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SYNTHESIS AND STUDY OF ENERGY CONSUMPTION MATHEMATICAL MODELS FOR THE GREENHOUSES HEATING

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The results of mathematical modeling for natural gas consumption for heating greenhouses depending on environment parameters to ensure the desired internal temperature in the greenhouse are shown. The mathematical model is a regression equation determined the optimal mode-conditioning for maximum productivity of photosynthesis.

Mathematical model, experiment, regression equation, greenhouse microclimate.

It is known that the optimal greenhouse temperature, especially in winter, is the most energy-consuming factor of vegetables production. In addition, temperature greatly affects photosynthesis and is related to the solar radiation intensity, which depends on duration of daylight and outdoor weather conditions. Some part of solar radiation is photosynthetically active (FAR), which is involved in photosynthesis process, and the rest turn into heat and increases the greenhouse temperature disturbing the climate of biotechnical object. The mathematical modeling of natural gas consumption for greenhouse heating with considering external disturbance is important.

The purpose of research – modeling the natural gas consumption in the greenhouse that will allow to investigate the external environmental factors effect on energy costs and to identify possible ways of increasing energy efficiency in vegetables production in greenhouses.

Materials and methods. Information about microclimate parameters and disturbing influences obtained using information-measuring monitoring system, which was developed using temperature sensors, humidity sensors and solar radiation intensity sensor, and was installed on department № 9 of private corporation “Teplychniy”.

The control system software which displays the current values of microclimate parameters was developed (Fig. 1). The input information is stored in the database using MS SQL Server Express.

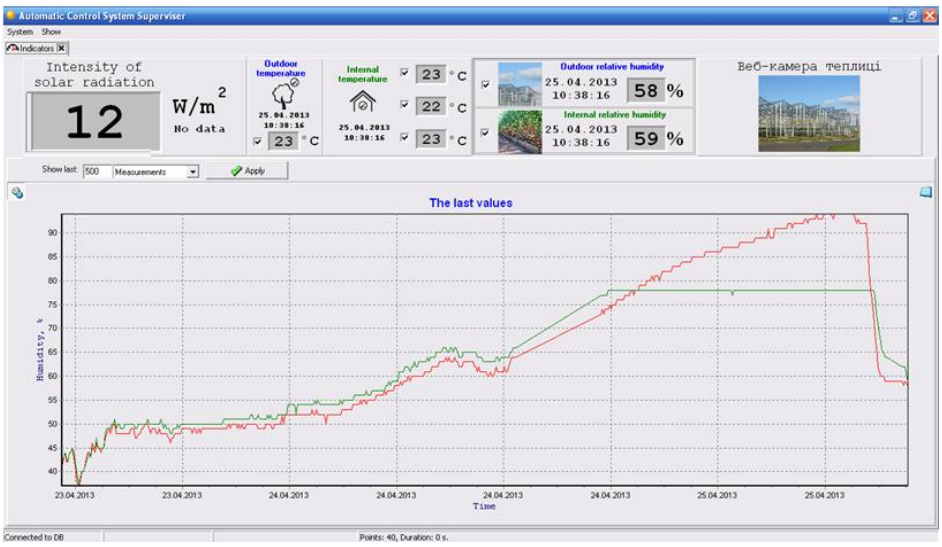

Fig.1. View of the window with the monitoring parameters of the greenhouse

Research results. Monitoring system and information in database allowed to statistic information, which was used to synthesize mathematical model.

This model is described by polynomial equation of the second order:

$$P(T,T1R) = -6{,}213\cdot10^{-3} + 1{,}86T + 5{,}98T1 + 0{,}038R + 0{,}314TT1 - 3{,}257\cdot10^{-3}TR + \\ + 7{,}41\cdot10^{-4}T1R - 0{,}056T^2 - 0{,}023T1^2 + 1{,}39R^2 \quad (1)$$

Conclusions. Mathematical model of natural gas consumption in the greenhouse was obtained. It takes into account the external environment parameters and allows maintaining the greenhouse temperature.

The simulation comparison of energy efficiency for three types of control systems was done. It shows the feasibility of control system with neural network forecasting for external disturbances and with optimizing plant mass growth.