WORLDLY KNOWLEDGE
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCHERS
ISSN : 3030-332X IMPACT FACTOR (Research bib) – 7,293

ANALYSIS OF THE DISTILLATION PROCESS AND THE DEVICES INVOLVED

Khabibov F.Y.
PhD, Bukhara engineering technological institute
Ruziboev Kh.F.
Master`s student, Bukhara engineering technological institute

Abstract: Distillation is a crucial process in chemical industries, used for separating components of a liquid mixture by heating and cooling to extract the desired substances from the mixture. Understanding the distillation process and the devices involved is essential to grasp how this operation is carried out effectively. To comprehend the distillation process better, it is vital to understand the functions of the devices employed and how they work. Each device involved in the distillation of both crude and refined oil plays a significant role in the success of the operation. Properly understanding and utilizing these devices lead to precise and efficient separation of substances.

Key words: Distillation process, distillation column, modern industries, engineers, project managers, laboratory technicians, chemists.

Introduction: The devices typically involved in the distillation process include the distillation column, condenser, main receiver, distillation column, thermometer, boiler, non-return valve, and vacuum pumps. The distillation column establishes the regulations of the substances through trays and systems. The condenser cools the vapor to condense it back into liquid form. The main receiver identifies the subject of separation and collects them. The distillation column facilitates the vaporization of substances, intelligent refluxing, and the timely opening of materials. The thermometer monitors the heating and material temperature, the boiler measures the volume of substances, and assesses their quality. The non-return valve keeps the system clean and safe from impurities. The vacuum pump aids in the operation of the distillation process and ensures continuity. The process of distillation begins with heating a liquid to boiling point. The liquid evaporates, forming a vapor. The vapor is then cooled, usually by passing it through pipes or tubes at a lower temperature [1]. The cooled vapor then condenses, forming a distillate. Vacuum distillation is one of the most common methods for the analysis and removal of water, and other volatile compounds, within lubricant and oil samples. Distillation is an approach that separates out the constituents of a fluid by their boiling point. The most common methods of distillation are simple distillation and fractional distillation. Simple distillation can be used when the liquids to be separated have boiling points that are quite different. Fractional distillation should be used when the boiling points are similar. A method of separating mixtures based on differences in their volatilities in a boiling liquid mixture. The components in a sample mixture are vaporized by the application of heat and then immediately cooled by the action of cold water in a condenser. Distillation is used in industry for a variety of purposes, including oil refining, water purification, and the creation of alcoholic beverages. Distillation is a physical process that uses heat and other methods to extract desirable pure chemicals from an original source. There are various types of distillation such as Fractional distillation, Steam distillation, Vacuum distillation, Zone distillation, etc. Fractional distillation seems to be more effective and suitable for volatile liquid mixtures [2]. To separate components with high boiling points, vacuum distillation is used. Distillation is used to purify a compound by separating it from a non-volatile or less-volatile material. When different compounds in a mixture have different boiling points, they separate into individual components when the mixture is carefully distilled. Distillation is most effective in removing inorganic compounds such as metals (iron and lead) and nitrate; hardness (calcium and magnesium); and particulates from a contaminated water supply. The boiling process also kills microorganisms such as bacteria and some viruses. Distillation is the process of separating components of a mixture based on different boiling points. Examples of uses of distillation include purification of alcohol, desalination, crude oil refining, and making liquefied gases from air. Fractional distillation leads to a better separation than simple distillation because the glass beads in the fractionating column provide

