HYDRATION OF RAPESEED OIL USING AN ELECTROMAGNETIC FIELD.

P.I. Osadchuk

Department of Agroengineering, Odessa State Agrarian University, Odessa, Ukraine

Abstract: The prospects of using physical fields for the process of rapeseed oil purification are considered. The analysis of the existing research on the use of the processing of liquid food products by the electromagnetic field is carried out. In the context of the influence of the process of separation between two or more inhomogeneous media in the systems "liquid - liquid" and "liquid - solid". An experimental plant for the hydration of vegetable oils with processing by an electromagnetic field has been developed. Experimental studies of this process are presented, which were carried out in order to intensify and increase the release of the amount of phosphorus-containing substances, fatty acids, waxes and other related substances. The obtained results of experimental studies confirmed the positive expectations. The graphic material is presented that describes a physical experiment, the result of which is the receipt of the recommended parameters for using the electromagnetic field. Under these conditions, a high quality oil is obtained. Energy costs are reduced by intensifying the process.

Keywords: vegetable oil, electromagnetic field, hydration, phosphatides

INTRODUCTION. The content of related substances, including phosphatides, in vegetable oils varies significantly and depends on their type, as well as on the method and mode of their production.

From a physiological point of view, it is highly desirable to eat oils with a maximum phosphatide content. In practice, this cannot be done, since phosphatides easily dissolve in oils at the temperatures of their production, and then, upon cooling, are spontaneously released from them. The sediment formed quickly deteriorates due to the course of intense oxidative, enzymatic and hydrolytic processes. Taking this into account, in the process of production and processing, sunflower oil, as a rule, undergoes partial or complete refining [1, 2].

RELEVANCE. Due to the growth of consumer demand for vegetable oils in packaged and bulk form for home cooking, public and diet food networks. One of the most urgent tasks in a market economy is improving the quality and competitiveness of domestic types of vegetable oils, which have increased biological value and stability during long-term storage.

ANALYSIS OF LITERARY SOURCES. The work [3, 4] discusses a new understanding of the removal of related compounds from waste and by-products generated during the production of olive oil. The use of electromagnetic pulses for the extraction of polyphenols, fatty acids, coloring pigments, etc. is presented. However, in this case, the electromagnetic field is not used for cleaning the finished product.

In work [5], experiments are presented that showed the possibility of using pulsed electric fields for various technologies in the food industry. It is emphasized that these technologies are a valuable tool that can improve the functionality, extractability and release of valuable nutrients, as well as the bioavailability of trace elements and components in various food products. However, despite the fact that the positive effect of the use of electromagnetic fields is highlighted in the work, its use in the purification of vegetable oils is not given.

The work [6] shows the advantage of using electromagnetic fields over thermal technologies that are used in the processing of liquid food products. The main results achieved within the framework of the integrated project FP6 EU "NovelQ", which concerns the influence of electromagnetic fields on the main compounds that affect the properties associated with product quality, are summarized. However, the experiments are given for a variety of non-viscous liquids. In [7], the phenomenon of electroporation caused after the application of pulsed electric fields during the processing of food tissues is presented, which leads to an improvement in the connections between the intra- and extracellular content, which makes it possible to increase the likelihood of coagulation formation. However, these experiments were carried out with the aim of intensifying ice formation.

Based on the above experiments, it can be assumed that using an electromagnetic field, intensification of the micelle formation process will be observed when phosphatides are removed from vegetable oils. This is also confirmed in papers [8, 9, 10, 11]. Where it is shown that each stage of refining (refining) of sunflower oil is characterized by its own specific characteristic frequency of the external sinusoidal field, at which the electrical conductivity of the oil remains constant, and it is called characteristic electrical conductivity. Research on the use of electromagnetic treatment for the production of wax and wax-like substances from sunflower oil. The obtained positive results in the intensification of this process.

However, it remains relevant to conduct experiments on the effect of an electromagnetic field on the process of hydration of vegetable oils in order to remove phosphorus-absorbing substances.

PURPOSE OF RESEARCH. The purpose of the study is to determine the technological parameters of electromagnetic processing of raw materials by conducting experimental modeling of the process of hydration of vegetable oil under the influence of an electromagnetic field. This will increase the amount of phospholipid removal and intensify the hydration process.

