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ACCELERATION OF HEAT AND MATTER EXCHANGE PROCESSES IN THE FINAL DISTILLER WITH A CONVEX-CONCAVE PLATE

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Abstract: In the article, it can be seen that the liquid-vapor system and the interfacial substance exchange and the reduction of hydraulic resistances are caused by the increase in the mutual contact of liquid and vapors using column devices. Use of modern coiled equipment in extraction plants and familiarization with their modes of operation, their application to industrial enterprises. Speeding up the exchange of substances due to the expansion of the phase surface in the final distillation process and the use of new technological equipment.

Keywords: convex-concave plates, nozzle, liquid, steam, casing, central and peripheral pouring pipes, final distillation, hydraulic resistance coil apparatus.

In modern oil extraction plants, the processes of substance exchange are carried out in large-sized devices with high consumption of heat and energy resources. For this reason, there is a need to develop new designs of compact and high-performance contact mass exchange devices.

Acceleration of heat and substance exchange events during the final distillation of cottonseed oil mistella is achieved by processing with convex-concave type plates in the working zone of the device.

Improving the hydrodynamic condition in column devices is a form of speeding up the technological process carried out in them, which implies the fulfillment of the following requirements:

- organization of flow of liquid and vapor phases in opposite directions;
- the hydrodynamic structure of flows should be close to the ideal displacement model;
- the contact surface of the phases should be maximal and the diameter of the bubbles in the bubble layer should be minimal, and the liquid should be evenly distributed along the cross-sectional surface of the device.

The following structural and technological methods are widely used to accelerate technological processes (Fig. 1).

Constructive methods include obtaining active contact surfaces of liquid and vapor phases and implementation of contacting flows in the turbulent regime. The series of technological methods includes such methods as creating a certain mode of movement of the liquid phase, organizing the pulsed movement of flows, and influencing the flows with mechanical vibrations.

At the stage of creating a structure of a mass exchange device, the main attention is paid to the most efficient way of the mass transfer process carried out in it. In general, the possibility of accelerating the process of substance exchange in the device can be determined based on the analysis of the following formula [1]:

$dM/dt=K{\cdot}F{\cdot}\Delta C$, (1)

where M is the amount of substance transferred from one phase to another; ◎ is a process

time; K - mass transfer coefficient; F is the contact surface of the phases, S is the driving force of the process. It can be seen from the formula (1) that to increase the intensity of the process, the values of the parameters listed on its right side should be increased. Based on this goal, we analyze the effect of each parameter included in the formula (1) on the process.

