Researching Heat Treatment Process of Seed Brutes on The Experimental Plant

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ABSTRACT

The article presents the main factors influencing the process of heat treatment of cottonseed oil, which are the heat flux density, radiation wavelength, the thickness of the layer of the processed material and the duration of processing, studied on an experimental setup.

Keywords: Free oscillations, dissipative system, vibrations, viscoelastic system.

1. Introduction

The process of roasting cottonseed oil is one of the main and necessary stages in the production of cottonseed oil by pressing. The quality of the extracted oil and meal largely depends on the frying process. However, there are factors that affect the course of the roasting process: heat flux density with a maximum radiation wavelength λ=1.1 μm, the thickness of the layer of the processed material and the duration of processing. Their influence on the process of heat treatment of cottonseed mash was studied on an experimental IR-installation.

2. Methods

For experiments, mint is used, moistened according to the known method from /5/. A portion of mint weighing 100 g is placed on a pallet with a certain thickness with IR lamps turned on, time is recorded. The process of heat treatment of cottonseed mash was studied under the influence of short-wave infrared radiation-IR generators of the KG-200-1000 type, recommended in /1, 2, 3, 4, 5/ at a maximum radiation wavelength λ=1.1 μm. By changing the heat flux density during the heat treatment, we determine the yield of black oil and its quality indicators. As can be seen from Table 1, with an increase in the heat flux density from q=4.8 kW/m^2, the yield of black oil decreases, the acid number increases, which negatively affects the yield of refined oil.

Table 1

Black oil output dependence								
From the wavelength of radiation								
$\lambda[\mu m]$	0,5	0,7	0,85	1,0	1,15	1,25	1,3	1,5
$\mathcal{Y}[gr]$	1,5	2,5	3,1	3,2	3,5	3,1	2,4	1,7
From heat flux density								
$q[kVt/m^2]$	3,0	3,8	4,0	4,4	4,8	5,2	5,6	6,0
$\mathcal{Y}[Gr]$	2,2	2,6	3,3	3,95	4,4	4,2	4,1	3,8
From the thickness of the layer of the processed material with one-sided irradiation								
$\delta[mm]$	8	10	12	14	15	16	18	20
$\mathcal{Y}[Gr]$	1,2	2	2,8	3,7	3,9	3,8	3	1,7
With double exposure								
$\delta[mm]$	8	10	12	15	18	22	25	30
$\mathcal{Y}[Gr]$	1,4	2,3	3,1	3,7	4,1	4,8	4,6	3,9

With a decrease in the heat flux density, the duration of the heat treatment process lengthens, the acid number increases, in the lower layers of the processed mint, the quality of the heat and moisture treatment deteriorates (undercooking).

With an increase in the thickness of the layer of the processed material more than 15 mm, undercooking is observed in the lower layers, which reduces the yield of press black oil and increases the oil content of the cake, as a result, the extraction process becomes more difficult. This is due to the fact that radiation does not penetrate into the pulp in the lower layers, thermal moisture treatment occurs due to the thermal conductivity of the layer. With an increase in the heat treatment time, the upper layers are overcooked. At the same time, a change in the heat flux density and layer thickness affects the humidity (Fig. 1, 2) of the processed material during heat treatment (roasting).

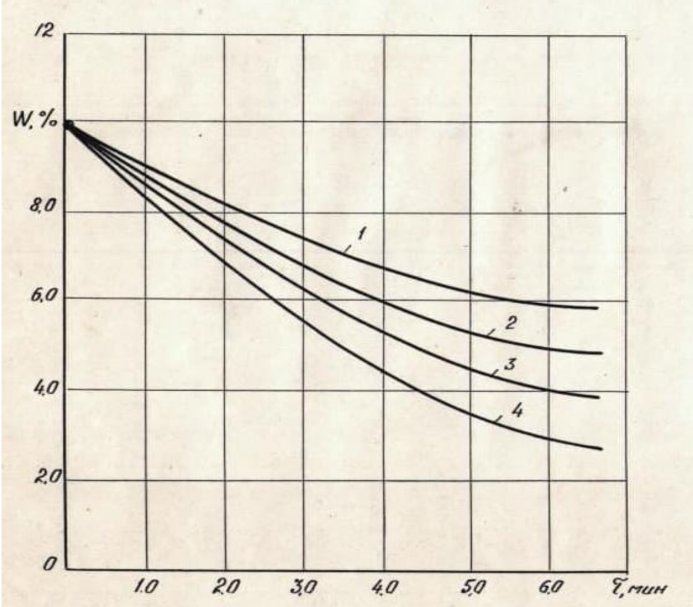

Fig.1. Change in the moisture content of oilseed oil over time at $\delta = const = 22\ mm:\ 1 - q = 3{,}3\ kVt/m^2,\ 2 - q = 3{,}9\ kVt/m^2,\ 3 - q = 4{,}8\ kVt/m^2, -q = 6{,}0\ kVt/m^2$

