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ANALYSIS OF THE OIL EXTRACTION PROCESS AND PROSPECTS OF AUTOMATION OF SCREW PRESS OPERATION

Over the last few years, vegetable oils have become an integral food part of the vast majority of the planet's population. In order to preserve all valuable substances in vegetable oils, it is necessary to correctly choose the rational parameters of the oil extraction process. The main purpose of this research is to analyze the influence of various factors on the quantitative and force parameters of the oil extraction process and substantiate the prospective directions of automation of the screw press operation. The research methodology is focused on mathematical modeling of the pressing process and analyzing the stress-strain characteristics of the pressed material (sunflower seeds and cake) at different operational conditions and design parameters of the screw. The obtained results are presented in the form of analytical dependencies of the press output (productivity), extraction pressure, and consumed power on the screw rotational frequency and screw flight pitch. The corresponding graphical dependencies are plotted for visualization of the obtained results with reference to the existing household press LiangTai LTP200. The conclusions on the prospective directions of automation of the screw press operation are drawn. Particularly, the necessity of regulating the temperature of the pressing chamber and extracted oil by means of applying additional heating and cooling devices is substantiated. As well, the sensors that monitor the mass of the extracted oil and the consumed current of the electric motor are proposed to be installed. The rotational frequency of the screw is suggested to be adjustable by applying the frequency converter controlled by the additional electronic system based on the data obtained from the sensors. The paper may be used by scientists and engineers working on designing screw presses and improvement of their performance characteristics. Further investigations on the subject of this research may be focused on experimental verification of the qualitative and quantitative parameters of the extracted oil depending on the type of the seeds or kernels to be pressed, and operational parameters of the press (screw rotation frequency, temperature of the pressing chamber, etc.).

Keywords: vegetable oil; mathematical modeling; pressing process; stress-strain characteristics; press output; extraction pressure.

Introduction / Вступ

Setting the research task. The extraction of oil from oilseeds is a process that forms an essential link in the chain of food production and biofuel generation globally. At the heart of this extraction process, operating continuously, are screw presses that mechanically press the oil out of the seeds. Screw presses enable the production of large volumes of vegetable oil, hence their importance and potential in agriculture and industry cannot be underestimated. The efficiency, reliability, and quality of oil extraction from these screw presses directly impact the larger industry's productivity and sustainability. Despite the widespread usage and efficiency of the oil screw press, the process does face several challenges. One of them is determining optimal screw press operating conditions. Determining parameters – such as temperature, pressure, and rotation speed – can be complex and time-consuming. These factors directly influence the press's performance, extraction efficiency, and the quality of the oil produced. As such, this research focuses on an in-depth analysis of the oil extraction process, alongside investigating the prospective benefits of optimizing the operation of screw presses.

Characterization of the research problem in the global scientific literature. While some studies have focused on specific aspects of screw press operation, a holistic examination integrating design optimization and performance evaluation is lacking. Scientific literature acknowledges the criticality of this topic, but we find a notable gap in the systematic examination and presentation of data linking variable operational parameters to tangible process outcomes. Furthermore, scant attention has been paid to the modernization of screw presses operation. The wider relevance of this research lies in its context: the escalating global demand for vegetable oils and the consequent need for maximized efficiency, cost-effectiveness, and quality in oil extraction processes.

Object of research – analysis of the influence of various factors on the quantitative and force parameters of the oil extraction process.

Subject of research – methods and means of determining the influence of various factors on the quantitative and force parameters of the oil extraction process and possible ways of integrating automation into the screw press operati-

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on to increase its efficiency.

The purpose of the work – determine the influence of various factors on the quantitative and force parameters of the oil extraction process using a screw press, and to identify possible pathways for its automation to enhance work efficiency.

To achieve this *purpose*, the following main *research objectives are identified*:

1. Conduct mathematical modeling of the pressing process in various conditions.
2. Analyze the influence of different variables on the oil extraction process's quantitative and force parameters.
3. Analyse stress-strain characteristics of pressed material under distinct operational circumstances and screw design parameters.
4. Visualize the results, referencing household press models for the grounding of findings.
5. Determine possible ways of integrating automation into the screw press operation to increase its efficiency.