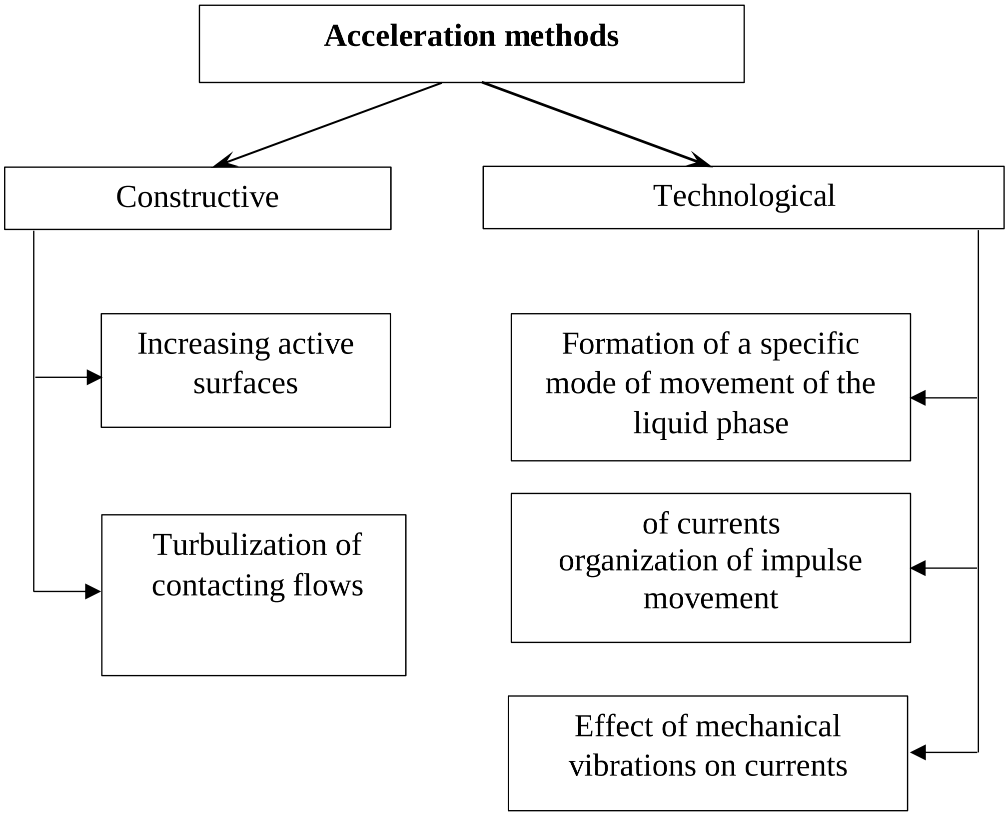

Figure 1. Methods of accelerating heat and matter exchange processes.

The mass transfer coefficient K reflects the interaction conditions of the phases, its value depends on the process temperature, pressure, substance concentration and physical properties of the interacting phases. The above factors are initial (fixed) data, i.e. process parameters, in the design of mass exchange devices. The mass transfer coefficient can be increased due to phase mixing.

Dependence of mass transfer coefficient on physico-chemical, geometrical, structural and hydrodynamic factors is presented in Fig. 2. According to it, process temperature and pressure, physical properties of the substances involved in the process, and the diffusion coefficient of the substance passing from the liquid phase to the vapor phase are physico-chemical factors. The overall dimensions of the device, the size and structure of the contact elements in its composition are among the geometric and constructive factors. Hydrodynamic factors include flow direction, speed and geometric size, as well as various external factors affecting it. Contact surface of phases. According to the basic mass transfer equation (1), the contact surface between the phases is directly proportional to the amount of components transferred from the liquid phase to the vapor phase. In the research work, the contact surface between the liquid and vapor phases is increased due to the replacement of horizontal nozzles located in the spray zone of the final distiller with tangential prismatic nozzle block, the use of convex-concave plates in the film zone, and the scraping of nozzles floating on the liquid layer collected in the cubic part of the device [2].

