Section 3. Food processing industry

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Erkaeva Nodira Choriyorovna,
Assistant of the Department of "General Technical Sciences"
Tashkent Institute of Irrigation and Agricultural Mechanization Engineers
Karshi branch. Karshi, Uzbekistan
Akhmedov Azimjon Normuminovich,
Doctor of Technical Sciences, Acting Professor
of the Department of Food Technology of Products
of the Karshi Engineering and Economic Institute, Karshi, Uzbekistan
Normurodova Ugiloy Uroz kizi,
Assistant of the Department of Food Technology of Products
of the Karshi Engineering and Economic Institute, Karshi, Uzbekistan

EFFECTIVE TECHNOLOGY FOR CLEANING MECHANICAL COMPOUNDS IN VEGETABLE OILS

Abstract. This article presents the results of research on primary purification processes of vegetable oils, i.e., data on the filtration performance of vegetable oils in a new type of filtrate called local basalt. As a result, it has been experimentally proven that there is no hygroscopicity and swelling, as well as virtually no elongation of the fibers forming a permanent porosity, thereby ensuring high filtration efficiency. As a result of primary purification of vegetable oils in the proposed filter cloth, the content of moisture and volatile substances in the main quality indicators of vegetable oils decreased from 0.20% to 0.10%, the amount of sediment in the oil from 0.05 to 0.02%.

Keywords: vegetable oils, technology for cleaning, filtration, basalt fibers.

Introduction: Industrially obtained vegetable oils consist of a mixture of fatty acids triglyceride (triacylglycerol), which is composed of a non-fat compound and oil-bearing substances [1, p. 35; 2, p. 73]. Non-fat mixtures include mechanical compounds (roasted kernels, shrot pieces, etc.), moisture, toxic chemicals, and other substances. The presence of toxic chemicals is explained by the fact that in agriculture, various toxic chemicals (pesticides, herbicides, etc.) are widely used in the fight against various pests and diseases of plants, which accumulate in the adipose tissue of the plant and are separated with oil.

During the production of vegetable oils, a purification process is carried out by distillation, centrifugation and filtration to remove coarse and mechanical impurities. It is also required after the refining (refining) process of vegetable oils, the retention of residual particles, the separation of bleaching reagent particles after the bleaching process.

One of the problems in the filtration process is that the filtration efficiency decreases as a result of the small particles in the oil blocking the filtration surface. The time and labor required to clean the filter is a factor that reduces production efficiency. Non-oily slurries in the primary purification process of vegetable oils, small particles that do not precipitate during the filtration of refined oil, and grinding of the bleaching soil to a very small size to form micropores during the bleaching process lead to rapid filling of the filter surface. The relevance of research in this area is determined by the fact that in the process of filtration can be used various agents that protect the filter surface from clogging in order to increase the life of the filter until the next cleaning and filtration efficiency.

The filtration process is an important stage in the organization of industrial production. Experts have established [2, p. 35; 2, p. 73] that the object being cleaned during mechanical filtration is divided into solid and liquid phases. In the production of vegetable oils, a purification process is carried out by distillation, centrifugation and filtration to remove coarse and mechanical impurities.

Materials and methods. The article uses modern methods of chemical, physico-chemical and other analyzes with the processing of the results by statistical methods [4, p. 107].

Vegetable oil analyzes were carried out according to the method described in the "Guidelines for research methods, technological control and production accounting in the oil and fat industry" [5, p. 22].

A method for determining the amount of moisture and light volatiles in vegetable oil

Weigh the weight of a pre-dried metal cup and add 5 g of oil to it and write the weight in the workbook. Then dry in a drying oven at a temperature of 100–105 °C for 30 minutes. After the allotted time, take the glass with a clamp, pour it into a desiccator, and after cooling, weigh it on a scale and record the result of the measurement. Then let it dry for another 15 minutes. After the allotted time, we take it out, cool it and weigh it. If there is no change between the previous and subsequent measurements, stop drying and calculate the moisture content of the oil using the following formula:

$$X = \frac{(m_1 - m_2)}{m} \cdot 100$$

where: m_1 – is the weight of the metal cup and oil before drying, g.

m_2 – weight of etal glass and oil after drying, g;

m – is the weight of the etal glass, g.

Determining the amount of crude oil precipitated

The sample of oil to be determined is weighed on a scale of 100 or 50 g of oil, depending on the amount of sediment, and placed in a 250 ml conical flask. On top of the oil sample obtained, mix three times the amount of oil with benzene. The dried filter is filtered through paper until the weight of the mixture remains constant. After the mixture is filtered, the remaining oil in the flask is washed with solvent and filtered again. The oil remaining in the filter is also washed away using a solvent. The greasy part left on the edges of the filter paper is cut, filtered and washed with solvent.

The filtrate should be clean and clear. The washed sediment is placed in a glass beaker together with filter paper and dried in a drying oven at 102–105 °C until the weight is constant, and the mass of sediment is calculated by the following formula:

$$X = \frac{(m_2 - m_1)}{m} \cdot 100$$

where: X – is the mass of sediment,%;

m_2 – is the mass of the filter paper and the dried sediment on it, g;

m – is the weight of the oil sample, g;

m_1 – is the weight of the dry glass and filter paper, g.