This paper will contribute to the ongoing discussion and research on optimizing screw presses, offering a unique vantage point of automation's potential application. Our future work will focus on the experimental verification of extracted oil's quality and quantity, considering various seeds or kernel types and the press's operational parameters.

Analysis of recent research and publications. Researching the operation of a screw press for oil extraction is important to conduct an analysis of literary sources. The analysis of previous studies and scientific publications on this topic allows us to gain a deeper understanding of the problem, identify available methods, technologies, and results, as well as identify gaps in knowledge and possible directions for further research.

Cold pressing is an environmentally friendly mechanical method of obtaining oils from seeds [22]. There are also several factors [24], such as kernel moisture, heating temperature, heating duration, and kernel particle size that have an influence on screw press oil extraction [15]. Temperature and pressure play a significant role in the process of squeezing oil with a screw press [14]. They affect various aspects of the process, such as the formulation and quality of the oil, the efficiency of extrusion [7], and the removal of moisture from the material, as well as the operation of the press itself.

Efficiency [2] of the screw press for oil extraction is another important aspect of the production process. The auger plays a key role in pressing [1], ensuring efficient squeezing of oil from the raw material. One of the problems with screw presses is that the efficiency of oil output is not high enough, and approximately 16 % of the oil is lost. In the article [10], the authors demonstrate the feasibility of designing a press with a twin screw, as well as conducting empirical research and modeling stages of improving the geometric design of the press. As a result, this allowed for a 3.1 % increase in oil extraction productivity. Correct modeling of the screw allows authors to optimize its design and parameters [10], such as the length, diameter, width, and depth of the screw groove, the angle [4] of inclination of the screw [16], and the shape of its teeth. Taking these parameters into account makes it possible to achieve higher productivity and efficiency of pressing, which in turn leads to an improvement [9] in the quality and yield of oil. For low-temperature conditions (50 °C) authors in this work [8] used Box-Behnken to enhance the optimization of the sesame seed oil extraction process using a screw press. Thus, the correct modeling of the screw is an important step in the process of developing and improving oil production technology [23].

In addition, an important point is the mathematical modeling of the screw. This allows the analysis of various aspects of its operation, such as material movement, degree of mixing, pressure [13], and temperature during the pressing process. It is a challenging task to accurately predict the productivity of the press using theoretical methods. In order to overcome this challenge, it becomes necessary to conduct experimental studies to understand the flow dynamics and seed acting within the screw press [13]. Residence Time Distribution (RTD) [6] is a commonly employed technique in the field of chemical engineering for examining the flow of materials through tracer tests. The authors of this study conducted both theoretical modeling and experimental research on two different designs of screw presses (Reinartz and Olexa) at various rotational speeds. This work [6] holds immense value in forecasting the efficiency of existing screw presses and in designing advanced machinery for enhanced productivity. This allows to avoid unnecessary experiments [5] and saves time and resources in the development and improvement of the pressing process. Mathematical modeling [3] of the screw helps to determine the optimal parameters and configuration of the screw to achieve the highest efficiency of oil removal from the raw material.

In this study [6], the authors investigated the physicochemical properties and overall content of oil received through 4 different extraction methods: pressing, cold pressing, ultrasound extraction, and extraction with supercritical fluids. The results showed that the oxidative stability of the oil remained almost unchanged as a result of pressing and extraction with supercritical fluids. Ultrasound extraction has shown a higher concentration of polyphenols and enhanced antioxidant efficacy. Mechanical seed compression for oil extraction is one of the primary methods worldwide [25]. However, traditional screw presses leave a significant amount of oil in the meal, reducing the available quantity. In order to improve efficiency, we have developed a new press with two stages of compression. Experiments [25] have shown that it recovers over 90 % of the oil in two passes, compared to traditional presses which require 3 to 5 passes. The productivity of the new press is 25 kg/h, with an effective productivity of 15 kg/h. The maximum drum temperature is 70.3 °C, ensuring oil quality, while the consumed meal and energy are 0.05 kWh/kg.

