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AN INFORMATION-CONCEPTUAL MODEL OF THE EXTRACTION PROCESS OF PLANT RAW MATERIALS

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Abstract: In the article, the role of automation in the efficient organization of the extraction process of vegetable oils is very large. Currently, the separation (extraction) of vegetable oils has not been fully realized, since several systems are proposed for automatic control of this process. The development of an information-conceptual model of the extraction process based on mathematical laws, this issue brings several innovations and resource saving.
Keywords: Extraction, Automation material balance equation, information-conceptual model, systematic analysis of extraction process.

Introduction. The study and application of the mathematical model of technological processes of extraction of vegetable oils can be characterized by the dynamics of the production volume of the activity of the combines. Reaching the maximum phase of the production volume means the balance in the life cycle of factories, and determines the need to move to a new quality stage of the product.
With the introduction of computer technology and modern electronic calculators into the control systems of the factories, it became possible to control not only individual technological processes, but also workshops and the entire factory. Today, plant managers can develop a management strategy by standing at the top level of the pyramid structure of modern management systems.
In modern technological conditions, the pressing method is usually used before the extraction process. Extraction of oil by pressing method is done only in small quantities.
The method of extraction of vegetable oils only by pressing is carried out in screws of different constructions. Previously, hydraulic presses were used for this purpose, but they have significant disadvantages: the process is periodic, heavy manual labor is required in the process of loading and unloading the product into the apparatus, a lot of auxiliary equipment is required for the process to be carried out, and the amount of residual oil in the resulting kunjara is high (7...8%). Currently, these presses are used only in laboratory conditions, and in industry, screw presses are used in all technological schemes of oil extraction [1,4] .
In the vegetable oil production industry, two different methods are used in global practice to extract oil from oily raw materials:
- technical method of obtaining oil - pressing;
- extraction of oil from a solution of volatile organic solvents.
The first group - schemes that end with the pressing process:
- one-time pressing in screw presses;
- double pressing in screw presses.
The oil extraction process consists of initial and final stages;
- Triple pressing, which uses two initial and one final extraction steps to extract the oil.
The second group consists of schemes ending with the extraction process
does:
- direct extraction of oil without initial separation;
- oil is first pressed once and then extracted in screw presses;

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- separation of oil by first double pressing, then extraction [5].
The pressing method does not allow mez to fully extract the oil contained in it. The kunjara particles coming out of the press are always covered with a thin layer of oil, which is held by the force of surface gravity, which is several times higher than the pressure generated in modern presses.
Oil content of kunjara from presses is 4...7%, and oil content of kunjara from forpresses is 15...17% [2] .
The total amount of oil contained in oily raw materials can be extracted only by the extraction method.
All vegetable oils dissolve well in non-polar hydrophobic solvents with close dielectric constants. Such solvents include hexane, gasoline, benzene, dichloroethane, and others.
As the difference between the dielectric constant values of solvents and oils increases, their mutual solubility decreases. In this series, acetone is in the last place, and its dielectric conductivity index εis =21.5 (at 20 ^{0}C).
Acetone dissolves oils well in any proportion and can also mix with water.
Alcohols, such as ethyl, methyl and isopropyl, mix with oils in small quantities at room temperature, the degree of solubility increases with increasing temperature. The solubility of oils in alcohols increases as the molecular weight of the alcohols increases.
The solubility of fats in alcohols is related to the formation of hydrogen bonds between the hydroxyl groups of alcohols and the carboxyl groups of acids and the forces of intermolecular attraction between hydrocarbon radicals in acids and alcohols.
The property of dissolving water in solvents is of great practical importance, because: - due to the high moisture content of the solvent, the normal course of the extraction process may be disturbed; - during auxiliary processes, the solvent is heavily affected by water, which causes an increase in the amount of losses.
Solving this problem can be done based on the strategy of systematic analysis with the help of mathematical modelling. The essence of this strategy is to consider the process as a complex interacting hierarchical system, to qualitatively analyze its structure, to develop a mathematical expression and to evaluate its unknown indicators.
The process flow is described in the conditional layer of the vegetable oil particle, the particle consists of five equal precision layers, in the mathematical modeling of the extraction process in layers, the layers are numbered sequentially starting from the outermost layer. The input and output indicators in the process flow of the innermost layer are described. Based on this system of layers, we will analyze the mathematical expressions of the conditional innermost layer of the cotton seed kernel particle [3].
Material balance equation in the innermost layer of vegetable oil