To achieve the goal, the following tasks were set:

- to create a design of an experimental installation for processing oil by an electromagnetic field;

- to develop a methodology for determining the effective band of the electromagnetic field strength, miscella temperature and hydration time of vegetable oils;

- to carry out experimental studies with the help of which to recommend rational technological parameters of the use of the electromagnetic field during oil hydration.

EXPERIMENTAL RESULTS

Despite a number of research and development, there is still no rational way to remove a complex sludge from the oil, which forms a so-called mesh in the oil when the temperature drops, worsens the presentation of the finished product.

Studies have shown that the amount of hydrophilic phosphorus-absorbing substances in unrefined sunflower press oil reaches an average of 0.4-0.5%. The molecules of these substances consist of two parts: hydrophilic, formed by the residues of phosphoric acid and alcohol, and hydrophobic, containing long chains of residues, fatty acids.

The most common method for extracting phosphatides from oils is hydration. This process combines the treatment of oils with water or highly diluted aqueous solutions of alkalis, salts and acids. In industrial practice, various modes are used that differ from each other in the amount of the hydrating agent, its composition, etc. Most often, water is used for hydration.

Thus, due to the presence of polar groups, phosphates have an affinity for water, they have the properties of hydrophilic colloids, which suggests a positive effect of the electromagnetic field during the hydration process. Therefore, to intensify the hydration process and increase the release of the amount of phosphorus-containing substances. We have carried out research on the influence of the electromagnetic field on this process.

The experiment was as follows. For the hydration process, the standard equipment UGRM - 20.2 was used with the use of an electromagnetic installation.

It is as follows. The apparatus consists of two concentric pipes of different diameters, located one inside the other. Oil flows through the outer pipe, it is galvanized, and the inner pipe is brass or stainless.

In the inner tube, three coils are located, which form a pulsed magnetic field with polarity, which alternates between the poles of the coil and the outer tube. The centering of the inner pipe is carried out by three ribs located at an angle of 1200. The sunflower oil is supplied through the lower branch pipe, and the outlet through the upper one. The magnetization of sunflower oil occurs in a concentric annular gap between the inner and outer tubes.

Technical characteristics of the apparatus.

The electromagnetic device can operate in damp heating and unheated rooms with air humidity up to 90%.

Nominal productivity - 1.5 m3 / hour.

The nominal speed of the oil is 0.3 m / s.

The maximum magnetic field strength is 200 kA / m.

Maximum device current - 1.2 A

The maximum power consumption is 25 watts.

Dimensions: length - 750 mm.

The pipe diameter is 48 mm.

Length of branch pipes 60 mm.

Diameter of branch pipes - 1/2 "

Weight no more than 15 kg.

The impulse power supply unit is designed to operate in dry heated rooms at an air temperature of 15-35 ° C and an air humidity of no more than 80%.

Power supply voltage - 220 V.

The maximum load current is 1.2 A.

Ripple current regulation range - 2-10 Hz.

The range of regulation of the current ripple amplitude is 0.5-1 A.

Dimensions: height - 150 mm.

Width - 150 mm.

Length - 180 mm.

Weight no more than 2 kg.

When the mixture of oil and water passed through the electromagnetic installation, the intensity of the electromagnetic field changed, as well as the temperature of the miscella itself. At the same time, the time of precipitation and its weight in percentage was recorded, relative to the total amount of phosphorus-containing substances in sunflower oil.Результаты проведенных исследований приведены на рисунках 1, 2.