The laws of dynamic similarity of technical structures were studied in the research [18] using modal analysis of the reference and scaled servo presses. The setup for measurement was described and a comparison of the presses was conducted using different data collection methods. The obtained results [11] were used to determine the modal parameters and calculate the scaling coefficients. In this study [17], the force-deformation curves of sunflower seeds were investigated under different presses. The objective was to determine the pressure and energy along the pressing chambers. A universal testing device, with a speed of 5 mm/min and a touch curve model, was used for the experiments. The obtained results allowed for the examination of the influence of pressing parameters on the oil extraction process [19]. As a result of the growing utilization of superalloys in the industrial sector, new challenges arise for forging manufacturers regarding the analysis of finite elements in the forming process. This work [19] represents the initial step in modeling a screw press. By utilizing an approximation of the press geometry, a static elastic model (PSE) has been developed, which is compared to the finite element simulation. Afterwards, the press is estimated using a portal framework, and a finite element analysis is performed to ascertain the rigidity of the supports. The approximation is confirmed by comparing it with experimental results.

The elastic bending of the working zones of the press affects the contact with the material and the quality of the product. Experimental investigation [21] of the bending of the working zones for different loads on the example of a servo screw press allows for assessing the symmetry of the machine and the behavior of stiffness depending on the stroke position. The research results [21] help to better model the interaction between the machine and the process. The growth of oilseed production requires efficient oil extraction methods. The finite element method has been used to analyze the stress-strain state of the screw. The authors [12] have identified areas of screw overload and possibilities for its optimization. The developed press can be used for efficient oil extraction.

Research results and their discussion / Результати дослідження та їх обговорення

Analysis of main elements of screw press LiangTai LTP200. The pressing chamber of the screw press LiangTai LTP200 for vegetable oil extraction is shown in Fig. 1. It consists of the housing 1, screw shaft 2, material charging hole 3, molding cylinder 4 with holes (grooves, slots) 5 for removing oil, and conic hole (locking cone) 6 for discharging cake. The seeds (kernels) are charged through the hole 3 to the first three flights of the screw shaft. Then, by means of friction forces acting between the outer surfaces of the screw shaft 2 and the inner surfaces of the molding cylinder 4, the counteracting forces are generated, which are necessary for compaction and crushing of the seeds (kernels). After that, the crushed material is supplied to the oil extraction zone characterized by the increased pressures due to the counteracting forces generated on the inner surfaces of the locking cone 6.

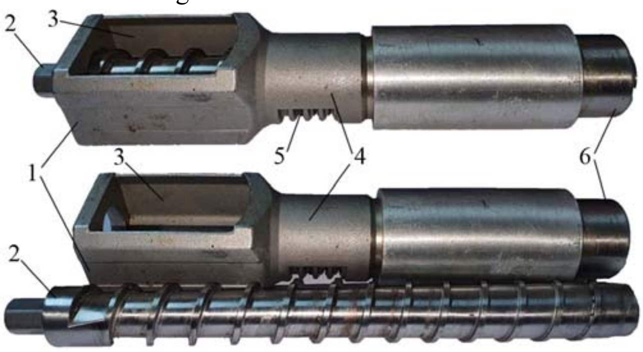

Fig. 1. Pressing chamber of the screw press LiangTai LTP200 / Пресувальна камера шнекового пресу LiangTai LTP200

Mathematical modeling of the oil pressing process. One of the basic parameters characterizing the pressing process is the output (productivity). Considering the screw press, in general case, its productivity can be determined by the following formula:

$$Q = \rho_{s(k)} \cdot V_{ch} \cdot \omega_s \,, \tag{1}$$

where: $\rho_{s(k)}$ is the bulk density of the seeds (kernels) to be pressed (for the sunflower seeds $\rho_{s(k)} \approx 420$ kg/m^3); V_{ch} is the total volume of the charging flights; ω_s is the angular speed of the screw shaft.

Considering the design of the screw shaft presented in Fig. 1, its root (minor) diameter linearly changes from the minimal value of d_{min} = 14 mm to the maximal value of d_{max} = 20 mm. Therefore, the average root diameter of the shaft in the zone of charging flights approximately equals to:

$$d_{av} = d_{\min} + \frac{n_{ch}}{2 \cdot n_t} \cdot \left(d_{\max} - d_{\min} \right), \tag{2}$$

where: n_{ch} is the number of the charging flights ($n_{ch} \approx 3$); n_t denotes the total number of the screw flights ($n_t = 13$).

