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IMPROVING THE DESIGN OF INTERNAL PLATES IN COLUMNAR APPARATUS

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Annotation

The article analyzes the operation of the distillation column plates used in the chemical and oil refining industries and suggests the use of plates with a new design. According to the experimental results, the hydraulic resistance of the plates of the new design is smaller than the hydraulic resistance of the traditional plates.

Keywords: fraction, condensate, rectification, column, corrosion, plate, phase.

Introduction:

In the chemical and oil refining industries are effective devices in the process of condensation of the required substances of two or more fractions. There are several disadvantages of such devices, and to date it has been one of the most pressing issues facing businesses. Elongation or breakage of the internal plates due to the internal temperature, aggressive environment, high hydraulic pressure in the rectification column devices, corrosion contamination of the plates due to their operation in a steam environment, leads to their deterioration. As a result of violation of the tightness of the plates in the floor grid, a decrease in friction with the contact surface with each other is observed during the rectification of substances. As a result, the quality of the product deteriorates and the enterprise spends more energy to recycle it.

Research methods:

Each metabolic apparatus is named after a specific metabolic process. For example, rectification columns are a device that performs a rectification process that goes on to accurately separate the components between the liquid and gas phases. In adsorbers there are metabolic processes between solid and liquid phases, in extractors there are metabolic processes between two liquid phases.

The main metabolic devices - rectification columns, adsorption, absorption, extraction devices make up more than 50% of all devices in the chemical industry, oil refining and pharmaceutical enterprises in terms of metal capacity. According to the contact method of phases, columnar apparatus is divided into plate, nozzle and film types, atmospheric pressure, high pressure and vacuum types according to the pressure in the apparatus.

60% of all columnar devices used are plate columns and 40% are nozzle columns.

In rectification columns, the rectification process takes place under the influence of multiple interactions of the vapor and liquid phases. For this purpose, the column will be equipped with special contact devices - plates. The plates are mounted horizontally inside the column.

The first mixture is heated to boiling point in a heater, then sent to the supply plate of the column.

The supply plate divides the device into two parts (upper and lower column). In the upper column, the vapor content is enriched with a light volatile component, resulting in vapors whose composition is close to the pure light volatile component are fed to the deflegmator. It is necessary to separate the maximum amount of light volatile component from the liquid content in the bottom column, while the composition of the liquid entering the boiler should be close to the hard volatile component in its pure state.

Due to the diversity of mass transfer processes, different plates are used: sieve, jet-oriented, s-shaped elements.The following basic requirements apply to plates:

- must have a high efficiency, ie provide a good connection between liquid and vapor;
- continuous operation with significant changes in steam and liquid consumption;
- simple construction;
- easy to use;
- various sediments should not settle.

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Analytical research results:

Plates in rectification columns as a result of hydraulic pressure shock and aggressive environment, it breaks, corrodes and cracks are formed. The design of the plates used in the rectification column apparatus has a negative impact on the reduction of contact surfaces, the evaporation process due to the magnitude of the hydraulic pressure stroke, the quality of cleaning from unnecessary additives, resulting in reduced quality of regenerated acetic acid.

In rectification column plates a new design of the plates was created in order to overcome the above-mentioned shortcomings.

Figure 1. Structures of rectification columns used in the production of acetic acid.

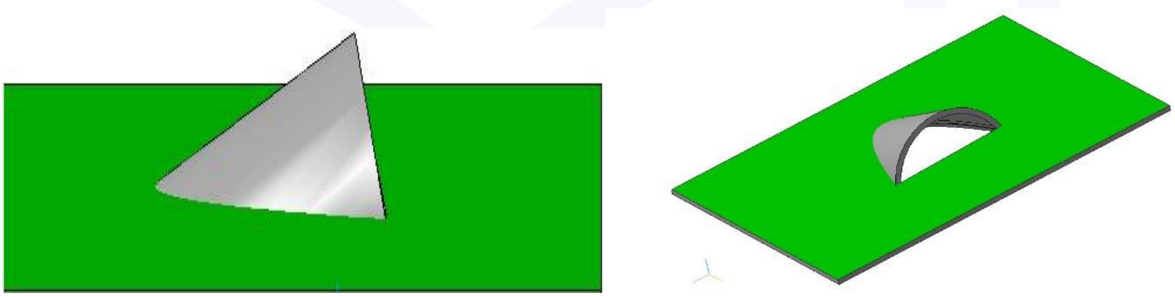

Figure 2. The structure of the proposed plate construction

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c)

Figure 3. Appearance of the proposed plate in the assembled state.