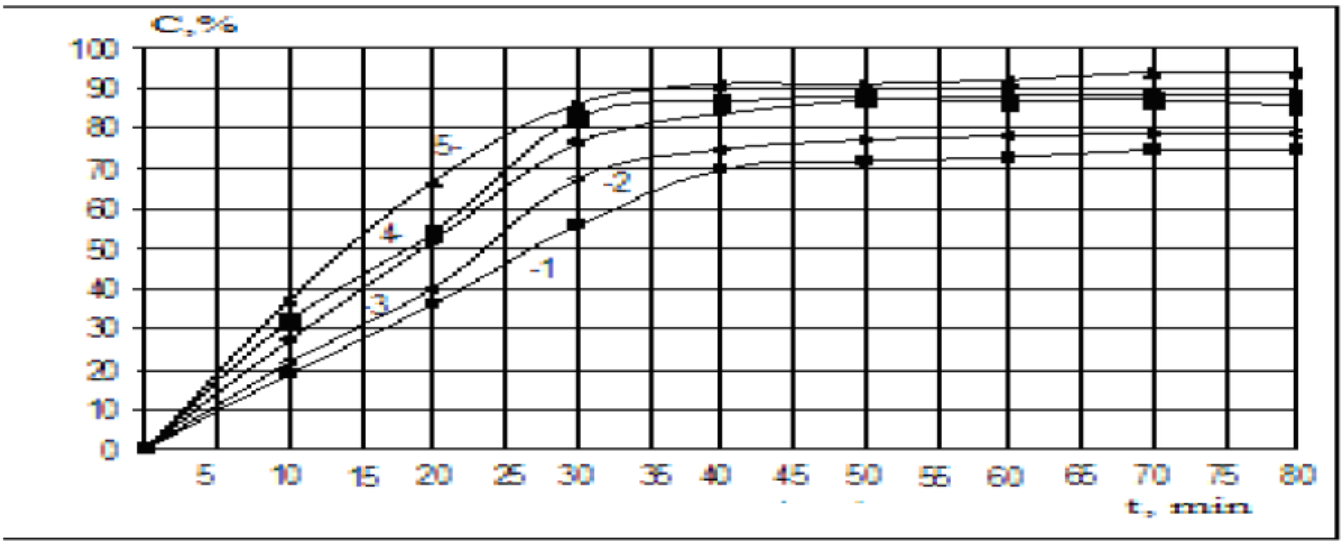

Figure: 1. Determination of the amount of removed phosphatides when the magnetic field strength changes: 1 - without an electromagnetic field, 2 - 115 kA / m; 3 - 135 kA / m; 4 - 155 kA / m; 5 - 175 kA / m.

Analyzing fig. 1 can be noted the observation of the positive effect of the influence of the electromagnetic field on the process of release of phosphorus-consuming substances. It can be seen from the family of curves that the amount of removed phosphatides without using an electromagnetic field is 15 percent less. Comparing the hydration process with a magnetic field strength from 115 kA / m to 175 kA / m, we see an increase in these indicators. However, the difference in the range of 155 - 175 kA / m is insignificant. Therefore, we determine the rational strength of the magnetic field 155 kA / m.