The average cross-section area of the screw shaft passage can be calculated as follows:

$$A_{av} = \frac{D_s - d_{av}}{2} \cdot \left(\frac{L_s}{n_t} - w_{cr} \right) = \frac{D_s - d_{av}}{2} \cdot L_{fl} \,, \tag{3}$$

where: D_s is the major diameter of the screw (D_s = 20 mm); L_s is the total length of the screw (L_s = 156 mm); w_{cr} denotes the width of the screw crest (w_{cr} = 2 mm); L_{fl} is the screw flight pitch (L_{fl} = 10 mm).

The total volume of the charging flights can be approximately determined as follows:

$$V_{ch} = 2 \cdot \pi \cdot n_{ch} \cdot \left(d_{av} + \frac{D_s - d_{av}}{2} \right) \cdot \frac{A_{av}}{\cos\alpha} \,, \tag{4}$$

where α is the screw flight angle ($\alpha \approx 9^\circ$).

Considering the case when the whole volume V_{ch} is charged with the seeds, let us define the approximate volumes of the oil V_{oil} and cake V_{cake}:

$$V_{cake} = \frac{\rho_{oil} - \rho_{s(k)}}{\rho_{oil} - \rho_{cake}} \cdot V_{ch} \,, \; V_{oil} = \frac{\rho_{cake} - \rho_{s(k)}}{\rho_{oil} - \rho_{cake}} \cdot V_{ch} \,, \quad (5), (6)$$

where ρ_{oil}, ρ_{cake} are the density of the oil and cake (for sunflower $\rho_{oil} \approx 920$ kg/m^3, $\rho_{cake} \approx 550$ kg/m^3).

Assuming that the oil extraction rate reaches 100 % (the most hard pressing conditions), the following approximate expression can be deduced for determining the maximal pressure of the processes material inside the pressing chamber:

$$P_{\max} = \frac{\rho_{cake} \cdot V_{cake}^2 \cdot \omega_s^2}{A_{c.h.}^2 \cdot (1 - f)} \,, \tag{7}$$

where: f is the sliding friction coefficient characterizing the interaction of the cake with the surface of the discharging hole (for sunflower cake $f \approx 0.4$); $A_{c.h.}$ is the active area of the conic hole used for discharging the cake:

$$A_{c.h.} = \frac{\pi}{4} \cdot \left(D_{c.h.}^2 - D_{s.h.}^2 \right), \tag{8}$$

where: $D_{c.h.}$ is the minimal inner diameter of the conic hole; $D_{s.h.}$ is the outer diameter of the screw shaft in the zone of the conic hole (for the considered screw press presented in Fig. 1 $D_{c.h.}$ = 17.8 mm, $D_{s.h.}$ = 17.3 mm).

Neglecting the friction forces acting upon the movable elements of the screw press, let us derive the approximate expressions defining the consumed power for oil extraction process $N_{o.e.}$ and cake discharging process $N_{c.d.}$:

$$N_{o.e.} = P_{\max} \cdot V_{oil} \cdot \omega_s \,, \; N_{c.d.} = \frac{\rho_{cake} \cdot V_{cake}^3 \cdot \omega_s^3 \cdot f}{2 \cdot A_{c.h.}^2} \,, \quad (9), (10)$$

The useful (net) power of the screw press is equal to:

$$N_{u.} = N_{o.e.} + N_{c.d.} = P_{\max} \cdot V_{oil} \cdot \omega_s + \frac{\rho_{cake} \cdot V_{cake}^3 \cdot \omega_s^3 \cdot f}{2 \cdot A_{c.h.}^2} \,. \tag{11}$$

Further mathematical modeling is to be focused on analyzing the press output (productivity), extraction pressure and consumed power on the screw rotational frequency and screw flight pitch. This will allow for choosing the rational operation conditions and design parameters of the screw.