Results. One of the main indicators of basalt fiber material used for the production of filter materials for the purification of vegetable oils is its quality oil production. Oil permeability is the ability of a basalt material to conduct vegetable oil at a certain pressure, which is characterized by a coefficient of permeability. In this case, the oil permeability coefficient is of special importance, it is measured in $dm^3/(m^2s)$ and indicates how much.

Technical characteristics of mineral fibers and wool before and after the recommendation of the new technology are given in Table 1. This indicator is determined by calculation [6, c. 48–50; 7, C. 48]. According to the method, a stream of liquid and air was passed through each sample.

Table 1.– Specifications of mineral fiber filters

№	Technical indicators	Basalt wool rock deposits			Glass wool	Asbestos wool
		Aydarkul	Asmansay	Gavasay		
1.	Density kg/m^3	up to 23	up to 26.3	up to 24.3	70	25÷60
2.	Thermal conductivity, W/mK	0.03 ÷ 0.08	0.02 ÷ 0.06	0.02 ÷ 0.06	0.12÷0.18	0.028÷0.45
3.	Working temperature, °C	–270 ± 800	–270 ± 800	–270 ± 800	–60 ± 400	до 500 °C
4.	Fire department qualification	ISO 3941:1977 (incombustible)	ISO 3941:1977 (incombustible)	ISO 3941:1977 (incombustible)	–	–
5.	Standard tile size, m	1.4·1.2·0.5	1.4·1.2·0.5	1.4·1.2·0.5	–	–
6.	Standard roll size, m	Length: 6÷10 Width:0.2÷1.8 Length: 0.1÷0.5			–	–

From the comparative characteristics, it can be seen that the basalt fiber material of the Asmansai deposit has a filtering capacity, on average, 3.78 times higher than that of glass wool, 5.98 times higher than that of asbestos wool. In general, as a result of studying the filtering ability, the basalt fiber material showed its high efficiency and performance, which opens up broad prospects for the creation of new cheap and competitive filter materials.

The technical characteristics of the basalt fiber filter material are given in Table 2.

Table 2.– Technical characteristics of basalt fiber filter material

№	Name of indicators	Sample performance basalt fiber filter			
		I	II	III	IV
1	*2*	*3*	*4*	*5*	*6*
1.	Dimensions of the basalt filter before and after pressing: – thickness, mm – diameter, mm – area of the cross. section mm2	 10* 120 130	 10 120 13	 10 120 113	 50 120 113
2.	Humidity of basalt fiber material before filtration,%	0.3	0.3	0.3	0.3
3.	Filtration time of vegetable oil by traditional method and basalt filter, min (traditional on the numerator)	31 12	31 27	31 30	31 34
4.	Weight of samples, before wetting and after pressing and drying, g: – before: – after:	 9.3 12	 9.3 24	 9.3 17	 9.3 15
5.	Humidity and volatile substances, %	0.20	0.17	0.15	0.10

1	2	3	4	5	6
6.	Soap (quality analysis)	Not found			
7.	Iodine number, in g J2100 g	125–145			
8.	Non-fat compounds (sediment, by mass),%,	0.05	0.04	0.03	0.02
9.	Dry residue mass, g – traditional filtration – on basalt fiber filter**	 5 4	 5 7	 5 5	 5 4
10.	Flow pressure forces liquids, per filter, kg/mm^2	0.3	0.6	0.9	1.2
11.	Actual deflection value basalt filter, mm	1.5	3.3	5.3	5.4
12.	Forces of pressing basalt wool, kN	16	18	20	–

*Note * F: en = 1:2.74. Grade-0.074, 90%. Laboratory of Technology and Geotechnology of the Central Scientific Research Laboratory of the State Enterprise NMMC*

*** Chemical analysis of filtered oil was carried out according to "RD118.3897485.6–92"*

Discussion and Conclusion. Four basalt fabrics in the same sequence were prepared for further research. In all four samples, the geometric parameters remained unchanged. The results of experimental studies showed that the filtration time of the basalt filter in the second and third samples exceeded that of the traditional filter material in terms of vegetable oil purification performance. Such results can be achieved due to the normal filling of basalt fibers. Subsequently, natural holes are formed in the basalt fiber filter material for the free passage of the filtrate. Normal packaging is obtained by pressing the basalt fibers with a force of 16 kN. Thus, the basalt material has been proven to be suitable for industrial refining of vegetable oils.

Experimentally, the absence of hygroscopicity and swelling, as well as the fact that the elongation of the fibers forming a permanent porosity is practically absent, thus ensuring high filtration efficiency. Moisture absorption of basalt was found. However, basalts can change their properties under hydrothermal conditions, under the influence of moisture accumulated in dense rocks. Consequently, due to the density of the material, excess moisture remains inside the fabric and is retained until processing. It was also found that the content of moisture and volatile substances in vegetable oils decreased from 0.20% to 0.10%, and the content of sediment in the oil from 0.05 to 0.02%. This makes it possible to obtain quality vegetable oils and achieve high economic efficiency in oil companies.

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