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MANAGEMENT OF THE EXTRACTION PROCESS OF PLANT RAW MATERIALS

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Abstract: The article discusses the technology of extraction of plant raw materials for the complete extraction of aromatic substances using carbon dioxide. The issue of managing the extraction process using information and communication systems is also addressed.

Key words: process, food, microcontroller, extraction, automation, control system.

The process of using the technology of extracting essential oils from plants with carbon dioxide ($CO2_{\text{extraction}}$) allows extracting from plant raw materials a virtually complete complex of aromatic substances in their natural balance and high concentration (98-99% with a product purity of 99.9%), and the process control system increases the efficiency of the installation and the quality of the resulting product.

CO2 extracts are intended for use in the perfumery and cosmetics, medical, food, in particular, in the beer and soft drink, liquor, confectionery, meat industries, as well as in household chemicals.

CO2 extracts are liquid oily or ointment-like products obtained from plants using the technology of extracting essential oils with carbon dioxide .

The use of CO2 - extracts eliminates the use of dry aromatic substances and makes it possible to obtain a manufactured product of uniform consistency without inclusions of dry substances (increases) several times, the costs of transportation and storage are reduced, and it becomes possible to automate the process of dosing finished products with extracts.

The use of CO2 - extraction of essential oils as a soft-mode, less labor-intensive and technologically fast method of processing medicinal and spicy-aromatic plant raw materials is a necessary condition for obtaining natural, environmentally friendly essential oils of high quality. They retain the native (natural) ratio of all components and, consequently, the biochemical composition and physiological activity. The raw materials for obtaining CO2 - extracts are various medicinal plants, spicy-aromatic products, secondary raw materials of processing industries (citrus peel, fruit and berry pomace, meal, cake, etc.), animal products.

Improvement of the technique and technology of extraction of plant raw materials with carbon dioxide is possible on the basis of research of both the extraction process itself, as an object of control, and the operation of the entire complex of devices of the extraction plant from the point of view of optimal control in order to obtain high-quality products with a relatively low cost.

Based on this, the control object in the process control system is the set of main equipment - the extractor and auxiliary equipment together with the shut-off and control elements built into it, as well as energy, raw materials and other materials determined by the characteristics of the technology used.

When developing a process control system for extraction, the following tasks are solved:

- obtaining primary information about the state of the technological process and equipment;

- direct influence on the technological process to control it;

-stabilization of technological process parameters;

- control and registration of technological process parameters and the state of technological equipment.

These tasks are implemented with the help of technical means including: selection devices, means of obtaining primary information, means of converting and processing information, means of converting and issuing information to service personnel, complete and auxiliary devices.

The extraction process control scheme provides for control of the temperature of the extractant supplied to the extractor. To measure the temperature of the extractant, a resistance temperature converter of the LM 35, DNT11, MSR2700 type is installed in the heat exchanger.

The analog signal from the temperature sensor output is fed to the microcontroller input. The process control circuit selected a microprocessor microcontroller of the Arduino - UNO type .

The microcontroller generates a control signal, which switches the thermal electric heaters via a magnetic starter.

The extraction process control system provides :

- measurement of pressure (8 MPa) and temperature (t = 35˚C) of liquid $_{CO2}$;

- regulation of the concentration of the extracted component by the consumption of the extractant;

- blocking – stopping the extraction of the extract when the maximum permissible required level of phase separation in the extractor is reached.

- control of the extractant supply valve.

- regulation of liquid carbon dioxide pressure in front of the condenser by changing the compressor power (P=8 MPa)

- regulation of pressure in the extractor by the flow rate of liquid $_{CO2}$

- regulation of the extract temperature at the separator outlet by changing the load of the heat pump.

The circuit is based on a microcontroller microcontroller equipped with a corresponding set of input/output modules. The controller is connected to the computer via the Ethernet network . The control computer is thus used to display the values of process variables, register and signal their limit values. The computer also forms control laws for the actuators.

For monitoring and automatic control of temperature, a special program has been developed, which works in a set of microcontrollers of the ARDUINOUNO brand, temperature sensors of the LM 35, DHT 11, MCP 2700 E brand .

The controller is designed to receive and process information coming from primary converters and discrete sensors, to issue control signals to actuators and signaling devices, and to transmit information to the operator station. The controller communicates with sensors and actuators using USO modules. Analog input modules can receive signals from normalizing converters, as well as directly from temperature, pressure, level sensors, etc.

In general, the features of the extraction process from plant raw materials using liquefied carbon dioxide were studied, and the properties of carbon dioxide as a solvent were studied.

