$$V = \frac{P_1 V_1}{P} + \frac{P_2 V_2}{P} = \frac{40 \cdot 10^2 \cdot 1 \cdot 10^{-3}}{1750} + \frac{10 \cdot 10^2 \cdot 3 \cdot 10^{-3}}{1750} = 2{,}286 \cdot 10^{-3} + 1{,}714 \cdot 10^{-3} = 4 \cdot 10^{-3} \text{м}^3$$

$$P_1V_1 + P_2V_2 = P \cdot V \quad 4+3=1750 \cdot 4 \cdot 10^{-3}=7$$

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UDC 66.021.3

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RESEARCH OF MASS TRANSFER APPARATUS WITH A MOVABLE PACKING

Abstract. *In the chemical industry, petrochemical, construction, metallurgical, mining and chemical and other industries, packed and plate columns are used for the mass transfer process.*

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ИССЛЕДОВАНИЕ МАССООБМЕННЫХ АППАРАТОВ С ПОДВИЖНОЙ НАСАДКОЙ

Аннотация. *В химической промышленности, а также в нефтехимической, строительной, металлургической, горно-химической и других промышленностях применяются насадочные и тарельчатые колонны для процесса массообмена.*

The development of industry with an increase in production volume is accompanied by emissions of industrial gases into the atmosphere. Purification of waste gases should ensure the recovery of valuable components and protection of the environment pollution. generally, a large volume of gas phase is supplied for purification, which requires a high degree of component extraction [1].

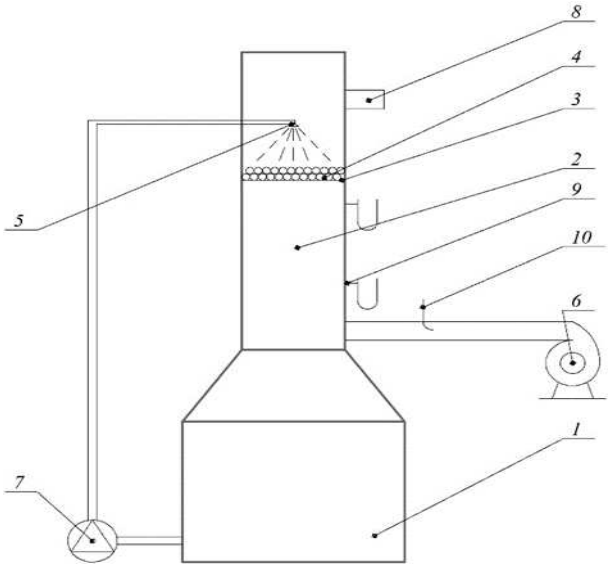
Absorption and desorption are the main applications of randomly packed columns, since separation processes generally occur in a moderate temperature range. Accentuation should be given to packed fills with random filling, which are characterized by low pressure drop, low specific gravity, good wettability by liquid, which leads to a reduction in the size of the structure and a reduction in operating costs. The discrepancy between disordered and structured packings in terms of hydraulic and mass transfer behavior has decreased over the past 10 years [2].

Absorption devices with a movable nozzle are most often used. Such apparatus is simple in design and effective. One of the significant advantages is the ability to work with liquids that, in contact with gases, release a solid phase and clog the plates and packing of typical absorbers. They differ from other classes of mass transfer apparatus in that the packed fills perform chaotic movements, and the path traveled by each element of the packing is different and unique in its own way, which significantly complicates their study [3].

The movable nozzle in the absorption columns works as apparatus for dispersing liquid, as well as distributing gas throughout the entire cross-sectional volume of the layer, which increases the degree of utilization of the kinetic energy of gas and allows working with high efficiency on distribution devices with a large free cross-section.

The disadvantages of this apparatus, noted during exploitation, can be considered the irregularly distribution of the gas phase in the over-plate space, both across the cross section and along the height of the column, and formation of dead area inside the packing.

The laboratory absorber was designed for the study (pic. 1) [3].



1 – tank; 2 – casing of apparatus; 3 – plate; 4 – packing; 5 – nozzle; 6 – fan; 7 – pump; 8 – outlet pipe; 9 – valve for measuring differential pressure with U-shaped differential pressure gauges, 10 – pitot tube

Pic. 1 - Laboratory absorber

The laboratory absorber consists of a cylindrical tank 1 with a conical part, on which a cylindrical vertical casing 2 is attached using a flange connection. A plate 3 with a ball packing 4 poured onto it is installed inside.

During operation of the absorber, gas moves in the voids between the packing and inside them in countercurrent to the liquid circulating in a closed circuit.

Before starting work, tank 1 was filled with water, from which the liquid was pumped by pump 7 and entered the column. To ensure uniform supply of liquid across the cross-section of the device, a nozzle 5 is provided. Under the influence of gravity, it flows back into the tank. Air was supplied using a fan 6, passed through the column and left it through the outlet pipe 8.

Water consumption was measured with a flow meter. The air flow rate was adjusted by changing the rotation speed of the impeller using a frequency converter. The air flow was determined by a differential pressure gauge connected to a pitot tube 10, the pressure drop was determined through a valve for measuring the differential pressure with a U-shaped differential pressure gauge 9. During the experiment, three types of plates were manufactured [4].

During experiments and modeling, a plate was selected, which subsequently underwent industrial testing at one of the plants of the Republic of Belarus. As a result, it was found that the hydraulic resistance of the plate decreased, and a more equable distribution of the movable ball packing

across the cross section of the apparatus during its operation was noted, which was observed through the viewing window.

Due to the fact that the elements of the packing, being in a suspended state, perform chaotic and pulsating movements, and also in the volume of the gas purification layer, the direction of movement and the length of the travel path of each element of the packing are of an equally probable and random nature, an absorption installation was designed with a diameter slightly larger than the diameter of the ball. This absorber uses one element of a movable packing, 4 different designed packing designs [5].

At the moment, computer modeling is being carried out to study the hydraulic resistance of the packing element using a computer model of the hydrodynamics of gas-liquid flows.

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