Automation and automatic control of processes are a key factor for technological progress in industry. Accelerated development of many branches of industry puts monitoring and control of gas purification and dust-trapping processes and apparatuses at the forefront. Most efficient are the automatic control systems that are based on the application of algorithms of adaptive and optimal control.

This type of control system employed by Lürghi (West German firm) for automation of electrostatic precipitators allows as much as 99.96% purification of process gases and 12% reduction in power consumption [1]. The complex nature of functions of the control systems, their increased reliability and flexibility, and scope for prompt adjustment during the variation in the technological process render application of programmable logical and regulating controllers based on microprocessor hardware (MPH) promising for control purposes [2].

Work is in progress at NIIogaz (Scientific-Research Institute of Gas Purification) for equipping gas purification processes and installations with MPH-based control systems. Standard plans of application of MPH for optimization of Claus sulfur extraction processes in gas treatment plants and refineries, which permit one to raise the efficiency of sulfur extraction from process gases to as high as 94-96%, have been completed now. The system is based on the Remikont type of microprocessor controllers. Standard plans of application of MPH for controlling carbon-adsorption gas purification installations have also been completed. The system is based on the GRAS-MIKRO flexible distributive automated system developed and mass-produced by the Grozny scientific-industrial association Promavtomatika.

In order to provide the equipment manufactured by the interdepartmental scientific-industrial association Gazozhishchastka with MPH, work is being carried out at NIIogaz to build local control systems based both on standard microprocessor controllers manufactured by Minpribor (MB57.01, MB57.02, MB57.03, etc.) and Minavtoprom (MPTsU-I-32, MPTsU-I-48, MKP-1) and on the unique programmable controllers. These controllers replace the control instruments based on "rigid" logic which were developed earlier by NIIogaz for the regeneration device of the pulsed-blow bag filters FRKI, FRKDI, and FKI (instrument PURF), ÉGA and ÉGD electrostatic precipitators (instruments AUR and UPO) based on the standard controllers MKP-1-48 and MPTsU-I-32 manufactured by VAZ (All-Union Automobile Plant) at Togliatti.

In 1987, NIIogaz, jointly with Giprogazozhishchastka, developed control systems of ÉGA electrostatic precipitators for the Berezovka State Regional Electric Power Plant, ÉGD electrostatic precipitators for the Dnepropetrovsk garbage incinerating plant, and FRO-6300 bag filters for the Krasnoyarsk heavy excavator plant.

Experience of developing control systems based on standard controllers showed that they are quite versatile, flexible in application, and simple in technological programming. However, the high cost of these controllers restricts their range of application by technological equipment costing not below 50,000 rubles. Moreover, these types of controllers have a limited set of units of communication with the object to be controlled and, in general, do not permit direct transmission of control signals to 220 V ac actuating mechanisms without pilot relays and magnetic starters.

With a view to eliminating these drawbacks, suitable controllers are being developed at NIIkhimmash (Scientific-Research Institute of Chemical Machinery) and SKTBA (Special Office of Technological Design of Automatic Machines). The controller design concept adopted by these organizations, which is based on the principle of free programmability
of the algorithmic functions of the controller with the help of monitors stored in its memory, promotes the universality of the controller and broadens its area of application, but lowers such consumer qualities as communication simplicity, reliability, size, power consumption, etc., and raises cost.

In view of the above, NIIOgaz, jointly with the Grozny pilot plant, has been working on the development of narrowly specialized controllers based on the K1816 type of single-crystal (SC) computers, whose structures, in our opinion, would permit one to get rid of the above-referred flaws.

The structural layout of the controller for controlling regeneration devices is shown in Fig. 1. The controller consists of four modules, viz., operator panel, special processor, device for linking with the object, and power source.

The device functions under the control of the central processing unit (CPU) in accordance with one of the working programs stored in the memory. The working program is chosen by jumpers. All variable parameters are entered from the control unit through the analog switch and the analog-to-digital converter. The variable parameters are preset in the analog form, which considerably facilitates operator's communication with the device and allows one to feed the external analog signals from the monitoring instruments of the technological equipment. The preset parameter can be monitored with the aid of the display unit where it is transformed into digital values in physical units, i.e., in C, kPa, min, sec, etc. The analog form of the parameters dispenses with the programming training of the personnel.

The filter control signals are stored in the output buffers and through the electrodecoupler reach the power amplifier and then the actuating mechanisms. A provision has been made for the possibility of monitoring passage of the control signal as far as the power circuits. If there be a defect in a unit, it is displayed in this circuit.

The choice of the K1816 single-crystal computer was dictated by the following parameters of this microcircuit: adequacy of technical data (speed, power input, capacities of main memory (MM) and read-only memory (ROM), etc.), low cost, easy programming, availability of adjusting devices, and possibility of further expansion of its area of application. Single-crystal 8-bit microcomputers of the K1816 series, viz., KM1816VE39, KM1816VE48, and KM1816VE49, are functionally complete devices which contain on a single crystal, the central processor, the MM, and the ROM, a multichannel input-output interface, an 8-bit timer, a vector interruption network, a time-pulse generator, and a synchronization device. The power is supplied from a 5 V source. All this ensures versatility, autonomy, and flexibility of their application in automation devices [3].

The microcircuits of the K1816 series have an identical structure and are distinguished by speed, type and capacity of the internal memory, and capacity of the internal MM. The distinctive features of the microcircuits of the K1816 series are listed in Table 1.

Each circuit provides for expansion of the program storage up to 4 kbyte, data storage up to 256 byte, and increase in the number of input-output lines by switching the external crystals of the program storage (ROM), MM, and the input-output interfaces of the KR580...