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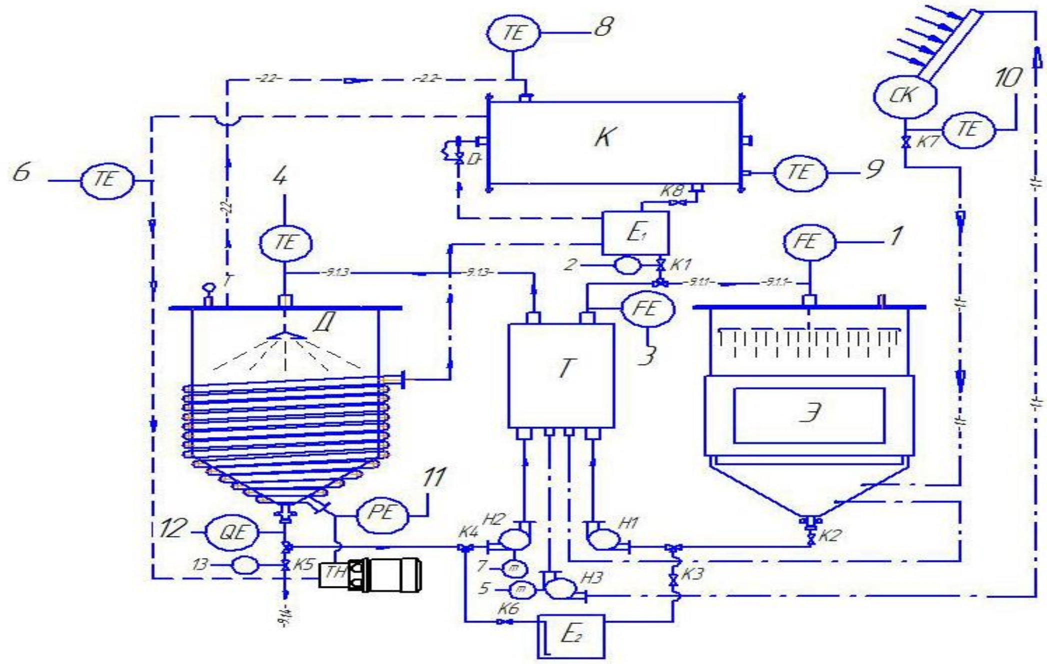
A functional control diagram for the extraction process was developed based on the information and communication system (ICS) Fig. 1.



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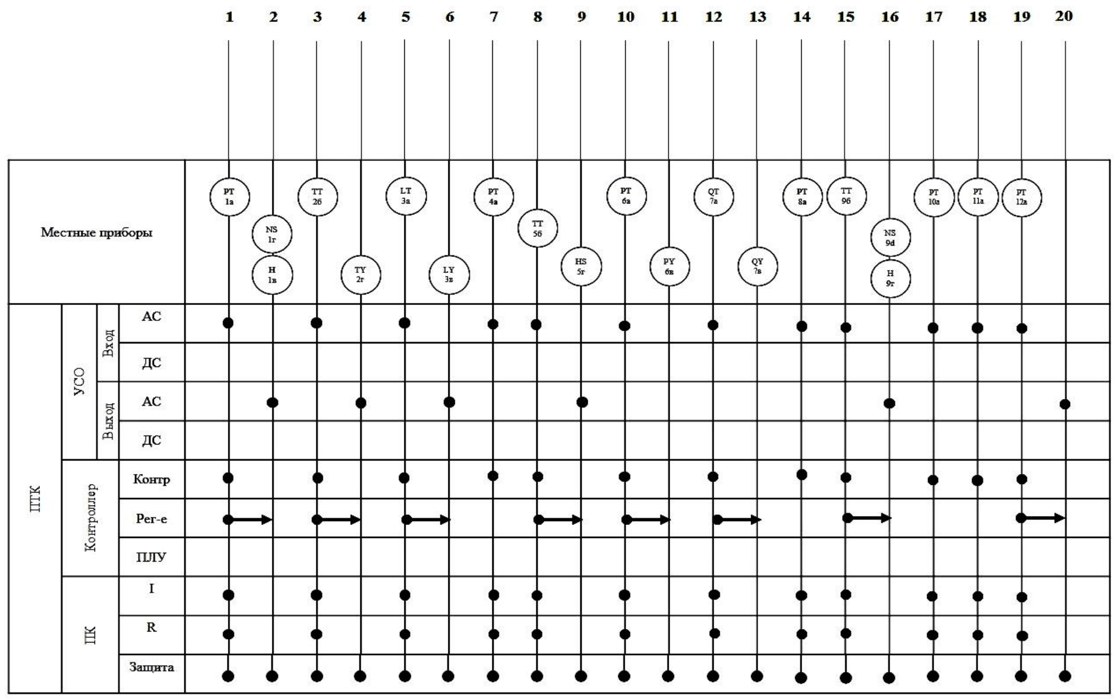

Fig. 1. Functional diagram of the extraction process control

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