DEFINITION OF INFLUENCE ON STRUCTURAL PARAMETERS dryer TECHNOLOGICAL PARAMETERS OF DRYING chicory ROOT

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Determined chicory root drying technology to ensure maximum preservation of its quality performance with minimum energy consumption of specific equipment used. As a result of analytical studies found rational technological parameters of dry chicory root and structural parameters of the dryer, in which are provided by technological parameters.

Structural parameters, drying, process parameters, chicory root, quality indicators of material.

Problem. Based on the natural potential of Ukraine, given the expert opinions of specialists agricultural market Ukraine has all possibilities to be among the world's leading manufacturers of plant products. However, relevant to domestic farmers face the problem of storage and processing of vegetable origin. Modern requirements that relate to the drying equipment, provide

together with high performance and low energy consumption, ensuring high quality indicators derived product [1, 2, 3, 4]. CMembers level of technical and technological support agricultural processing industry in general and drying plants, in particular, is inefficient and energy intensive. There are currently technical solutions for the drying process plant materials, chicory root, and including, characterized by high levels of energy consumption equipment (sometimes more than 2 kWh / kg evaporated water), and irrational and poorly informed choice technological parameters of drying causes leakage of biologically composite objects drying to 20-30%

Analysis of recent research indicates that modern drying technology materials of agricultural origin and related equipment are characterized by relatively high specific energy consumption, performance and quality of the final product was taken into account [5, 6]. Consequently, the resulting product does not always meet the requirements of customers, and its market value is reduced [1, 2, 3, 4]. Address the growing competitiveness of agricultural products origin, subject to drying in order to increase its shelf life and further processing, possibly by finding efficient drying technology at the maximum possible reduction in specific energy consumption of the process to the amount of dry matter obtained product.

Analysis of theoretical and experimental studies [5, 7, 8] shows that mechanization to dry bulk materials of plant origin has not been sufficiently studied. The perspective is a further development of such equipment, particularly for chicory root, create designs dryers drum with providing periodic action on the material energy of infrared (IR) radiation that will help limit the critical effect of high temperatures and therefore obtain a final product with high quality and performance ensure desired performance provided specific energy consumption minimization.

The purpose of research. Justification rational technological parameters of drying and structural parameters related equipment that will help improve the quality of the final product and reduce enehomistkist production itself.

Results. In order to determine rational technological parameters of drying in the dryer with chicory termoradiatsiynym enerhopidvedennyam feasibility study of technological parameters of the changing quality performance of the drying performance and energy consumption of the process. On the basis of expert estimates [8, 9, 10, 11, 12, 13] built structural and logical model of dry bulk food in the dryer with infrared enerhopidvedennyam (Fig. 1) where the relationship of process parameters and drying process some structural parameters of equipment performance quality of the final product (inulin content, moisture drying facility) process performance and power consumption. Based on the laws and regulations of the theory of fuzzy logic mathematically modeled workflow drying chicory roots and proposed theoretical assumptions of rational study of structurally-drying process parameters that ensure regulatory (or higher) quality indicators of material with minimal energy consumption process.

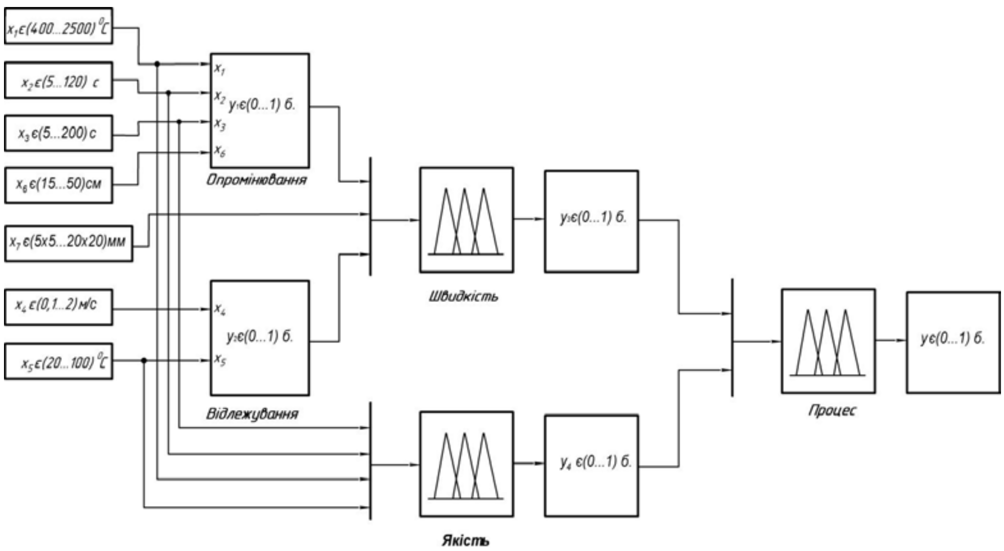

Fig. 1. Structural and logical model of the process of drying materials of plant origin in the dryer drum with termoradiatsiynym enerhopidvedennyam: x1 - linguistic variable temperature transmitter; x2 - linguistic variable exposure time-ment; x3 - linguistic variable time softened; x4 - linguistic variable speed air blowing material; x5 - linguistic variable temperatures, blowing material; x6 - linguistic variable distance between the source of infrared radiation and material; *x7* - Linhvisttychna variable particle size chicory; Ui - corresponding knowledge base.

