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ANALYSIS OF ABSORPTION PROCESS AND ABSORBER DEVICE IN GAS PURIFICATION PROCESS

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ABSTRACT:

The process of selective absorption of one or more components in a gas or vapor mixture in a liquid is called absorption. The gas absorbed is called an absorbent; the absorbing liquid is called an absorbent. Depending on the interaction of the absorbent with the absorbent, the absorption process is of two types: physical absorption and chemical absorption (chemisorption). In physical absorption, the absorbent does not chemically combine with the absorbed gas. Chemisorption is when the absorbed gas interacts with the absorbent to form a chemical compound.

Keywords: absorption process, Conventional absorber, bubbling process, thin-layer liquids, physical absorption, technological system.

INTRODUCTION:

Physical absorption is often reversible, meaning that the gas absorbed into the liquid can be separated, which is called desorption. Continuous absorption and desorption processes make it possible to extract the absorbed gas cleanly and reuse the absorbing absorbent several times. Because the absorbent and absorbent are inexpensive and secondary products, they are often not reused after the absorption process (e.g., when cleaning gases). Absorption devices are periodic and continuous depending on the mode of operation. In small-scale productions, only periodically operated absorption devices are used. Modern industrial plants often use continuous devices. Depending on the direction of the gas and liquid phases, there are opposite and direct absorption devices [1].

RESEARCH METHODS:

Absorption devices are single- and multi-stage, recirculating and regenerative, depending on the principle of operation. A schematic of an absorber connected in series is shown. In addition to absorbers 2, the device includes solution collectors 1, centrifugal pumps for solution transfer and heat exchangers 3 for solution cooling. The absorbing liquid is fed to the last absorber in the direction of the gas, flows from top to bottom, falls into the receiving collector and is pumped to the previous absorber through the cooler. In this way, the gas and the liquid interact in opposite directions.

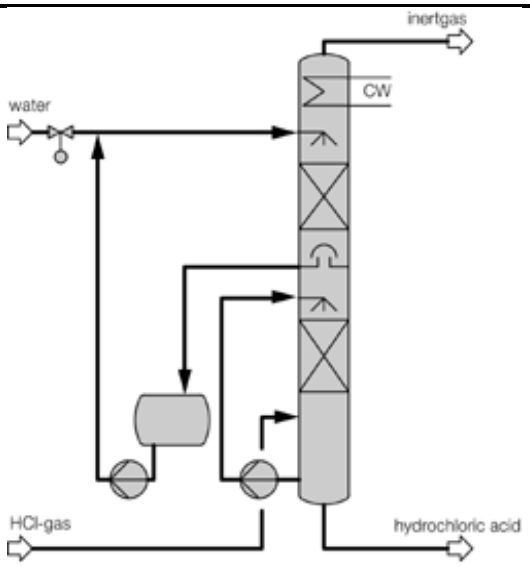

Figure 1. Technological system of absorption process in gas and vapor mixtures

The absorption process takes place on the phase separation surface. Therefore, the surface area of the absorbers in the event of a liquid or gas phase collision should be as large as possible. Absorbers for the organization and design of mass transfer surfaces are divided into 4 groups: surface and thin-layer absorbers; nasal absorbers; bubble absorbers; spray absorbers [2].

In surface absorbers, gas is transferred over the moving liquid. In such devices, several devices are installed in series due to the very low fluid velocity and low collision surface. A washable absorber consisting of horizontal tubes is described. When a liquid flows through a pipe, the gas moves in the opposite direction. The liquid level inside the pipes is maintained at the same height using the threshold.

To remove the heat generated during the absorption process, the pipes are flushed with water flowing from the distribution device (2). A gear divider (1) is used to distribute the cooling water evenly. These types of absorbers are used to absorb well-dissolved gases. Thin-layer absorbers are compact and highly efficient. In these absorbers, the collision surface of the phases is formed by a thin layer of flowing liquid. The group of thin-layer devices includes tubular, list able, ascending layer absorbers [3].