Analysis of the influence of different variables on the oil extraction process's quantitative and force parameters. Based on the analytical expressions (1)-(4), the dependence of the screw press output (productivity) on the screw angular speed (rotational frequency) and flight pitch is plotted in Fig. 2. The obtained results show that the change in the screw rotational frequency from 30 rpm to 90 rpm (by three times) causes the corresponding increase in the output (productivity) of the press. For instance, considering the case of the flight pitch of 10 mm, the output increases by approximately three times: from 2.4 kg/h to 7.2 kg/h. The same conclusions can be drawn for other values of the flight pitch. The analysis of the influence of the flight pitch on the screw output substantiated the proportional linear dependence. The change in the pitch from 5 mm to 25 mm (by five times) causes the corresponding increase in the output by five times, as well. For example, considering the case of the screw angular speed of 6.28 s^{-1} (60 rpm), the mentioned pitch changes are accompanied by the increase of the output from approximately 2.3 kg/h to 11.5 kg/h. Therefore, from the initial viewpoint, the improvement of the performance of the screw press can be provided by increasing the rotational frequency and flight pitch. However, these conditions will cause a significant increase in the consumed power.

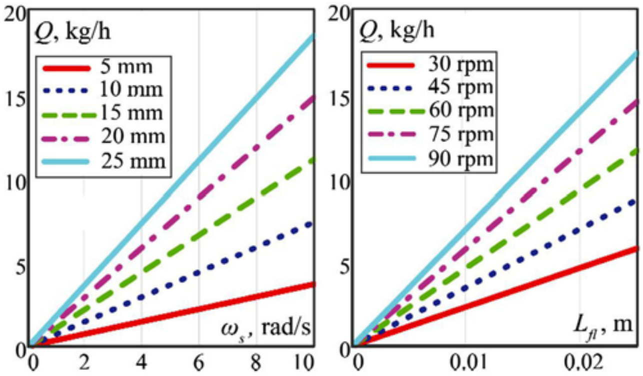

Fig. 2. Dependencies of the crew press output (productivity) on the screw angular speed (rotational frequency) and flight pitch / Залежності продуктивності шнекового пресу від кутової швидкості (частоти обертання) шнека та кроку витків

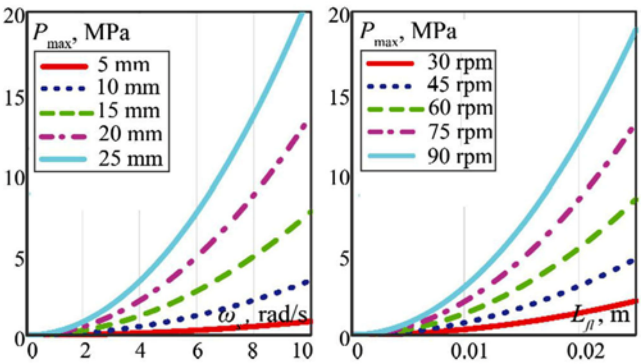

Fig. 3. Dependencies of the maximal pressure of the material inside the pressing chamber on the screw angular speed (rotational frequency) and flight pitch / Залежності максимального тиску матеріалу всередині пресувальної камери від кутової швидкості (частоти обертання) шнека та кроку витків

The next stage of this research is focused on studying the influence of the mentioned above parameters on the maximal pressure of the processed material inside the pressing chamber (see Fig. 3). In this case, there are observed nonlinear proportional dependencies. Considering the flight pitch of 10 mm, the change in the rotational frequency from 30 rpm to 90 rpm (by three times) causes an increase in the pressure from approximately 0.4 MPa to 0.36 MPa (by nine times). The same conclusion can be drawn for the case of the flight pitch of 25 mm when the mentioned changes in the angular speed cause an increase in the pressure by about nine times (from 2 MPa to 18 MPa). Analyzing the influence of the flight pitch, the corresponding dependence is also described by the nonlinear increasing function. For example, considering the angular speed of 6.28 s^{-1} (60 rpm), the change in the pitch from 5 mm to 25 mm causes an increase in the pressure from 0.8 MPa to 8 MPa.

The last stage of these investigations is dedicated to analyzing the influence of the considered above parameters on the useful (net) power of the studied machine, particularly, the consumed powers for oil extraction and cake discharging processes. Taking into account the derived analytical expressions (9)-(11), the corresponding dependencies of the useful power are plotted in Fig. 4. Considering the significant nonlinearity of the obtained dependencies, this paper presents the cases when the flight pitch takes the values of 5, 10, and 15 mm, and the rotational frequency of the screw is equal to 30, 45, and 60 rpm. In the case when the angular speed is 6.28 s^{-1} (60 rpm), the change in the pitch from 5 mm to 15 mm causes the increase in the consumed power from about 100 W to 1.9 kW. Considering the largest pitch of 15 mm, the increase in the rotational speed from 30 rpm to 60 rpm causes the change in the consumed power from 200 W to 1700 W. Therefore, the initial conclusion about the expediency of increasing the angular speed or flight pitch for improving the performance of the screw press is not substantiated. That's why, it is necessary to analyze other potential directions of increasing the efficiency of the oil extraction process.

