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**INTENSIFICATION OF THE PRESSING PROCESS FOR THE  
PRODUCTION OF SAFFLOWER OIL**

**ANNOTATION**

the dissertation work of PhD-doctoral student Mursalykova M.T for the degree of Doctor of Philosophy (PhD) in the specialty 8D07101 - Technological machines and equipment

**The relevance of the work.** One of the main areas of food industry development in Kazakhstan is the oil and fat industry. The oil and fat industry is gaining popularity and developing in Kazakhstan from an economic point of view. Within the framework of the oil and fat industry development program, the area under oilseeds in Kazakhstan is planned to expand from the current 2.36 million hectares to 5 million hectares by 2030, and their average yield to increase from 10.5 to 14 c/ha. This program is integrated into the national program for the development of the agro-industrial complex, the operators of which are the Government of Kazakhstan, the Ministry of Agriculture of Kazakhstan and key sectoral ministries. Also, the main factor for the successful development of the oil and fat industry is the active trade in products due to the increasing global demand for oil and protein food products, especially since the export potential of organic oil and fat products from Kazakhstan to the markets of Central Asia, Europe, Russia and China is quite high.

Currently, the basis for sustainable development of the agro-industrial complex of the state is to increase the cultivation and production of agricultural products. As a result, we have a goal to fully satisfy domestic demand, reduce imports and increase exports. In this regard, it is necessary to bring the work on the proper use of land and water resources of Kazakhstan, cultivation of grain and oilseed crops to a new level and expand the range of manufactured products. It is worth paying attention to the types, varieties and alternatives of cereals and oilseeds that are highly effective. For example, in addition to sunflower oil, which is popular among oilseeds, linseed oil, soybean oil and safflower oil are now growing in popularity and attitude year after year. It follows that safflower oil has low popularity in Kazakhstan, but its advantages with benefits have been known since ancient times.

Safflower oil is a unique product of plant origin, the chemical composition of which allows you to use it for medical, cosmetic purposes, for the production of food products Taking into account the biological values and rich composition of vitamins and phospholipids safflower oil production is currently an urgent task.

Today, one of the main methods of vegetable oil production is the pressing method. Currently, only the continuous pressing method, i.e. screw presses, is used in vegetable oil production. The use of screw presses not only ensures

uninterrupted operation of the network, but also makes it possible to fully mechanize production.

However, there are disadvantages to using a screw press, such as, material intensity, high costs for electrical and thermal energy and more. In addition, one of the main disadvantages of screw presses is the instability of the pressure value in the screw turns due to changes in structural and mechanical properties caused by the mass-exchange process in the pressing process. This implies that the pressure value is not effectively distributed through the channel of the screw coils. As a result, the physical properties and process conditions of the product during pressing and after pressing do not meet process and production requirements. As a consequence, lower productivity on the equipment, additional processing operations on the line after pressing and higher inter-operating raw material and labor costs. Therefore, the improvement of vegetable oil press is one of the problems arising from modern needs.

Thanks to a large amount of research work carried out in different branches of the national economy of our country and abroad for several decades, significant successes have been achieved in increasing the efficiency of pressing. The following scientists have worked on the problems of pressing: M. Ionescu, F. Salaberria, A.I. Peleev, V.A. Maslikov, I.A. Rogov, A.V. Gorbatov, A.Y. Sokolov, M.B. Azarov, D.T. Zhailaubaev, S.N. Tumenov, A.A. Ospanov, E.S. Spandiarov, A.B. Ospanov, M.J. Erkebaev, M.Ch. Tultabaev, A.E. Erengaliev, A.K. Kakimov, A.L. Kassenov.

The prospective direction of development of many branches of agro-industrial complex, including safflower oil production, is the improvement of screw press designs, which determines the relevance of this dissertation work.

**The purpose** of the dissertation work is to improve the pressing process for safflower oil production by using a pressure control mechanism.

In accordance with the objective, the following **tasks** are defined in the paper:

- on the basis of literature review, determination of optimal ways to improve the pressing process in the production of safflower oil, organization and design of research objects;

- description of the system of mathematical modeling and methodology of engineering calculations of improving the pressing process with the help of pressure control mechanism;

- to describe the dependence of improvement of the pressing process by means of ratios of various constructive and determinable parameters and to determine the optimal parameters experimentally;

- evaluation of qualitative indicators of safflower oil and providing ways of practical realization of the results of scientific research.