In the fuzzy model of the process of drying of bulk materials of plant origin in the dryer with infrared vypromi-nyuvannyam input variable parameters that affect the performance of the process while ensuring high quality performance source material taken: temperature transmitter (x1); material exposure period (x2); softened period (x3); speed airflow inside the dryer (x4); the temperature of the air flow supplied to the product (x5) the distance between the emitter and the surface of the product (x6) particle size before laying on drying (x7).

The output variable model (in) - general description of the drying process, which is a function of aggregate quality indicators derived material (U1) and drying speed (V2). Due to building relationships of input and output variables logical system obtained fuzzy model of the process of drying materials of plant origin in the dryer drum with termoradiatsiynym enerhopidvedennyam (Fig. 1).

By analyzing the fuzzy model of drying of bulk foods of plant origin found that obtaining high performance speed drying material and, consequently, reduce energy consumption, while maintaining its quality indicators achieved by the following values of input parameters: temperature transmitter T = (800 ... 1300) 0 C; duration of exposure topr = (30 ... 50) s; duration softened tvidl = (90 ... 150) s; air flow rate u = (0,8 ... 1,3) m / s; air temperature $T_{пов}$= *(20 ... 30) 0 C*; the distance between the radiation source and the material h = (15 ... 25) cm; line particle size material S = (10 ... 15) mm.

Ensure discontinuous exposure of the material, in general, and in the dryer drum, optionally by adjusting the duration of the working fluid in the areas of radiation and its softened, thanks to the introduction of new advanced design solutions dryers. In order to fulfill this task during the analytical studies, we proposed installation guide shelf above a radiator (Fig. 2) to allow the energy dose effect of infrared radiation to the material being processed.

As a result, graph-analytic studies of motion of material in a drying drum at a different number of blades that established the inner perimeter of the drum and dependence interval duration exposure of the material on the number of blades and rotational speed of the drum:

$$t_{onp} = \frac{15\left(1+\frac{4}{z}\right)}{n}, \qquad (1)$$

where t_{onp} - Exposure time interval, s; z - The number of blades, pcs .; n - Frequency of rotation of the drum, min-1.

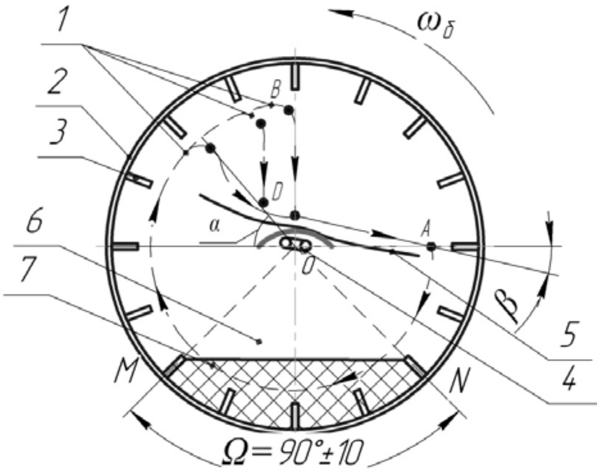

Fig. 2. Scheme of the internal structure of the drum: 1 - trajectory of the particles of the material; 2 - Drum Corps; 3 - blade; 4 - IR emitter; 5 - directing shelf; 6 - zone exposure; 7 - material irradiated; Ω - Angle radiation; α - Angle of climb particle material above the horizontal axis of the drum; β - Angle guide shelves; $\omega_б$ - Angular velocity of the drum

Analyzing the dynamics of a particle in the drum and dependence to determine the effect of structural parameters of the drum to the length of the softened material at the periodic action on his energy infrared radiation:

$$t_{\text{âlâë}} = \frac{60\left(\frac{\pi}{2}+arc\,sin(1{,}1\cdot sin\beta)\right)}{\pi n} + \sqrt{\frac{0{,}088\cdot D_{\text{á}}\cdot sin\beta}{g}} + \sqrt{\frac{1{,}6\cdot D_{\text{á}}}{g\left(sin\beta - f_2 cos\gamma\, cos\beta\, cos\left(arctg\left(\frac{sin\gamma}{sin\beta}\right)\right)\right)}} + \frac{15\pi-60\beta}{2\pi n} \qquad (2)$$

where $t_{відл}$ - Duration softened, c; β - Angle guide shelves, boards; $D_б$ - Diameter drum, m; g - Gravitational acceleration, m / s2; n - Frequency of rotation of the drum, min-1; f_2 - Coefficient of friction between the material and the surface of the shelves; γ - Angle to the longitudinal axis of the drum horizontally councils.