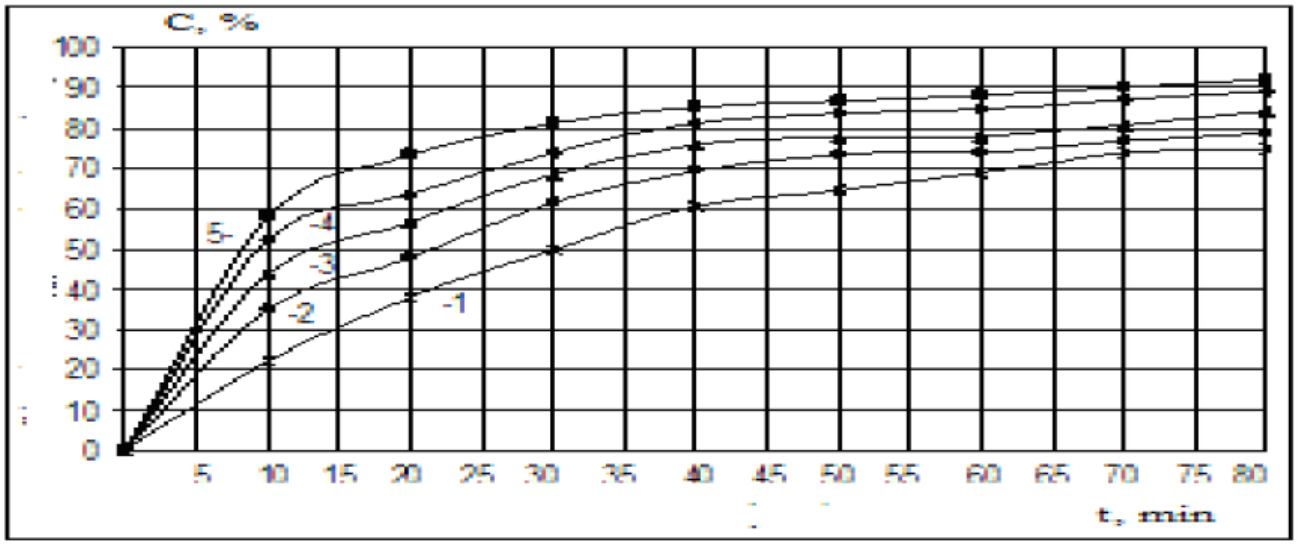

Figure: 2 Determination of the amount of sediment at a magnetic field strength of 155 kA / m, and various temperatures of the miscella: 1 - 20 ° C, 2 - 30 ° C, 3 - 40 ° C, 4 - 50 ° C, 5 - 60 ° C.

It can be seen from the family of curves in Fig. 2 that the amount of removed phosphatides with a change in the temperature of the miscella increases in direct proportion to the increase in temperature. The difference between sediment removal at minimum and maximum micelle temperatures is 15 percent. Comparing the hydration process with a miscella temperature from 20 ° C to 60 ° C at a magnetic field strength of 155 kA / m, we see an increase in the coagulation rate and the amount of sediment. However, the difference in the range from 50 ° C to 60 ° C is insignificant. Therefore, we determine the rational temperature of the miscella 55 ° C. Also, based on the obtained experimental dependencies, it is possible to determine the rational time of treatment with an electromagnetic field, which is one hour.

Figure 3 shows the percent removal of phosphotides with and without an electromagnetic field.

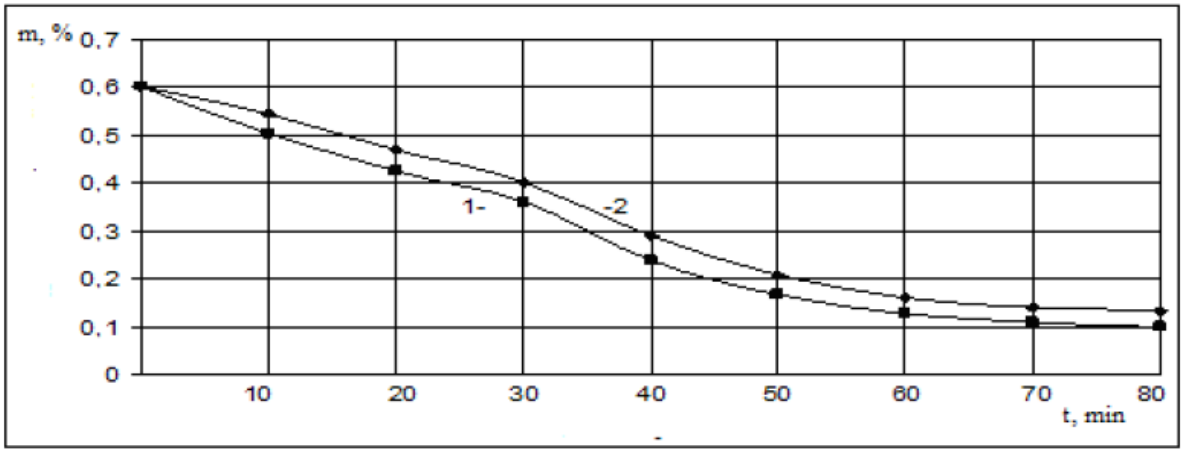

Figure 3. The number of removed phosphatides: 1- using an electromagnetic field; 2- without the use of an electromagnetic field

An intensification of the process is observed when using an electromagnetic field. The graphs show an increase in the rate and amount of phosphatide removal when using an electromagnetic field. The recommended parameters for using the electromagnetic field are the magnetic field strength of 155 kA / m, the miscella temperature is 55 oC, the rational time for the process is one hour.

CONCLUSIONS.

1. The design of an experimental installation for processing oil by an electromagnetic field has been developed.

2. The method for determining the effective band of the electromagnetic field strength, the miscella temperature and the hydration time of vegetable oils is presented;

3. The recommended technological parameters at which the intensification of the process of hydration of vegetable oils through the use of an electromagnetic field is observed.

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