Figure 1 shows the construction of the rectification column plates used in the acetic acid production process and Figure 2 shows the structure of the proposed plate structure and Figure 3 shows the assembled view of the proposed plate.

The recommended plate differs not only in increased contact surfaces and strength, but also in the simple construction. The new plate was found without changing the slope angle of the old plate, the plate is mounted on 300 slopes and measures 120 x 11.5mm. Changing the design appearance of the set plates serves to increase the surface area, improve the quality of acetic acid and prevent the plates from cracking at hydraulic pressures in the process, ensuring the set temperature in each layer. The advantage of the new plate over the old one is that the production of the plates does not require complex technological processes, has a robust and simple design. The heat exchange on the surface of the new plate is improved and an increase in the regeneration of acetic acid is achieved.

The plate of this design can be used not only in the chemical industry, but also in the oil refining industry, in the rectification column apparatus in the primary oil refining processes.

A laboratory device was created to test the newly constructed plates under laboratory conditions (Figure 4).

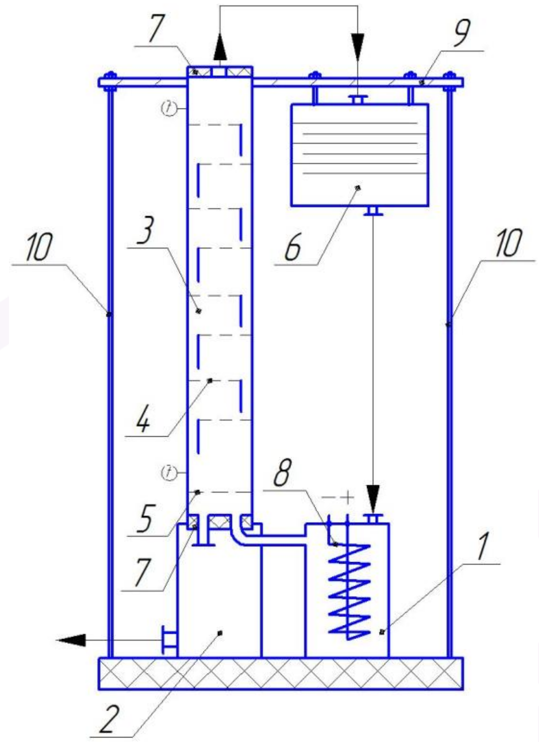

Figure 4. Scheme of the experimental structure.

1 raw material cube, 2 product cubes, 3 columns, 4 plates, 5 distribution plates, 6 deflegmators, 7 lids, 8 heaters, 9 plates, 10 bases.

The experimental process in the laboratory device is performed as follows. The raw material selected for the sample is collected in cube 1 and heated to evaporation temperature through heater 8. The resulting product vapor enters the column through a tube. Using a distributor 5 located inside the column, it is evenly distributed along the diametrical surface of the apparatus. There is a process of mass transfer with a similar substance sprayed from the nozzle 7 mounted on the top of the apparatus when the plates 4 installed inside the apparatus and the surface 3 formed by the irrigation effect pass through the gap. Steam that is not involved in the mass transfer process exits the top of the column and enters the distillation device 6. There it is partially condensed. Inside the column, the product involved in the mass transfer process is collected in 2 cubes. The process is continuous.

During the experiment, rectangular, round and oval (proposed design) perforated plates were selected in order to compare the performance of plates of different constructions.

