INTENSIFICATION OF PROCESSES OF PRODUCTS STORAGE USING METHODS OF ELECTROTECHNOLOGY

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The article presents the results of studies of import-substituting technology of storage of fruits and vegetables with ultrasound As a result of the experimental studies on the lab bench we have model of process of humidifying the ventilation flow. In the article presented analytical dependence to determine the energy consumption of humidification using special humidifier, identified the optimal values of the factors, appropriate minimum energy consumption of process of humidification and allowing to reveal optimum performance of the process. Using of the designed import-substituting technology in storehouses will allow to improve the quality while reducing core indicator of energy efficiency production - energy efficiency of fruits and vegetables.

Keywords: storage of fruits and vegetables, ultrasonic technologies.

Introduction

Ultrasonic technologies refer to electro-technological methods of intensification of processes of storage of agricultural production (fruits and vegetables) [4,5,6]. This technologies recognized as the most environmentally friendly and high-performance, ensuring minimum energy consumption for obtaining high-quality products at the end of shelf life [7,8,9]. Now more than ever topical issue of provision of Russians fresh and quality vegetables using import substitution technologies.

The priority importance for the preservation of vegetables is moisture. Water vapor in varying concentrations is always present in the air. And the absolute and relative humidity fluctuate according to the temperature change. Each species or variety of fruits and vegetables is designed for content in the atmosphere at certain humidity, deviation can cause a change in the direction of chemical and biochemical processes occurring in them. Storage of fruits and vegetables involves maintaining storage areas in high relative humidity (80-95%) [11, 12, 15].

An active ventilation system recognized as most effective today, it allows several times to increase the storage ability of vegetable production due to the higher speed of its cooling and drainage, "address" directional airflow uniformly purge each instance of the product. Meanwhile, the existing energy-intensive technology, which does not meet modern requirements of energy production.

In this connection this article dedicated to the development of import-substituting technology with using ultrasonic humidification technology is extremely urgent.

The objective of the work: The object of research is the process of moisture ventilation flow in the storage of fruits and vegetables, using ultrasound.

The material and methods of the investigation: We use experimental and statistical research methods.

The results of the investigation and discussion about them: At the Department "energy Supply companies and electrotechnology", Saint-Petersburg state agrarian University developed import-substituting technology using a humidifier domestic production (Fig. 1) [2, 10, 14]. The humidifier can be used as part of an experimental stand, simulating real conditions of the main duct vegetable store.

As a result of experimental studies on laboratory bench [1,2,14] a model of moisture ventilation flow:

$$W \cdot 10^8 = 0{,}448 \cdot t_W^2 - 4{,}617 \cdot P_{us}^2 + 23{,}167 \cdot P_{us} \cdot t_W - 1556{,}6 \qquad (1)$$

t_w — spray water temperature; P_{us} — power ultrasonic vibrations; W — machine performance

The model is the dependence of device performance on two factors:

- Atomized water temperature;
- Power used by ultrasound.

Analysis of the data allowed to establish analytical dependence to determine the energy consumption of humidification using the represented apparatus, identified the optimal values of the factors, appropriate minimum energy consumption of process of humidification, construct graphic dependences (Fig. 2 and 3), help identify the optimal characteristics of the process [2,3,14].

$$E_{us} = \frac{10^8 - \left(0{,}448 \cdot t_W^2 - 1556{,}6 \big/ W\right)}{3{,}6 \cdot 10^6 \cdot (23{,}167 \cdot t_W - 4{,}617 \cdot P_{us})}, \left[kW \cdot hr / kg\right] \qquad (2)$$

E_{us} — energy intensity of hydration with an ultrasonic device

Technique of engineering calculation potato storehouse humidification system is also developed. Determined [3] that humidifier can generate finely water spray at the energy intensity of the order 0,144 (kw·hr)/kg, while with an energy steam humidifiers - 0,75 – 1,0 (kw·hr)/kg (the particulate composition of the vapor and aerosol generated by the ultrasonic device, commensurate).

