International Journal of
Inclusive and Sustainable Education

ISSN: 2833-5414
Volume 2 | No 5 | May-2023

Microprocessor Control System for Heat Treatment of Reinforced Concrete Products

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Abstract: The article deals with the application of an automated quality control and management system in the production of reinforced concrete products. A block diagram and algorithms for processing a microprocessor control system for the process of heat treatment of reinforced concrete products are given.

The effectiveness of building production management in modern conditions is largely determined by the availability of methods and technical means for managing product quality at all stages of the technological process. The tasks of product quality management, optimization of technological processes are solved on the basis of integrated production automation, the widespread introduction of modern systems and tools in automation.

Automation of the technological process of production of reinforced concrete products requires the use of microprocessor tools to control the main disturbing influences and quality characteristics of reinforced concrete products, information from which can be used for optimal production management.

When creating an automated quality control and management system in the production of reinforced concrete products, it is necessary to solve a number of scientific and technical problems:

- to carry out a feasibility study of the feasibility of creating an automated process control system;
- to develop a rational structure of the system;
- to develop algorithms for information processing and management;
- determine the composition of the technical means necessary for the implementation of the system, and select commercially available ones;
- prepare the initial requirements for the devices and equipment of control and management to be developed;
- create new control devices and microprocessor tools, conduct experimental studies to verify the principles of building a system of developed algorithms, as well as created automation tools and control devices [1].

It should be noted that the success of the introduction of automated control and management systems in the production of reinforced concrete products largely depends on the following factors:

- ✓ degree of knowledge of the control object and its readiness for automation;
- ✓ availability of reliable, accurate and efficient technical means of automatic control;

- ✓ the availability of appropriate software and effective algorithms for information processing and control.

One of the important technological processes in the production of precast concrete products is heat treatment, which provides accelerated hardening of molded concrete products in special heat units.

The main purpose of automatic control and management of this process is to comply with the specified modes of concrete hardening with minimal power consumption.

On fig. 1 shows a block diagram of a microprocessor control system for the process of heat treatment of reinforced concrete products. The system is intended for use in construction industry in automatic control systems for the process of heat treatment of reinforced concrete products with continuous information about the strength of concrete.

The system is designed to work with TSM resistance thermocouples with nominal static conversion characteristics of 50 M. and gr. 23. The nominal value of the current through the sensitive element of the thermal converter is 10 mA.

The system generates output signals according to. voltage 0 - 10 V, proportional to the temperature and strength of concrete according to the equations [2]:

$$V_T = C_1 T \qquad (1)$$

$$V_R = C_2 T \qquad (2)$$

where VT is the output signal proportional to the concrete temperature, V;

C1 – coefficient, B/C°;

T - concrete temperature, from 0 to 100 ° C;

VR - output signal proportional to concrete strength, V;

C2 - coefficient, V/unit;

R - concrete strength units, determined by the formula:

$$R = K\frac{\int_0^{\tau}(T_0+T)^n d\tau + K_2\frac{R_H}{K_1-R_H}}{K_2+\int_0^{\tau}(T_0+T)^n d\tau + K_2\frac{R_H}{K_1-R_H}} \qquad (3)$$

where K1 - coefficient, from 100 to 200 units;

K2 - coefficient, from 102 to 105; (°C)", h;

RH - coefficient, from 100 to 200 units;

T0 - coefficient, from 0 to 20 °C;

n is the exponent, from 1.0 to 2.2 units;

T - current value of concrete temperature, from 0 to 100 °C;

τ - current time, hour.

The values of the coefficients T0 and K2 and the exponent n in formula (3) are selected using formula (1)

$$T_0 + T_H \geq 2\,°C \qquad (4)$$

$$2{,}1n - 4{,}8 \leq \lg K_2 \leq 2{,}1n - 2{,}5 \qquad (5)$$

where Tн is the current value of concrete temperature at τ=0±°C

At the same time, the formation and programs for changing the temperature of concrete, we will divide into three successive sections, according to the equations [3]

$T_n = T + K_3\tau^m$ - first section (6)

$T_n = 1$ - second section (7)

$T_n = T_1 + K_4\tau^m$ (8)

where Tn is the current temperature value according to the program, °C.