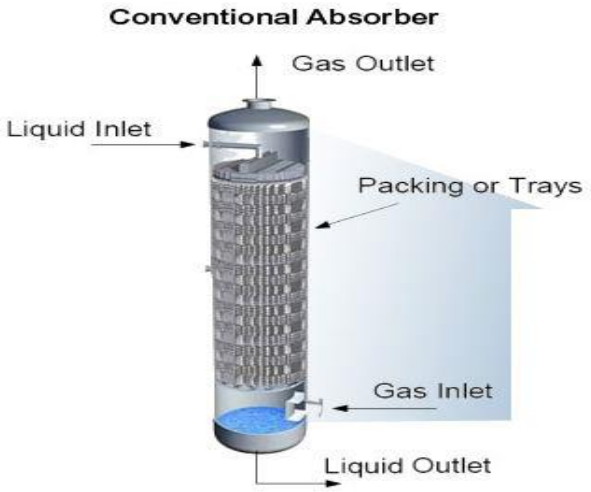

Figure 2. Conventional absorber

In tubular absorbers, the liquid flows downwards from the outer surface of the vertical tubes, while the gas phase moves upwards in the opposite direction. In other types of absorbers, the phase direction is similar to that of tubular absorbers. Tubular absorbers are similar in structure to shell-to-tube heat exchangers. Water or other cold carrier is sent into the pipes to dissipate the heat generated by the device. The nozzles are in the form of vertical sheets, which divide the volume of the absorber into several sections. The liquid is fed to the absorber through a pipe and distributed to the nozzle using a distribution device [4, 5].

As a result, both sides of the flat sheet are washed with liquid. Depending on the relative velocities of the gaseous and thin-film liquids, the thin layer of liquid may flow downwards or move upwards as it clings to the gas stream. If the phase flow velocity increases, the value of the mass transfer coefficient and the phase collision surface increase. This is due to the turbulence of the boundary layer and it's the formation of clutter [6].

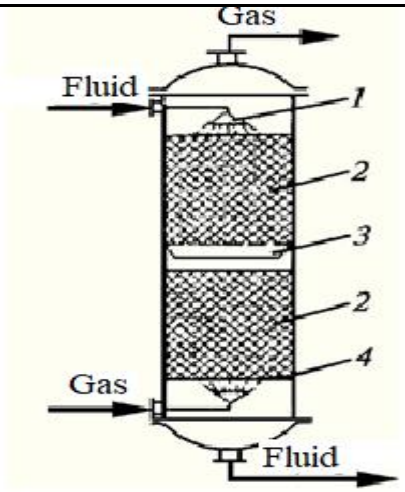

Figure 3. Nozzle absorber: 1-distributor; 2-nozzle; 3- fluid redistribution device, 4 - perforated grille.

If the absorber operates under high pressure, small nozzles are used. Because hydraulic resistance is not important in this type of device. In addition, the smaller the size of the nozzles, the larger their specific surface area, and the greater the mass transfer from one phase to another during the absorption process [7, 8].

In absorbers, it is difficult to neutralize the heat released during the absorption of gases. In order to reduce the heat in such devices and increase the humidity of the nozzles, it is necessary to recirculate the liquid with a pump.

The structure of absorbers operating in this way is complicated and the cost increases. In addition, plastic balls are used in boiling absorbers to separate contaminated liquids, which begin to boil abstractly as the gas velocity increases. In boiling absorbers, the gas velocity is usually very high, but the hydraulic resistance of the layer increases only slightly. The formation of bubbles and cracks during the passage of the gas phase through the liquid layer is called bubbling. Bubbles are used when liquids and gases (or vapors) must collide. Figure 3 shows the passage of gas or steam through the cap nozzle. Bubbling can take place in two main modes: bubble and flow. If the gas or steam consumption is small, a bubble mode can be observed. The gas bubbles burst the liquid layer one by one. The size of the bubbles depends on the structure of the bubbler and the properties of the liquid and gas. If the gas velocity increases, a flow mode will occur. The flow of gas from the barbate forms a "torch" that does not change shape or size. Usually a torch height does not exceed 30 - 40 mm [9, 10].

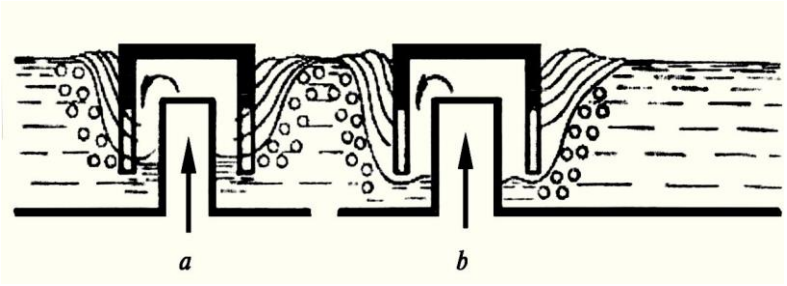

Figure 4. Bubbling process

a- Gas outlet from the cap nozzle at low speed
b- The gas outlet from the cap nozzle at high speed

CONCLUSION

In this research work, the absorption process used in gas processing was studied on a scientific basis. Theoretical analysis of the devices used in the technological system. In this regard, the principle of operation and types of absorber devices were studied. The article reflects the fact that one of the most pressing issues today is the processing of high-quality gas and high-precision cleaning of aggressive components.

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