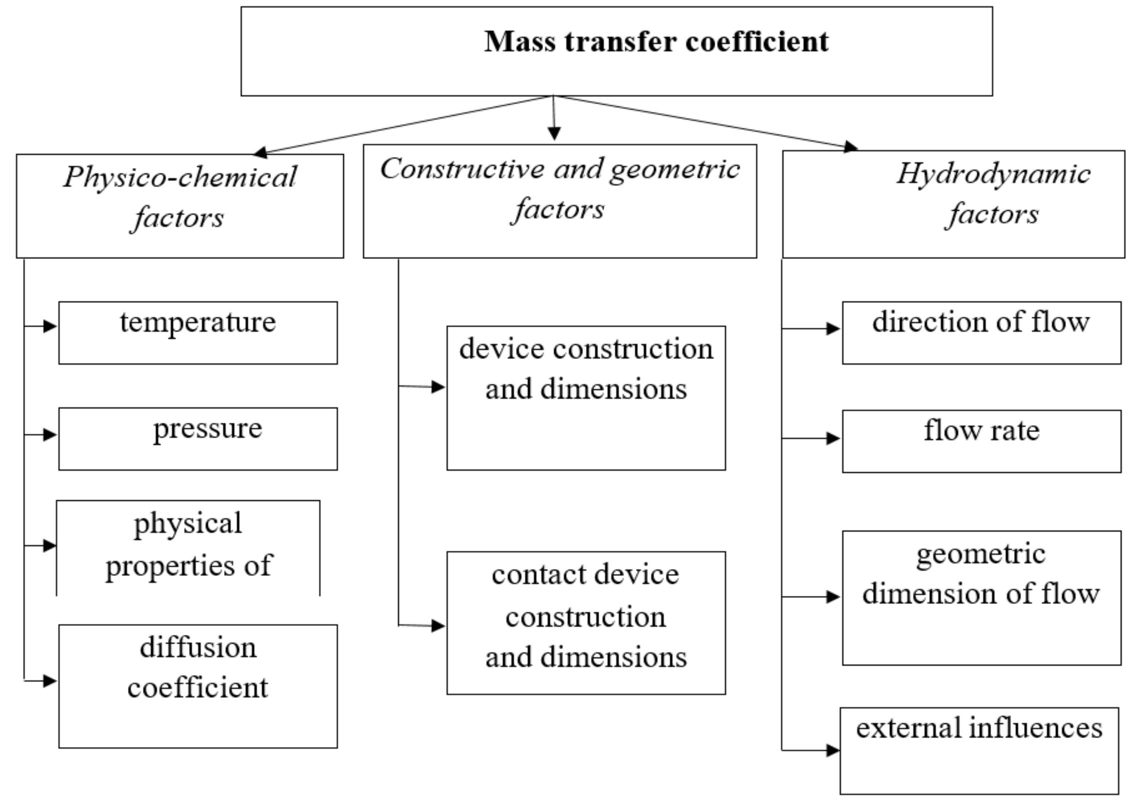

Figure 2. Dependence of the transfer coefficient on various factors.

The driving force of the process. In the design of the device, the average driving force of the process is the input technological parameter, and its value cannot be changed during the design period. It is known that the rate of substance transfer increases during the formation of an interphase contact surface. Over time, this speed value decreases and asymptotically becomes acts constantly. In this case, in order to increase the intensity of substance exchange, it is necessary to *create conditions in the system that allow the interphase contact surface to be renewed for a short time.*

When setting up the process of driving (distillation) with water vapor, first of all, it is necessary to set up opposite currents. In this process, it is difficult to ensure that the contact surface between the phases is uniform in both vertical and horizontal directions. For this reason, we consider it appropriate to use the proposed convex-concave plates in the implementation of this process [3].

Acceleration of the final distillation process is carried out by increasing the contact surface between the liquid and vapor phases in the convex-concave plate zone of the device and mixing the phases uniformly.

It is appropriate to study the technical parameters of distillers used in oil extraction plants during the acceleration of the final distillation process of cottonseed oil mistella [4, 5].

Table 1. Technical description of final stage distillers.

Indicators	ND-1250 ME3 De-Smith	ND-1250 ME3 De-Smith	ND-1250 ME3 De-Smith
Oil yield, t/milk	**40**	31,2	**20,4**
Heating surface, m2	28,3	42,3	78,2
Overall dimensions, mm:			
- inner diameter	**1184**	1020	**1020**
- steam shell diameter	**1250**	1460	**1460**
- total height	**7570**	6516	**6328**
Water vapor pressure in shells, MPa	**0,2÷0,3**	**0,2÷0,3**	**0,2÷0,3**
Mistletoe pressure in front of spray nozzles, MPa	**0,25÷0,3**	**0,25÷0,3**	**0,25÷0,3**
Black oil stay time in the device, min	**4÷6**	**6÷8**	**6÷8**
Residual pressure in the device, MPa	**0,015÷0,04**	0,067÷0,08	**0,01**
Open water vapor pressure, MPa	0,3	0,05÷0 ,093	
Mass, kg	**3250**	3663	**3529**

As can be seen from the table, the residence time of black oil from the existing ND-1250 final distiller is 4-6 minutes. In the convex-concave plate distiller offered by us, it takes 3-4 minutes.

In order to obtain oil that fully meets the requirements of the standard, it is necessary to reduce the time of its exposure to high temperature. To do this, create a bubble mode of the distiller and some of the devices it will be necessary to improve the construction of working elements. In this way, it is achieved due to the formation of a dispersed system and by changing the hydrodynamic regimes of the flows, increasing the contact surface between the phases and regularly renewing it. This allows to significantly reduce the time of oil processing in the device.

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