Using the obtained relationships based on physical and mechanical properties of chicory roots, Dependence of frequency of rotation of the drum by design and technological parameters of the drying drum:

$$n = \frac{120 arc\sin(1{,}1 \cdot \sin\beta) + 75\pi - 60\beta}{2\pi\left(t_{\grave{a}l\ddot{a}\ddot{e}} - \sqrt{\frac{0{,}088 \cdot D_{\acute{a}} \cdot \sin\beta}{g}} - \sqrt{\frac{1{,}6 \cdot D_{\acute{a}}}{g\left(\sin\beta - f_2 \cos\gamma \cos\beta \cos\left(arctg\left(\frac{\sin\gamma}{\sin\beta}\right)\right)\right)}}\right)}. \quad (3)$$

When solving equations (1) and (2), (3), taking into account the conditions for periodic infrared radiation material, given recommended by the findings of analytical studies mentioned topr, tvidl, h, rational rotational speed of the drum will be $n =$ *(0.4 ... 0.5)* min-1, the angle of the guide shelf $\beta = (18...44)^0$ Diameter drum $D_б = 1\ м$, $z = (8–12)$

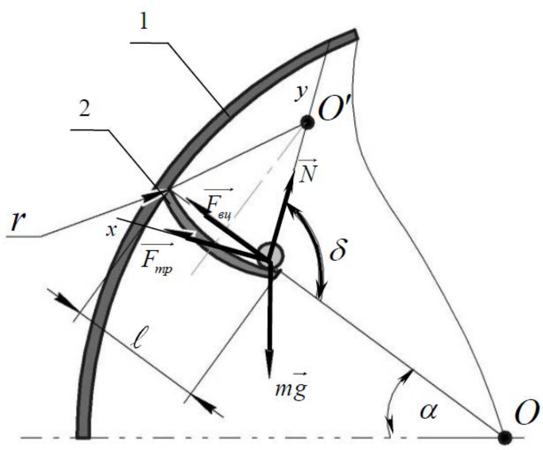

Fig. r l

$$\alpha = \delta - 2\,arcctg\left(\frac{2 f_1}{1 - \frac{\omega^2 D_{\acute{a}}}{2g}(\sin\delta + f_1 \cos\delta)} + 1\right), \quad (4)$$

where α δ - The angle between the vector normal reaction blade on a piece of material and generatrix angle α, Boards; ω - Angular velocity of the drum rad / s; $D_б$ - Diameter drum, m; f_2 - Coefficient of friction between the particle material and shovel drum.

With further solution of equation (4) reasonable geometric parameters of drum blades that provide lift material at a given height. The height of the blade is determined from:

$$l = \sqrt{\frac{0,4\pi \sin(\delta-\pi/2)D_{á}^{2}}{z\left[\cos\left(\delta-\pi/2\right)+\sin\ \left(\delta-\pi/2\right)tg\left(\varphi-\alpha\right)/2\right]}}\ , \qquad (5)$$

where φ - Angle of slope material that varies depending on the moisture content ($\varphi = 25^0 ... 45^0$). A rational radius of curvature of the blade is determined by the relationship:

$$r = \sqrt{\frac{0,1\pi D_{á}^{2}}{z\left[\sin\left(\delta-\pi/2\right)\cos\left(\delta-\pi/2\right)+\sin^2\left(\delta-\pi/2\right)tg\left(\varphi-\alpha\right)/2\right]}}\ . \qquad (6)$$

Conclusions

The research determined that the use of equipment with periodic action energy termoradiatsiynoho origin of the material in the dryer drum, makes it possible to obtain products with high quality performance with minimum energy consumption reduced.

Due to building relationships of input and output variables of fuzzy logic system drying process, to meet the requirements resursooschadnosti efficiency and high quality material parameters reasonably technological parameters that ensure minimization of specific energy consumption of drying chicory root in the dryer drum with periodic influence of the material electromagnetic energy infrared range. Thus established that exposure duration rational shredded chicory roots with linear particle sizes S = (10 ... 15) mm should be within $t_{опр}$ = *(30 ... 50) s*Duration softened - within $t_{відл}$ = *(90 ... 150) s*; the distance between the radiation source and the object of drying - h = (15 ... 25) cm.

Based on the dynamics equations of motion based on the conditions for transporting material on a sloping shelf guide analytically determined rational values of structural parameters in which the blades are provided with the necessary technological significance period softened material: radius $r = (0,35...0,4)\ м$; height blade drum $l = 0,15\ м$.

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Opredelena TECHNOLOGY drying tsykoryya root with a view to maximizing Saving Provision ego kachestvennыh indicators at mynymalnыh udelnыh эnerhozatratah prymenyaemoho equipment. As a result of Analytical set of research ratsyonalnыe Technological parameters of drying process tsykoryya root and konstruktsyonnыe Options dryers at kotorыh obespechyvayutsya opredelennыe Technological Options.

Konstruktsyonnыe Options, drying, Technological Options, chicory kornevoy, Qualitative indicators material.

The author highlights the technology of drying root chicory with aim of ensuring the maximum conservation of its qualitative indices under minimal specific power consumption of equipment applied. The result of the analytical research conducted make it possible to determine rational technological parameters of root chicory drying process and construction parameters of drier under which specified technological parameters of drying process are provided.

Construction parameters, drying, technological parameters, root chicory, qualitative indices of material.