"theoretical plates" on which the vapors can condense and then re-evaporate, and re-condense, essentially distilling the compound many times over. Distillation is a separation technique used to separate liquid (the solvent) from a mixture and keep the liquid part. Distillation involves boiling the solution and then condensing. the vapor back into a liquid by cooling it down. Distillation refers to the selective boiling and subsequent condensation of a component in a liquid mixture. It is a separation technique that can be used to either increase the concentration of a particular component in the mixture or to obtain (almost) pure components from the mixture [3]. The process of distillation exploits the difference in the boiling points of the components in the liquid mixture by forcing one of them into a gaseous state. The temperature at which the vapor pressure of a liquid becomes equal to the pressure of the surrounding area is known as the boiling point of that liquid. At this temperature point, the liquid is converted into its vapor form via the formation of vapor bubbles at its bulk. It is important to note that the boiling point of the liquid changes with the surrounding pressure. It is important to note that distillation is not a chemical reaction but it can be considered as a physical separation process. An illustration describing the laboratory setup that is generally used to execute this process is provided below [4]. When a mixture of liquids is heated, the vapor pressure of the individual components increases, which in turn increases the total vapor pressure. Therefore, the mixture cannot have multiple boiling points at a given composition and pressure. At the boiling point of a mixture of liquids, all the volatile constituent's boil. However, the quantity of a constituent in the resulting vapor is based on its contribution to the total vapor pressure of the mixture. This is why the compounds with higher partial pressures can be concentrated in the vapors whereas the compounds having low partial pressures can be concentrated in the liquid. Since a component in the mixture cannot have zero partial pressure, it is impossible to obtain a completely pure sample of a component from a mixture via distillation. However, samples of high purity can be obtained when one of the components in the mixture has a partial pressure which is close to zero. When heated, the liquid mixture is converted into vapors that rise into the fractioning column. The vapors now cool and condense on the walls of the condenser [4]. The hot vapors emanating from the distilling flask now heat the condensed vapor, creating new vapors. Many such vaporization-condensation cycles take place and the purity of the distillate improves with every cycle. An illustration depicting a fractional distillation setup is provided below. The ethanol particles vaporized inside the distiller were stagnated or their discharge was accelerated according to the magnitude and frequency of vortex. If the center is narrow and the fluid rotates, the vortex decreases or changes to a regular form. To effectively control the vortex, six simple models and two materialized models were designed and the optimal design was derived. When compared with the traditional distiller, the outlet fluid speed of the final design increased by 78% and the residence time dispersion of ethanol particles decreased by 39%. Furthermore, to suppress the temperature spread of fermented wash, a streamlined blade structure that can promote convection current was added. This structure had the effect of reducing the temperature spread of fermented wash by 57%. In addition, a reflux ring structure that can control the recondensed fermented wash caused by heat loss at the inner wall of the distiller was designed and applied. In the first step, the temperature change caused by the energy that fermented wash received from the heat source and the flow and speed of fluid inside the liquid were tracked. The fermented wash area was set as one sub fluid area, and 27-point goals for tracking temperatures were set at the centers of three-dimensionally evenly distributed grids. The number of goals that satisfy the condition of 78°C at which ethanol vaporizes was coupled with the inlet mass flow boundary condition of the fermented wash surface. In the second step, the fluid flow of the ethanol vapor was observed based on the inlet mass flow in the fluid area of fermented wash. The gas area was also set as a subfluid area. To implement the recondensation effect of ethanol vapor due to heat loss at the outer boundary, 12 surface goals were set in the direction of height on the bulkhead comprising the gas area. Then the ethanol vapor loss was calculated by setting the outlet volume flow boundary condition in the area where the vessel temperature decreased to 75°C or lower [5]. The changes in streamlines, speed, and temperature inside the fluid area were accumulated, and the flow of fluid in the gas area was analyzed continuously according to the time dimension. In the last step, the residence time, speed, and emission of individual particles were checked

by floating objects assumed to be ethanol vapor particles in the fluid flow over time, which was obtained in the second step using the particle study module. The trajectory can be tracked by assuming that ethanol vapor is made up of individual spherical particles of a constant mass and merging the physical particles with the flow analysis result. The analysis condition was set in such a way that particles do not influence the flow, but the flow governs the particle speed and temperature according to density change. The outlet ethanol vapor flows were compared while changing the shape of the distiller using the above analysis method. After the first analysis of the distiller of the traditional shape, six simple models were analyzed to verify the change trend of the internal fluid flow according to the outlet diameter and combination structure.