T is the same as in formula (3);

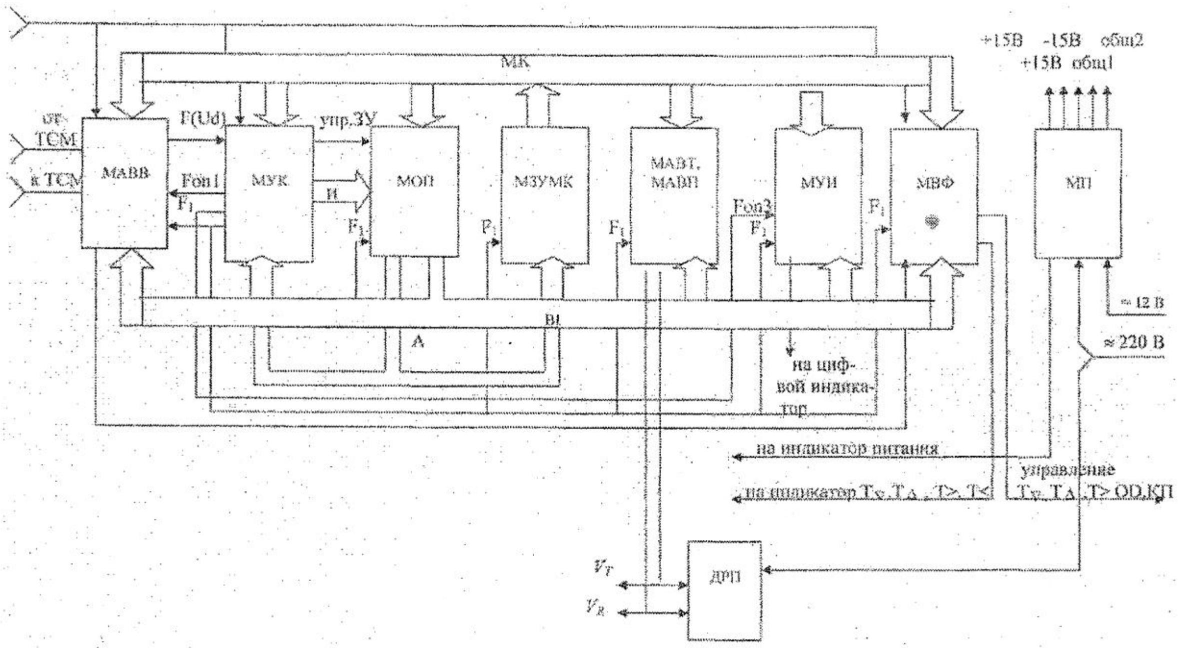
T1 - coefficient, from 0 to 100 °C;

K3 - coefficient, from 0 to 60 °C/h;

K4 - coefficient, from 0 to 60 °C/h;

m - exponent, from 1 to 2.2 units";

τ - current time, h;



Rice. 1. Structural diagram of a microprocessor control system for the process of heat treatment of reinforced concrete products

As you can see, the block diagram of the system (Fig. 1) is built according to the functional-modular principle. All processing of input and output and the formation of output information is carried out in the processing and control unit. At the same time, there is a continuous exchange of current information between all modules of the block.

The system consists of: analog input module MABB, which is connected to the device by a four-wire line, tested with UTCM current;

a channel control module MUK, in which the output frequency signals used as reference and synchronizing for a number of models of the system generated by time intervals;

module operating full MOS, consisting of four identical four-bit operating models;

microinstruction memory module MZUMK, which is a matrix of persistent storage devices, serves to store a set of microinstructions in the module;

analog output module via the registration channel. temperature of the MACH and through the channel for recording the strength of the MACH. The difference between them is determined by the values of the conversion coefficients specified during the setup;

an EOR indicator control module that generates dynamic control signals for a four-digit digital indicator;

module output shapers IMF, which serves to form five galvanically separated signals;

MP power supply module containing three continuous compensation stabilized power supplies.

The use of the considered microprocessor control system for the process of heat treatment of reinforced concrete products allows, due to the use of specified modes of concrete hardening, to save 30% of energy consumption.

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