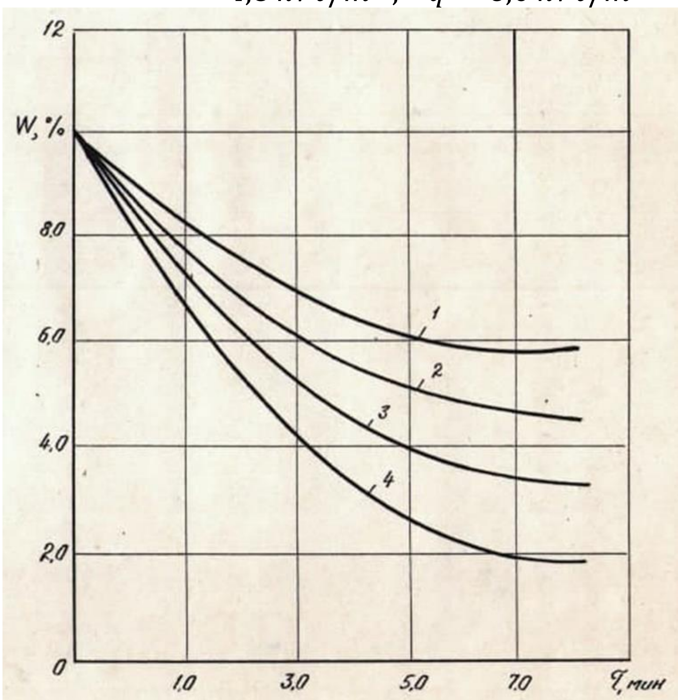

Fig.2. The change in the moisture content of oilseed oil over time at $q = const = 4{,}8\ kVt/m^2:\ 1 - \delta = 30\ mm,\ 2 - \delta = 25\ mm,\ 3 - \delta = 20\ mm$

The effect of IR frying on the duration of extraction is determined in the following sequence:

a) sampling of mint. For the experiments, we used seed oil of the 1st grade with an oil content of 24%, selected at the Bukhara oil-extraction plant. The oil content of the oilseed is 40%, the humidity is 8.5÷10.5%. Mint samples were taken manually, brought to a sample of 500 g for analysis.

b) mint processing. The heat flow is set to q=4.8 kW/m^2, the processing time is τ=10 min, the thickness of the mint layer is δ=22 mm. The product of moisture-thermal processing of mint in a brazier, called pulp, is taken out of the installation. The residual moisture content of the mint, which has undergone IR treatment, is 4.5÷5%. Separately, after IR treatment of the product and after processing in a roaster, 30 g of pulp are taken, placed in a 250 ml flask, poured over with 150 ml of extraction gasoline and carefully mixed.

Then the contents are poured onto a sieve with a diameter of 0.25 mm and the solvent content in the product is determined, direct extraction is carried out in 8 flasks (4 flasks for the pulp after IR treatment and 4 flasks for the pulp from the roaster). The extraction process is carried out under isothermal conditions. Before processing, each flask is numbered and the duration of the extraction is indicated:

I j, I IR- flasks - τ=30 min;
II j, II IR- flasks - τ=1 h;
III j, III IR- flasks - τ=1,5 h;
IV j, IV IR- flasks - τ=2 h.

After the extraction time has elapsed, the miscella and the rest of the meal are taken in turn from each flask, and its oil content is determined. Experiments are carried out three times, taking the average value. The data obtained are entered in a comparative table. 2;

Table 2

The existing method of frying			IR- roasting mint		
Continue-validity extraction min	Reducing the oil in the material		Continue-validity extraction, min	Reducing the oil in the material	
	g	%		g	%
0	39,0	100	0	39,0	100
30	31,7	81,3	30	25,0	64,1
60	28,4	72,8	60	24,1	61,6
90	24,8	63,6	80	23,9	61,3
120	24,0	61,5	100	23,8	61,0
150	23,8	61,0	120	23,8	61,0

Roasted in a 6-pot roaster in the traditional way, it is extracted until the oil is completely extracted within 150 minutes. Mint prepared with IR frying is extracted much faster. So in the first case, 18.7% is extracted in 30 minutes of extraction (at 40% oil content of mint), in the second - 35.9%. To extract 39% of the oil, in the first case, the duration of extraction reaches 150 minutes, in the second - 100 minutes. The mathematical description of the effect of IR frying on the duration of extraction is given by the formula.

$$y = 79{,}9216 \cdot e^{-0{,}00367\tau}$$

Conclusion. Thus, under the influence of IR rays, intensive penetration of moisture into the cells of the oil-containing material occurs, heating of the material and partial evaporation of moisture, destruction of the oil-containing cells of the material leads to the opening of the pores of the material, due to which its extractability increases significantly. Also, with IR roasting of mint, as with the existing method, complete extraction of the oil is ensured, the extraction process is reduced by 1.5 times.

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