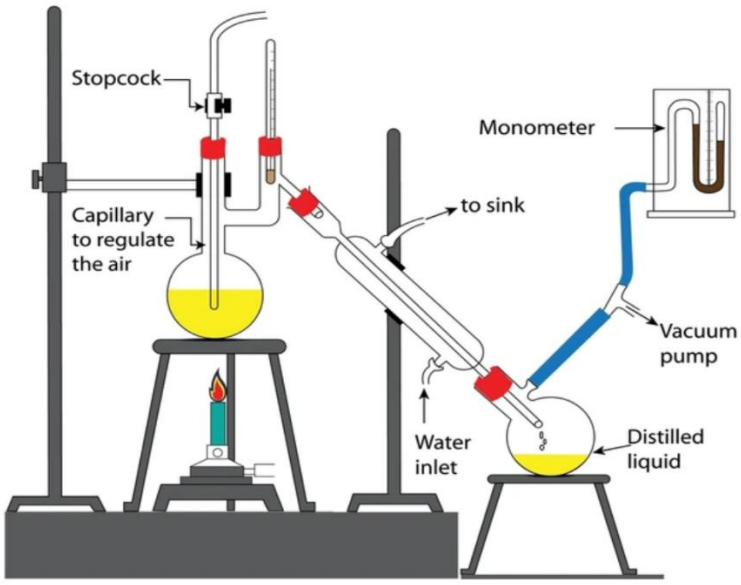

Figure 1. Distillation under reduced pressure

Based on this, two materialized models that can be manufactured with a real earthenware material were designed. The final model was completed by reviewing the problems of fluid flow based on the analysis result of the materialized models and referring to the structural technology for turbulence control. The smaller the angle between the outlet's direction vector and the side wall's direction vector, the smaller the frequency of vortices around the outlet was observed. This appears to be because the discharge airflow formed by the pressure change of the fluid with momentum does not match the flow generated by the momentum; as a result, some fluids pass through the outlet and are pushed against and collide with the opposite wall [6]. Considering the intrinsic angular momentum of the streamlines approaching the outlet, the outlet discharge pressure, and the change in tube diameter, the momentum vector should match the outlet vector as much as possible for an efficient outlet structure. The distillation process requires skilled and patient professionals in modern industries, education, and chemical fields. Experts including chemical engineers, project managers, laboratory technicians, chemists, and other professionals are quintessential for a thorough understanding of distillation processes, equipment, and their functionality, troubleshooting potential issues in the distillation process, and obtaining necessary expertise for producing high-quality products.

Conclusion: Understanding the properties of the extracted substances, ensuring cleanliness of substances, and acquiring advanced methods and technologies are essential for producing high-quality products and gaining a deep understanding of the distillation process. The analysis of the distillation process and the devices involved is crucial for professionals like material managers, chemical engineers, and production specialists in understanding how to acquire valuable expertise and create efficient methods and

technologies for producing high-quality products. It is a significant question how the distillation process is understood and how to gain experience in this analysis to produce high-quality products efficiently.

References

1. M.S. Narziev, O.R. Abdurakhmanov, F.Y. Khabibov, Karimova, D. Sh. Investigation of flow hydrodynamic structures in the final distillation of a cotton miccella. "Problems and prospects of development of innovative cooperation in research and training." Bukhara, 2017, Pp. 52-53.
2. Computer – aided methods of analysis and synthesis of chemical engineering systems: textbook for undergraduates of technological specialties/ Ministry of higher and secondary special education of the Republic of Uzbekistan - T.:"Voris - nashriyot". 2012/c -160
3. М.С. Нарзиев, Ф.Ю. Ҳабибов, Д.С. Каримова Разработка системы управления процессом окончательной дистилляции мисцеллы хлопкового масла на основе адекватной математической модели // Международная научно-практическая конференция “Интеграция современных научных исследований в развитие общества” I- том. 28-29 декабр, 2016. Кемерово. - С.41-44.
4. Franklin, N.L. Forsyth, J.S., The interpretation of Minimum Reflux Conditions in Multi-Component Distillation.
5. Zhang Hui, Li Xingang, Gao Xin. A method for modeling a catalytic distillation process based on seepage catalytic packing internal. Chemical engineering science, 2013, P. 699-711.
6. Brinkmann Ulf, Janzen Anna, Kenig Eugeny Y. Hydro dynamic analogy approach for modelling reactive absorption. Chemical Engineering Journal, 2014, P. 342-353.