**The object of the study.** The object of research is screw press - pressure control mechanism, safflower seeds.

**The subject of the study.**

1. Chemical composition of plant raw materials (safflower)
2. Change of granulometric composition of raw materials

3. Changes in the density of safflower cake
4. Pressure changes during the pressing process
5. Change of structural and mechanical properties of raw materials in the process of pressing
6. Change in the performance of the experimental unit
7. Variation of the power of the experimental unit

**Scientific novelty of the work:**

- based on the literature review, determined the optimal ways to improve the pressing process in the production of safflower oil, organized methods of research objects;

- mathematical modeling systems and methods of engineering calculations for improving the pressing process with the help of pressure control mechanism are described;

- the dependence of the improvement of the pressing process by means of ratios of various constructive and determinable parameters is described and the optimal parameters are determined experimentally;

- quality assessment of safflower oil was carried out and ways of practical realization of the results of scientific research were provided.

**The main points put forward for defense:**

- new design of the press (auger);

- results of analytical and experimental studies of safflower oil pressing process by the pressure control mechanism of the proposed screw design;

- safflower oil production line and engineering methodology of technological calculation of the press.

**Scientific and practical significance of the work.** On the basis of the complex of researches carried out in laboratory and production conditions the expediency of application of the mechanism of pressure regulation of the press screw design for safflower oil production is shown. The technical solution of the novelty of the design is confirmed by the patent for utility model RK № 7977 and produced and implemented a sample of the grate of the proposed design in LLP "QAZAQ ASTYQ GROUP" and in Semey branch of LLP "Kazakh Scientific Research Institute of Processing and Food Industry".

**Personal contribution of the author.** Development of mathematical model and engineering methodology of technological calculation of the press and development of a screw design with a pressure control mechanism.

**Approbation of practical results:** The main provisions and results of the work were reported at international scientific-practical conferences: "Innovative approaches in modern science" (Moscow, 2022); "Seifullin Readings-18(2): "XXI century: the era of scientific transformation" (Astana, 2022); "State and prospects of industrial-innovative development of agro-industrial complex of the Republic of Kazakhstan" (Semey, 2022); "Innovative development of food, light industry and hospitality industry" (Almaty, 2022); "Modern trends in the development of chemical technology and engineering in food and light industry" (Almaty, 2022).

**Publications.** 15 printed works have been published on the subject of the dissertation work: 5 articles in international conferences; 5 articles in publications

recommended by the Committee for Quality Assurance in Education and Science of the Ministry of Science and Higher Education of the Republic of Kazakhstan; 3 articles in scientific journals with non-zero impact factor (Scopus and Web of Science databases); 1 patent for utility model of the Republic of Kazakhstan and 1 patent for invention.

**The structure and scope of the dissertation.** The thesis consists of an introduction, five chapters, a conclusion, a list of used sources and appendices. The main content of the work is presented on 110 pages of computer-typed text, contains 52 figures, 10 tables, the list of literature includes 80 sources and 8 appendices.

**Assessment of the completeness of solutions to the tasks.** According to the results of the thesis work, it can be considered that the goals and objectives have been achieved:

1. The analysis of the process of pressing of vegetable raw materials and designs of machines for realization of this process has allowed to reveal reserves for improvement of this process by development of a screw design - mechanism of pressure regulation.

2. To improve the process of safflower oil pressing the design of the press was developed, the novelty of which is confirmed by the patent of the Republic of Kazakhstan for utility model No. 7977.

3. The optimal values of velocity  $\omega=6.2$  rad/s and diaphragm gap  $\delta=5-10^{-3}$  m, satisfying the objectives of the work, on the basis of velocity and pressure dependences obtained from the results of experiments, are verified. It was found that the deviations between the results of experiments and analytical system of mathematical modeling do not exceed 4.3 %.

4. Production tests of the press and experimental screw designs were carried out, the quality of the obtained product was investigated in a special laboratory-testing center and its compliance with the requirements of STST 12096-76, ST RK 1428-2005 was confirmed by documents.

5. The qualitative indicators of safflower oil were investigated and the results of scientific research were experimentally realized.