air ratio is controlled by a MIK-51 controller (Fig. 2). The project authors note the reliability of Microl products, the controller's compliance with the technical requirements, its good value for money, and the easy-to-use software for writing the control program. Air and gas pressure transmitters are connected to two of the MIK-51's four analog inputs; the other two are kept in reserve — for example, for a flue gas oxygen sensor and ratio correction. The controller's PID loop was tuned individually for each boiler, which considerably shortened transients. The MIK-51 output goes to the frequency converter, which changes the motor speed.



Fig. 2. MIK-51 multifunctional controller

The boiler control program was developed jointly by ADVES and Microl engineers, the boiler manufacturer and service heat engineers. Operators now see exact gas and air pressure values on the controller's digital displays instead of draft gauges. For light-off, when a small air flow is needed, the MIK-51 program provides manual setpoint entry from the front panel, so the flame does not blow out. An automatic linear operating chart was drawn up for the boilers; oxygen and CO_2 sensors installed at the customer's request confirmed that the boilers operate at the optimal point.

Draft at the induced-draft fan is controlled by a PID controller built into the frequency converter itself, using the signal from the draft sensor; the speed ramp of the high-inertia drive was tuned accordingly.

Results

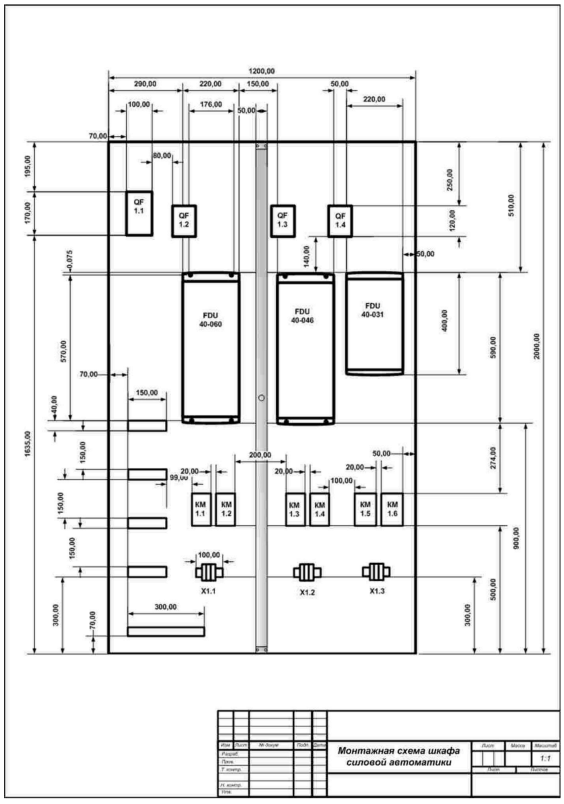
- pressure and draft are now controlled by changing motor speed instead of dampers with fixed positions of 30, 50, 75 and 100 %;
- the electrical power drawn by the drives fell by a factor of 1.8…2.3, and cos φ rose from 0.76 to 0.95;
- natural gas consumption fell by 1.8…3.5 % (according to the energy metering system);
- the starting currents, which used to be 5…7 times the rated value, are gone: the current never exceeds the rated value at any stage of motor operation, and the built-in load monitor protects the motor from mechanical overloads;
- there have been no failures in 3 years of operation, and all equipment is in good working order;

- the payback period is 1.5…2 years depending on the boiler type, not counting savings on repairs and longer motor life, which are hard to estimate precisely.

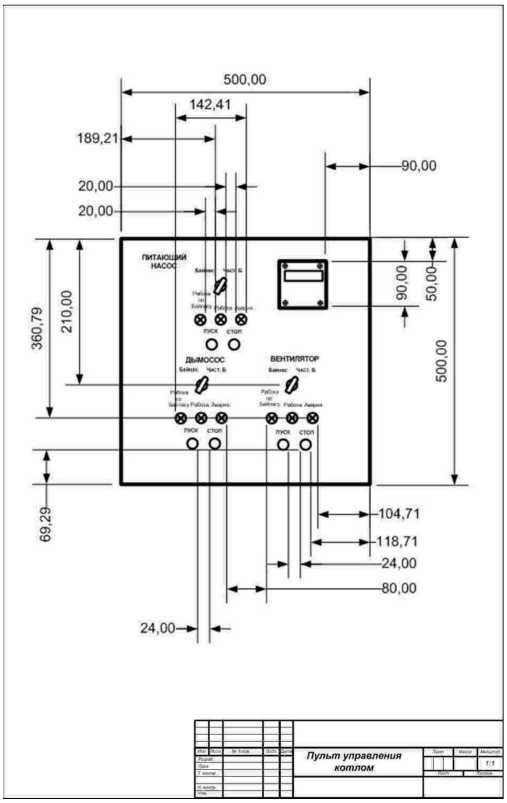


Fig. 3. Boiler control system

This control scheme is also being introduced at other enterprises.



Assembly drawing of the power automation cabinet



Boiler control panel

Contacts

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Prepared on the basis of materials from ADVES LLC (www.adves.biz) on the boiler upgrade at the Brovary heating network.