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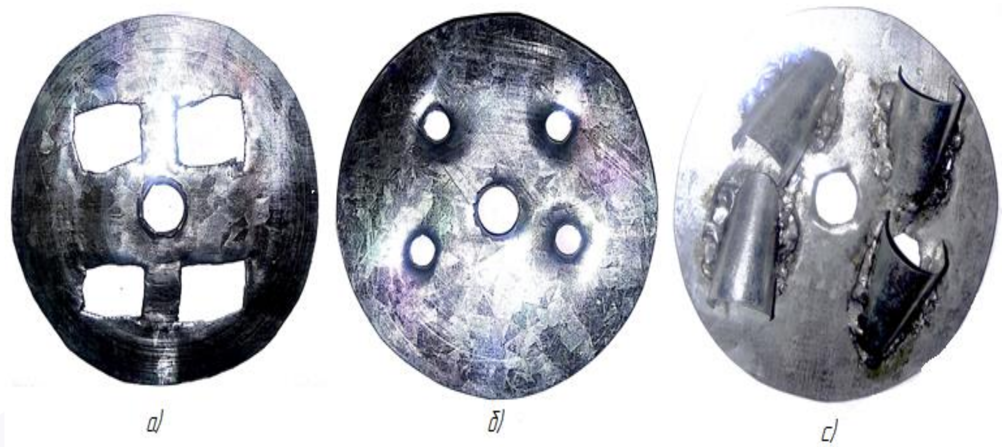

Figure 5. Constructions of plates selected for the experiment

a) A rectangular hole is drilled. b) - a round hole is drilled. c) - an oval hole is drilled and a guide device is installed

Separate experiments were performed with each plate. The results of the experiments were presented in Table 1.

The hydraulic resistance of the plate	A plate with a rectangular hole	A plate with a round hole	A plate with an oval hole drilled and a guide device mounted
ξ_1	1.20	1.13	1.04
ξ_2	1.17	1.09	0.98
ξ_3	1.15	1.11	1.07
ξ_4	1.15	1.09	1.07
ξ_5	1.19	1.13	1.09

Based on the results of the obtained experiments, a graph of the change in the coefficient of hydraulic resistance in the plates over time was constructed.

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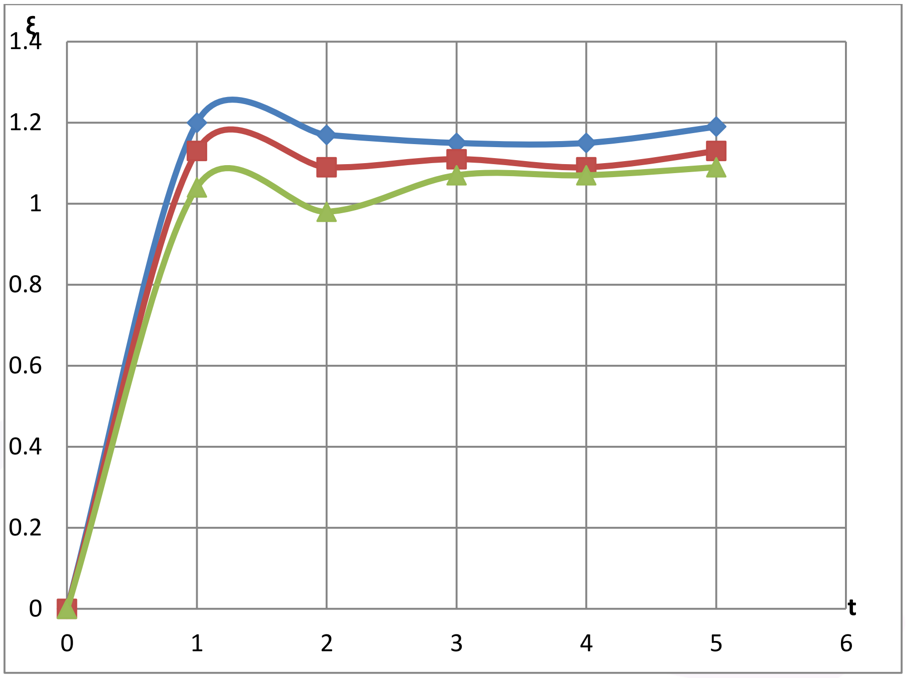

Figure 6. Graph of change of hydraulic resistance coefficient in plates over time.

Conclusion:

From the results of the above experiment, it was found that the plate with the oval hole drilled and the guide device is installed has a relatively low hydraulic resistance compared to other plates tested. This is due to the presence of a guide device on the plate with an oval hole drilled in relation to the remaining plates and a guide device installed. This in turn ensures long-term operation of the plates, as well as a decrease in the rate of corrosion on the plate.

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