$$\frac{dM_{oil5}}{dt} = G_{in\ 5} - G_{out\ 5} \quad (1)$$

It is known that the amount of vegetable oil particles, i.e. kunjara, sunflower, safflower, etc., transferred from the conditional inner layer to the outer layer is equal to the quantity of mistella that passed through this layer and the product of concentration.

$$M_{oil5} = M_{mc5} * a_{ёr5} \qquad (2)$$

In that case, expression (3) looks like this:

$$\frac{d(M_{mc5} * a_{oil5})}{dt} = G_{in} - G_{out} \qquad (3)$$

$G_{out\ 5} = 0$, that is, the consumption of the oil reaching the innermost layer is zero, and (3) we can express the expression in the form of a melody.

$$\frac{da_5}{dt} = \frac{1}{m_5} \ (-G_{out\ 5}) (4)$$

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In this case: $G_{кет\ 5}$- consumption of oil from the innermost layer; ($м^3/с$)
The mass of the mistella in the conditionally innermost layer of the cotton seed kernel , flax seed particle is equal to the product of the mistella volume in this layer and the density of the mistella of this layer.

$m_5 = V_5 * \rho_{mts5}$ (5)

Here: m_5 is the mass of the mistletoe; (kg)
The volume of the mistletoe in the conditional innermost layer of the cotton seed kernel particle is given by formula (6). is found.

$V_5 = (V_{5_{sphere}}) * Z(6)$

Here: $V_{5_{sphere}}$- the size of this layer; ($м^3$), the porosity of the Z-particle, that is, the oiliness of the particle.
In order to find the size of the conditional innermost layer of cotton seed, sorghum, sunflower and linseed particles, we use the expression of the size of a sphere, taking into account that the particle is spherical.

$V_{sphere} = 4/3 * p * r_5^3$(7)

In this case, the r-innermost layer radius: (m) The radius of this layer is found by dividing the particle radius by the number of conditional layers:

$r_5 = R/n(8)$

Copper ts ella density until the house of q is found

$\rho_{mc5} = \rho_{gasoline} * (1 - a_5) + \rho_{oil} * a_5(9)$

In this case: $\rho_{gasoline}$, ρ_{fat} -solvent and oil densities; (kg/m ^{3}) concentration corresponding to this layer.
During the extraction of vegetable oils, the consumption of the oil, which has passed from the conditionally innermost layer of their particle to the outer layer, is equal to the product of the substance delivery coefficient, the passing surface and the concentration difference, that is, the driving force:

$G_{out5} = k * F_t * (a_5 - a_4)(10)$

The speed of the extraction process, i.e., the yield coefficient, is directly proportional to the molecular diffusion coefficient and the density of the mistella.
inversely proportional to the thickness of the layer:

$$k = \frac{D * p_{mc}}{\delta} \qquad (11)$$

We determine the conditional layer thickness of a particle of oil plants by the ratio of the radius of the particle to the number of layers.

d = R/n (12)

The outer surface of the oil particle conditional layer of plant raw materials is found from the following formula:

$F_t = 4 * \pi * r_5^2(13)$

In the process of extracting vegetable oils, the amount of oil transferred to the solvent from cottonseed, linseed, and linseed can be expressed according to the mathematical model:

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$$\begin{cases} G_0 - G_0 * a_0 = G_2 - G_2 * a_2 \\ G_0(1 - a_{0)} = G_2(1 - a_2) \\ G_2 = G_0 * \dfrac{1 - a_0}{1 - a_2} \\ G_m = G_0 * a_0 - G_2 * a \\ G_m = G_0 * a_0 - G_0 * \dfrac{1 - a_0}{1 - a_2} * a_2 \\ G_m = G_0 * (\dfrac{1 - a_0}{1 - a_1} * a_1 - \dfrac{1 - a_0}{1 - a_2} * a_2) \\ G_m = G_0 * (\dfrac{1 - a_0}{1 - a_1} * a_1 - \dfrac{1 - a_0}{1 - a_{i+1}} * a_{i+1}) \end{cases}$$

Solving these problems requires the development of methods and algorithms for the intellectualization of the process of managing technological objects in conditions of uncertainty. From this point of view, in this article, an information-conceptual model of the process was developed based on mathematical laws .

In this case, the variables in the tune were identified as the main indicators describing the extraction process .

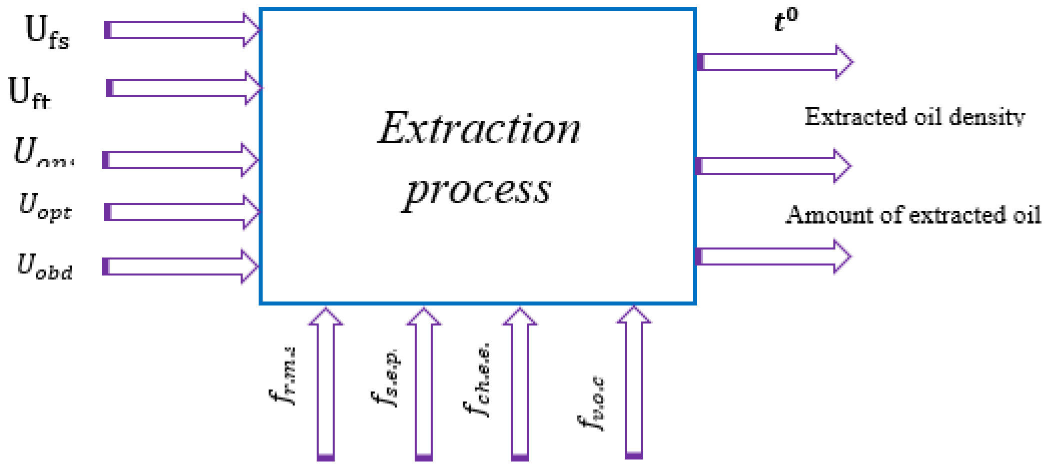

Figure 1. Information-conceptual model of the process.

-control parameters -U={U_{fs}, U_{ft}, U_{ops}, U_{opt}, U_{opd}}; by U_{fs}- phenol fluid consumption, U_{ft}- phenol temperature, U_{ops}- oil product consumption, U_{opt}- oil product temperature, U_{opd}- oil product density;
-output parameters -U= { t^0 , Q_{eoq} , U_{eod} } ; where t^0 -extractor temperature Q_{eoq} -extracted oil $f_{eq.}$quantity, U_{eod}-extracted oil density;
-external effects - F= { $f_{r.m.c.}$, $f_{s.e.p.}$, $f_{ch.e.e.}$, $f_{v.o.c.}$}where $f_{r.m.c}$ –the concentration of raw materials, $f_{s.e.p}$- the speed of the extraction process, $f_{ch.e.e.}$- changes in the external environment, $f_{v.o.c.}$- the viscosity of the oil to be cleaned.

Conclusion. In the process of extraction of vegetable oils, the variables of mathematical expressions describing the process of extraction of cotton, flax and linseed particles in the conditional innermost layer of the extraction process were determined and an information-conceptual model of the process was developed.

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Attention was paid to simplifying the above mathematical expressions in the form of small blocks and partial blocks. One of the conveniences of the MATLAB program is the possibility of expressing the calculated constants in their own form.

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