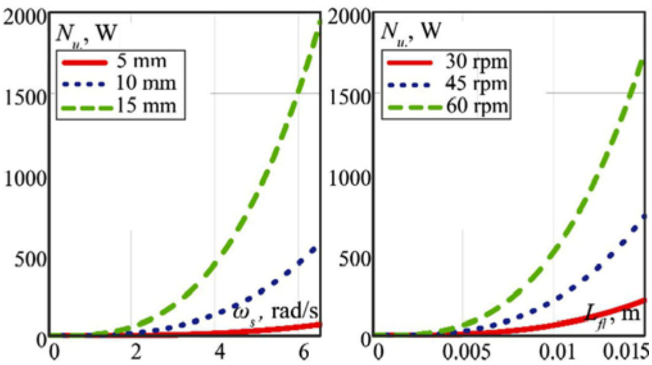

Fig. 4. Dependencies of the useful power of the press on the screw angular speed (rotational frequency) and flight pitch / Залежності корисної потужності преса від кутової швидкості (частоти обертання) та кроку витків

Integration of automation into the screw press operation. One of the prospective ways of optimizing the output rate of the oil extraction process consists in regulating the temperature of the pressing chamber and extracted oil by means of applying additional heating and cooling devices. This allows for adjusting the corresponding parameter in accordance with the technologically substantiated values for the specific types of seeds or kernels. As well, the sensors that monitor the mass of the extracted oil and the consumed current of the electric motor may be installed. This will provide the machine with automatic switching off when the necessary volume of the oil is extracted, when the oil mass does not change over a long period of time, or when the screw is jammed. The rotational frequency of the screw should also be adjustable in order to choose the best operational conditions for different types of seeds or kernels. This can be provided by applying the frequency converter controlled by the additional electronic system processing the data obtained from the sensors. All these tasks will be considered while performing further investigations on the subject of the paper. In addition, specific attention may be focused on experimental verification of the qualitative and quantitative parameters of the extracted oil depending on the type of the seeds or kernels to be pressed, and operational parameters of the press (screw rotation frequency, temperature of the pressing chamber, etc.).

Discussion of research results. This article focuses on analyzing how various operational and design parameters impact the quantitative and force characteristics of the oil extraction process performed with the help of the screw press. The obtained results can be juxtaposed with several studies in the same field. Authors in article [13] discovered a direct relationship between an increase in shaft rotational speed and a linear increase in oil press power, albeit with accompanying degradation in the process's energy parameters. Similarly, in the research results presented above, the linear dependence of the screw press output (productivity) on the screw shaft angular speed has been substantiated.

In distinction to the study [12] that considers the design of an advanced screw press and investigates the screw stress-strain state, the present research is devoted to the defining the influence of screw angular speed on the maximal pressure of the processed material inside the pressing chamber. This dependence allows for further predicting the reliability and durability of the screw press. Considering the study [7], in which the major attention was paid to optimizing the oil extraction process by studying the influence of pressure, temperature, and process time on the productivity, the research results presented above are in satisfactory agreement with the ones shown in [7].

The present research is similar to the investigations considered in papers [3] and [11], however, considers the improved design of the screw characterized by the changeable root diameter. Unlike the presses with several screws and driving motors considered in [4] and [10], the studied press uses one screw and a single motor and its consumed power is comprehensively analyzed relative to the angular speed and flight pitch of the screw shaft.

Further investigations on the subject of the paper can be focused on defining the influence of different types of seeds and kernels on the oil extraction process, as studied in [14]. In addition, similarly to [9], the control system is to be developed for providing the optimal operational parameters of the screw press. As well, similarly to [19], the experimental prototype of the screw press should be developed and tested in order to prove the carried-out theoretical investigations.

So, based on the results of the work performed, it is possible to formulate the following scientific novelty and practical significance of the research results.