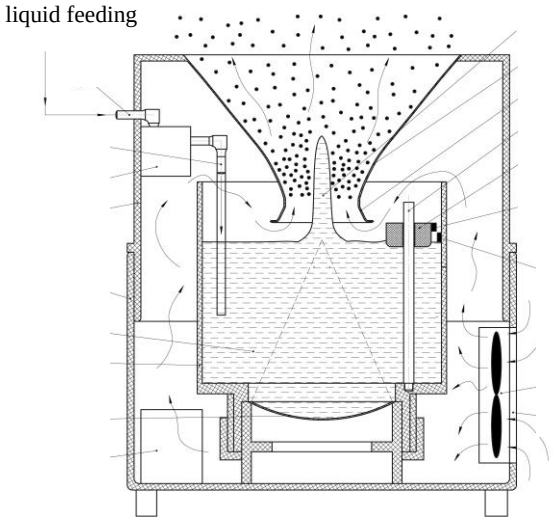

Fig. 1. Model ultrasonic

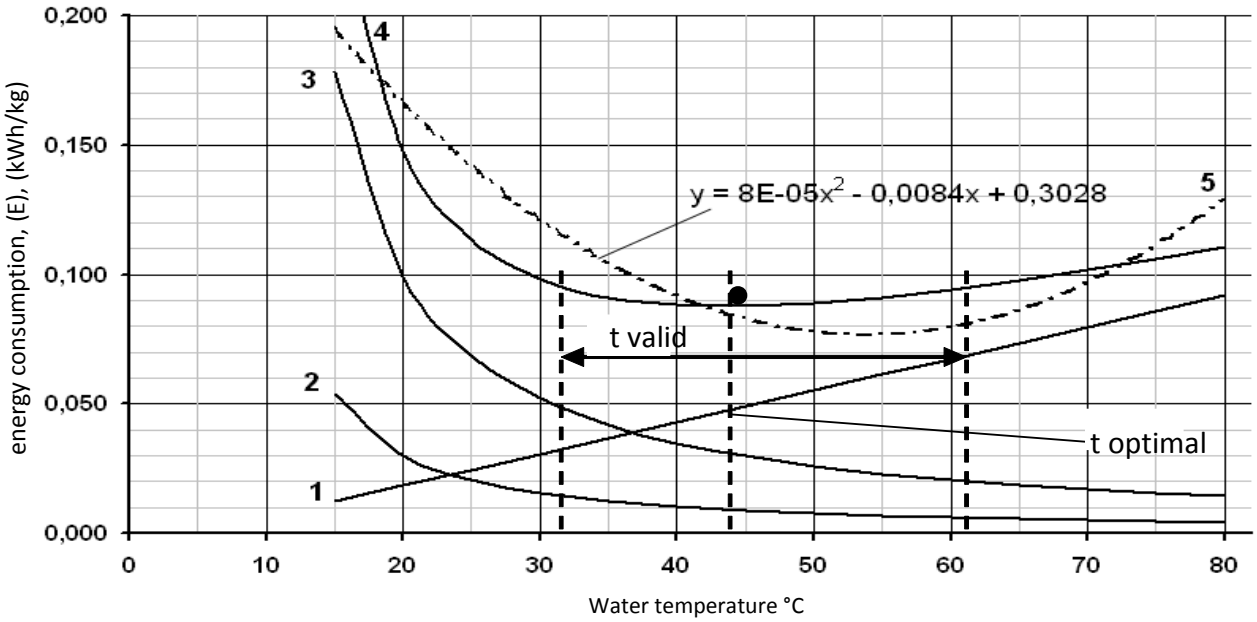

Fig. 2. Dependence of the energy intensity of ultrasonic device of the spray water temperature (P_{us} = 10 W):
1 – $E_{int} = f(t_w)$; 2 – $E_{blow} = f(t_w)$; 3 – $E_{us} = f(t_w)$; 4 – $E_{УЗР\text{-}У} = f(t_w)$; 5 – a trend line to a chart «4».

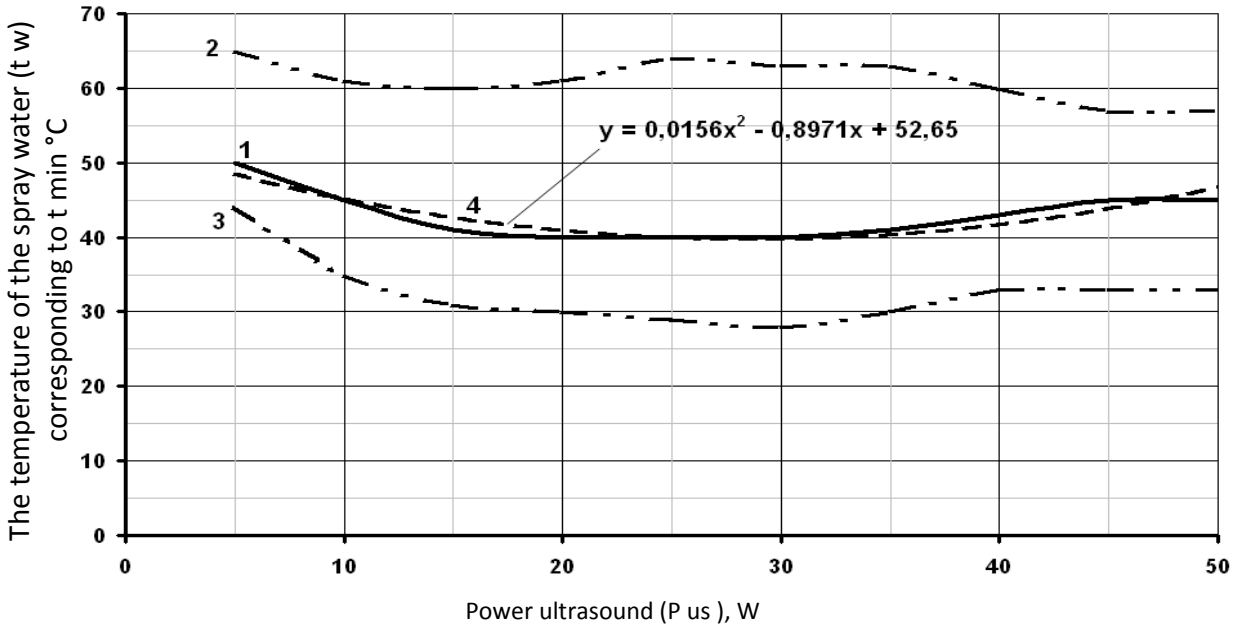

Fig. 3. The dependence of the optimal water temperature on the power of ultrasound: 1 - for a minimum of $E_{УЗР-У} = f(tw)$; 2 and 3 - the interval boundaries for *t valid*

Conclusion

Thus, analysis of research shows that the generation of highly dispersed water aerosol atomization of water by ultrasound less energy-intensive and most technologically compared to the currently used methods of obtaining the humidifying agent in storage. The application of import-substituting technology in storage will improve the quality while reducing the main indicator of the production of energy - energy consumption of fruits and vegetables.

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