Using the Adaptive Approach in the System of Monitoring the State of Grain Storage Technological Process

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Abstract. *One of the requirements for modern monitoring systems is the timely detection of changes in the state of the system and ensuring continuous operation. Using the adaptive approach in the operation of the SCADA system, it is possible to ensure complying with the technological process parameters and obtaining quality products.*

Keywords: *controller, SCADA system, operating algorithm, microclimate, object, adaptive system.*

I. Introduction and Problem Statement

The SCADA systems are used to monitor and control technological processes in the agricultural industry. Modern requirements for the SCADA systems must have many parameters that will ensure trouble-free operation. Conventional engineering approaches and tools, such as development methodologies, architectural styles, modeling techniques, have limited capabilities to work with many quality attributes at the same time, and require important initial knowledge of the exact goals of the system and of every interaction that it enters and with which it can face in the future, should be known at the time of design. A possible solution to the problem is to build adaptive systems that can effectively adapt to failures, component replacement, and environmental changes with less human intervention or centralized operation [1-2]. If the system is adaptive, it implicitly means that it is flexible to adapt to dynamic changes in the environment, has a scalable ability to control the increase in size, and is able to cope with the evolution of its complexity.

II. Problem solution and Results

After analyzing the technological process of grain storage and drying, it can be determined that to maintain the microclimate in the granary for high-quality and long-term grain storage, as well as to be able to dry and cool the grain, a programmable logic controller with sensors of moisture and temperature of grain and air in the granary is used. The control system also includes a flowmeter to control the air supplied to the grain embankment and general air exchange in the granary.

In the presented study it is offered a mathematical model of temperature forecasting and correction, which describes the change of temperature and other microclimate parameters depending on the external environmental conditions, the algorithm of microclimate control is developed. When interrogating the sensors, the microcontroller determines the values of the microclimate parameters and then, in accordance with the agrotechnological requirements, issues control effects on the electrical equipment.

When designing the SCADA system, the following requirements were made: optimization of the electricity consumption of the object; possibility to connect electronic analytical scales with a unified output current signal of 4-20 mA; implementation of protective algorithms for the technological equipment; protection against incorrect sequence of switching on of the equipment; automatic stop of the equipment in case of emergencies; automation of working algorithms (choice of transport routes, start/stop/breaks); execution of protective algorithms; reduction of freelance and emergency situations; visualization of implementation of new technological processes on mnemonic circuits and reports; realization of object performance control, quantity of production at each stage); multi-level access system [3, 4].

The microclimate control subsystem includes:

1) maintaining the optimum air temperature during grain cooling to increase storage life;

2) sustaining humidity of air within 65-75% that provides the optimum one at storage of grain moisture equal to 14-16%.

3 controlling over the minimum required air flow depending on grain moisture

The developed SCADA provides support for the operation system that uses the adaptive approach to ensure quality while dynamically changing process parameters and system components.

III. Conclusions

The offered approach allows predicting the mutual influence of microclimate parameters and applying the adaptive working principle of electrical equipment with flexible hierarchical structure in real time while changing technological tasks to support them. An efficient automated system for monitoring temperature and humidity in the granary has been developed, which allows saving energy resources through using controllers with the adaptive control approach.

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