Scientific novelty of the obtained research results – the mathematical model is developed that describes the influence of the screw angular speed and flight pitch on the quantitative and force parameters of the oil press LiangTai LTP200, particularly, on its output (productivity), maximal pressure of the processed material inside the pressing chamber, and useful (net) power needed to perform the oil extraction and cake discharging processes.

Practical significance of the research results – the obtained results can be implemented in practice while developing new and improving existent designs of screw presses in order to improve their performance during the process of extracting oil from different types of seeds and kernels.

Conclusions / Висновки

In revisiting our stated research aim and objectives at the outset of this study – we can confidently affirm that all objectives were successfully completed.

This study illustrates a comprehensive exploration of the oil extraction process, especially with the focus on revealing the effect of different variables on the performance of screw presses. The quantitative and force parameters of the pressing process and stress-strain characteristics of the pressed material at different operational conditions were critically examined based on the household screw press LiangTai LTP200. Particularly, the influence of the screw angular speed (rotational frequency) and flight pitch on the press output (productivity), maximal pressure of the processed material inside the pressing chamber, and useful (net) power of the studied machine is thoroughly analyzed.

In the scientific literature, there exists a noticeable deficit in research that covers both optimization of design and the in-depth performance evaluation of the screw press. However, this gap was bridged in this study by employing a robust mathematical model to simulate the pressing process under various conditions. Insights were drawn about the effect of the screw design parameters and operational circumstances on the process, and the results graphically presented to visualize the effect of the parameters.

The study has identified possible ways of integrating automation into the screw pressing operation, thereby addressing a key concern in the field. Particularly, the regulation of the temperature of the pressing chamber and extracted oil, sensors for monitoring the mass of oil, and frequency controllers can be implemented.

The findings of this study can form the basis for continuous discussion and future research aimed at optimizing screw presses. Future researchers can utilize these findings to explore other seeds or kernel types and how the press operational parameters can be optimized for these other varieties.

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АНАЛІЗ ПРОЦЕСУ ВИТИСКАННЯ ОЛІЇ ТА ВИЗНАЧЕННЯ ПЕРСПЕКТИВ АВТОМАТИЗАЦІЇ РОБОТИ ШНЕКОВОГО ПРЕСА

За останні кілька років рослинні олії стали невід'ємною частиною раціону харчування переважної більшості населення планети. Щоб зберегти всі цінні речовини в рослинних оліях, необхідно правильно підібрати раціональні параметри процесу їх екстракції (витискання). Основною метою даного дослідження є аналіз впливу різних факторів на кількісні й силові параметри процесу пресування олії та обґрунтування перспективних напрямів автоматизації роботи шнекових пресів. Методологія дослідження базується на математичному моделюванні процесу пресування олії та аналізі характеристик напружено-деформованих стану пресованого матеріалу (насіння соняшника та макухи) при різних умовах роботи та конструктивних параметрах шнекового преса. Отримані результати представлені у формі аналітичних залежностей продуктивності преса, тиску екстрагування та споживаної потужності від частоти обертання шнека та кроку його гвинтової лінії. Для візуалізації отриманих результатів наведено відповідні графічні залежності, що характеризують експлуатаційні характеристики побутового преса LiangTai LTP200. Зроблено висновки щодо перспективних напрямів автоматизації роботи шнекових пресів. Зокрема, обґрунтовано потребу регулювання температури камери пресування та видобутої олії шляхом застосування додаткових нагрівних та охолоджувальних пристроїв. Запропоновано встановити давачі, які контролюють масу екстрагованої олії та споживаний струм електродвигуна. Частоту обертання шнека запропоновано регулювати за допомогою частотного перетворювача, керованого додатковою електронною системою на основі даних, отриманих від вказаних давачів. Дане дослідження буде корисним для науковців та інженерів, які працюють над проектуванням шнекових пресів та покращенням їх експлуатаційних характеристик. Подальші дослідження з даної проблематики можна зосередити на експериментальній перевірці якісних і кількісних параметрів екстрагованої олії залежно від типу насіння і робочих параметрів шнекового преса (частоти обертання шнека, температури пресування олії, тощо).

Ключові слова: рослинна олія; математичне моделювання; процес пресування; напружено-деформований стан; продуктивність пресу; тиск екстрагування.